



The human nature of culture and education

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Human cultures educate children with different strategies. Ancient hunter-gatherers 200,000 years ago, with bodies and brains like our own, in bands of a hundred well-known individuals or less, depended on spontaneous cooperative practice of knowledge and skills in a natural world. Before creating language, they appreciated beautiful objects and music. Anthropologists observe that similar living cultures accept that children learn in playful ‘intent participation’. Large modern industrial states with millions of citizens competing in a global economy aim to instruct young people in scientific concepts and the rules of literacy and numeracy deemed important for employment with elaborate machines. Our psychobiological theories commonly assume that an infant starts with a body needing care and emotional regulation and a mind that assimilates concepts of objects by sensorimotor action and requires school instruction in rational principles after several years of cognitive development. Evidence from archeology and evolutionary anthropology indicates that *Homo sapiens* are born with an imaginative and convivial brain ready for the pleasure of shared invention and with a natural sense of beauty in handmade objects and music. In short, there are *innate predispositions for culture* for practicing meaningful habits and artful performances that are playfully inventive and seductive for companionship in traditions, and soon capable of grasping the clever purpose of shared tasks and tools. This knowledge of inventive human nature with esthetic and moral sensibilities has important implications for educational policy in our schools. © 2014 John Wiley & Sons, Ltd.

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INTRODUCTION

Many social animals move together and make expressive signals to share experience and to make use of the environment in cooperative ways. They develop ‘habits’ or ‘instinctive practices’ that assist mating, care of the young, and collection of food. They learn and imitate. In all these activities, primates and some birds excel but human communities demonstrate more invention and more

imaginative celebration of community than any ape or parrot. The human brain is larger in proportion to the body and has a longer development, which is dependent from prenatal stages on an intimacy of vital functions and emotional health of the mother’s body and on emotional harmony in the community. This dependency is common to mammals, but the human body and brain are adapted even in fetal stages to a more elaborate psychological intimacy than a chimpanzee, dependent on new sensorimotor capacities, especially an unlimited capacity for poetic narrative of vocal learning. Human parents develop lifetime attachments and divide responsibility for care of young children over a longer period than other animals, with support of group practices that value childhood learning as education.

In infancy, a 2-year period of dependence on parental and community care before symbolic

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communication by speech, a child shows a growing readiness for imaginative play with ‘musical’ narrations of movement to which affectionate caregivers are immediately responsive. Rituals or games of artful play develop with the child’s favorite companions, and before the end of the first year, ‘technical’ use of objects and tasks is imitated and developed in ‘person–person–object’ play. This development in the motives and learning of the child, with the amused collaboration of parents and other family members in response to the infant’s inventions, lays the ground for learning the syntactical conventions and semantic categorizations of language. While the vocabulary of the child’s language is growing prodigiously in years 2–5, with much playful invention, the child is also intensely interested in playing with peers. In every culture, where they have an opportunity, groups of young children, of ‘preschool’ age, imitate and elaborate among themselves customs of the adults, with esthetic enjoyment and moral regulation of roles and personalities. This is the phase of child culture before the effects of formal training in more rational practices and social teamwork begin to differentiate community cultures and traditions from national aspirations for a cooperative workforce of adults who labor to maintain the politics of a progressive economy. Here, we explore the evidence for how educational practices of modern nation states diverge from the natural impulses for learning cultural meanings demonstrated in early childhood in all levels of human community practice or ‘habitus’.¹

My aim is to shew, although this is not generally attended to, that the roots of all sciences and arts in every instance arise as early as in the tender age, and that on these provided foundations it is neither impossible nor difficult for the whole superstructure to be laid; provided always that we act reasonably with a reasonable creature (Ref 2).

...it is surely the case that schooling is only one small part of how a culture inducts the young into its canonical ways. Indeed schooling may even be at odds with a culture’s other ways of inducting the young into the requirements of communal living (Ref 3).

PREHISTORY AND EVOLUTIONARY BIO-ANTHROPOLOGY OF CULTURE

The Rise of Human Imagination: Evidence from the Silent Past

In the earliest cultures we know, dated in Africa between 150,000 and 200,000 years BP, *Homo*

sapiens, modern humans, were living in small communities with little technology.⁴ They had much larger, slow-growing brains compared to body size than contemporary apes and earlier hominids, had skeletons built to walk upright with two hands free to manipulate in complementary ways, a head and neck capable of restlessly orienting, and a skull shaped for large agile eyes, and jaws, face and mouth muscled for clever ways of dealing with food. All these movements would be capable of expressing intentions and feelings richly. The females had large pelvises for birth of infants with very large skulls to hold brains with cerebral hemispheres shaped like those of modern infants for conceiving and communicating a mental life full of ideas of how to move with intelligent awareness, and with feelings about what to do.^{5,6} These infants were born very immature, beginning a long development to maturity, and dependent on maternal nourishment, support, and protection for years.^{7,8}

Adults made tools and left evidence in decorative paints and ornaments that shared esthetic values, making creations ‘special’.⁹ They were making symbols^{10,11} presumably to celebrate fantasies of community awareness that could, in oral prophecies and legends, reach far into the future or back to the remembered past.⁴ They were inhabiting an embodied thought world of metaphors and narrations that no other species can share.^{12,13} We must assume that their infants’ brains were adapted of ‘environment expectant’ for such novelties.¹⁴

