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Musical improvisation: A mixed methods study on social interactions in younger and older adults

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ABSTRACT

Introduction: As a complex phenomenon, musical improvisation can be addressed from the perspective of different disciplines. In music therapy, improvisation is a central practice; however, as a technique, it lacks methodological guidelines and scientific evidence justifying its use. The aim of this study was to investigate the social interaction features that emerge during group musical improvisation. We conducted a mixed methods study with an exploratory sequential design comparing improvisation and imitation tasks, performed by groups of younger and older adults, separately, by generating and analyzing six categories of nonverbal communication and social interaction.

Method: Younger (n = 131) and older adults (n = 110) participated in one of two types of music activities: group musical improvisation or group rhythmic imitation. Eight group musical improvisation tasks – as implemented in music therapy settings – were compared with eight group rhythmic imitation tasks, according to six categories of analysis: visual contact, body movement, type of production, music interaction, vocal aspect, and leadership.

Results: Statistical analysis using a Chi-square test (χ^2) showed greater social interaction among the participants of the improvisation groups than among those in the rhythmic imitation groups, in both age ranges.

Conclusion: Our results provide specific evidence for this type of music task and a complementary approach to musical improvisation analysis, contributing to the knowledge of music therapy.

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KEYWORDS Musical improvisation; music therapy; interrelation; communication; social interactions

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Introduction

Musical improvisation is a complex phenomenon that can be investigated and interpreted from different disciplinary fields (musicology, music therapy, pedagogy, psychology, among others). However, the characteristics and implications of improvisation vary according to the perspective from which it is considered (Abrahan & Justel, 2015).

In general, improvisation is strongly associated with certain musical styles, such as jazz. Therefore, it is considered a specific skill that requires formal knowledge (Pressing, 1988; Wilson & MacDonald, 2012). In a broad sense, improvisation can be defined as any combination of sounds created within a frame with a beginning and an ending (Aldridge, 1998; Wigram, 2004). This conception of improvisation is guided by educational, psychological, and sociological theories rather than musical theories. It explores the processes rather than the products of improvisation (Alexakis et al., 2013).

In the realm of music therapy, improvisation is one of the most widely used interventions for establishing non-verbal communication between therapist and client, or therapist and educational/therapeutic group. Clinical and non-clinical improvisation in music therapy allows participants and clients to use musical expressive means for nonmusical proposes, according to their own capabilities and technical abilities (use of voice and/or body, musical instrument manipulation), cultural background, and musical preferences (Bruscia, 1987; Carroll & Lefebvre, 2013; Seabrook, 2018; Wigram, 2004).

Musical improvisation is a core resource in many clinical models, such as Nordoff-Robbins Music Therapy (Nordoff & Robbins, 1977), Juliette Alvin's free improvisation (Alvin, 1975), Riordon & Bruscia's experimental improvisation (Bruscia, 1987), Psychodynamic Music Therapy (Metzner, 2016), Vocal Psychotherapy (Austin, 2008), among others (Zarate, 2016). The wide range of uses and scopes of improvisation (e.g. a technique, a model of interaction, a musical experience, a process, an activity, a resource, etc.) makes it a difficult term to conceptualize. The definition is fuzzy, and the concept of improvisation is usually taken for granted in the music therapy field (Sutton, 2019; Weisethaunet, 1999). These models provide few and general explicit directions for applying the technique and offer only a few guidelines for sustaining the activity over time (Sutton, 2019). At present, there is little systematic evidence of the specific characteristics of improvisation that make it a therapeutic resource (Albornoz, 2011). The evaluation methods developed so far focus on the analysis of the musical characteristics that emerge during improvisation, based on subjective opinions (Wigram, 2004). For example, Wigram (2004) argues that several conclusions about client behavior can be drawn from the melodic analysis of improvisation. In this case, "behavior" refers to different types of responses (physiological, emotional, cognitive, psychological), without including domain-specific assessments. The widespread use of the terms shows the lack of systematization and objectivity when evaluating. At the same time, the advantages of improvisation, in terms of eliciting these specific responses, as compared to other types of music–social activities, such as playing together or singing a well-known song, are unknown (Wilson & MacDonald, 2016). Along these lines, the Improvisation Assessment Profile (Bruscia, 1987) was developed to explain the role of music in improvisation. However, the description and guidelines provided by this profile are too limited to facilitate the

analysis of the social and intersubjective aspects that emerge during improvisation (Wigram, 2004). This gap in the literature was considered when planning the present investigation.

From the fields of music psychology, musicology, and music education, several studies describe musical improvisation as an interactive music-making event in which intersubjective communication between participants is the central focus (Laroche & Kaddouch, 2015; MacDonald & Wilson, 2005; Procter, 2016; Wilson & MacDonald, 2016). Also, some studies rooted in educational, musical, social, and philosophical orientations describe musical improvisation as interactive music-making with special attention given to music interaction (Procter, 2016). From this perspective, musical improvisation is considered a social act in itself, which involves the personal contribution of two or more people – each acting or responding musically to the others – creating music spontaneously in the moment (MacDonald & Wilson, 2014). Some authors argue that musical interactions in these experiences could provide knowledge about the nature of human social interactions (D´Ausilio et al., 2015; Moran, 2014; Walton et al., 2018). We believe that this knowledge could contribute substantially to understanding improvisation in music therapy.

