



Review

Music as a Tool for Affiliative Bonding: A Second-Person Approach to Musical Engagement

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Abstract: Music listening or playing can create a feeling of connection with other listeners or performers, with distinctive levels of immersion and absorption. A major question, in this regard, is whether the music does have an ontological status, as an end in itself, or whether it is only a tool for the mediation of something else. In this paper we endorse a mediating perspective, with a focus on the music's potential to increase affiliative bonding between listeners, performers and even the music. Music, then, is hypostasized as “something that touches us” and can be considered a partner of affiliative exchange. It has the potential to move us and to modulate the way we experience the space around us. We therefore elaborate on the tactile dimension of being moved, as well as on the distinction between personal, peripersonal, and extrapersonal space, with a corresponding distinction between first-person, second-person, and third-person perspectives on musical engagement.

Keywords: gentle touch; affiliative bonding; extended body space; motherese; hypostasizing of music; immersion; skin-to-skin contact; affective neuroscience



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1. Introduction

The presence of sound is undeniable in today's society. There are not only the sounds from nature, but man-made noise and industrial sounds in particular have created soundscapes that are overwhelming in terms of sonic energy. In addition to their direct, physiological effect and influence on perception, sounds can be very intrusive and invasive, even to the extent that they can modify the perceived space around us. Many people, therefore, are in continuous search for a kind of protective bubble, as evidenced by the increasing use of personal music systems, which seem to function as a cocoon of self-chosen sounds that delineate a private zone of safety [1]. This seems to suggest a need for people to create their own personal space that is not shared by others.

Such cocooning behavior, however, cuts both ways. As a shielding behavior, it may create a distance from the environment, with possible repercussions on the experience of peripersonal space and interpersonal distances. Yet, it is also possible to listen with others to the same music, which is likely to bring listeners together rather than separating them. It can be questioned, moreover, whether this “shared experience” can be considered a tool for affiliative bonding and “feeling close”. This seems to be the case for attending live performances, which may evoke a feeling of togetherness in a here-and-now experience, but this holds even more strongly for playing music together. Collective music making, in fact, is a kind of social music interaction, which can be seen as a dynamic and ongoing process of co-regulation with performers mutually adjusting to one another in a complex interplay of action and perception [2].

A major question, in this regard, concerns the role of the music: does it have some ontological status, as an end in itself, or is it only a tool for the mediation of something else? In this paper we endorse to some extent this mediating perspective, without, however, ignoring the importance of the music as a sound structure with intrinsic qualities. The

latter, however, can be regarded as the eliciting factor for the sharing of a lived experience, which can be regarded also as a tool for affiliative bonding.

There have been multiple studies on the affective–emotional effects of music listening or playing. The music, in these studies, has been considered mostly as an inanimate instance with acoustic qualities that can be described in objective terms, a so-called “third-person description”. Though this is a legitimate approach, it is lacking in terms of interactional dynamics. We therefore intend to broaden the approach by also incorporating the “second-person” perspective into our description. It is an approach that conceives of music as an agent or virtual person that can be addressed directly in an actual here-and-now encounter. Music, moreover, is mostly not a neutral stimulus, but something that can trigger affective reactions of approach or withdrawal (see below). As such, it can facilitate the establishment of affiliative bonding and reward.

In what follows we elaborate on this approach. We start our argument with a quick overview of the most prototypical example of affiliative bonding—the bonding between mother and child—to enlarge our scope from maternal singing to broader interactions with the sonic world. We then explore how music can modulate the way we perceive the space around us by dissolving to some extent the boundaries between our body and the peripersonal space. We thereafter elaborate on the metaphor of being moved by the music by redefining music as a tactile art and celebrating the sense of touch. Music, in that view, can be considered as a kind of gentle touch, either in a manifest or an imaginary way. To make these claims more empirically grounded, we finish our overview with some clinical findings of the psychological and physiological value of close tactile contact, as exemplified in the method of kangaroo mother care, to conclude, finally, with a debatable hypothesis that hypostasizes music as a virtual caregiver, and the listener as the object of care.

As we bring together a lot of theoretical frameworks and empirical evidence from diverging fields of research, we provide in Box 1 a list of core assumptions, which may provide a common thread for the remainder of this article.

Box 1. Overview of core assumptions of the arguments throughout the paper.

Core assumptions:

- Music can be seen as an end in itself with ontological status;
- Music is also a mediating tool for interpersonal exchange;
- Shared musical experiences can trigger affiliative bonding between performers, listeners and the music;
- Music, in this view, can be hypostasized as a virtual agent and as a partner for interactional exchange;
- Interactions can be described from a first-, second- and third-person perspective;
- Musical interactions modulate the way we perceive the space around us;
- Music invades our peripersonal space, contributes to the dissolution of boundaries, and can even trigger an experience of immersion;
- Music as a vibrational art has a tactile dimension that impinges on the boundaries of the body;
- Music, therefore, can be considered a kind of gentle touch;
- The metaphor of being touched by the music has attracted empirical evidence from neurobehavioral and neurobiological studies of emotion.

2. Maternal Singing and Broader Interactions with the Sonic World

The case of a mother singing to her baby is prototypical example of affiliative exchange [3–5]. Being a universal and cross-cultural phenomenon to soothe infants and engage in early interaction and communication, it belongs to the broader category of *motherese* or emotional *infant directed speech* or *singing* (IDS). This is a simple kind of language that mothers use when addressing their infants through their voices. IDS, therefore, has several characterizing features: it exhibits affective properties, it expresses the involvement of the mother or caregiver, and it is a marker of the quality of mother–infant interactions [6]. It mostly uses a loving voice and the expression of positive emotions to enhance emotional closeness and to draw the attention of the infant towards its caregiver [7–9]. As such, it

is considered a means for affiliative bonding with proven beneficial effects on postnatal and early development. Most notable are the behavioral and systemic outcomes on the newborn, such as better feeding, autonomic stability, cardiorespiratory regulation, and neurobehavioral development in general [10–13]. It is, in sum, the example par excellence of building a connection between the mother and the child.

2.1. Mother–Infant Bonding as a Starting Point

Maternal singing is a prototypical kind of communication that inherently activates reward in both the mother and the infant. It is multimodal, in the sense that auditory stimulation through singing is mostly accompanied by tactile stimulation, in the case that the mother holds the baby closely in her arms. Such tactile stimulation is very favorable for the promotion of bond formation and the induction of affiliative reward by releasing a number of sociosexually related hormones. Touch, however, has many faces. It may range from the brutality of a physical blow to the most sensual caress [14], but in general it can be considered as a kind of tactile communication and contact. Due to the immediacy of physical contact, moreover, it expresses more profoundly and instantly what language can only confer at length.

This is apparent in the case of gentle and *pleasant touch*—as in caresses and skin-to-skin contact between individuals—, which is transmitted by different afferent sensory nerves than those for hard, unpleasant touch [15,16]. Skin-to-skin contact, in particular, stimulates tactile afferent nerve fibers, with the release of oxytocin as a critical factor [17–19]. This mammalian neuropeptide has a primary role in birth and lactation, but it has a function also in the oxytocinergic system that plays a major role in attachment bond formation and parenting [20].

