University of Graz
Centre for Systematic Musicology
MU0.071UB Music, language, communication (S)
Lecturer: Richard Parncutt
Winter Semester 2019/2020

The Gestural Origin of Music and Language

Embodiment and Communication

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26 April 2020

Abstract

The sharing of information between groups and individuals is both the foundation and the objective of human communication. Researchers have long speculated about the origin of the exclusively human ability to convey meaning through language and music. Many hypotheses have involved vocalized sounds. This paper proposes a theory based on our ancestors' non-vocal behaviors and asks how physical gestures influenced the development of music and language. Investigations of great ape gestural behavior suggest that language and instrumental music may have emerged from humans' inherited ability to make arbitrary connections between meaning and gesture. Great apes may have developed a gestural communication system that laid the foundations for the development of both domains. Language resulted from the transfer of meaning from gesture to speech, whereas instrumental music developed through sound producing gestures that facilitate the communication of more abstract meanings and emotions. The hypothesis of a gestural origin of language and music is challenged by research on great apes' deliberate use of vocalizations, and their ability to adapt vocal signals to different circumstances, which propose that vocalizations might be the precursor to language and music. However, the more elaborate use of gestures and more advanced gestural, rather than vocal, repertoire among apes suggests that vocalizations might be merely a behavioral consequence of affective states. The theory of a gestural origin of language and music suggests that new epistemological concepts and methods, as well as greater empirical research on the matter are needed. This theory has important implications for primary education and music teaching, in which instruction techniques should be adjusted with regard to the importance of gestures in communication. Music theorists might reconsider aspects of the interrelation between physical and musical movement (e.g., chord progressions, melodic phrases). Also, performance aesthetics might include artistic standards that focus on the use of physical gestures.

Contents

List of Figures

Introduction

The sharing of information between groups and individuals is both the foundation and the objective of human communication. Its effectiveness is determined by the accuracy and unambiguity of data exchange and interpretation. Depending on the context in which the communication occurs and the type of information that is being transferred, a sender has a set of communication methods to choose from and employs one or multiple strategies to ensure the receiver's successful conversion of information into knowledge. The methods can be divided into three main, broad categories: spoken (i.e., verbal) communication, written communication, and non-verbal communication. The last of these is particularly interesting as it conveys information without the use of language – the principal mechanism of the other two types – but rather through behavioral cues such as facial expressions, body postures, and gestures that can be used supplementary, but also complementary to language (see Iverson & Goldin-Meadow, 2005).

Eliminating the imperative use of spoken or written language enables communicative interactions in different modalities and domains, including music. Departing from a formalist position and embracing the expressionist leads to the recognition that music, like language, conveys information. In fact, performers' gestures function as "contextualization cues" that contribute to the construction of meaning in music (DeNora, 1986, pp. 91-92). Are they, however, fundamental to the communication of that meaning? What is a successful communication in music? According to Juslin (2013), to be communicative, an interaction requires not only the correspondence between a sender and a receiver, but also the receiver´s accurate recognition of the conveyed meaning. For instance, in a musical performance, effective communication occurs if the listener perceives the same emotion that the performer intends to express (p. 2). On the other hand, Ekman and Friesen (1969) are more flexible about the necessity of a shared decoded meaning and argue that a gesture, in order to be classified as communicative, must simply be employed consciously with the explicit intent of conveying a specific information (pp. 55-56). Nevertheless, both positions clearly share the view that communicative acts must be *intentional*. Are gestures in music truly goal-directed? If so, how is the meaning of a gesture established and understood?

Interaction exclusively through nonverbal behavior allows for communication among different species as well. For instance, great apes demonstrate a quite sophisticated communicative use of gestures (see Tomasello, 2007). Moreover, it appears that gestural communication is in fact limited to humans and great apes (Pollick & De Waal, 2007, p. 8184). Do they consequently share the same gestural vocabulary? Consider the example in Figure 1. A chimpanzee extends its arm and reaches out the palm seeking food. The picture beside shows Lara when she was an infant, using the same gesture asking to be fed. In her teenage years, Lara applied the same gesture when indicating her need for something, e.g., pocket money for a school trip. Growing up, Lara became an opera singer and continues to display the gesture in numerous performances. Her husband, who is a pianist, sometimes extends his arm and palm in the same way during his recitals. Are they all using the gesture intentionally? Do they use it to communicate the same information? Did they inherit the ability to communicate something with this gesture from the chimpanzee? Is the meaning of the gesture understood by both humans and chimpanzees in the same way?