The communicative and interactive processes that underlie musical improvisation have been examined in different neurocognitive investigations (MacDonald & Wilson, 2005; Wilson & MacDonald, 2012, 2016). These studies analyzed (a) experimentation, exploration, creativity, and participatory sense-making in interactions during musical improvisation (Lage-Gómez & Cremades-Andreu, 2019), and (b) body movement characteristics, as an indicator of interrelation (Walton et al., 2018). However, most of this analysis is focused on the interaction between musicians or jazz performers (Sawyer, 1999, 2008; Seddon, 2007). What is needed is an exploration of music therapy improvisations, where the characteristics of the musical process and its product are not oriented to the achievement of musical aesthetic goals and the members do not have, in general, formal knowledge of music.

About this study

The general aim of this research was to analyze the communicative and social interactive processes that emerge during musical improvisation by comparing its effects with those of other musical activities. For this purpose, six analytical categories were generated to evaluate different aspects of the social interrelation and nonverbal communication of the participants during two different musical experiences: improvisation and imitation. Rhythmic imitation is a musical-social activity that allows group production but does not include the shared musical creation involved in improvisation. We used music therapy-based improvisation in non-clinical settings. Unlike typical music therapy models of improvisation, in this work, the therapist-client relationship was not considered (Seabrook, 2018). Taking into account that improvisation in music therapy is used with different populations, the performance of young and older adults was registered and analyzed.

Based on the existing research literature in the fields of music psychology, musicology, and music education (Lage-Gómez & Cremades-Andreu, 2019; MacDonald & Wilson, 2005; Sawyer, 1999, 2008; Seddon, 2007; Walton et al., 2018; Wilson & MacDonald, 2012, 2016) components of non-verbal communication and interaction were expected to emerge more frequently during an improvisation than during an

imitation task. We assumed that group musical performance improves interaction and non-verbal communication differentially according to the kind of musical task performed. For this reason, the experimental design of this study included the comparison between improvisation and imitation.

Because music is a social activity and one of its main contributions to the therapeutic set is the establishment and reinforcement of social interactions, the central motivation of this study was to assess musical improvisation as an interaction process. In this sense, it was necessary to describe the socio-related details of musical improvisation to complement other studies developed by our team about cognitive modulation in children (Diaz Abrahan et al., 2021), younger adults (Diaz Abrahan et al., 2020b; Diaz Abrahan et al., 2021) and older adults (Diaz Abrahan et al., 2019). For this reason, this study aims to answer the research question: What are the communicative and social interactive characteristics that emerge during musical improvisation that differentiate it from other musical tasks?

Method

A mixed methods study with an exploratory sequential design was implemented. This approach was intended to produce a rich description of the social and communication phenomenon, through inductive reasoning with generalizations from specific observations during musical improvisation and rhythmic imitation.

Participants

One hundred and thirty-one young adults (43% female) aged between 18 and 40 years (27.53 ± 0.83) and 110 older adults (73% female) aged 60 or over (72.5 ± 0.81) participated in this study. The inclusion criteria were as follows: (a) participants in the age range from 18 to 40 were included in the group of younger adults and (b) participants aged 60 or over were included in the group of older adults. The exclusion criteria were the presence of (a) visual or hearing impairment, (b) amusia, (c) music-related pathology, and (d) cognitive impairment or depression. We recruited older adults from adult day programs and younger adults from university classrooms. We went to each of these places and, after explaining the research tasks, invited those interested to participate. The participants were residents of Buenos Aires, Neuquén, and Chubut provinces.

Musical instruments

Participants were allowed to choose among percussion instruments (e.g. drums, maracas, bells, woodblocks, shakers, and tambourine) or melodic/harmonic instruments (e.g. guitar, melodica, xylophone, flutes). These instruments were selected because they are easy to handle.

Conditions

Musical improvisation

This study is rooted in a broad music-therapy perspective of improvisation. In such real-time musical experiences, different sounds, melodies, and rhythms are created and combined spontaneously with the available resources, according to the

capabilities of the subject in musical interaction with others (Bruscia, 1987; Wigram, 2004). In this way, although non-musicians are not typically trained to play complex pieces of music, they are able to improvise and create melodies and rhythms (Sági & Vitányi, 1988).

The participants listened to a rhythmic pattern played live by the music therapist and when they wished, they created and combined musical patterns with instruments, voices, or bodies, spontaneously creating music according to the context provided by the base pattern. A "guide" leading the improvisation through the performance of some idea (in this case a rhythmic pattern) is frequently used in music therapy practices (Bruscia, 1987; Wigram, 2004). The following directions were given for this condition: "You will listen to a rhythmic base, from which you have to create something musical as a group. This rhythmic base will help you to start the improvisation at any time you want. You can use instruments, your voice, or your body. It is important to listen not only to the base but also to the group members."

Rhythmic imitation

This activity involved the group imitation of a rhythmic pattern. The participants listened to a rhythmic pattern and when they wished, they started to imitate the pattern as faithfully as possible, avoiding variations or new musical ideas. The following directions were given: "You will listen to a rhythmic base and, at any time you want, you can start to imitate me. You can use instruments, your voice, or your body."

Procedure

Adult day institutions and teachers from university classrooms were contacted, informed about the study and asked whether they wanted to participate in it. This introduction was repeated with each group of potential participants, who signed informed consent if they desired to participate. Each participant's involvement in the study consisted of engaging in a single meeting with an approximate duration of one hour. Each participant was randomly given a number 1 or 2. The people with number 1 got together and performed the musical improvisation. Those with number 2 performed the rhythmic imitation. Participants worked in groups of 8 to 13 people (younger and older adults worked separately). As a first action, participants chose any instrument from a musical set. The use of voice and body were also allowed. Both activities were conducted in different classrooms or multipurpose spaces within the institutions.