The combination of auditory and tactile stimulation is exemplified most typically in mother–child interactions with preverbal children, where maternal touch provides an additional dimension to vocalizing. The “mother touch”, then, is added to the “mother language” [21], even to the extent that it has become a major issue in healthcare in general, and childcare with newborns in particular [22]. Touch is a powerful tool in the interactions between human beings. It has conspicuous potential for aggression, sex, and physical coercion, which represent direct invasions in the “bubble of privacy” that people maintain around themselves [23]. This intrusion, however, is not always undesirable, and can even be beneficial, provided that it is wanted, enjoyed, and searched for. Touch, in that case, does not only function as a compensatory mode for shortcomings of other sensory modalities—as in the case of blind people who rely more strongly on tactile exploration—but may become instead a primary mode of communication.

2.2. From Maternal Bonding to Broader Interactions with the Sonic World

Maternal bonding is a rather limited field of research. The question can be raised, therefore, whether affiliation in mother–infant nurturing is to be distinguished from that between mates—as in close friendships—and whether it can be extended even further to the broader context of a (shared) musical experience? Major issues here are the dimensionality of affective bonding (e.g., being warm and affectionate vs. social dominance and leadership; gregarious and extraverted vs. aloof and arrogant) and the extent to which these relationships are able to develop attachment characteristics. One position is the assumption that affiliative bonding is mediated mainly by the capacity for experiencing affiliative reward, which underlies the foundation for establishing close interpersonal relationships that are characterized by a positive affective component [24]. It is assumed, further, that specific classes of stimuli inherently activate reward in both participants of an affective exchange [3]. The assumptions are appealing, as they broaden the study of affiliative bonding from the private sphere of mother–infant relationships to the broader field of interpersonal exchange.

In what follows, we propose to extend these interpersonal relationships even further by hypostasizing the sounding music as a virtual agent [25], and by conceiving of musical engagement not merely in terms of a *third-person description* of the objective acoustic and

structural characteristics of the music, but also in terms of a *first-person description*—the subjective experience—and even a *second-person description*, where the music is conceived as a partner in a dyadic affiliative relationship. The concepts of “exchange” and “mutual engagement” are quite important here. They highlight the critical role of the real-time experience of music and its primary definition as a temporal and sounding art.

Music, thus defined, is a real-time vibrational phenomenon that is situated in the world and in the moment of its production and reception. This holds for a live performance—both as performer and as listener—but even if the generation of sound is not visible nor tangible, as in the case of listening to pre-recorded music through loudspeakers, it is possible to conceive of the music as existing in a kind of virtual space, where the actual sound production can be transported both in time and place. The resulting experience, then, can be regarded as a reduced form of virtual reality, with sounds emerging as it were from nowhere, but without losing the potential to evoke a feeling of presence and immediacy [26]. It is this presentational immediacy, further, that turns the musical experience into a first-person experience, and which makes it possible to describe the music in phenomenological terms as it appears to the listener [27,28]. The first-person perspective, however, does not exhaust the musical experience, which is not always a private matter, but it is also a relational event that can take place in the context of social interactions. Conceiving of music in terms of affiliative bonding, therefore, also entails the introduction of a *second-person perspective* in which the listener directly encounters another subjectivity [29,30]. This is obvious in the context of collective listening or playing together, but it is possible also to conceive of the music as another agent in an interactional exchange. It is an approach that “hypostasizes” the music as a virtual agent (see below) and that defines the major role of musical engagement in terms of mutual exchange and interactions with the sounds.

3. Music as Surrounding Space and Interactions with the Sounds

Defining music listening in terms of an interactional exchange presupposes ongoing and real-time access to the sounds, hence the decisive role of the hearing system as one of the major sensory systems of our body. Establishing our first connection with the world, it starts in mid-pregnancy when the fetus is immersed in the continuous wealth of uterine sounds (the voice of the mother, breathing sounds, peristaltic movements of intestines, heartbeat) [31,32]. This familiar sonic environment—coined in more poetic terms the “uterine symphony”—changes abruptly at birth with a simultaneous ignition of the other senses, which gradually take over the primordial role of hearing [33]. This has led to the predominant and almost exclusive attention being paid to the role of sight in academic studies, with a corresponding neglect of the contributions from the other senses. This “ocular-centric dominance”, however, has been challenged by embracing the larger sensorium beyond the sparse view of a limited set of sensory modalities. There is, as such, a broadening of scope, by reconceptualizing the processing of sensory information in terms of multisensoriality [26,34,35] (and [26] for a broad overview). This is the *sensorial turn* in the study of perception, which argues for a broader definition of the sensorium as an operational and productive complex that embraces the entire perceptual system [36,37]. It criticizes so-called “single-sense epiphanies” that restrict engagement with objects or events of perception to one sense only [38].

3.1. Challenging the Single-Sense Epiphanies: The Multisensorial Approach

Our senses are not limited to the Aristotelian five—smell, sight, touch, taste, and hearing—but include also other senses such as proprioception, equilibrioception, the vomeronasal system, sense of hunger, thirst, wet and dry, weight, fullness of the bladder, suffocation and respiration, sexual arousal and appetite, lactiferousness, and others [39,40]. This means that both humans and animals perceive the world in a multimodal manner, or put differently: they engage with the environment through the coordination that is conveyed and picked up simultaneously through multiple sensory modalities [41–43].

This multisensorial approach has implications for the way human listeners engage with their environment and delimit their personal space. Some senses, such as vision and hearing, are “distance senses”. They refer to actual objects or events in the environment, as contrasted with “near senses”, such as taste, smell, touch, proprioception, and the vestibular system, which are dependent on patterns of energy that impinge directly on our sensory system. The sense of hearing holds a somewhat atypical position in this regard. Being attuned to physical vibrations, which stimulate directly the surfaces and deep tissues of our body, it involves a conflation of distal and proximal stimuli. The actual stimulus energy is associated primarily with the distal stimuli, but perceiving them depends most directly on proximal stimuli that impinge upon the body. For some perceptions, therefore, there is little distinction between distal and proximal stimuli, with touch as a typical example. The distal stimulus, which is responsible for the sensation of touch, is created as it were when it is itself in physical contact with the observer [44].

It is tempting to apply this to the process of music listening, which, after all, can be quite invasive. As a vibrational art, it has penetrating power, not only in a physical sense, but even in the sense that it can penetrate the private zone of felt experience [45]. Music, therefore, is not to be described merely in terms of cognitive categories, but also in terms of real-time interactions with the sounds, which can take place at many levels. There are, first, the physical interactions with sound-producing devices—as when playing a musical instrument—but, at a less manifest level of interaction, there are also the so-called epistemic interactions with the sounds—mental operations that are performed merely at the level of the imagination (see [46] for an overview), and the affective–emotional reactions to the sounds [47].

It is important, further, to consider the distinction between action, reaction, and interaction. The latter, in particular, seems to have a lot of operational power, as it entails the concept of reciprocity between the participants of a mutual exchange. It means that the sounds are not the only objects of attention. Equally important are the agents that produce or listen to the sounds, who pave the way for the study of social interactions in the context of musical engagement. It is an approach that makes it possible to describe the relationship to the music and others in terms of personal and interpersonal space (see below). Music, then, but also other people, can be mediating factors in the management of interpersonal distance and social interaction. Both concepts have a lot of explanatory power, allowing one to experience music in terms of a defensive bubble that surrounds our body, and to define several zones of spatial distance between the music and/or other people.