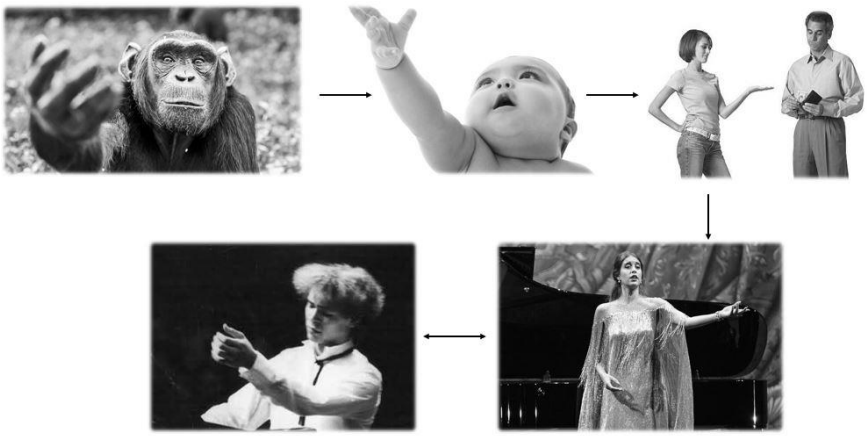

Figure 1. The same gesture type displayed by a chimpanzee, a baby, a young adult, an opera singer, and a pianist. The images are taken from the following links:
Chimpanzee: https://www.theallineed.com/technology/20151002/cameras-on-wings-join-ecology-toolbox-2/
Infant: https://www.theatlantic.com/magazine/archive/2009/04/the-case-against-breast-feeding/307311/
Teenager: https://www.irishtimes.com/business/financial-services/new-bank-may-be-loving-and-kind-but-it-s-also-driving-up-house-prices-1.2633683
Opera singer: https://www.abouther.com/node/20121/entertainment/music-film-television/about-opera-singer-farah-el-dibany-first-arab-female
Pianist: http://chopinreview.com/pages/issue/4/1

In nonverbal communication, the meaning of what is being conveyed is *embodied* and therefore manifested in hand-, face-, and bodily gestures. Questions regarding embodiment and gestural communication inspired diverse research fields. Neuroscientists, for instance, investigate the neural basis of gesture-speech integration and semantic processing (see Dick et al., 2012; Dick et al., 2009; Green et al., 2009); psychologists examine the role of gestures in thought and language creation, production, understanding and learning (see Goldin-Meadow & Alibali, 2013); researchers in the field of music psychology and performance studies focus on the influence of gestures on the perception of structure and emotion in music (see Clark & Davidson, 2017; Vines et al., 2011); scholars in the field of music theory and music history engage in theory, analysis and semiotics of musical gestures (see Gritten & King, 2006; Hatten, 2004); and ethologists question the link between non-human primate species and human communicative systems (see Arbib, Liebal & Pika, 2008; Call & Tomasello, 2007). With respect to the latter, this paper explores the evolutionary origin of human physical gestures and their influence on the development of (expressivity through) music and language. Although the origin of individual gestures and the construction of a species-specific gestural repertoire is often considered ontogenetically, the assumption that humans inherited the ability of making the arbitrary connection between meaning and gestures from great apes also requires a phylogenetic consideration of relevant issues.

The positive impact of promoting research on physical gestures, their origin and role in interaction transcends significant scholarly contributions and knowledge creation. It shows potential to offer new insights into the improvement of important communicative and social skills in everyday life and specific occasions. Along similar lines, it can present new perspectives on different cultures, encouraging tolerance and integration, and improving general quality of life. Moreover, the identification of an improper usage of gestures for communicative purposes among prelinguistic children, or the complete lack thereof, will contribute to an early recognition of developmental, cognitive, and psychological impairments and, consequently, timely treatment. Broadening knowledge about the role of gesture in musical expressivity will advance the quality of performances allowing for musicians' greater careers and better remuneration. Research on music-related gestures

focused on sound-implied movement is relevant for the progress of creative disciplines such as music theory and composition.

The following chapters review the possibility that physical gestures are the foundation of human expressivity. However, as discussions on the origin of human behaviors remain largely based on speculative theories, multiple hypothesis demonstrate potential plausibility. For instance, gestures might have influenced the development of language, but not music; or they might be merely an unconscious bodily reaction to affect and the environment and hence played a role in the emergence of neither language nor music. The latter would be further supported if evidence shows that there is no similarity between gesture types present among apes and humans. Furthermore, gestures in music might be used to create the effect of theatricality in performance rather than to convey specific meanings. These hypotheses are addressed through the consideration of relevant literature with the purpose of creating a theoretical framework for future research. Comparisons between great ape and human gesture repertoires outline the possibility of a sequential development of human communication systems, beginning with a manual modality and progressing towards spoken language and music.

Gestural interaction among great apes

Orangutans, gorillas, chimpanzees, and bonobos are tailless non-human primates with advanced cognitive abilities and humanlike features. They are classified as *great apes* (henceforth apes) and, together with humans, they belong to the family of Hominidae (Groves, 2018). Genetic evidence demonstrated that humans are most closely related to bonobos and chimpanzees. Moreover, it appears that these two species share more genetic material with humans than with each other (Prüfer et al., 2012). Therefore, they are the best candidates for research based on the origin of human behavior, including nonverbal, gestural communication. If apes, particularly bonobos and chimpanzees, use humanlike gestures for communicative purposes, it would imply that gestures are part of human nature, i.e., they are an inherited and innate ability that might have been the first stage in the emergence of other means of expression, such as spoken language and music.

In order to be distinguished from unconscious bodily movement, e.g., physical reflexes to the environment and affective states, a communicative gesture is identified as intentional and conscious nonverbal activity that is consistently and regularly used under specific circumstances in order to achieve a desired and appropriate response from the observer (Ekman & Friesen, 1969, pp. 53-54). Consequently, this type of interaction requires the direct monitoring of target audience. For instance, Liebal et al. (2004) observed that bonobos and chimpanzees understand whether they are being seen by a target individual or not. Rather than choosing other types of nonverbal behavior to attract the attention of a not compliant partner, apes prefer to establish a 'face-to-face' interaction and perform visual gestures instead. Consistent with the above study, Lurz et al. (2018) additionally determined that chimpanzees recognize if being seen even without a direct line of gaze with the target partner. Furthermore, Cartmill and Byrne (2007) observed that captive orangutans are sensitive to the degree of apparent misunderstanding. After a period of awaiting followed by the lack of the desired behavioral response from the partner, orangutans continue gesturing, thereby regulating the intensity and type of gestures depending on the degree of misunderstanding (partial or complete). Such behavior clearly demonstrates "audience targeting, response waiting, and persistence and elaboration in cases where the target audience fails to react" (Byrne et al., 2017, p. 756). This supports the "gestural flexibility hypothesis", which Pollick and de Waal (2007) explained as follows: "our closest primate relatives use brachiomanual gestures more flexibly across contexts than they do facial expressions and vocalizations. Gestures seem less closely tied to particular emotions, such as aggression or affiliation, hence possess a more adaptable function" (p. 8187).