Then the researcher, a music therapist, performed a rhythmic pattern of two 4/4 bars played as a loop (ostinato). A percussion instrument was played at a medium volume, for three minutes, as a base to encourage the groups of participants to start playing their instruments (Diaz Abrahan et al., 2020a). Eight groups performed the musical improvisation task and the other eight performed the imitation task.

For further analysis, both musical productions were recorded with a portable audio-video recorder, Zoom Q2 HD. Eight musical improvisation tasks (four performed by young adults and four performed by older adults) and eight rhythmic imitation tasks (four performed by young adults and four performed by older adults) were recorded and analyzed in this study. Each video was encoded to protect the participants' identities.

Categorization analysis

The analytical categories emerged through a process of inductive reasoning instead of being previously determined (Glaser & Strauss, 1967), as follows: the team of researchers watched each improvisation and imitation video recording, using a constant comparative method and resorting to their theoretical and empirical expertise. Classical aspects of social interaction (e.g. visual contact and leadership; Sawyer, 1999, 2008; Seddon, 2207) and the differences and similarities identified between each type of condition (improvisation and imitation) were noted which led to the derivation of theoretical categories that could help to understand the phenomenon under study and the specific characteristics of music improvisation. After overall observation and qualitative analysis, six categories with a set of sub-categories were generated and defined as follows:

Visual contact refers to the participant's gaze fixed on (a) the researcher or (b) another partner.

Body movement refers to visualization of body movements according to two subcategories: (a) production movement (movements made by the participant to produce sound from a musical instrument) or (b) free movement (other movements, e. g. head movements accompanying the rhythm).

Type of production refers to the degree of integration of the people in the musical production. It included three sub-categories: (a) group (the whole group got involved in the musical production), (b) subgroups (only some members of the group got involved in the musical production), or (c) individual (no interaction between participants was observed).

Music interaction refers to the temporally structured way in which interaction occurred, in accordance with two sub-categories: (a) successive interaction, whereby the cohesion of successive events was determined by the structure of musical components (rhythmic, melodic, dynamic, etc.) and/or the subjects' bodily attitude (disposition of the bodies, crossing of glances, etc.) or (b) simultaneous interaction, with actions in synchrony linked by their structure and/or the predisposition of the intervening subjects.

Vocal aspects refer to the presence of vocal articulation such as (a) talking (participants talk to each other during music production), and (b) laughing.

Leadership refers to the presence of participants who acted as guides for the music production. Leadership was identified when any participant systematically copied sound ideas from another one.

Each video was divided into three 1-minute excerpts (Min 1, Min 2, Min 3), and three external evaluators (a music therapist, a senior student in music therapy, and a musician) watched them and analyzed the frequency of occurrence of each subcategory for each participant. A Pearson correlation between evaluations was significant, with a high level of agreement $r(9) = .915$, $p < .01$. The obtained data were codified for statistical analysis.

Statistical analysis

Comparisons for conditions (improvisation vs imitation) for each category (Visual contact, Body movement, Type of production, Music interaction, Vocal aspects, and Leadership) and for the three excerpts (Min 1 vs Min 2 vs Min 3) were analyzed using

a Chi-square test (χ^2). To analyze the differences between the three excerpts, we employed the McNemar test. The alpha value was set at 0.5, and the software SPSS Statistics 17.0.2 was used to compute descriptive and inferential statistics.

Ethical considerations

Each participant signed a written informed consent form according to current ethical principles for research involving human subjects. Authorization to film each musical experience was obtained from all participants. All aspects of the study implementation followed the principles of the Declaration of Helsinki (World Medical Association Declaration of Helsinki, 2013).

Results

Table 1 presents the means of frequencies of the six categories, with the respective subcategories for each condition (improvisation and imitation) and group of participants (young and older adults).

Young adults

Visual contact

The statistical analysis indicated that the imitation group established more visual contact with the researcher than the musical improvisation group as follows: Min 1, $\chi^2 = 110.99$, $p < .001$; Min 2, $\chi^2 = 67.71$, $p < .001$; Min 3, $\chi^2 = 23.26$, $p < .001$. Concerning visual contact with other partners, the improvisation group established more visual contact than the imitation group, as follows: Min 1, $\chi^2 = 21.06$, $p < .001$; Min 2, $\chi^2 = 66.80$, $p < .001$; Min 3, $\chi^2 = 27.75$, $p < .001$ (Figure 1A).

Over time, an increase in visual contact with a partner was observed in the improvisation group, as shown in Figure 1A. A McNemar test indicated that, in the musical improvisation group, the visual contact with a partner was higher in Min 2 than in Min 1 ($p < .001$) and in Min 3 than in Min 1 ($p < .001$). The imitation group exhibited this pattern only in the comparison between Min 1 and 3 ($p < .001$).

Body movement

Concerning production movement, the statistical analysis showed significant differences for condition in Min 1, $\chi^2 = 5.31$, $p = .021$, and Min 3 $\chi^2 = 17.63$, $p < .001$. This difference indicates that people who imitated the rhythmic pattern exhibited more production movement than those who improvised (Figure 1B). As regards free movement, the analysis showed that the participants who improvised moved more freely than those who imitated the rhythmic pattern in Min 1, $\chi^2 = 5.34$, $p = .019$, and Min 3 $\chi^2 = 5.50$, $p = .019$.

Production movement in the improvisation group decreased over time, as shown in Figure 1B. A McNemar test indicated that the improvisation group displayed less production movement in Min 3 than in Min 1 ($p < .001$), and in Min 3 than in Min 2 ($p = .003$).