3.2. *The Space around Us and the Extended Body Space*

The space that surrounds the body determines how we deal with our environment. Living organisms continuously monitor the objects—both animate and inanimate ones—that enter this space. Some major questions can be raised here: (i) Is there a clear distinction between our body and the environment, with a boundary between so-called internal and external spaces? (ii) Is there a directionality in the way we face the external space, with a direction from our body to the environment (centrifugal) or from the environment to our body (centripetal)? (iii) Are both approaches to be conceived as being in an asymmetric relationship (from one space to another, unidirectional) or as a symmetric relationship that celebrates the reciprocity of outgoing and incoming directionality (bidirectional)?

The questions are not new. They echo somewhat the phenomenological conception of the “embodiment of the mind”, which means that our mind and first-person experiences are intimately bound up with our body. This *body–mind* construct—as advocated by Husserl [48], Merleau-Ponty [49] and later also in the embodied approach to cognition [50]—is a two-faced construct that entails both subjective and experiential openness to the world and its objective and material description (see [51] for a critical discussion). It is an approach that stresses the intertwining aspects of the body as “sensing” and “sensible” [49,52,53] (see [54] for an overview). We both “are” a body in space, but we also “have” a body in space, which means that we use space to realize our movements, goals and intentions.

In making this distinction, Merleau-Ponty made a radical departure in his later writings from the dominance of vision—the so-called ocular-centrism—in the Western philosophical tradition, with its long-standing Cartesian consciousness/object dualism. Vision, in his view, is only a synecdoche for sensing in general. In what he coined as an “ontology of the flesh”, he argued that the visual and the tactile are bound up in a general sensing which is embedded in the “flesh of the world”. It is an approach in which sensing and sensible, and subject and object, occur together, and wherein “between the seeing and the seen, between touching and the touched, between one eye and the other, between hand and hand, a blending of some sort takes place—then the spark is lit between sensing and sensible, lighting the fire that will not stop burning.” [49] (p. 102).

There is, as such, a tension between the reference frame of our body space, which is egocentric, and the external space in which the objects of the world exist out-there. Together, they constitute a “practical space” for interacting with the world, with a blurring of the boundaries between both spaces. This is the case when we monitor our limbs as they extend beyond the boundaries of our body space, or when we rely on tools to increase the dimensions of our body. It allows us to interact with objects in the outer world, which become integrated in an extended body schema. The outcome, then, is an impression of shrinking or de-distancing of the external space, which is shrunken to the level of a near space [54].

This extended body space, however, is not merely a practical space. It is also a “social space” in the sense that the space around our body has been defined as an area that people maintain around themselves and into which other people cannot intrude without causing some discomfort or withdrawal [55,56]. As social beings, we are inclined to establish a kind of safety zone around our body during social interactions, with determining factors as the type, the strength, and the cultural meaning of our social relationships and interactions [57,58]. Intrusion in this space can be experienced as a threat to our psychological or biological integrity [59], which clearly shows the importance of emotional and motivational factors in establishing the space between people [54]. The boundaries of the space around us—our peripersonal space—therefore act as a kind of defensive bubble that may change as the outcome of both the emotional content of the approaching stimuli and the individual characteristics of the interacting people [60–64]. It has been found, e.g., that our safety zone shrinks in the presence of a stranger, but expands after prosocial and trustworthy interpersonal exchanges [65–67].

3.3. Interpersonal Space and the Dissolution of Boundaries

There have been several attempts to provide operational definitions of the spaces that surround us. Most of them start from the concept of body space as defined by the actions that the spaces can afford. There are basically three of them: the extrapersonal space, defined as the far space outside of reach; the peripersonal space, which is the space within reaching distance; and the personal space, which coincides most directly with our body surface [68]. The interpersonal space, moreover, is the space where social interactions typically occur [69], but also where feelings of discomfort and fear may possibly arise when other individuals infringe on it [54,70,71]. This may urge people to move farther away to reinstate a safer and more appropriate interpersonal distance, as an obvious example of interpersonal “space regulation”. An additional but not insignificant factor is the level of tolerance for physical proximity, which may depend also on the level of familiarity of the intruding instance [72].

The use of space, further, is not gratuitous. Being an important part of the social interactions of both animals and humans, it has been studied most typically through measuring the proximity that individuals allow between themselves, and through studying those factors that modify personal space regulation [54]. Four zones of spatial distance have been identified in this regard: (i) an intimate zone of about 6–18 inches as used in very close relationships, with all senses involved but with limited vision; (ii) a personal zone of 1.5–4 feet, which is used in the near space of the other, with vision, touch and hearing

but without smelling the other; (iii) a social zone of 4–12 feet, which is used in more formal interactions with eye gaze, loud voice and body movements; and (iv) a public zone of more than 12 feet, which is the distance kept from public figures [73]. They have been classified also as flight, critical, personal and social distances [74].

Critical issues in this regard are the differentiation between personal and extrapersonal space, the instantiation of a preferred comfort distance, and the mediating role of social–affective factors. This means that the malleability of the peripersonal space can be compromised in cases such as attachment anxiety, which is characterized by heightened checking for signs of support and worries about rejection or abandonment. Such reduced malleability can lead to a rigid segregation of the peripersonal from the extrapersonal space, with an increase in social hypervigilance [58]. The evaluation of the context as being social or non-social, however, seems to be a major modulating factor here.

It thus seems that the valuation and instantiation of the peripersonal space can be influenced by personality traits—such as fear and anxiety—that, as part of the human defensive system in general, locate the safety margin of anxious individuals at a further distance from their body. It can be asked, then, whether music can act as a virtual agent that might function as an “intruder” or as a kind of “social glue” that facilitates the blurring of the boundaries between peripersonal and extrapersonal space. The latter, in particular, deals with the so-called “we-space” [75] or “interpersonal space” [54] as the action space that exists between participants. It is the space par excellence that enables interpersonal multisensory exchanges of information.

It is challenging to translate this to the realm of music, in the case of either playing music or merely listening. Playing music is an obvious example, with the musical instrument being seen as an extension of the body space where the distinction between personal space and peripersonal space is blurred to some extent. Playing together with other musicians goes even further, by also blurring the peripersonal and extrapersonal space. But a most inspiring instantiation is the case of Classical Indian Dhrupad vocal improvisation, which can be considered as an example of “sound sculpting” [76], where singers are invited to engage with melodic ideas through the manipulation of intangible, imaginary objects with their hands. Such tangible manipulations seem to require some amount of effort, as singers appear to manually sculpt spaces, which are conceived as quasi-pervasive substances (e.g., an elastic band, a ball, water, etc.). They afford distinct interactions such as stretching, expanding, compressing, pulling, throwing, and others, which are experienced as if they were physically tangible and posing a distinct sense of resistance [77].

Another interesting example of the identity/community-building capacity of music is the technique of throat singing of the Inuit and Mongolian (Tuvan) people [78,79]. The Inuit performance style, in particular, traditionally consists of two women who are facing each other using their throat, belly, and diaphragm to expel sounds. They sing duets in a close face-to-face formation without instrumental accompaniment in an entertaining contest that is aimed at outlasting the other.