Ethograms of ape gestural repertoire showed three main categories of gesture types: a) visual gestures, which require visual attention; b) tactile gestures, that involve physical contact with the partner; and c) audible gestures, which produce sound to attract the partners' attention (see Byrne et al., 2017). An example for each gesture type is pointing (a), tapping (b), and slapping (c). In her theoretical review, Pika (2008) maintains that most ape gestures are used to mediate primarily dyadic interactions (pp. 127-128). However, gestures used imperatively, e.g., when asking for food or pointing at something, demonstrate apes' ability to use also referential gestures in triadic interactions that are typical among humans. Coherently, Pika and Mitani (2006) observed that wild chimpanzees request grooming of a

body part from another chimpanzee by "making a relatively loud and exaggerated scratching movement" on that body area (p. 191). In response to the gesture, the target chimpanzees initiate the desired action on the indicated spot, which demonstrates not only the intentional and communicative use of the gesture, but also a shared understanding of its meaning. In fact, Graham et al. (2017) examined the degree of receptive gestural vocabulary among bonobos and determined the existence of "a mutually understood communication system that is, unlike many other visual displays, largely unconstrained by sex or age, and wherein all individuals are potentially signallers and recipients for all gestures" (p. 176). Moreover, they found a 96% overlap between the gestural repertoire of chimpanzees and bonobos. 'Understanding' was determined by the recipient's appropriate reaction to the signaler's gesture (i.e., Apparently Satisfactory Outcome). In this regard, is there a specific gesture-meaning relationship present across species? According to Cartmill and Byrne (2010), apes typically attribute more than one meaning to a single gesture. Simply put, analogous to human language, multiple gestures can function as synonyms for a single meaning. However, following a goal-outcome matching observation, the researchers were able to identify 29 (out of 64) gesture types that orangutans use to convey a single information. According to the meaning they communicated, the gestures were assigned to either one of the six categories: "Affiliate/play", "Move away", "Share food/object", "Stop action", "Co-locomote", and "Look at food/object" (p. 801).

How are these gestures learned and when do they become communicative? Tomasello et al. (1997) argued that gestures emerge during an individual learning process called ontogenetic ritualization. Consider the example of the 'extended arm' gesture (see Introduction). To get food, a young chimpanzee reaches out its arm to grab it and repeats the same action each time it is hungry. Over time, the mother learns to interpret the movement and responds in advance. Hence, she takes the food and feeds it to the young chimpanzee as soon as she sees it reaching out its arm. In the future, the infant becomes accustomed to the mother's anticipatory reaction and starts extending its arm not to grab food, but to communicate hunger to the mother expecting her to feed him. Ultimately, the action of reaching out the arm becomes a communicative gesture acquired through a ritualized behavior-response process between mother and infant (for a similar example see Byrne et al., 2017, p. 762). As such, however, ontogenetic ritualization does not require the

comprehension of communicative intentions and produces presumably idiosyncratic gestures, limited to those that 'ritualized' them. Hence, ontogenetic ritualization is conceived of as a means of achieving a goal rather than a shared communicative system (Pika, 2008, p. 129).

However, Graham at al. (2017) found that the gesture type "Present (Climb on)", largely used by mothers to make the infant climb on their back and therefore believed to be limited to mother-infant interaction, is also used by adult male bonobos for the same purpose (p. 176). Also, Byrne et al. (2017) assembled a comprehensive catalogue of great ape gestures, in which 33 out of 84 gesture types occur among all species, including 27 that are, according to the present author's estimation, shared with humans as well (pp. 758-761). This evidence suggests that the theory of ontogenetic ritualization is inconclusive and not generalizable for all gesture types. Also, supposing that ontogenetic ritualization is the sole process involved in the formation of gestures, it does not interfere with the later spread of those gestures across species through social interaction and imitation, which at this stage involves their understanding and use for communicative purposes.

According to Byrne et al. (2017), "an ape develops its communicative repertoire of gestures by exploring its own innate potential to make a large range of different gestures for a range of different purposes" (p. 764). Relying further on Darwin´s (1872) reasoning allows for a more flexible theory. Under the influence of strong sensations (e.g., starvation, sexual arousal, etc.), the nervous system becomes so excited that the body produces movement often unwillingly and unconsciously. Eventually, the movement is used with the intention of relieving or gratifying the sensation and is repeated in response to the same circumstances many times. Ultimately, the movement is associated to the sensation that triggers it and is later used as means for communicating that sensation. This is when the movement becomes a gesture. The gesture is acquired by other individuals within and across species through interaction, and social learning (e.g., imitation). Finally, following the use of gesture by several generations, it becomes inherited and persists in evolution due to its important contribution to survival and reproduction. More advanced species that inherited the gesture transformed it into a more sophisticated and effective form of communication or combined it with other means of expression. Hence, it follows that apes developed a gestural

communication system which laid the foundations for the development of human language and music.