Table 1. Means of frequencies for each condition and group of participants

		Young adults						Older adults					
		Improvisation (n = 71)			Imitation (n = 60)			Improvisation (n = 65)			Imitation (n = 45)		
		Min 1	Min 2	Min 3	Min 1	Min 2	Min 3	Min 1	Min 2	Min 3	Min 1	Min 2	Min 3
Visual contact	Researcher	0.03 (0.02)	0.00	0.03 (0.06)	0.9 (0.04)	0.65 (0.03)	0.35 (0.02)	0.63 (0.06)	0.31 (0.06)	0.23 (0.05)	0.91 (0.04)	0.84 (0.05)	0.89 (0.05)
	Partner	0.45 (0.00)	0.76 (0.05)	0.77 (0.04)	0.07 (0.06)	0.05 (0.03)	0.32 (0.06)	0.20 (0.05)	0.57 (0.06)	0.66 (0.06)	0.00	0.11 (0.05)	0.07 (0.04)
Body movement	Production Movement	0.92 (0.03)	0.9 (0.04)	0.75 (0.05)	1.11 (0.00)	0.98 (0.02)	1.00 (0.00)	0.82 (0.05)	0.72 (0.06)	0.00	1.00 (0.00)	1.00 (0.00)	0.00
	Free Movement	0.08 (0.03)	0.10 (0.04)	0.10 (0.04)	0.00	0.03 (0.02)	0.00	0.18 (0.05)	0.28 (0.06)	0.14 (0.04)	0.00	0.00	0.02 (0.02)
	Subgroups	0.35 (0.06)	0.41 (0.06)	0.20 (0.05)	0.03 (0.02)	0.00	0.00	0.18 (0.05)	0.35 (0.06)	0.17 (0.05)	0.00	0.00	0.00
	Individual	0.55 (0.06)	0.23 (0.05)	0.08 (0.03)	0.97 (0.02)	1.00 (0.00)	1.00 (0.00)	0.71 (0.06)	0.52 (0.06)	0.45 (0.06)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Music interaction	Successive	0.06 (0.03)	0.08 (0.03)	0.10 (0.04)	0.00	0.00	0.00	0.00	0.11 (0.04)	0.08 (0.03)	0.00	0.00	0.00
	Simultaneous	0.94 (0.03)	0.92 (0.03)	0.79 (0.05)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	0.88 (0.04)	0.91 (0.04)	1.00 (0.00)	1.00 (0.00)	1.00(0.00)
Vocal aspects	Talk	0.11 (0.04)	0.11 (0.04)	0.18 (0.05)	0.03 (0.02)	0.08 (0.04)	0.23 (0.06)	0.00	0.17 (0.05)	0.06 (0.03)	0.00	0.00	0.00
	Laugh	0.13 (0.04)	0.27 (0.05)	0.35 (0.06)	0.07 (0.03)	0.17 (0.05)	0.22 (0.05)	0.09 (0.04)	0.17 (0.05)	0.29 (0.06)	0.00	0.02 (0.02)	0.07 (0.04)
Leadership		0.40 (0.02)	0.11 (0.04)	0.14 (0.04)	0.02 (0.02)	0.02 (0.02)	0.02 (0.02)	0.05 (0.03)	0.06 (0.03)	0.25 (0.05)	0.00	0.00	0.00

Note. Means and standard deviations in parentheses for each sub-category on minute 1 (Min 1), minute 2 (Min 2) and minute 3 (Min 3).