Important, in this context, is the feeling of the dissolution of boundaries, both between musicians but also between the musician and his/her instrument. This merging of musician and instrument, in particular, paves the way for an “extended” and “embodied” view of music cognition that conceives of the musical instrument as a natural extension of the musician, somewhat analogous to the blind person and their cane. The musician, then, no longer experiences a boundary between his/her own body and the instrument, but the instrument is felt from within as an organic component of the body [80,81], with an integration of the musical instrument in the dynamic structure of the body—the body schema—so as to become a part of the somatic know-how of the musician [82].

3.4. Presence, Immersion, and Absorption: The Feeling of Being There

Music is one of the most intangible and elusive arts. Sounds appear and fade away, they are not visible, and we can also not grasp them as external objects “out-there”. Perhaps the best way to describe them is to compare them to a fluidum, which can be defined

as a substance (liquid or gas) whose particles can move about freely. The analogy to sounds that surround us—a kind of sonic envelope—is obvious, though there is something peculiar in the sense that sounds are experienced simultaneously as “being there” and “not being there”. Music, in fact, is not tangible in a strict sense. It cannot be manipulated as an external object, but it is possible to adopt a milder and more attenuated definition of tangibility. Music, then, can be defined as a kind of *virtual touch* (see [25] for a more in-depth discussion), somewhat analogous to taking a shower with sounds instead of water.

Much more can be said about these quasi-tactile aspects of sounding music. Yet these sounds can be experienced not merely in terms of sensory (tactile) sensation, but also as a means to transport the listener to another space, which is partly real and partly imaginary. Much inspiration can be found here in the domain of virtual reality, with two conceptual categories that are quite useful: *physical presence* and *self-presence*. The first—physical presence or telepresence—refers to the illusory feeling of actually being present in another environment than the one we are physically in [83–85]; the second—self-presence—evokes the capacity to map our physical body movements onto the moving body of another instance—such as, e.g., an avatar—so as to create the illusory feeling of owning, controlling, and being a body other than our own [86–88]. Bodily acting within a virtual social context, moreover, may create a sense of being together or interacting with others—called co-presence or social presence—while being physically remote [89–91] (see [2] for an overview).

The concept of physical presence—also termed teleportation—can be considered a kind of transportation to a simulated place, while simultaneously providing a high degree of presence, involvement, and engagement. According to Lombard and Ditton, it can be defined by three descriptions: “you are there”, which means that the user is transported to another place; “it is here”, when another place and its inhabiting objects are transported to the user; and “we are together” when two or more users are transported to a common place [92].

Presence, as the more encompassing term, thus seemingly has a lot of meanings. Some of them are borrowed from the scientific literature on virtual reality, revolving around a loose interpretation of the “feeling of being there”, often in combination with the term “immersion”. Both terms are even used interchangeably [93], though there is a difference in meaning.

“Presence”, as distinguished from immersion, can be defined as a phenomenon of distal attribution or *externalization*, which means that our perception refers to a space that is external to and beyond the limits of our sensory organs [94]. Such an experience is obvious in unmediated perception, where the immediate physical surrounding is the object of perception. This is different, however, when the object is transmitted by communication technology, in which case there is a distinction between the environment in which we are actually present (i.e., the natural perception of an environment) and the environment that is presented through the medium (i.e., the mediated presence or telepresence). “Immersion”, on the other hand, is a cognitive state of engagement that is independent of the medium in which it is experienced. It has been defined by Murray as an experience of being transported to an elaborately simulated place that is pleasurable in itself, somewhat analogous to the physical experience of being submerged in water. As such, it has its psychological equivalence in the experience we have when we plunge into the ocean or a swimming pool, namely “the sensation of being surrounded by a completely other reality, as different as water is from air, that takes over all of our attention, our whole perceptual apparatus” [95] (pp. 98–99). Immersion, in sum, can be defined as a state of engagement that holds our interest through sensory, challenge-based, or imaginative means [96], resulting in a shift of attention by allocating perceptual resources to focus on an alternative reality. The resulting experience, then, is a cognitive state and a subjective experience that is characterized by several characteristics: being mentally absorbed, attending to some information to the detriment of other, disregarding to some extent the real world, loss of awareness of the external reality, and the instigation of temporal dissociation. It is an experience that

is not constrained to one medium, but that is found in the context of gaming, virtual environments, films, and music [97].

Immersion, further, entails a process of becoming physically or virtually a part of the experience itself [98]. It has been described as a heightened and effortless form of attention, together with a reduced generalized orientation to reality. As such, it entails an altered consciousness of time, of our body, of the surroundings, and a sense of forgetting about ourselves [99–103]. The immersive musical experience, in this view, is an experience in which one may lose oneself, either as performer or listener, and where the music seems to break down distinctions between self and others to evoke feelings of belonging, cohesion, and shared conceptions of identity [104].

Virtual environments and embodiments are interesting domains of application in this regard. They target a psychological dimension of the user experience, namely, the feeling of *presence* [92,105–107], which has also been formally defined as the perceptual illusion of non-mediation [92] (see also [108]). There is a sense of realism in this feeling, in the sense that a virtual reality can be defined as “an event or entity that is real in effect but not in fact” [109] (p. 109). It is important, however, to note that presence is a mental state rather than a sensation, which means that the mental construction of the user is more important than the stimuli themselves [110].

It is not difficult to translate this to the realm of music, which is a multifaceted phenomenon. There is the sound, a sound-producing device, and an agent that generates the sounds. Even if these components of the construct of music are logically distinct, it is common to see them as aggregates. As such, we can conceive not only of a merging of musician and instrument, but it is possible also to go further and to conceive of the merging of the musician, the instrument, and the produced sound. Such a conceptual construct can then be experienced as a kind of virtual agent that can be physically present or absent, as in the case of an actual performance, or listening to prerecorded music that sounds only through the speakers. It makes it possible to conceive of the latter in terms of virtual reality, with music sounding as if it were generated here and now at the moment of listening, but at a reduced level of presentational immediacy.

There is, of course, the limitation to only one sensory modality (the auditory modality) in the case of mere listening. The level of *presence*, however, can be increased by adding other modalities, as in the case of looking at a recording of a live performance in the format of an audiovisual rendering such as a YouTube video. But the use of digital technology goes even further by introducing augmented reality (AR) (a rendering of the real, physical world with the overlay of digital elements), mixed reality (MR) (the real world with the overlay of digital elements where both can interact), virtual reality (VR) (a fully immersive digital environment), and extended reality (XR) (the umbrella term that embraces AR, MR and VR) (see [111,112] for an overview). All these formats may even raise the feeling of “presence” by making the mediation invisible by creating an illusory feeling of non-mediation, encompassing multiple categories that are related to the physical environment, the user’s own body and the social environment [2,92,113]. The possibilities, moreover, are almost endless, as they provide technological mediation between performed actions on the one hand, and multisensory perception on the other hand, by extending the natural sensorimotor capacities of human beings into the digital world [114].

