Creativity in and through music

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Chapter 14

Creativity in and through Music

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Music Creativity and Children

C14P1 Understanding children's musical creativity has sparked interest and research investigations from several scholars, each contributing different approaches and methodologies (Barrett, 2012; Cardoso de Araújo, 2019; Deliège & Wiggins, 2006; Hargreaves, Miell, & MacDonald, 2012; McPherson & Welch, 2018; Miell & Littleton, 2004; Odena, 2012).

C14P2 Several studies have focused their attention on the measurement of children's musical creativity: Webster (2002) studied children as creative thinkers in music and proposes a model of creative thinking in music; Hickey and Lipscomb (2006) also offered a model of assessment of children's creative musical thinking; McPherson (2005) elaborated a grid to assess the student's ability to improvise that includes evaluative criteria for creativity.

C14P3 Other perspectives are oriented toward a concept of creativity as a means of expression for the child: for example, Baroni (1997) describes several examples of children's improvisation in the context of expressive activities in classroom settings in the Italian kindergarten and primary school; Sundin (1998) introduces the observation methodology to analyze songs creativity in four-to-six-year-old children in the Swedish school; Delalande (1993) observes the musical exploration and inventions of children on the basis of the Piagetian concepts of sensory-motor, symbolic, and rule games, placing musical invention as the first objective of music education.

C14P4 The topic of creativity has seen new perspectives of investigation within a constructivist and interactionist approach, where attention shifted from individual to collective and collaborative processes (see Barrett 2012; Burnard 2012; Miell & Littleton

2004). Burnard and Dragovic (2015), for example, underline that collaborative creativity can support and enhance the wellbeing experience in young pupils involved in instrumental groups. Cross, Laurence, and Rabinowitch (2012) and Seddon (2012) introduce the concept of "empathetic creativity," based on the idea of listening to others and regulating their behavior during musical interaction. Veloso (2017) underlines the notion of "collaborative creativity," which considers creativity as a property distributed in the group, as suggested by Sawyer (2006). These studies support the idea that creativity cannot only be studied from a purely musical point of view but also on the basis of the interactive and communicative context between the participants, and on the basis of social interaction characteristics (e.g., Kawase, 2015; Littleton & Mercer, 2012; Pesquita, Corlis, & Enns, 2014).

C14P5 The link between music improvisation and creativity was emphasized in neurobiology: for example, it was found that the greater connectivity between brain regions sharing functional properties observed in professional piano improvisers than in classical piano players may be due to a more efficient working of the associative networks of musical creativity (Pinho et al., 2014). They conclude that the neural circuits involved in creativity can be optimized by systematic training. Some scholars also attempt to identify a genome for musical aptitude and creativity in music (see Ukkola-Vuoti et al., 2013).

C14P6 Studies coming from ethnomusicological or anthropological research have investigated musical creativity in childhood in a transcultural and historical lens. The collection of studies in Damon-Guillot (2018), for example, introduces several interesting examples: children's sensory experiences of flamenco, children's song repertory inspired by linguistic and cultural diversity, children's creativity in the nursery rhyme, children's song tradition in a French village at the end of the Ancien Régime, and further several studies on children musical experience in the Ivory Coast, Morocco, Germany, and North India.

C14P7 In the field of technology-enhanced learning, most studies deal with internet devices, teaching strategies, composition, performance, and music therapy: the new technology opens new scenarios on musical creativity (e.g., Addessi & Pachet, 2005; Bauer, 2014; Brown, 2007; Delalande, 2003; Dorfman, 2013; Finney & Burnard, 2009; Folkestad et al., 1996; Webster, 2007; Williams & Webster, 2008). New technology can be considered not only as a "tool" to aid teaching, but also as providing languages and "brainframes" (De Kerckhove, 1991; Turkle, 2015) that deeply influence the processes of musical learning and the musical creativity of children. Several experiments have been carried out with children who interact with a machine through body movements, listening, and visual feedback (e.g., Addessi, Anelli, & Maffioli, 2017; Friberg & Kallblad, 2011; Njis et al., 2012; Frid et al., 2016; Sano, 2018). According to Williams and Webster (2008), technology offers the opportunity to move from an education based on the "information age" to an education based on the "age of creativity." In fact, the novelty and the richness of the new digital devices reside in the characteristics of interactivity and feedback in real time.