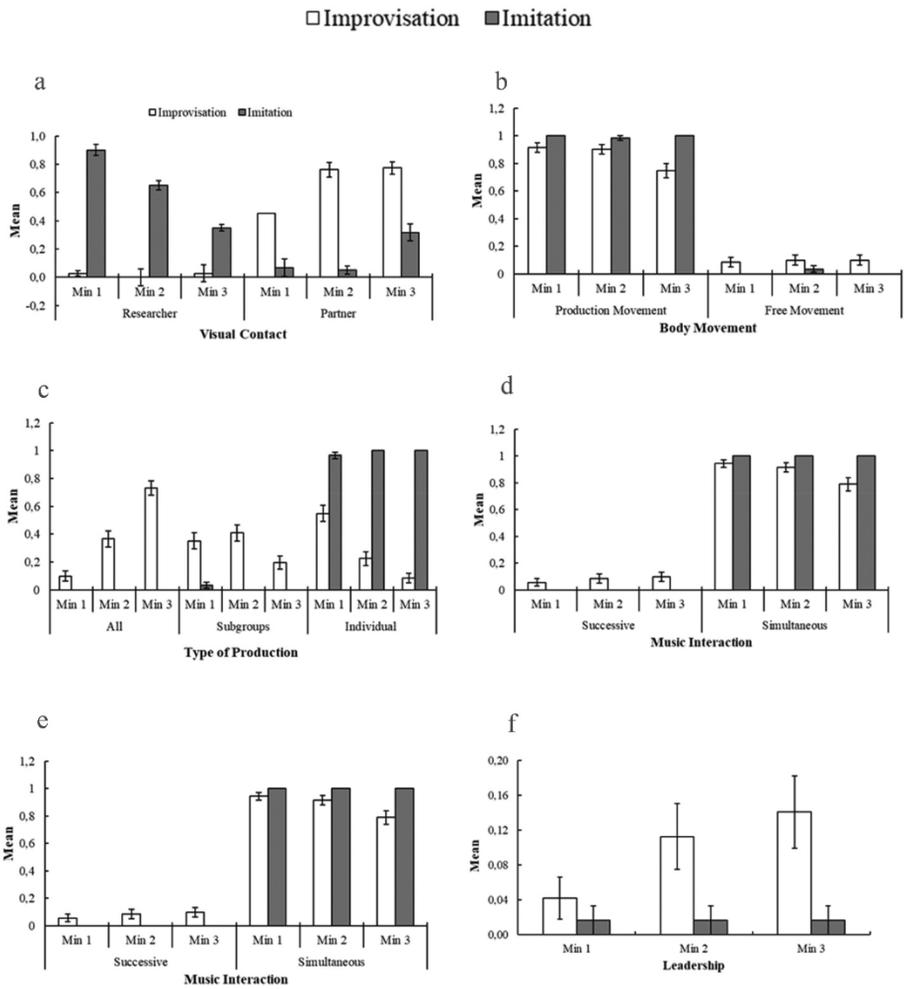

Figure 1. Five categories analyzed for the younger sample *Note.* A: Visual contact; B: Body movement; C: Type of production; D: Musical interaction; E: Vocal aspects; F: Leadership, for improvisation (white bar) and imitation (grey bar) condition on minute 1 (Min 1), minute 2 (Min 2) and minute 3 (Min 3). Vertical lines indicate standard error.

Type of production

The statistical analysis indicated significant differences for condition in Min 1, $\chi^2 = 6.24$, $p = .012$; Min 2, $\chi^2 = 27.41$, $p < .001$; and Min 3, $\chi^2 = 109.02$, $p < .001$. This means that the musical improvisation condition showed greater whole-group involvement in the musical production than did the imitation condition. Concerning subgroups' production, significant differences were found for condition in Min 1 $\chi^2 = 20.19$, $p < .001$; Min 2, $\chi^2 = 31.47$, $p < .001$; and Min 3, $\chi^2 = 13.24$, $p < .001$, which indicated that the improvisers were more involved in subgroup production than those who imitated the rhythmic pattern. Finally, as for individual production, significant differences were observed in Min 1, $\chi^2 = 29.47$, $p < .001$; Min 2, $\chi^2 = 80.11$,

$p < .001$; and Min 3, $\chi^2 = 109.02$, $p < .0001$, indicating that the participants in the imitation group exhibited greater individual production than those in the improvisation group.

Over time, the improvisers abandoned individual productions and joined the subgroups, performing a total production. This impression was corroborated by the McNemar test, which indicated that, in the improvisation group, whole-group production was greater in Min 3 than 1 ($p < .001$), and Min 2 ($p < .001$). Subgroup production was lower in Min 2 than 3 ($p < .001$). Finally, individual production was lower in Min 1 than 3 ($p < .001$).

Music interaction

Regarding successive interaction, the statistical analysis showed significant differences for condition in Min 2, $\chi^2 = 5.31$, $p = .021$ and Min 3 $\chi^2 = 6.24$, $p = .012$, indicating that the improvisation group displayed more instances of successive production than the imitation group. As regards simultaneous production, the analysis indicated significant differences for condition in Min 3 $\chi^2 = 14.31$, $p < .001$, showing that the imitation groups produced more instances of simultaneous performance than the improvisation group (Figure 1D).

Over time, the improvisers decreased their simultaneous productions. This pattern was not observed in the imitation group. The McNemar test corroborated this impression, showing that the participants who improvised exhibited more instances of simultaneous production in Min 1 than 2 ($p = .001$) and 3 ($p = .004$).

Vocal aspects

The statistical analysis indicated significant differences for condition, as regards talking, in Min 1, $\chi^2 = 3.91$, $p = .045$, which indicated that, at first, the improvisation group talked more than the imitation group. As for laughing, significant differences were found in Min 2, $\chi^2 = 4.39$, $p = .036$ and Min 3, $\chi^2 = 8.46$, $p = .004$, suggesting that the improvisers laughed more often than the imitators (Figure 1E).

Over time, an increase in utterances and laughing was observed in both conditions, as depicted in Figure 1E. This impression was corroborated by the McNemar test, which indicated that the improvisation group laughed more often in Min 2 than 1 ($p = .006$) and in Min 3 than 1 ($p < .001$). The same pattern was observed in the imitation group ($p = .022$). As for talking, the participants who imitated the rhythmic pattern talked more often in Min 1 than 3 ($p = .004$).

Leadership

The statistical analysis indicated significant differences for condition in Min 2, $\chi^2 = 4.68$, $p = .030$ and Min 3, $\chi^2 = 6.51$, $p = .011$, which indicated that a greater number of participants acted as guides for the music production in the improvisation than in the imitation group (Figure 1F).

Over time, an increase was observed in the number of participants who guided the improvisation, as shown in Figure 1F. This impression was corroborated by the McNemar test, which indicated greater leadership in Min 1 than 3 ($p = .039$).

Older adults

Visual contact

The statistical analysis indicated that the imitation group established more visual contact with the researcher than the musical improvisation group, as follows: Min 1, $\chi^2 = 14.01$, $p < 001$; Min 2, $\chi^2 = 30.73$, $p < 001$; Min 3, $\chi^2 = 46.06$, $p < 001$ (Figure 2A). Concerning visual contact among partners, the improvisation group established more visual contact than the imitation group, as follows: Min 1, $\chi^2 = 10.20$, $p < .001$; Min 2, $\chi^2 = 23.64$, $p < .0001$; Min 3, $\chi^2 = 38.67$, $p < .0001$ (Figure 2A).