The feeling of presence and perceptual immediacy, further, is of paramount importance when it comes to having a shared experience between the listener and the originator of the sound. The latter can be the performer, which is the default version of interpersonal interaction, but it is possible also to hypostasize the music as a virtual agent. This raises a question about the ontological status of music as a virtual agent or the partial equivalence of music and performer. The question is beyond the scope of this paper, though it may open perspectives for an approach to musical sense-making in terms of interaction dynamics [115]. We therefore make a first attempt to bring these interpersonal interactions closer to the personal and peripersonal space by relying also on the sense of touch. Thinking of music in terms of “something that touches us” is perhaps one of the most challenging

questions when trying to explain the musical experience. In what follows we try to partially answer this question by conceiving of music as a tactile art.

4. The Metaphor of Being Moved: Music as a Tactile Art

Music is a vibrational art [25]. It activates the sense of touch and the vestibular system of the inner ear [116–119], besides the sense of hearing, which makes hearing a multisensorial experience. The vibrations impinge not only on the eardrum and the basilar membrane of the cochlea, but they also impinge directly on the skin, which is the largest sense organ of the body. Vibrations, therefore, can be regarded as exteroceptive sensations as long as the contact is limited to the skin. Once they intrude also on the viscera and deep tissues of the body—as in the case of extremely loud music—the sensations become proprioceptive [120]. It can be questioned, however, to what extent there is really actual tactile stimulation in the case of music, as the vibrational energy is not always very strong. There are, however, many reports of listeners who experience the music as having penetrating power, either in a consensual or forced way [121], and some listeners who look for such intruding power when listening to extremely loud music [122] describe listening as a shared experience of “being touched-without-being-touched” by the vibrating air [14]. Music, in that case, has the potential to intrude on our so-called “bubble of privacy”, either mildly or in a rather aggressive way. In general, it is a powerful tool for interactions between human beings with conspicuous risk of unwanted physical contact, as it has the potential to influence the listener at a very basic level of physiological functioning [23]. This penetrating power of music can be even more drastic, as illustrated in the use of sonic weapons with the aim of dominating and confusing targets, or destroying a prisoner’s subjectivity in the interrogation room. Music, then, is considered an “acoustic weapon” and a kind of “no-touch torture” based on the insight that sound has an immersive weight, liminal force, and substantive presence that cannot be escaped or denied. The audible stimuli, in that case, become tangible and haptic in an almost literal sense [14,123,124].

Music, however, can be experienced also in a less intruding way as a kind of (quasi)tactile stimulation. The intrusion, in that case, is perceived as non-lethal but beneficial, provided that it is wanted and enjoyed. Care should be taken, however, not to overestimate this so-called tactile dimension of listening. More promising is an “as-if” approach, with listening being experienced as if we were touched by the music. It is an approach that echoes somewhat the shared representation theory of mirror neurons in the perception of actions by other persons, which is an assumption based on the finding of visuo-motor cells in the premotor cortex of humans and primates, which respond either when a goal-directed action is performed, or when it is merely observed [125–127]. It allows people to simulate the experiences of others and to embody their thoughts, which, together, may also provide a basis for social embodiment [1,128].

The tactile approach, further, celebrates the sense of touch. As an object of study, it has long been underrepresented in academic studies, though there is actually a cautious reappraisal currently underway, as exemplified in the *tactile turn* in aesthetics [129–131]. This tactile approach has received some attention in clinical settings, in the sense that caregivers and clinicians have started to recognize the psychological and physiological benefits of tender touch. Affectionate tactile stimulation, in particular, has long been discarded in child-raising, for fears it would soften the children. This conception has changed drastically, however, since the 1970s, when affectionate touch has been redefined as a basic requirement for a healthy, happy, and well-socialized life [132,133]. This is exemplified, in particular, in studies on the significance of maternal touch besides vocalizing, with a major emphasis on the “mother touch” as a complementary approach to the “mother language” [131]. Touch, therefore, has become an issue in healthcare in general, and in childcare in particular [22].

4.1. From Primordial Sharing to Progressive Distancing and Back

The role of touch is not merely a private experience. Affectionate touch, in particular, entails an interaction between the partners of a tactile exchange. Touch, then, becomes

social touch, and this can be used to directly affect and regulate the affective state of others through the skin, with the aim of calming them or to providing a high-speed channel for emotional bonding. It makes touch an important social tool, as the skin opens a window on the other's sensing and emotional state, which is almost literally tangible [53]. Touch, moreover, has many faces. As tactile communication, it can be brutal and aggressive, as well as tender and sensual, but due to the immediacy of the tactile experience, it can express more profoundly and instantly what language is able to confer only more circumstantially. As such, it is exemplified most typically in the mother–child interactions with preverbal children.

It is challenging, therefore, to reconsider the early stages of development in the ontogeny of the individual child, which are characterized by a position of primordial sharing between the mother and the child—or more generally, between the caregiver and the one to be cared for—that is characterized by a feeling of fusion rather than distancing from the world. There is, quite in general, an early level of development that aligns with the lower level of visceral experience that underlies more developed levels of interaction with the world. These early stages describe the interactions in terms of the direct apprehension of presented content, and they value the world in subjective terms as “ego-bound things-of-action” rather than “ego-distant cognitive objects”. They are typical of the syncretic perception of the young child, with its initial fusion and lack of differentiation, and its overemphasis of the subjective over the objective stance, and have received theoretical support in the context of the influential organismic–developmental approach to language acquisition and symbol formation by Werner and Kaplan [134–139]. Known as the *orthogenetic principle* of development, this approach describes the delineation of progressive levels of organization, claiming that lower levels are integrated within higher forms. There is, then, an assumed proper direction—hence the term “ortho”-genetic—that moves away from the initial fusion and lack of differentiation to a more progressive differentiation and integration through processes of distancing and polarization between a subject and its environment. This is the transition from a subjective to an objective stance (see [26] for an overview).

It is possible, however, to argue against this claim, especially in the case of listening to music, which can be seen as a kind of regression to the undifferentiated state of fusion. Music, then, is not apprehended as something objectively “out-there”, but as something that entails interactions—externalized sensorimotor patterns—that are involved in the initial grasping of objects, rather than relying on internalized cognitive schemas. It is a perspective that challenges to some extent the generally accepted view of growing distancing from the external world, as exemplified in Cassirer's famous transition from “prehension” to “comprehension”. Typical in this assumed transition is the decreasing role of concrete sensorimotor actions in favor of a more distanced and detached kind of symbolic reference in ontogenetic development [140] (Cassirer, 1956 [1923]). The distinction was also taken up by Merleau-Ponty, who relied on Goldstein's distinction between “grasping” and “pointing” [52,141].

These developmental claims have proven quite fruitful to the description of ontological development in general. What we argue for, however, in the particular case of listening to music, is a kind of inverse orthogenetic development, as a kind of regression to the stage of less differentiation, recalling somewhat the oceanic feeling as an insoluble bond of being one with the external world as a whole [142] (p. 12), [143,144], and to the original oneness that is so typical for the younger child [145], which celebrates the subjective experience of non-duality as captured to some extent in the above-mentioned concept of immersion. The experience, then, is valued as a sense of oneness that softens the distinction between subject and object, and between inside and outside. It can be conceived even in terms of the integration of exteroceptive and interoceptive signals into a common integrated representation, echoing somewhat the classical Asian tradition of the “subtle body” as a body that functions outside the horizon of ordinary consciousness [146,147].