The evolution of speech: From gestures to spoken language

When seeking for evidence that would support the assumption that the first human communication system was based on a manual modality inherited from great apes, it is reasonable to first examine communicative interactions among those humans that do not yet possess the ability to speak. Hence, if the above were true, communicative gestures are primarily expected among prelinguistic children. The hypothesis of a 'gestural origin of language' would be further supported by evidence of a shared gestural vocabulary between human infants and apes. If so, do gestures persist alongside spoken language and are they used intentionally to convey meaning?

Kersken et al. (2019) investigated whether referentiality is used also by 1- to 2-year-old prelinguistic children. For a better comparison with ape gestures, the researchers applied the same gesture classification methodology. Children were observed while engaging in their natural interaction and the gestures they produced were categorized as either declarative (if used to attract and share attention) or imperative (if used to request something). Audience checking, response waiting, and persistence were used as indicators of intentionality for the following purposes: "Direct attention", "Move closer", "Pick me up", "Move away", "Acquire object", "Follow me", "Affiliation", "Play", "Travel with you", and "Stop behaviour" (p. 585). Of the 788 observed gestures, 680 were identified as intentional and systematized according to 52 gesture types. An overlap of 89% (i.e., 46 gesture types) was recognized in chimpanzees, 4 gesture types were observed among gorillas and only two gesture types were children-specific (p. 586). Like chimpanzees, children´s gestures were goal-directed, used to convey single or multiple meanings, and flexible. Furthermore, both children and chimpanzees demonstrated sequential use of gestures, but preferred to produce them singly (see also Hobaiter & Byrne, 2011). This not only demonstrates the existence of a shared gestural vocabulary between humans and apes, but also that gestures appear earlier than language and are used referentially with the intent of communicating information that can´t be yet expressed verbally.

Iverson and Goldin-Meadow (2005) found evidence that gestures not only persist alongside language, but they influence its emergence and development as well. They found that lexical items appear first in gesture and then spread to speech after approximately three months (p. 369). For instance, a child that has been referring to an apple by pointing at it, will eventually combine the gesture with the word 'apple'. At some point, the child starts pointing at the apple while saying 'table', indicating that the apple is *on* the table. Hence, the child will use gestures to either complement or supplement speech. Following several months, the child moves from single gesture-word combinations and starts adding two words to a gesture. The earlier the child uses supplementary gesture-word combinations, the earlier it switches to two-word combinations. Since both combinations "communicate two semantic elements within a single communicative act", their correlation demonstrates that "gesture facilitates the emergence of early speech combinations", and consequently language as a method of communication (p. 369).

That gestures are integral to communication and part of human nature is evidenced by the fact that children blind from birth, who have thus never seen and experienced gestures in social interaction and speech, exhibit the same gesture types as sighted children, also in the absence of accompanying words (Iverson & Goldin-Maedow, 1997). Moreover, despite possible differences in culture-specific (gestural) pragmatics, spatial cognition, linguistic syntactic and lexical aspects, and meaning associations, gestures are present across-cultures (see Kita, 2009) just as they occur between different ape species. Future research might explore the possibility of a correlation between the diversity of gestural vocabularies and the existence of multiple languages.

Although humans use gestures to accompany speech independently of the presence of a conversational partner (e.g., when speaking on the phone), like chimpanzees, they produce more gestures when seen by a listener (Alibali, Heath & Myers, 2001). Moreover, the fact that particularly the rate of representational gestures (i.e., those directly associated to the narrative) increases with a listener´s presence, indicates that gestures indeed have communicative purposes, whether or not speakers use them with conscious intention to communicate (p. 182).

Based on research by Bavelas et al. (1992), Ekman and Friesen (1969), and McNeill (1985), representational gestures (also referential gestures or illustrators) can be classified as: a) Iconics (which represent concrete features of an object or action); b) Metaphorics (which represent an object figuratively); c) Spatial deictics (which are used to communicate a direction or a point in space); c) Literal deictics (which literally refer to the object in question); d) Interactive gestures or Regulators (which are addressed towards the interlocutor and used to include her in the conversation); e) and Emblems (i.e., culture-specific gestures). Two further categories, a) Beats and b) Adaptors, are used to a) emphasize certain words or indicate moments of digression from the initial narrative, and b) to manage emotional states, and have therefore a more ambiguous and less significant communicative role.

Figure 2. Example of an iconic gesture. The image is taken from the following link: https://www.unikautomation.com/service/consulting-services/

If *verbal* implies direct transmission of information, then gestures are as verbal as speech. According to McNeill (1985), "they are the overt products of the same internal processes that produce the other overt product, speech" (p. 350). He maintains that "speech and gesture cooperate to present a single cognitive representation" (p. 353), in that the content of speech can be "temporarily transferred to the person´s gestures" during moments of silence, such as within hesitations or gestural anticipations of the word that follows (p. 365). For instance, suppose the lady portrayed in Figure 2 is referring to an object and using the gesture to communicate its shape and/or size. She engages in this nonverbal act, without providing an explicit, verbal explanation of its meaning. Hence, even without articulating that the gesture symbolizes a particular feature of the object in question, the conversation partner is still able to understand the information conveyed. This indicates that implicit meanings in speech can be displayed explicitly through gestures (McNeill, Cassel, & McCullough, 1994, p. 225).