Over time, an increase in visual contact among partners and a decrease in visual contact between participant and researcher were observed in the improvisation group, as shown in Figure 2A. This impression was corroborated by the McNemar test, which indicated that the visual contact among partners was greater in Min 2 than 1 ($p < .001$) and in Min 3 than 2 ($p < .001$), and that visual contact between participant and researcher was lower in Min 2 than 1 ($p < .001$) and Min 3 than 2 ($p < .001$).

Body movement

Concerning production movement, the statistical analysis indicated significant differences for condition in Min 1, $\chi^2 = 9.32$, $p = .002$; Min 2, $\chi^2 = 14.90$, $p < .0001$; and Min 3, $\chi^2 = 12.69$, $p < .0001$, which means that the imitators exhibited this behavior more often than the improvisers (Figure 2B). As regards free movement, the analysis showed that the participants who improvised moved more freely than those who imitated the rhythmic pattern in Min 1, $\chi^2 = 10.21$, $p < .001$; Min 2, $\chi^2 = 14.90$, $p < .0001$; and Min 3, $\chi^2 = 4.35$, $p = .037$.

Over time, a decrease in production movement was observed in the improvisation group, as displayed in Figure 2B. This impression was corroborated by the McNemar test, which indicated that the improvisation group moved less in Min 3 than 1 ($p = .039$).

Type of production

As for group production, the statistical analysis indicated significant differences for condition in minute 1, $\chi^2 = 5.18$, $p = .023$; minute 2, $\chi^2 = 5.97$, $p = .015$; and minute 3, $\chi^2 = 22.39$, $p < .0001$, showing that the musical improvisers were more involved in whole-group production than the imitators of the rhythmic pattern. Concerning the subgroups' production, the analysis indicated significant differences for condition in minute 1, $\chi^2 = 9.32$, $p = .002$; minute 2, $\chi^2 = 20.13$, $p < .0001$; and minute 3, $\chi^2 = 8.46$, $p = .004$, showing that the participants who performed a musical improvisation task were more engaged in subgroup production than those who imitated the rhythmic pattern. Finally, individual production showed significant differences in minute 1, $\chi^2 = 15.90$, $p < .0001$; minute 2, $\chi^2 = 29.88$, $p < .0001$; and minute 3, $\chi^2 = 37.05$, $p < .0001$, with the imitation group exhibiting greater individual production than the improvisation group.

Over time, improvisers abandoned their individual productions and joined the subgroups, performing a total production. This impression was corroborated by the McNemar test, which showed that whole-group production in the improvisation group was greater in Min 3 than 1 ($p < .001$), and 2 ($p < .001$). Individual production was lower in Min 2 than 1 ($p < .001$) and in Min 3 than 1 ($p < .001$).

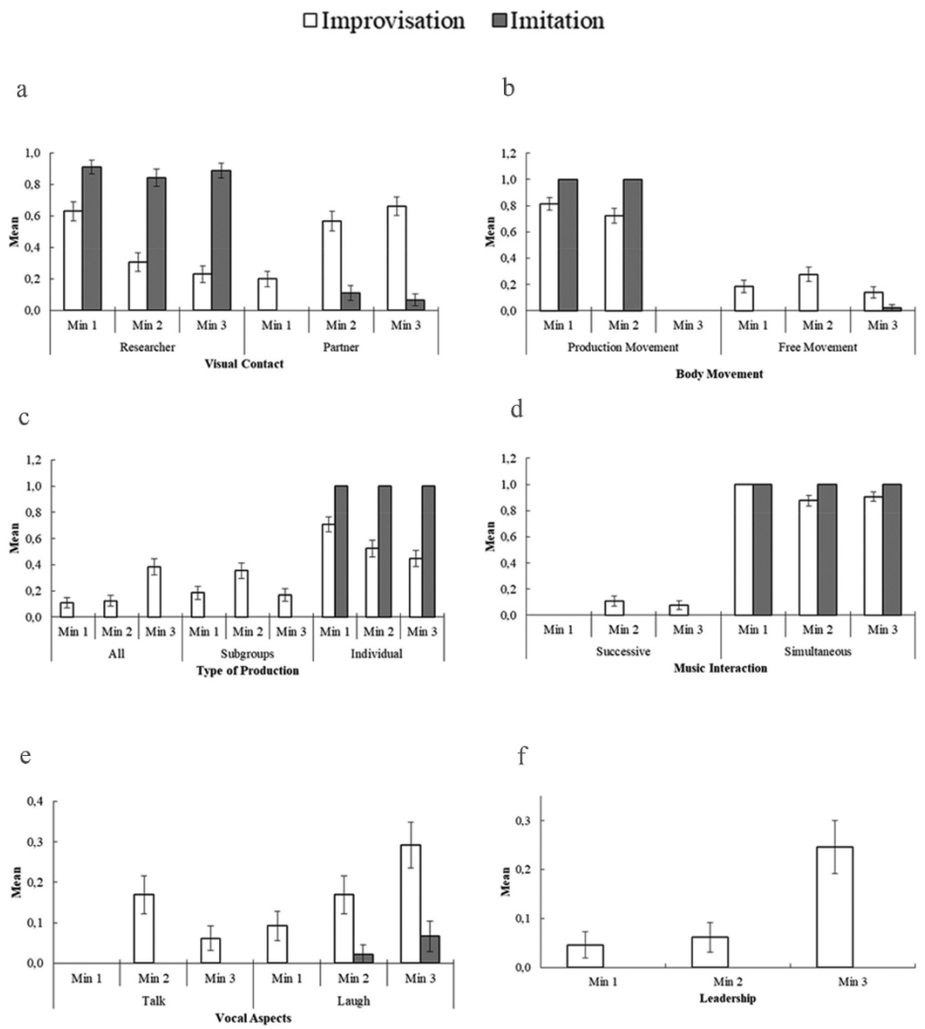

Figure 2. Five categories analyzed for the older sample *Note*. A: Visual contact; B: Body movement; C: Type of production; D: Musical interaction; E: Vocal aspects; F: Leadership, for improvisation (white bar) and imitation (grey bar) conditions in minute 1 (Min 1), minute 2 (Min 2) and minute 3 (Min 3). Vertical lines indicate standard error.