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Creativity and "Reflexive Interaction": Theories and Pedagogical Concepts

C14P8 Initially born in the field of human-machine interaction studies (Turkle, 2015), the paradigm of *reflexive interaction* refers to the so-called interactive reflexive musical systems (IRMS), which have been described as musical software that responds to the user by imitating their style, like a mirror (Pachet, 2006). We studied reflexive interaction with children, trying to outline a pedagogical frame of reflexive interaction and implemented a new pedagogical tool, called the MIROR platform, for fostering music and movement creativity (Addessi, 2014; Addessi et al., 2013). The main characteristic of the reflexive interaction paradigm is the mechanism of *repetition-variation*: something is repeated and varied during the interaction, through a continuous process of imitation and variation. Turn-taking and co-regulation between the partners are also fundamental. The turn-taking allows the child to produce, to feel listened to, and to listen; during the reflexive dialogue, the child and the system adapt to each other and co-regulate the content, the rhythm, and the shape of the interaction. Several studies suggest that the repetition-variation mechanism, which includes imitation, imitation recognition, self-imitation, repetition-variation, plays an important role in the development of infant musicality and represents one of the ontological foundations of human musicality (Dissanayake, 2000; Imberty, 2014; Malloch & Trevarthen, 2009; Mithen, 2005; Gratier & Apter-Danon, 2008; Papoušek, 1997; Stern, 2004). In the field of children's musical experience, it was observed how the repetition-variation action during the explorations of sound objects in early childhood allows the child to know a sound, to share it with others, to invent music, and to express emotions (e.g., Baroni, 1997; Delalande, 1993; Tafuri, 2006; Young, 2004). The repetition-variation mechanism has also found interesting interpretations in light of recent studies in neuroscience: Zatorre (2012), for example, highlighted some neural and cognitive mechanisms that allow the transformation and manipulation of pre-existing music mental representations.

C14P9 The ability to replicate the behavior of others can find its neuroscientific foundations in the mechanism of the mirror neuron system, a network of neurons that become active during the execution and/or the observation of actions (Rizzolatti et al., 2002). Further studies have shown that the *resonance* mechanism also works through the auditory channel (Kohler et al., 2002). In the field of *embodied music cognition*, Leman (2007) points out that there is evidence that mirror neurons are amodal, in the sense that they can encode the mirroring of multiple sensory channels. Therefore, the interaction in a reflexive environment would stimulate a *resonance* mechanism in the motor areas of the child's brain, based on the link between action and perception, and can be interpreted through the lens of *enactive approach*, which sees the interaction between mind, body action, and environment as the fundament of the mental processes (Varela, Thompson, & Rosch, 1993).

C14P10 From a pedagogical perspective, it is important to underline that reflexive learning is not based on imitation; on the contrary, during a reflexive interaction the learning

mechanism is activated by the experience of "being imitated." Reflexive interaction stimulates the individual to engage in a dialogue during which repetitions and variations enhance cognitive conflict that the child solves during the interaction, giving rise to learning by both problem finding and problem solving. Reflexive interaction could be said to exploit Vygotsky's concept of "zone of proximal development" (Vygotsky, 1962), where the term "proximal" refers to those skills that the learner is close to mastering thanks to the guidance and encouragement of a skilled partner, usually the teacher. Nevertheless, the interaction that takes place between the child and an interactive reflexive system is closer to the model of interaction between peers, as described in the concept of "collaborative learning" by Dillenbourg (1999): a situation in which two or more people learn or attempt to learn something together.

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Empirical Studies in a Reflexive Environment and Implications for Practice

C14P11 Several empirical studies have been carried out to observe and measure children's creativity during the interaction with the MIROR reflexive systems. The results showed that the mechanisms underlying reflexive interaction, that is, repetition-variation, turn-taking, and co-regulation, can give rise to creative behaviors, states of flow, children's improvisation, and inclusive processes.

C14S4

Music and Flow in Educational Contexts

C14P12 The observation of children interacting with reflexive systems showed that children reach high levels of wellbeing and creativity very similar to those described by the Flow Theory (Addessi, Ferrari, & Carugati, 2015). Csikszentmihalyi (1996) describes the "flow" state as the "optimal experience" enjoyed by creative people while they are doing their favorite activities, and it is perceived by the subject as a balance between the goals he or she wants to achieve and the skills that the subject possesses to achieve these objectives. Flow is characterized by the presence of high levels of intensity of several variables, namely: focused attention, clear and immediate feedback, clear objectives, pleasure, control of the situation, no worry of failure, self-consciousness disappeared, and changing of the perception of time. The studies carried out by Custodero (2005) revealed that the flow theory could be an effective tool to approach children's musical creativity. We carried out two experimental protocols, where the children were asked over three sessions to play a keyboard, with and without the reflexive system, alone or with a friend. We implemented an original grid to both observe and measure the flow experience of children. The results show that the flow emotional state increases when children play with the reflexive system, both alone and with a friend. In the second study, it was

also possible to observe that the flow is higher for children who played with the more reflexive setup of the system.