In summary, it can be stated that there is an alternative way to cope with the environment. Rather than relying on the concept of distance to the objective world—as exemplified most typically in the current visual culture of the image—there is also a culture of non-duality and fusion, with the tactile sense, as the near sense par excellence, having a preferential role in establishing an intimate bond between personal, peripersonal and extrapersonal spaces.

4.2. From Skin-to-Skin Contact to Being Touched by the Music: Celebrating the Tactile Sense

The metaphor of being touched by music is widespread and almost universal. It is an interesting starting point to conceive of music as a vibrational phenomenon that affects the body and the senses. Music, in that view, can be experienced as a kind of tender touch with the potential to facilitate conditions for affiliative bonding.

A lot of inspiration for this analogy is to be found in the clinical findings of the psychological and physiological benefits of close tactile contact, as exemplified in the method of *kangaroo mother care* (KMC) [25]. This is a method that consists of holding the baby against the chest of the mother, by analogy with kangaroos, who hold their babies in their pouch. It involves skin-to-skin contact on the parent's bare chest, with the baby in an upright position, wearing only a diaper [148]. As such, it is a non-invasive, supportive, and natural early intervention for preterm babies that compensates for the negative effects of the physical separation of the mother from the baby when placed in an incubator. Holding the baby against the chest of the mother is seen also as the most prototypic affiliative bonding, with stimuli that elicit rewards both for the baby and the mother [3,149,150].

Gentle and pleasant touch, as in skin-to-skin contact between individuals, is transmitted by sensory nerves (slow afferents) to the insular cortex of the brain, which is the place where several sensory modalities are integrated to characterize the emotional character of the sensory input [24,151]. Skin-to-skin care, therefore, should be considered most beneficial to allowing the newborn infant grow and thrive. It provides multiple threads of sensory stimulation—olfactory, auditory, tactile, thermal, and proprioceptive—that are provided by the mother [152], and has been proven to have a positive influence on physiological stability, neurobehavioral organization, feeding success, and socio-emotional benefits such as affective bonding [153]. It seems to have a regulatory effect on changes in the autonomic, thermal, hormonal, and behavioral systems, which become manifest in cases of the physical separation of the mother from the child [154]. These changes, which are typically not observable, have therefore been called “hidden biobehavioral regulators”. They reflect, in a more pronounced manner, the phenomenon of *separation distress* or *separation anxiety*, which acts as a basic neurobehavioral system that reflects the anxiety of uncertainty that is generated by the removal of protective and supportive safety cues, as well as the dysphoria that accompanies the loss of a source of reward [155]. It acts as a motivator to restore the distress caused by social isolation, rejection, and psychic pain via reintegration into a social group [24,156,157].

The KMC method, with its reliance on skin-to-skin contact, is assumed to facilitate the establishment of a pattern of mutual interaction and coordination between the mother and the infant, especially in the first hours after birth [158]. It is supposed to facilitate the neurobehavioral self-regulatory responses that are needed to enhance stabilization and adaptation to the outside world after the dramatic transition from fetal to neonatal life [19,159]. Stated differently, KMC can be helpful in establishing a kind of protective function by raising the protective threshold or stimulus barrier for potential aversive stimuli.

KMC, further, should not be limited to preterm babies. It can be applied more broadly to full-term infants, but it should occur as soon as possible. It should also not be restricted to maternal contact, but should be extended to fathering behaviors, as evidenced by findings that paternal holding and contact with infants triggers multiple hormonal responses, such as increases in prolactin, vasopressin, and oxytocin levels and a decrease in testosterone values [160]. It can be questioned, finally, to what extent the benefits of KMC can also be

translated to the realm of music [25]. The answer is to be found, at least partially, in the neurochemistry of affective behavior.

5. From Metaphor to Empirical Evidence: Neurobehavioral and Neurobiological Claims

KMC can be provided in a pure form with a restriction to mere skin-to-skin contact. It is possible, however, to also complement the tactile sensation with an auditory one by allowing the mother to sing or by using prerecorded or live music [161–164], and there is even the possibility of exposing the child to maternal singing or music without skin-to-skin contact. There are, as such, three possibilities for the establishment of a communicative exchange between the mother and the child: (i) using KMC in its basic form, (ii) using KMC in combination with music, and (iii) using the maternal voice or music without KMC. The latter should offer some of the soothing characteristics of mother–infant vocal interactions.

This brings us to the question of whether it is possible to hypostasize music as a virtual caregiver, and to conceive of the listener as the object of care (see [25] for an in-depth discussion). The question can go even further by inverting the roles of caregiver and care receiver, and conceiving of the listener as a caregiver and the music as the virtual object of care. The claim is highly speculative, but as a thought experiment it opens interesting perspectives for a dynamic–interactive approach to musical engagement [115]. It means that listeners are not merely receptive to the music, but that they can actively interact with sounds or sound-producing devices. This is obvious in the case of playing music, with a whole range of physical actions that are needed to produce the sounds, but in the case of listening, there are also multiple interactions. Broadly speaking, there are four of these, reflecting somewhat the distinctions between three components of the music construct: there are, firstly, the motor-related interactions, such as the *sensorimotor couplings* that link the sound-producing actions to the produced sounds, which must be heard to be evaluated, as well as the *ideomotor simulations* that simulate actions as if they are performed at a virtual level of imagery [165,166]; besides these motor-related interactions, there are *epistemic interactions*, which are mental operations on the sounds—such as comparing, recalling, anticipating, transforming, and others (see [167]); there are finally also the *affective–emotional interactions*, which imply a kind of mutual relationship between the music as an agent and the listener.

The distinction between these kinds of interactions has a lot of operational power. It shows the major role of “reactions” to the music with a whole range of responses, which may be either conscious and manifest or unconscious and covert. Moving along with the music is manifest and objectively demonstrable; subtle modifications and changes in physiological parameters—the so-called biomarkers—are, on the contrary, mainly hidden and accessible only through skilled observation, or by using sophisticated measurement tools [168–170].

As soon as these responses receive a kind of directionality towards the eliciting stimuli, there is a transition from mere “reactivity” to “interactivity”. This is exemplified quite obviously in the motor responses of our body in the case of dancing, where listeners are attuned to move along with the music as an entraining stimulus, but also with the movements of the partner. And this is even more the case for synchronized group dancing, where dancers are reacting with their motor system in an ongoing way while perceptually tracking the unfolding of the music.

The sensory cues are quite important here. They exemplify the physical coupling between dancers through direct bodily contact, or indirectly via some kind of mediation. They operate also through different sensory channels, such as the visual, auditory, and haptic ones, which seem to mutually reinforce each other [171]. The example par excellence is tango dancing, where the partners must entrain both to the sounding music and to each other. Their close bodily contact increases their physical coupling but also their joint reaction to the musical cues, which may trigger their capacity for interpersonal coordination in time. The result is a feeling of moving “as with one body”, which is obvious while moving together. The same feeling, however, can also be felt when uttering

sounds or singing together “as with one voice”. The fixed rhythms and pitches are then acting as coordinative constraints [172]. Figure 1 provides another example. It shows the tacit interaction between conductor and performer—in this case pianist Alice Sara Ott and conductor Mikko Franck—who communicate to each other by means of eye contact, but also through the ears. The music, in that case, acts as a mediator for establishing a kind of bonding between two personal spaces through different sensory channels—visual (eye contact), auditory, tactile (pressing the keys, holding the baton)—and sensorimotor couplings (piano playing, conducting). There is, further, a bonding between the personal spaces of both agents, between their peripersonal spaces (they are at a very close distance from each other), and even between the extrapersonal spaces of both the other members of the orchestra and the audience.