Hence, what is the underlying mechanism of understanding information conveyed by gestures? According to Skipper et al. (2009), observing co-speech gesticulation activates those areas of the brain involved with semantic aspects of speech processing, facilitating thus meaning extraction (p. 661). The activated areas of the brain are those also involved in the preparation and production of gestures. The mechanism that allows "an individual to understand the meaning and intention of a communicative signal by evoking a representation of that signal in the perceiver's own brain" is called *mirror neuron system* (MSN), (Molnar-Szakacs & Overy, 2006, p. 235). Rizzolatti and Arbib (1998) proposed that

> The development of the human lateral speech circuit is a consequence of the fact that the precursor of Broca's area was endowed, before speech appearance, with a mechanism for recognizing actions made by others. This mechanism was the neural prerequisite for the development of interindividual communication and finally of speech. (p. 190)

This implies that language originated from the ability to identify actions (p. 193). However, how are actions (in this case gestures) assigned specific meanings?

The mutual influence between perception and action is called embodied cognition and can either occur as action-perception or perception-action. The former is called forward model in which a sensory outcome is achieved through a specific action. The latter is called inverse model in which a sensory representation activates a corresponding motor action (Maes et al., 2014, p. 2). Perception and action become integrated through associative learning processes such as *associative sequence learning* (ASL), by which a link between intended goal and gesture is created through repeated experiences of gesture-outcome matching (Maes et al., 2014; on the subject of MNS and ASL see also Catmur, Walsh, & Heyes, 2009). Consequently, ASL expands gestural repertoire and MNS facilitates its understanding. Corballis (2010) nicely summarized that

> Language, then, may have begun as a largely iconic system, with hand movements creating spatial images of real-world objects and actions. Once conventionalization sets in, representations become more efficient and abstract, losing their iconic nature. At this stage, signals need not be conveyed manually or even visually, and articulate voicing provides a more economical and energy-efficient alternative …. In short, then, language can be understood as a gestural system, with vocal gestures gradually replacing manual and perhaps facial ones. (p. 3).

Research on ape deliberate use of vocalizations (Hopkins et al., 2011), and their ability to adapt vocal signals to different circumstances (Hopkins et al., 2007) might oppose

the hypothesis of a gestural origin of language. However, evidence of the existence of a more elaborate use of gestures and a more advanced and sophisticated gestural repertoire among apes (see Chapter 2), suggests that vocalizations might be merely a behavioral consequence of affective states. In fact, it appears that intentional vocalization, contrary to gestures, are not part of apes' mirror neuron system (Ploog, 2002 as cited in Corballis, 2010, p. 4). Hence, vocal calls might be simply an adaptive way of signalizing changes in the environment, such as in case of danger due to the attack of another animal. Despite the obvious evolutionary relevance of this behavior, Seyfarth and Cheney (2003) explained that

> Whereas signalers may vocalize to change a listener's behavior, they do not call with the specific goal of informing others or in response to the perception of ignorance in another. Similarly, whereas listeners extract subtle information from vocalizations, this does not include information about the signaler's knowledge. Listeners acquire information from signalers who do not, in the human sense, intend to provide it. (p. 168).

These observations reinforce the assumption that humans inherited the ability to make the arbitrary connection between gestures and meaning from apes and eventually learned to transfer that meaning from gesture to words to enable their hands to perform other functions (Corballis, 2013, p. 181).

The gestural origins of musical expressivity

As a consequence of technological growth, the modalities of music listening have progressed towards a prevalence of audio-only renditions, diverting attention from other aspects of performance, including its visual contribution to music perception (Thompson, Graham, & Russo, 2005, p. 203). However, according to Nusseck and Wanderley (2009), "visual cues constitute an important channel of information in the perceptual experience of music" (p. 336). For instance, visual aspects of performance can influence the perception of dissonance and interval size (Thompson, Graham, & Russo, 2005). Gestures, as visual constituents of performances across cultures (see Pearson, 2013) are thus worth investigating, and so is their role in music creation and communication of musical expressivity.

According to Young (1999), compared to the sciences which convey knowledge through "systematic demonstrations" of argument-supported claims, the arts convey knowledge through "immediate demonstrations", i.e., they place "someone in a position to

recognize that something is the case" (p. 42). Alongside movements required to facilitate the achievement of specific techniques that result in specific sounds, and to co-ordinate ensemble performances, musicians use gestures to emphasize aspects of the musical structure and express (i.e., communicate) affective states. Like for language, the mirror neuron system explains also how gestures in music are understood. For instance, during a live piano performance the listener and the pianist activate the same brain areas and share a "co-representation" of the musical experience (Molnar-Szakacs & Overy, 2006, p. 236). This theory usually refers to inverse models of embodied music cognition. For example, listeners can recognize affect in performance by being prompted to move to the music in ways typical for that affect (see Young, 1999, pp. 45-46). Maes et al. (2014) approached forward modelling processes and explained that "from this perspective, it is not about how the body resonates with the music, but rather about how predicted sensory outcomes of planned or performed actions can be projected onto the perceived music" (p. 2). Accurate communication of emotion particularly benefits from this mechanism: a listener can understand emotion better when it is communicated (also) visually, for this visual representation allows her to imagine embodying that emotion herself (see Molnar-Szakacs & Overy, 2006, pp. 238-239). Hence, how important are gestures for musical expressivity? What parallels can be drawn between ape gestures, gestures in language and those in music? Is there a gestural origin of music as well?