C14P13 Pedagogical implications: the results of our experiments suggest that the teacher can use reflexive systems and reflexive strategies (mirroring, turn-taking, co-regulation) in order to enhance children's flow emotional state within a creative experience. More precisely, to engage children in focused activity both when playing and listening (*focused attention*) and with well-controlled movements (*control of situation*); to increase the activities started by the children (*self-assignment*: see Custodero, 2005), their ability to manage and organize the rules of interaction and the game with the partners, to play in a self-motivated way, without any external constraints (*clear goals*); to analyze the feedback produced by the partner (*clear-cut feedback*); and to explore and play musical ideas, create fun games, and play collaboratively (*excitement*).

C14S5 Enhancing Flexibility, Originality, and Dialogue in Children's Musical Improvisation

C14P14 The analysis of the children's musical improvisations during the interaction with the reflexive systems showed rhythmic and melodic patterns, formal structures, forms of singing and accompaniment, individual improvisation styles, and short formal constructions based on imitation, repetition, alternation, and contrast. Both in exploration and in the improvisations, the individual styles of each child are strengthened by the response of the system. Therefore, we decided to investigate in controlled way whether reflexive interaction influences children's improvisation skills. The study was conducted in a public primary school with forty-seven children aged seven and eight years (Addessi, Anelli, & Benghi, et al., 2017). The experimental design involved three sample groups: the control group trained by playing the keyboard with and without the reflexive system and with a non-reflexive system; the experimental group 1, which played the keyboard and the keyboard with a non-reflexive system; and the experimental group 2, which played only the keyboard with the reflexive system. One week after the training activities, the children were asked to improvise a musical piece on the keyboard alone (solo task), and in pairs with a friend (duet task). Three independent observers evaluated the solo and the duet tasks. They used the TAI-Test of Ability to Improvise (McPherson, 2005), which includes four evaluative criteria: instrumental flexibility, musical organization, musical quality, and creativity. We added three more evaluative criteria: musical dialogue, reflexivity, and attention span.

C14P15 The experimental group 2, which trained only with the reflexive system, reached the highest average results in all criteria, both when the children improvise alone and in a duet. The difference between experimental group 2 and 1, which did not use the reflexive system, was statistically significant in the duet task. In the duet task, the correlation between reflexive interaction and all the other criteria, including creativity, is high and statistically significant, which could indicate that practice with the reflexive system "teaches" children the mechanisms of reflexive musical interaction

(turn-taking, co-regulation, imitating, being imitated, repeating, and varying), and they are then able to use these reflexive behaviors also when they interact with a human partner.

C14P16 Pedagogical implications: reflexive technologies and reflexive interaction can support a music improvisation program by means of individual and collective "deliberate practice" (Ericsson, 1997; McPherson, 2005). These systems can become children's sound companions, be placed in a corner, at school and at home, and be available to children for extemporaneous explorations in individual sessions, or with their friends or siblings (e.g., Ferrari & Addessi, 2014/2017; Pscheidt, Cardoso de Araújo, & Addessi, 2021). The teacher can use reflexive interaction to enhance children's creativity, that is: (1) Musical flexibility: the child's ability to generate differing musical ideas, and manipulate/elaborate these ideas during the course of the improvisation; and (2) Musical originality: the child's ability to provide a musically unique or unusual response, which can result from the manipulation and/or elaboration of pitch, rhythm, or other musical elements (McPherson, 2005). Furthermore, reflexive systems can enhance the quality of children's musical dialogue, their ability to musically dialogue and interact with the partner, by paying attention to the musical proposal (listening), the ability to reply in a way correlated to the friend's musical proposal, to co-regulate and share musical ideas, and to interact using repetition and variation, and turn-taking.