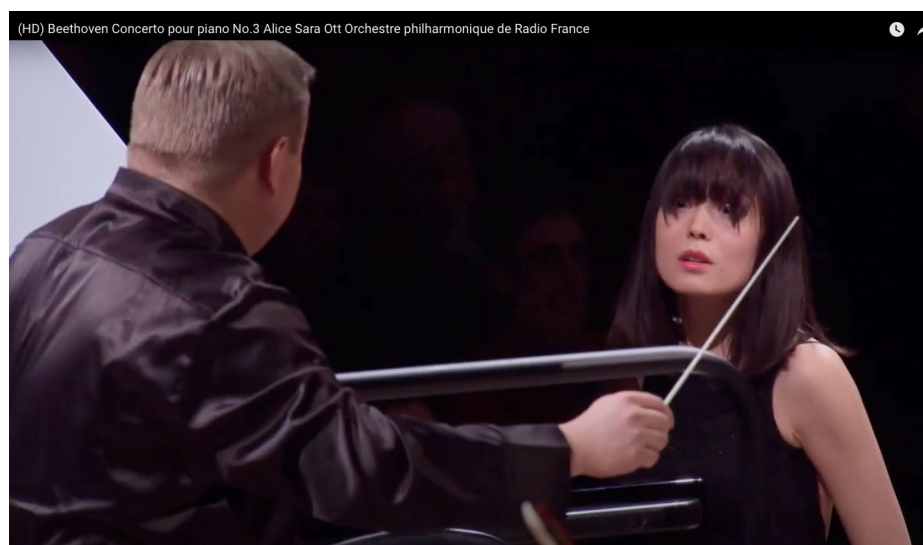


Figure 1. Example of nonverbal communication between pianist Alice Sara Ott and conductor Mikko Franck, performing the 3rd piano concerto by L. van Beethoven. Image retrieved from <https://www.youtube.com/watch?v=1kxai2rCs7k>, accessed on 22 July 2024.

This brings us to the major role of *affiliative bonding*. As a field of study, it has received a lot of attention, with major findings related to neurobehavioral research: its core content seems to revolve around the creation of a gratifying subjective emotional state; it is characterized by warmth and affection; it is elicited by others; and it motivates also close interpersonal behavior [24]. It reflects also the capacity to experience reward as elicited by a broad array of affiliative stimuli, which may be considered a key element for the development and maintenance of long-term affiliative bonds that are characteristic of social organization in humans and primates [173,174].

The neurobehavioral evidence of such affiliative behavior is growing steadily, with a major focus on maternal–infant bonding, which plays a major role in the release of oxytocin, which, in turn, seems to trigger an increased proximity of mother and child [173,175]. This echoes the neurobiological perspective in animal studies, which proffers that all forms of social bonding are modulated by this mammalian neuropeptide [176]. It is also a key feature of attachment theory [177], which, revolving around the concepts of attachment, separation, and loss, refers to the degree of closeness to or distance from the mother [154,178–182].

There is substantial grounding today with regard to the neural organization and neurochemical modulation of behavior-affiliative characteristics of trait affiliation. Affiliative behavior enables physiological adaptations that facilitate trophotropic processes—i.e., the energy storing mechanism in the ergotropic–trophotropic balance, such as calmness, relaxation, digestion, metabolism, growth, and healing—and fosters the physiological coregulation of bonding partners [183,184]. There is, as such, a strong connection between affiliative stimuli, neurobiology, and neurochemistry, though care should be taken not

to generalize too early, as many of the significant findings rely on rodent studies rather than on humans. As to the latter, however, there is admittedly a whole bunch of studies on early mother–infant interactions, with a focus on infant-directed singing and interactions [185–187] and on stress and affect regulation by maternal singing [188,189].

Much is to be expected here from research on the role of neurotransmitters or neuropeptides, and the particular contributions to the affiliative reward and affiliative bonding of dopamine, oxytocin, vasopressin, gonadal steroids, and endorphins in general [24]. There is, moreover, a lot of fine-tuning in the modulation of the dopaminergic activity within the reward circuit of the brain with the release of specific endogenous opiates or related substances, these being dependent on the specificity of the reward process (see [190]). A distinction must be made, in fact, between the three core processes of affiliative bonding: the appetitive and consummatory phases of reward, and the formation of affiliative memories as their outcome [24]. The underlying neurochemistry of each of them is rather complex but quite revealing, with a major role for dopamine in the appetitive phase, and the release of endogenous opiates (endogenous B-endorphin) in the consummatory phase of affiliation. The latter is typically accompanied by a state of physiological quiescence and behavioral calmness, and subjective feelings of liking and pleasure [191].

The role of the appetitive phase is quite important here. It entails an incentive state that is inherently rewarding. Animals, therefore, spend a lot of energy to obtain rewards even if there is no evidence of being sated [151]. Humans, in turn, also experience the incentive state as associated with several subjective feelings, such as desire, wanting, excitement, elation, enthusiasm, energy, potency, and self-efficacy. These feelings typically co-occur with feelings of pleasure and liking [191,192]. The positive incentive motivation and experiences of reward, moreover, are also associated with approach behavior, which motivates incentive-motivated behaviors, such as active searching for novelty and food, exploratory, aggressive, affiliative and sexual behaviors, approach and avoidance behaviors, food-hoarding, and nursing behaviors [24]. This clearly shows how neurobehavioral and neurobiological mechanisms may mutually reinforce each other. They pave the way for bringing together affiliative behavior and interaction dynamics by conceiving of music as a virtual partner in a referential exchange.

6. Music as a Virtual Partner and the Concept of Bonding

Musical interactions are interesting examples of interaction dynamics with distinct levels of concreteness and presence. A lot of inspiration for this approach can be found in the contexts of virtual, extended, or augmented realities, with a gradual transition between what is considered real or virtual. Rather than thinking in terms of a reality–virtuality dichotomy, with reality and virtuality at opposite ends, it makes sense to conceive of a dynamic tension between these poles and to embrace the concept of a *reality–virtuality continuum* [193]. Both terms, therefore, are not necessarily opposed, but can also go together, as exemplified in multiple applications in digital games and virtual environments. It must be possible, however, to also consider more explicitly the realm of music.

There is, first, the distinction between *listening* to and *playing* music. Playing occurs in the actual here and now with a high degree of presence and immersion in the sounds. It embraces a first-person perspective, as musicians are largely locked in the private complex of body, instrument and sound. Music playing, however, does not always happen in a solipsistic way. There is also the possibility to play together, as in ensemble playing, which broadens the first-person perspective to embrace also a second-person perspective, in both one-on-one and one-on-many engagements. The same holds also for listening, which can take place in a private sphere—alone or when using headphones—but also collectively, as in the case of attending a live concert. Music listening, then, is above all a shared experience, which is an important aspect in the establishment of affiliative bonding.