Musical Interaction

As for successive production, the statistical analysis indicated significant differences for condition in Min 2, $\chi^2 = 5.18$, $p = .023$, showing that the improvisation group had more instances of successive production than the imitation group. Regarding simultaneous production, significant differences were observed for condition in Min 2, $\chi^2 = 5.97$, $p = .015$, and Min 3, $\chi^2 = 4.39$, $p = .036$, indicating that the imitation groups produced more instances of simultaneous performance than the improvisation group (Figure 2D).

No significant differences were found over time ($p > .05$).

Vocal aspects

Significant differences were found for condition, concerning talk, in Min 2, $\chi^2 = 8.46$, $p = .004$, indicating that the improvisation group talked more than the imitation group. With respect to laughing, the analysis indicated significant differences in Min 1 $\chi^2 = 4.39$, $p = .036$; Min 2, $\chi^2 = 5.91$, $p = .015$; and Min 3, $\chi^2 = 8.46$, $p = .004$, showing that the improvisers laughed more often than those in the imitation group (Figure 2E).

Over time, a decrease in utterances and an increase in laughing were observed in the improvisation group (Figure 1E). This impression was corroborated by the McNemar test, which showed that the improvisation group laughed more often in Min 3 than 1 ($p = .006$) and in Min 2 than 1 ($p < .001$). As for talking, the participants who improvised talked less in Min 3 than 2 ($p < .001$).

Leadership

Significant differences were observed for Condition in minute 3, $\chi^2 = 12.96$, $p < .001$, which indicated that a greater number of participants in the improvisation group, than in the imitation group, acted as guides for the music production (Figure 2F).

Over time, an increase was observed in the number of participants who acted as guides in the improvisation, as illustrated in Figure 1F. This impression was corroborated by the McNemar test, which indicated greater leadership in Min 3 than 1 ($p = .001$) and 2 ($p = .002$).

Discussion

The general aim of this study was to analyze the social interaction and nonverbal communication that emerge during musical improvisation. For this purpose, we present a novel and alternative analysis of the social aspects that emerged between the participants in a musical improvisation activity. The major findings of this study indicated greater social interaction and nonverbal communication among the participants of the improvisation groups than among those in the rhythmic imitation groups. Music improvisation is a music therapy technique used with several populations from children to older people. In this study, music improvisation was associated with greater social interaction for both younger and older adults. These findings contribute to the evidence for the therapeutic use of this technique.

Our hypothesis was that the elements of non-verbal communication and interaction would emerge more frequently during an improvisation than an imitation task. This idea was corroborated by analyzing a set of musical improvisations performed by two different populations – younger and older adults – and by comparing it with a rhythmic imitation task. In general, we found that the improvisers exhibited greater social involvement when we proposed "creating something musical as a group".

This inference is based on the characteristics presented by the categories analyzed during the musical improvisation, as follows: (a) all group or sub-group production, which indicated that the group was involved in the music production; (b) visual contact with a partner; (c) musical interrelation characterized by a predominance of successive productions, which could be thought of as a dialogical turn-taking activity; and (d) the presence of group leadership roles.

At the social level, when people interact, there is sensorimotor coupling dependent on the behavior of others (Dumas et al., 2014). This coupling could explain the observations around group production and the musical interrelation observed in the musical experience. There is a play between the autonomy of each person and progressive interactive coupling as a dialogue (Laroche, 2015). During improvisation, the participants listen to and respond to each other collaboratively and intersubjectively, through verbal and non-verbal behaviors (Sawyer, 1999). Visual contact with partners during the improvisation reinforces the interactive state. This aspect is important since people spend a large part of the day interacting with others through established visual contact (Skarratt et al., 2012), a behavior that optimizes a collective task (Brennan et al., 2008).

Regarding leadership, social interactions in the real world often require differentiating roles between the members of the interaction, coordinating group action, and developing production (D'Ausilio et al., 2015; Schilbach et al., 2013). This aspect was observed in the presence of leaders and followers throughout the musical improvisation tasks. The presence of this category in rhythmic imitation groups could not be accurately assessed since the instructions indicated that participants should follow the music therapist's musical production. Thus, the analysis of leadership was not equivalent for both music tasks, since one condition was instructed not to do this behavior.

In our opinion, two other aspects complement the interactive framework observed during improvisation. On the one hand, the category of verbal aspects was integrated with two subcategories: talking and laughter, which were present and increased over time in the groups of both younger and older adults who performed the improvisation. During musical productions, two types of behaviors were displayed: the interaction concerned strictly with the sound-musical production and simultaneously the verbal, gestural exchanges, and emotional expressions such as laughter. In this sense, Seddon (2005) argues that during a musical improvisation there are different modes of communication, both verbal and non-verbal, which allow the group members to reach an agreement regarding the production. The use or not of utterances as a tool to reach an agreement about what will be done depends on the characteristics of the group members. It is notable that in the group of older adults, a verbal agreement was necessary in the initial stages of improvisation; however, over time the interaction shifted towards the bodily and musical aspects without the need to talk to make music together. Regarding laughter throughout the improvisations, music induces emotions in interactive contexts that produce feelings of community (Seddon, 2005), which could indicate a state of well-being through the musical experience.