C14S6 Creativity through Music: Embodied and Enactive Reflexive Approach

C14P17 We carried out several experimental studies aimed at investigating whether interaction in reflexive musical environments can improve creative processes and children's ability to improvise with movement (Addessi et al., 2017; Volpe et al., 2012). Maestu and Trigo (1995) define motor creativity as "the intrinsically human capacity of putting bodily life at the disposal of the individual's potential . . . in the innovative search for a valuable idea" (p. 623). We implemented a movement observation grid based on Laban Movement Analysis (LMA) (Laban, 1980/1950), and we used the Thinking Creatively in Action and Movement (TCAM) test (Torrance, 1981). The LMA, which was originally created to describe, visualize, interpret, and document human movement, in this case was used with a more specific application in the field of dance and movement education. The LMA has been used with excellent results in the field of musical studies, for example to observe and analyze marimba players' bodily movements (Broughton & Davidson, 2016). Our grid was made with the Observer software (Noldus) and includes the six aspects of LMA, namely: body, flow, space, time, weight, and effort. A controlled study was conducted in Italy in two classes of the first cycle of a public primary school, with forty-seven children aged seven and eight, divided into two groups: experimental group (23 children) and control group (24 children). Both groups participated in four lessons, one each week. In the control group, the children improvised different bodily activities while they were listening to a child playing a keyboard. The children in the experimental

group improvised different bodily activities while listening to a child playing a keyboard and the reflexive responses of the MIROR-Impro. An example of an activity carried out:

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> On the moon. Children pretend to be in a science fiction film set on the Moon: "Pretend to be animals, aliens and rocks of a lunar landscape." The child-musician therefore has the task of playing the soundtrack of a science fiction film. To the rest of the class we propose alternatively: "move like flying animals during the sound proposal of your musician-partner, and move like creeping animals during the computer's response"; "Move like rocks that roll during the proposal of your music-companion and freeze in a position during the computer's response." The children took turns in the role of musician. The same activities carried out with the experimental group were carried out with the control group, but the child who played did not have the reflexive response of the system and the children who danced responded with movement only following the sound proposed by the musician-partner.

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Before and after the activities, we measured the children's motor creativity using the TCAM test. We used a modified version of Activity 2 "Can you move like that?" of the TCAM test, suitable for measuring the child's ability to imagine and take on different roles by moving like animals or objects, and which then evaluates the imaginative capacity. For example: "Can you move like a tree in the wind? Imagine you are a tree and a wind is blowing very hard. Show me how you would move by moving forward toward the camera."

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The control group and the experimental group did not show different results on the TCAM test performed before the activities, whereas after the activities a significant difference emerged between the two groups. In particular, and in line with our hypothesis, there was an increase in the creativity scores of the experimental group, which had performed activities with the MIROR-Impro reflexive system, compared to the control group. These results support our hypothesis that reflexive interaction, thanks to its mirroring mechanisms, turn-taking, and co-regulation, positively influences the development of motor creativity in children.

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The analysis using the LMA highlighted some qualities of movement and use of space. In particular, in the post-test phase, we observed that in the experimental group the children showed, compared to the control group: a wider kinesphere, that, is the sphere around the body (Laban, 1980/1950)—for example, during the post-test, it was noted that the amplitude of the gesture of the arms was greater in the experimental group than in the control group; a safer use of the general space; greater use of individual parts of the body, not only the arms, but also the shoulders, the head, and the feet.

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Pedagogical implications: we believe that the usefulness of the reflexivity paradigm is that the children remain with thought-movement on the same activity while elaborating variations. This allows the teacher to organize activities that support children in experimenting with various body responses to musical proposals and vice versa, placing greater attention on the relationship between elements of music (sound, melody, rhythm, etc.) and elements of movement (body, space, relationships, time, etc.). It is important that children express themselves without going through verbal language, but taking on "other" languages. It is necessary to discover unusual and original

correspondences between the two languages (music and body), which for teachers can represent an interesting aspect from which to start along new pedagogical paths.

C14S7 Inclusive Potentiality of Mirroring, Turn-Taking, and Co-Regulation

C14P23 Reflexive interaction can be a "transversal" device for creativity, music education, and music therapy, and enhance expressive and creative behavior in situations of disability and/or in which it is important to promote inclusion. The flow experience generated by the interaction with MIROR applications favors states of creativity and wellbeing, suggesting an effective therapeutic and rehabilitative potential. Reflexive interaction stimulates and activates the interactive processes that deeply involve the person, as well as specific brain areas of resonance. For example, Nadel (2002) emphasizes that the processes of imitation and recognition of imitation are fundamental for understanding the autism spectrum disorder. According to Rizzolatti et al. (2002), autism may have a neurobiological basis in the malfunction of mirror neurons. The reflexive interactive musical systems can therefore be placed at the crossroads between music education and music therapy, where the music therapist's task is to set, through listening, the conditions to promote creativity and social processes (Bunt, 2012). In particular, they are adaptive and intuitive systems, analogous to the extemporaneous character of music therapy improvisation. They are based on the co-regulation of a communicative process defined as "a continuous disclosure of the individual action that is susceptible to introducing new actions from the constantly changing actions of the partner" (Fogel, 2000). Further constitutive characteristics of reflexive interactive musical systems useful for inclusive education are the *priority given to child/ren and to their musical style(s) and identity(ies)*, *the child-centered learning approach*, a *tool for the children to express themselves*, their emotions and symbolic imaginations, by means of the body and the music, the *interaction based only on sound feedback* (no need for music notation or the computer screen), the *collaborative learning*, the *direct peer learning*, and the *self-organization* of groups.