Musical engagement thus entails a lot of interactions and “doing things together”. There are the physical interactions with sound-producing devices—the instruments—in the case of playing music, the interactions with other players or listeners in the social context

of ensemble playing or collective listening, and, perhaps more challenging, also the interactions with the sounds. The latter can be described in terms of a third-person perspective by relying on an objective description of the acoustical characteristics of the music. Such a matter-of-fact approach, however, does not exhaust the musical experience, which can be experienced also in terms of a second-person perspective. Mere listening, then, can evoke a sense of presence and togetherness by hypostasizing the music as a virtual person. The example of a mother singing to her baby while holding the baby in her arms is a prototypical example. It entails an interaction at multiple levels with, at a basic level, the maternal sounds, which are produced in real-time, and which provide a beautiful combination of third-person (the description of the sounding vocalization), second-person (the mother, the child, and their interactions), and first-person (what the child/the mother experience themselves) approaches. It is not difficult, however, to generalize from the mother–child interaction to the broader field of music listening or playing together, where dyadic settings between the listener, music players, and the music are experienced preferentially in terms of one-on-one engagements.

There are many reasons to argue for this broadened approach. Musical interactions, first, seem to intensify empathic effects via the promotion of mutual affiliation, and by acting as a kind of social glue [194,195]. This holds for an intimate coupling, such as a mother singing for her child, but also for other interpersonal settings such as choir singing and playing together. Singing together, in particular, has been found to facilitate social bonding [196–200], and choir singing even has other benefits. It facilitates the establishment of social bonds, due to the shared intention, attention, and achievement of a collective goal [201–204]. Besides, there are the neuroendocrine effects, such as the endorphin release that is triggered by the synchronous activity of doing things together. The result, then, is an increase in closeness between group members, and a feeling of increased positivity towards each other [205–207].

Critical readers may find all this somewhat speculative. Their reservations seem legitimate, and underline the importance of gathering empirical evidence to ground our claims. There are several strands of research seeking to fill this gap. The first is the recently developed field of affective neuroscience, which studies how the brain processes emotions. It combines neuroscience with the psychological study of personality, emotion, and mood [208,209]. Secondly, there are evolutionary claims that corroborate the findings. One of them is the theory of social cognition [210], which states that, as group and brain sizes increased in the course of evolution, prehistoric hominins required more time to invest in activities such as social bonding, foraging, eating, and traveling, with biological developments and cultural innovations that were assumed to be helpful to dealing with these demands. Activities such as laughter, singing, dancing, religion, feasting, and emotional storytelling must be seen in this context as modes of virtual touch that make it possible to touch, as it were, many others at once [211]. There is finally also the emerging field of shared entrainment (see [115] for a broad overview). Being roughly defined as a process in which two or more autonomic oscillators interact with each other to adjust towards and lock into a common phase and/or periodicity [212], the concept of entrainment can be used in a broader context to describe how people interact with and tune in to each other or to the music. It is the mechanism par excellence that musicians rely on to synchronize their performance and to be in time with the music. It allows them to be “entrained” to some degree [213]. As such, it is an essential part of cooperative behavior, which is manifested most typically in the performance of synchronized movements. The latter seem to promote social bonds among toddlers, children, adolescents, adults, and even toward virtual avatars [207,214–216]), and is likely to create a sense of camaraderie or social glue between in-groups and out-groups [217].

The findings are quite convincing with respect to interactional dynamics between human beings. The case of hypostasizing music also as a partner in affective and affiliative exchange, however, is more challenging. The idea is still somewhat tentative, though it has a lot of potential for future research.

7. Conclusions and Perspectives

Music is an important part of our sonic environment. It can be very intrusive and invasive when imposed on us in a compulsory way, but its penetrating power can also be sought out as a protective bubble to delineate a private zone of comfort and safety. Such self-chosen cocooning can work both ways: it can function to shield us from others or from the environment, but we can also use it to share our private zone with others. Music, as such, can modulate the way we experience the space around us.

We have taken this experience of space as a starting point to examine the extent to which music can trigger the establishment of affiliative relationships and bonding. Music, in this view, should not only be described in terms of its acoustic or structural characteristics, but also as something that moves us to some extent. This “being moved” can be taken quite literally, as meaning being touched—music, after all, is a vibratory phenomenon—but also in the sense of hypostasizing the music as “something that touches us”. Music, then, is considered a virtual partner of affiliative exchange.

The claims, however, may seem somewhat metaphorical. We therefore have started from an operational definition of the space that surrounds us by relying on the broadly accepted division between personal, peripersonal, and interpersonal spaces, with special attention paid to the role of music as a kind of social glue in the social space, and the possibility of the dissolution of boundaries between these spaces. We have relied also on the less commonly used distinction between first-person, second-person, and third-person descriptions of the musical experience. It is a broader approach that allows us to describe several kinds of musical engagement in terms of subjective experience (first person), the mutual relationship between the music and the listener (second person), and even in terms of the objective and acoustic description of the music (third person). The second-person approach, in particular, seems to be quite promising, as it stresses an interactional exchange between partners (both real and virtual) in a here-and-now context of presentational immediacy. The musical experience, then, is to be seen as an ongoing real-time interaction between partners of a mutual exchange. The latter involves the listener, the performer(s), and also the music, hypostasized as a virtual person, each of them beings considered as having some degree of agency.

Music, however, is different from a mere communicative exchange. As a sounding phenomenon, it impinges on the body and the senses, soliciting not only the auditory system, but other sensory systems as well. The role of the tactile sense, in particular, seems to offer an interesting broadening of scope in this regard. It makes it possible to conceive of music as a kind of sonic envelope, with sounds that act as real vibrations, and, in a more derived sense, also as a kind of virtual touch.

The concept of “virtual” is central to our approach. By conceiving of the music as a virtual agent, and of touch as virtual touch, it opens up the possibility of transportation to the realm of non-reality. But rather than conceiving of a qualitative distinction between the real and the virtual, we are inclined to think in terms of a reality–virtuality continuum, with the possibility of a smooth transition between the real and the virtual. The terms presence and immersion seem to have a lot of operational power in this regard. What makes music distinct from other kinds of virtual environment, however, is the intrusive character of sound, with its high degree of presentational immediacy. Sounds are always there in a here-and-now context. We also cannot close our ears as we can do with our eyes. This means that there is always an obtrusive form of realism, with sounds invading our personal and peripersonal spaces.

Sounds, moreover, are not gratuitous. We can like or dislike them, but there is mostly an affective component, which may trigger behavioral responses of approach or avoidance. This affective component seems to play a major role in affiliative bonding, both in dyadic or multiple-persons interactions, with many studies already being undertaken in the field of affective neuroscience. We therefore elaborated to some extent on the prototypical case of affiliative bonding, namely, the interaction between the mother and the child. It is an interesting case that brings together neurobehavioral and neurobiological studies, with

interesting findings about the release of neurochemicals, as studied in attachment theory. The investigation of the mother–child interaction, however, also has another advantage: it is an example par excellence of the multisensory approach. Mothers do not rely solely on their maternal voice. Just as important is the maternal touch, and the spatial proximity of the skin–skin contact. We therefore briefly discussed the phenomenon of kangaroo mother care and its possible extension beyond the narrow mother–child relationship. The translation of these findings to the realm of music, however, is still largely yet to be done.

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