Gestures in music can be classified as sound-producing, sound-accompanying, sound-facilitating, and communicative (Jansenius et al., 2010, pp. 23-24). As in ape and human (nonverbal) communication, gestures in music can adopt several functions (p. 24). Davidson (2012) observed the bodily movements produced by two flautists, two clarinetists, and a pianist. In the case of the wind instruments, she identified three basic movements which were, "crucial in the disclosure of information about intention", namely rotation, swinging and swaying (p. 613; Davidson referenced to the "centre of moment" theory by Cutting & Proffitt, 1981; and Cutting, Proffitt, & Kozlowski, 1978). From the piano performance, Davidson (2012) deduced again swaying, hand and/or arm lifts, and head shakes and nods as communicators of expressiveness, which often correlated with musical structure (p. 617). This study demonstrates two relevant points: a) just as gestures in language are conditioned by culture-specific differences, gestures in music are constrained by the nature of the

instrument; and b) similar gesture types can be also observed during ape communication (see Byrne et al., 2017). The swinging motion is particularly tied to the communication of expressive intentions, as evidenced by its absence in performances intended to be highly inexpressive (Davidson, 2007, p. 395). Swaying and hand lifts are also frequently used in co-performer communication and coordination (Williamon & Davidson, 2002, pp. 60-61). Furthermore, gestures in music demonstrate a certain degree of consistency in location of occurrence, but not in type (Davidson, 2007, p. 399). This suggests that, at the same location of the musical piece, different meanings can be communicated with different gestures. This further implies flexibility and adaptiveness, hence intentional use of gestures relative to the planned expressive intention.

In a study by Dahl and Friberg (2007) participants watched silent video clips of a soprano saxophone and a bassoon player and were asked to rate the emotional content for happiness, anger, fear, and sadness. The results demonstrated that performers' bodily movements convey the underlying emotions also when the sound is omitted. Overall, sadness, happiness and anger were easily communicated, in contrast to fear. The latter was probably harder to recognize because individuals typically tend to 'freeze' when scared, i.e., there is no gesture that can be readily associated to this particular emotional state.[1] Consequently, this finding is in favor of the mirror neuron theory. Moreover, ambiguously expressive music acquires the emotional meaning associated to co-occurring movements (Maes & Leman, 2013), and the expressivity of musical elements such as rubato, phrasing, and dynamics increases with greater bodily motion (Juchniewicz, 2008).

Referring to MacDonald et al. (2012), Juslin (2013) argued that "whatever a listener perceives in the music is what the music is expressing—for him or her at least!" (p. 2). Therefore, whether referentially or (merely) emotionally meaningful (see Tolbert, 2001), music has the potential of being conceived of as 'communicative'. If both music and language are means of communication, do they share the same origin as well? The catalogue of ape gestures includes also "Body drum", "Drum object", and "Drum other" (Byrne et al., 2017, p. 758). Fitch (2006) suggested that ape percussive behavior might be the precursor of instrumental music (pp. 194-195). If humans inherited ape gestures and the ability to

[1] Special thanks to Richard Parncutt for the suggestion.

associate meanings to them, perhaps early humans discovered that they can produce sound by drumming on resonant objects and constructed other sound producing tools that eventually evolved into the musical instruments of today.

Another potential hypothesis is inspired by Parncutt's (2018) theory that (some) human behaviors are the "evolutionary by-products" of the *mother schema* (i.e., the fetal/infant experience of the mother). It might be that when the mother schema is activated, emotions and behaviors that support the infant's survival are triggered. For instance, the mother schema will motivate the infant to trust the caregiver and seek her protection (pp. 479-480). Parncutt (2018) explained that

> From an evolutionary viewpoint, behaviours that affect chances of survival in life-and-death situations are generally adaptive. If some infants choose behaviour A in a given situation and survive, and others choose behaviour B and die, behaviour A may be passed to future generations. (p. 479).

Living in groups, joint actions, caring for each other, sharing food and other altruistic behaviors might have helped early humans to survive. Our ancestors probably developed means to promote social bonding, togetherness, solidarity, and intragroup empathy. If humans inherited all three gestural categories from apes, i.e., visual, tactile, and auditory, we could speculate that the sound that auditory gestures produced in highly reverberant spaces such as caves, activated the mother schema thus encouraging the above behaviors (on the subject of music and social cohesion see Huron, 2001, and Clarke et al., 2015 as cited in Parncutt, 2018, p. 486). Because it offered an emotional reward and promoted survival, the making of sound-producing gestures persisted and perhaps forged the first stage in the development of music as we know it today. Ultimately, one might argue that music is, in fact, the sensory outcome of sound producing (i.e., auditory) gestures. Consider percussion instruments. Producing sound by stroking for example a drum or a xylophone might be regarded as the closest representation of early auditory gestures.

A hypothesis of a gestural origin of music, however, requires further investigation, including evidence on ape 'drumming' and early humans' musical behavior. The theory of a 'gestural origin' would further imply that gestures are fundamental to communication in music. However, studies showed that performers can convey emotion relying on acoustic cues as well (Juslin, 2000). But then again, meaning in language can be also conveyed by

words only. This, however, does not denounce the important communicative role of gestures in both language and music, nor does it necessarily discredit the possibility of a gestural origin of these two domains. Consider Darwin´s theory of evolution. By analogy, gestures (as a heritable ability) changed over time allowing more advanced primates (i.e., humans) to adapt to the demands of the new environment. Hence, they evolved into new methods of communication, like language and music. That we find remnants of these gestures still today (in whatever form the domain affords), and actively use them, only confirms their significant role in communication.