C14P24 Several empirical experiments and practices have been implemented with meaningful results using reflexive interaction with adults and with children with autism (Anagnostopoulou, Alexakis, & Triantafyllaki, 2012; Ferrari & Addessi, 2019; Figueiredo, Luders, & Addessi, 2021), as well as with children with impaired hearing (Gurioli, Ferrari, & Addessi, 2019), and in dance schools with children in wheelchairs (Bertocchi, 2017).

C14S8 Bonded Creativity in Infant–Adult Vocal Interaction

C14P25 Finally, we have observed that reflexive interaction can reinforce the creativity of children not only during the interaction with reflexive systems, but also during vocal interaction with adults. Several observations were carried out at home with

nine-month-old children and their parents and grandmothers during the daily routine of diaper change (Addessi, 2020). The video analysis was carried out by applying the grid of Vocal Activism, which allows to register and measure the duration of *vocal productions*, *imitation/variation*, and *turn-taking* for each partner of the dyads. Three different vocal productions were registered with the adults: *vocalization*, *singing*, and *speech + IDS*. The results of four case studies showed that the child is vocally more active when the adult's imitation-variation and turn-taking are higher, both with the parents and the grandmothers, and both when they sing or speak. In case study 1, the father and son "played" at improvising like two singers playing together, displaying remarkable anticipation and synchrony. We observed how the situation is co-constructed over time as a result of co-regulation. The father and son reached attunement step by step, constructing a series of shared and co-regulated actions that allowed them to anticipate the other's gestures and to regulate their own actions in relation to their expectations of their partner. This is precisely the function of reflexivity: to construct a type of format, or "frames" (Bruner, 1983), allowing children to control time and its content made up of gestures, emotions, and actions. Repetition creates a pattern that allows the child to anticipate the course of time and thus, in a certain way, to master it.

C14P26 Costa-Giomi (2014) highlighted that many studies have focused on infants' differential attention to speech and singing, with different and sometimes opposite results, and that further variables can affect infants' preference, such as the mode of presentation. The results of the study presented here highlight that the interactive processes of repetition-variation and turn-taking can affect children's preference, whether with speech or song. These results could have some importance for the development of singing, namely the acquisition of conventional songs as well as the invention of creative songs (Barrett, 2006; Cohen, 2011; Ilari, 2014). For example, in case study 1, the child repeats and modifies the melodic profile of their vocalizations in real time together with the father: a good exercise to learn how to sing and invent new songs, before actually singing. From a pedagogical point of view, these results suggest that in order to enhance the vocal production of the child, the adults/educators should find a balance between their own vocalization and the vocalization of the child, leaving the child time to produce vocalization, respecting the turn-taking, following the nuances of the child's voice, and giving preference to musical play and the pleasure of musical vocal interaction, imitating the child rather than trying to be imitated.

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Conclusion

C14P27 This chapter has explored the idea that creativity in early music development and learning is grounded in reflexive interaction, a new paradigm initially born in the field of technology and then exploited in the field of children's creativity and musical experience. Several empirical studies have been conducted on reflexivity and flow emotional

state, musical improvisation, body action, inclusive context, and infant-adult vocal interaction, highlighting how interaction based on repetition and variation, turn-taking, and co-regulation could stimulate and enhance children's creative processes in and through music, both in child-machine and human interaction. Several music and dance activities have been suggested, in which children experience reflexive interaction by making or listening to music and moving the body. Furthermore, it was suggested that the teacher/adult could use reflexive interaction to guide the children from spontaneous explorations toward musical and motor invention, exploiting it as a kind of "scaffolding" (Bruner, 1983; Vygotsky, 1962). In conclusion, the reflexive interaction paradigm introduces an original contribution to the field of children's creativity, which originates in the ancient myth of Echo and now resonates with the contemporary psychology of musical embodiments.

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