The last category associated with the high level of involvement in the group task is body movement. The studies on this theme propose that the body movement that emerges in social situations is an indicator of intersubjective involvement (Walton et al., 2018). For example, some studies have analyzed spontaneous and synchronous/asynchronous body movements with the rhythms of speech that occur during a conversation between two people (Richardson et al., 2005), as well as in other situations that do not necessarily involve verbal communication, such as dancing (Woolhouse et al., 2016) or the interrelationships during musical experiences between professional musicians (Volpe et al., 2016). In our case, the involvement was observed from the presence of free movements, such as body movement of the head or upper body accompanying the rhythm of the general musical production, in contrast to the movement caused by the use of the instrument in the rhythmic imitations.

Finally, a remarkable point for us is the dynamics and evolution of improvisers' behaviors over time. Free improvisation is unprecedented and does not involve a specific structure; in this sense, its content and form are actively developed over time, whereby each member of the group must articulate his or her spontaneous experience with that of the other members. This implies that the members must implicitly find a way to communicate based on what is happening during the experience. Leaving aside musical aesthetic aspects arising from the experience, in music therapy the interest lies in what happens *in the process*. Although we used a rhythmic base that could have had a unifying effect on the sound resources used and the manifest interactive behaviors, we observed that the diversity of musical content and relationship behaviors emerged, developed, and unfolded throughout the minutes devoted to the improvisation. The characteristics and development of the variables analyzed over time may indicate an interactive dynamic that characterizes an improvisational musical experience. This dynamic could be one of the reasons why improvisation is an effective tool for music therapy intervention.

Interpersonal interaction is a central aspect of the identification of features in musical improvisation. This characterization allows improvisation to be differentiated from other musical activities and experiences, which is particularly relevant to the field of music therapy. Music therapy focuses on the cognitive (Thaut & Hoemberg, 2014; Zarate, 2016) or psychodynamic aspects (Pavlicevic, 2000) that occur at the individual and/or group level or in the therapist-client dyad, associated with non-musical objectives (Bruscia, 1987; Carroll & Lefebvre, 2013; Wigram, 2004).

Some music therapy models propose a guide to explain what happens during a musical improvisation. For example, the Improvisation Assessment Profile (Bruscia, 1987) includes six areas for analysis, one of them being the "autonomy profile", which addresses, in a general way, the interpersonal events that occur during the musical experience. However, the description and guidelines to analyze social and intersubjective aspects during improvisation pose challenges to the music therapist (Wigram, 2004). In this sense, we intended to contribute with systematic evidence of the specific characteristics of improvisation that make it a therapeutic resource by proposing a novel method for analyzing social interaction.

Limitations and future studies

This study represents, in our opinion, a novel approach to the study of social characteristics of music therapy improvisation. However, certain limitations were identified. First, the development of improvisation in music therapy is based on educational or therapeutic objectives. Here we implemented and analyzed a free improvisation task outside a therapeutic context. It would be interesting to analyze the deployment of the variables presented in this work by analyzing improvisations performed by therapeutic groups or in a longitudinal process.

Second, by working with a mixed methods study with exploratory sequential design, we limited the duration of the experience to three minutes, in order to control the variables involved in the tasks. In music therapy, except for referential improvisations, the tasks do not delimit a time frame. It would be interesting to evaluate an improvisation without a temporal limitation to observe the course and development of the interrelation variables.

Many challenges remain. The third limitation is related to scientific problems like the generalizability of results and the lack of ecological validity. These involve various technical concerns related to data acquisition and analysis, such as recording protocols, the availability of tools for the synchronization and annotation of multimodal signals, and the management of large data sets. The variables analyzed in this study were approached from an observational method. Although a reliability analysis of the observations was carried out, which in our opinion solves the problem reported in the literature on subjective opinions in the field of music therapy (Wigram, 2004), we consider that this aspect is a limitation in this study. Without diminishing the importance of observation and subjective opinion of the professional music therapist, we consider that the analysis of this type of complex musical experience requires complementing different types of data and testimonials. In this sense, adding complementary analysis by applying temporal dynamics analysis would be enriching.

Fourth, the studies that address the aspects of social interrelation during musical activities focus on sensorimotor coupling processes, motor coordination, and synchronization of movements, from enactive approaches (Schiavio & Høffding, 2015). It would be interesting to analyze these aspects, both in a group musical improvisation and within the therapist-client relationship.

Finally, interviews could be included in future studies. The participants' testimonies about their self-perception of what happens during improvisation could be taken as complementary data for the analysis.

Conclusion

Considering all the results, we conclude that musical improvisation is characterized by the presence of indicators that reveal a greater interrelation and communication between the participants in the activity, an aspect that is not observed in the rhythmic imitation activity. In general, the results showed that the improvisation activity elicits behaviors of social interaction, in comparison with another type of musical activity, an aspect corroborated in productions made by different age groups (younger and older adults).

The communicative and interactive processes that sustain the musical improvisations performed by the younger and older adults who participated in this study allow us to see the particularities that this technique presents over other musical experiences. This complexity does not seem to be present in the music therapy literature (Sutton, 2019). There is a variety of approaches to explore interactions between people, whether they use words or music. This study was based on the observation mainly of non-verbal phenomena. We propose this approach for the study of improvisation and the relational aspects that occur during performance. The exploration of interrelationships through joint improvisation is considered one of the most important and rewarding aspects of free improvisation, as well as the essential characteristic for the applied use of improvised music in music therapy.

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