Concluding Remarks

Communication is the foundation of human society and knowledge proliferation. Research on animal communicative interaction shed light on the origins of the communication pillars of mankind. In fact, communication among our closest relatives, great apes, demonstrates that human spoken language and (expressivity in) instrumental music originated from the inherited ability of making the arbitrary connection between meaning and gesture. The theory that the first stage in the development of human communication systems was based on primarily manual gestures becomes valid if verbalization is not required for the successive transmission of information. Sign-languages, in which a visual-manual modality is used to convey meaning, are a perfect example (see Corballis 2010; 2013.). Instrumental music is itself already non-verbal, however gestures are also effective when discussing about it (Fulford & Ginsborg, 2013).

A gestural origin of human expressivity finds support in the intentional, elaborate, and flexible use of gestures among both apes and humans; the primate's cortical control of gestures mediated by the mirror neuron system; the similarity of ape and human gestural repertoires; the manual-only modality of humans' earliest attempts of communication (e.g., in infancy); the inherited ability to use movement to convey meaning evidenced by the use of gestures by individuals blind from birth; and gestures' potential to fully replace spoken language. However, the limited use of explicit communicative gestures in music performance (due to instrument-related constraints), limited evidence on ape behavior that can be directly linked to music, research on animal vocalizations, and suggestions of other non-verbal

behavior's greater effectiveness in conveying information (e.g., the communication of emotion through facial expression) maintain fertile ground for contesting theories on the origin of human expressivity. Furthermore, a weakness of this paper, and hence the theory, is the author´s lack of practice in animal research and limited education in linguistic studies, which might have impeded the accurate understanding of relevant concepts and valid reasoning.

Nevertheless, returning to the example from Figure 1 in the Introduction, the theory proposed in this paper implies that the chimpanzee learned to use the "extended arm" gesture to communicate his longing for food and repeated it every time it found itself in the same situation. The ability to use this gesture to convey hunger helped it survive and reproduce and was therefore maintained over generations. Through evolution, early humans inherited the ability to associate meanings to gestures and developed a communication system based on a visual-manual modality. This system is still fundamental to preverbal infants' attempts to communicate information. Consequently, the chimp' extended arm remains the primary means for baby Lara to express hunger or simply that she *wants* something. Because of further biological and cognitive development and the demand of new environments, humans turned nonverbal gestures into verbal ones, i.e., words. However, despite the increasing use of language, gestures persisted as intensifiers of meaning. Consequently, Lara still uses the gesture to signalize her need for something, whether alongside or separate from speech. Expressivity through gestures allowed for the emergence of other domains such as music. Lara, now an opera singer, and her pianist husband display the same gesture to attract the attention of the audience, elucidate moments in the musical structure and communicate specific emotions.

Welcoming the theory of a gestural origin of (domains of) human expressivity would have a stimulating impact on the academic world, offering new concepts, theories, and methods, thus creating new opportunities for research. Acknowledging the importance of gestures in communication would facilitate the planning of improved instruction techniques, particularly in primary education. Music teaching would adopt new methods focused on the appropriate use of gestures in performance. This would most likely set new performance aesthetics and encourage creative ideas and avant-garde artistic movements. Therefore,

future studies should elaborate the link between ape drumming behavior and music, provide empirical evidence on the similarity between ape-, speech-, and music gestures not only in physical form but also in meaning, and demonstrate a correlation between intended and perceived meaning in both speaker-listener and musician-listener interaction.

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Appendix: Tabular argument for MA seminar paper

Introduction

Example	A chimpanzee, a baby, a teenager, an opera singer, and a pianist displaying the same gesture.
Main topic	The role of gestures in the emergence of and expressivity in spoken language and instrumental music.
Academic background	Neurosciences: The neural basis of gesture-speech integration (Dick et al., 2012; Dick et al., 2009; Green et al., 2009); Psychology: Gestures' role in language creation, production, understanding and learning (Goldin-Meadow & Alibali, 2013); Ethology: The role of gestures in primate communication (Arbib, Liebal & Pika, 2008; Call & Tomasello, 2007); Music Psychology and Performance Studies: Gestures' influence on music perception (Clark & Davidson, 2017; Vines et al., 2011); Music History and Theory: Analysis and semiotics of musical gestures (Gritten & King, 2006; Hatten, 2004).
Main question	How did physical gestures influence the development of music and language?
Context and relevance	Improved communicative and social skills in everyday life and important occasions; improved integration and tolerance through better understanding of different cultures; improved child development through better identification of psychological, developmental, and cognitive impairments; improved financial status of musicians through advanced performances; progress of disciplines such as music theory and composition.
Possible theses	Gestures are the foundation of expressivity in language and music; Human communication systems developed from great ape gestures; Gestures influenced the development of language, but not music; Gestures are merely an unconscious bodily reaction to affect or the environment; There is no similarity between gesture types present among apes and humans; Gestures in music are used to create the effect of theatricality in performance rather than to convey specific meanings; Listeners do not pay attention at all to gestures in either speech or music performance.
Approach	Review of relevant literature: 1) Great ape gestures (emergence, gesture-type, meaning, usage); 2) Gestures in language (preverbal period, co-speech gestures, parallels between human and ape gestures; 3) Gestures in instrumental music (the role of gestures in music creation and expressivity).

Main section

Subtopic 1	Gestural communicative interaction among great apes
Subquestion 1	How do apes use gestures to communicate?
Possible subtheses	Apes use humanlike gestures intentionally and flexibly.
Arguments and evidence	Great apes demonstrate the employment of gestures which are goal-directed, persistent (Liebal et al., 2004), flexible/adaptable (Cartmill & Byrne, 2007), mutually understood (Graham et al., 2017), better controlled than vocal or facial signals (Ploog, 2002, as cited in Corballis, 2010), and in some cases referential (Pika & Mitani, 2006).
Subthesis 1	Great apes developed a gestural communication system that laid the foundations for the development of human language and instrumental music.
Counter-arguments or -evidence; rebuttal	Apes learn gestures through the process of ontogenetic ritualization, which does not involve the understanding of communicative intentions. Hence, such behavior is understood as a means of achieving a goal rather than a shared communicative system (Pika, 2008; Tomasello et al., 1997).

Subtopic 2	The development of communication from gestures to speech
Subquestion 2	What evidence supports the assumption that the first human communication system was based on a manual modality inherited from great apes?
Possible subtheses	Language is the result of meaning transmission from gesture to speech.
Arguments and evidence	Chimpanzees and preverbal infants use the same gestures (Kersken et al., 2019); Lexical items appear first in gesture and then spread to speech after ca. 3 months (Iverson & Goldin-Meadow, 2005); Children blind from birth use the same gesture forms as sighted children (Iverson & Goldin-Meadow, 1997); Gestures are present across-cultures (Kita, 2009); Speech and gesture are a single cognitive representation. They can also replace or anticipate words (McNeill, 1985); Implicit meanings in speech can be displayed explicitly through gestures (McNeill, Cassel, & McCullough, 1994).
Subthesis	Humans inherited the ability to make the arbitrary connection between gestures and meaning from great apes and eventually learned to transfer that meaning from gestures to words.
Counter-arguments or -evidence rebuttal	Apes vocalize deliberately (Hopkins et al., 2011), and adapt vocal signals to different circumstances (Hopkins et al., 2007).

Subtopic 3	The role of gestures in musical expressivity: Exploring the 'gestural-origin' hypothesis in music
Subquestion 3	How essential are gestures for the creation of music and the communication of musical expressivity?
Possible subtheses	Gestures are fundamental for the communication of musical affect; Instrumental music originated from the making of sound producing gestures (see Fitch, 2006);
Arguments and evidence	Gestures correlate with musical structure: rotating, swinging and swaying (Davidson, 2012); Gestures convey underlying emotions (happiness, sadness, anger), also when the sound is omitted (Dahl & Friberg, 2007); Musical gestures exhibit a certain degree of consistency in location of occurrence, but not in type (Davidson, 2007); Gestures increase perception of expressiveness of rubato, phrasing, dynamics, and overall performance (Juchniewicz, 2008); Ambiguously expressive music acquires the emotional meaning associated to co-occurring movements (Maes & Leman, 2013); Gestures affect perception of dissonance, interval size, and "joyfulness" (Thompson, Graham & Russo, 2005); Musical gestures can be observed across-cultures (see Pearson, 2013).
Subthesis 3	Music is the result of sound producing gestures used to facilitate the communication of more abstract meanings and emotions.
Counter-arguments or -evidence; rebuttal	Listeners experience emotional reactions to music also in audio-only listening modes (Juslin, 2000); Insufficient empirical research on ape drumming and early human musical behavior.

Conclusion

Main question	How did physical gestures influence the development of music and language?
Main thesis	Language and instrumental music originated from the inherited ability of making the arbitrary connection between meaning and gesture.
Domain of validity	Transmission of information in sign-languages and instrumental music indicates that successful communication does not require verbalization (Corballis, 2010; Fulford & Ginsborg, 2013).
Main arguments and evidence	Intentional and elaborate use of gestures by both humans and apes; Apes have a greater cortical control of gestures than of vocalizations; Similar gestural repertoire of great apes and humans. Gestures demonstrate the potential to fully replace spoken language; Gestures increase musical expressivity; Instrumental music itself is the product of sound-producing gestures.
Main counterevidence; rebuttal	Limited use of gestures in music performance; Limited evidence on the link between ape behavior and music; Other non-verbal behaviors are also effective in conveying information (e.g., facial expressions).
Methodological limitations	Lack of practice in animal research and limited education in linguistic studies.
Application to example	The chimpanzee learned to use the 'extended arm' gesture to communicate hunger. This gesture helped him survive and was therefore adopted by other chimps and maintained over generations. Humans inherited the ability to make meaning-gesture associations and developed a communication system based on a visual-manual modality. Meaning was transferred from gesture to speech, whereby the former was retained as meaning intensifier. Expressivity through gestures allowed for the emergence of other domains such as music.
Implications	New epistemological concepts and methods, and greater empirical research; Adjustment of instruction techniques in primary education and music teaching; Reexamination of music theoretical aspects; New artistic standards in performance.
Suggestions for further research	Link between ape drumming behavior and music; Similarity between ape-, speech-, and music gestures in both form and meaning; Correlation between intended- and perceived meaning in both speaker-listener and musician-listener interaction.

Statement of Authorship

Name: Noemi Silvestri

I hereby certify that I wrote this paper myself and used only the literature cited in the reference list.

26.04.2020, Noemi Silvestri

Date, Signature