Archeologists consider the rich array of artworks that sprang into being in France and Spain around 40,000 years ago to be relics of a greatly expanded ‘religious’ self-awareness.⁴ Late Paleolithic humans evidently lived in imaginative cultures comprising small communities of hunter-gatherer people who had a rich family and community life and clever children, imagining, making, and storytelling in both practical world-directed and artful or spiritual, self-gratifying sociable ways.¹⁴ Religion, with its gods, is a particularly transcendent, other worldly ‘locus of concern’ for human intentions,¹⁵ and a way of accounting for our emotions of self-awareness and moral relationships in community.¹⁶

The Invention of Language in Song

Archeologists of language infer evidence that early humans used distinctive expressive sounds that led to enduring forms as preverbal signs to express the importance of ‘belonging’ in relationships, as well as to identify experiences.^{17,18} The most ancient affiliative or attention-getting and evaluative sounds appear to persist as common features of modern languages that

enable the tracing of family tree of languages across Europe and Asia to Alaska over the past 15,000 years. Research on the prosody of human expressive sounds, with support from genetic research, claims to trace the beginning of language to the southwest coasts of Africa 150,000 years ago.¹⁹ The earliest languages of hunter-gatherers and agriculturists through the next 130,000 years are judged to have been rich in expressions of emotional relationship and, like some bird song, invented to declare individual identity and belonging in a community.²⁰

It appears from the analysis of the expressive gestures that we make with our body, head and eyes, hands and intricate modulations of voice in our throat and mouth, far more elaborate and imaginative than those of any ape,^{21–23} and communicative with a ‘plastic song’ that no other primate can imitate,^{24,25} that passionate story-making ‘play’ with movement, performance of fantasy in dance and musical poetic narrations of song must have been present even in the early man.^{17,26} A storytelling imagination and new powers of movement for expressive vocalization and gesture to communicate perceptions of the shared environment have changed the world²⁷ and modified the human brain.^{28,29} Cultivation of these talents becomes the task of education, the importance of which grows with the accumulation of cultural habits and crafts, and the prodigious growth and mobility of human populations. Education of our children will have effects in the ecology of every part of the planet.

Transformations of Rules for Human Communities: Changing Children’s Brains

From 10,000 years BP, settled farming communities, no longer small hunter-gatherer bands, made great monuments of earth and stone to celebrate their place on the land and to track the motions of celestial bodies thus marking the years and seasons. Permanent settlement, domesticated cattle, and storage of produce sustained larger communities with longer life expectancy and supported a social hierarchy ruled by more codified laws, endowing some with more wealth, power, and ambition.^{4,30}

Culture became more material and technical, requiring organized labor in industrial complexes, and social or moral values were guided by mythical and religious explanations that lent themselves to elaborate ritualization and codification with centralized authority. A life more planned or ‘civilized’ transformed the task of education. While it is unlikely that the genes for brain growth transmitted to the fertilized human ovum and active in the early embryo of a living human are much different from those

of a child conceived in the upper Paleolithic, the epigenetics of that brain, the ways its genes are expressed will be very different.^{31–33} Practices of education, as well as the ecology of the human families and communities, moulds intelligence, skill, and personality, in engagement with innate motives for action and relationships.

In a modern culture, a child’s learning is not left to family or to ‘intent participation’ in the community of well-known companions of all ages.³⁴ Nation states legislate a syllabus that takes little notice of local customs and beliefs, or local conditions for childhood experience and acquisition of creative skills. The aim becomes to inculcate as uniform as possible ‘age-appropriate’ levels of knowledge and skill, especially for mastery of reading and computation. Universal abstract principles of grammar, literacy, and mathematics are defined as a graded set of exercises to be learned. ‘Intelligence’, a measure of performance on prescribed tests, became conceived in the twentieth century as a mental process, or set of rational processes, apart from interest and ingenuity, or feeling.

Interestingly, the psychology of intelligence tests encountered a powerful biological characteristic of the human brain hemispheres, an asymmetry of preference for ‘language’ on one side, as against ‘visuo-spatial’ capacities on the other side, with puzzling differences between left-handers and right-handers, interacting with sex differences.^{35,36} Only now is it clear that left–right differences of body and brain reflect innate *motivational* differences for affective and affectionate receptivity and executive focus,^{6,8,35,36} or ‘appositional’ and ‘propositional’ thought,³⁷ differences that engage powerfully with artificial cultural practices and institutions.³⁸

CULTIVATION OF MOTIVES AND RULES FOR SHARED EXPERIENCE

Evolutionary Anthropology and the Creative Social Brain

Comparisons of social cooperation, cultural practices, and childhood between surviving communities of hunter-gatherers and much larger societies with different degrees of sedentary, agricultural, urbanized, and technologically elaborated culture indicate that the biological roots of imaginative culture may be found in mother–infant communication and children’s play.^{30,39,40} The foundations of human cooperation in care of dependent young and in use and transformation of environmental resources depend on affective–emotional processes, on the regulation of

vitality by assistance in nourishment, shared motor activity, and its imaginative enjoyment, not just in awareness, discrimination, and configured awareness or representational memory (Figure 1).

Dunbar has proposed that a principal factor in the evolution of the large human brain, compared to other primates who are also intensely social creatures, is the size of the cooperative group and its divisions.⁴¹ Humans have, for thousands of years, lived in communities that are larger and more cooperative than those of apes, with more numerous and more stable relationships in organized clans. They have also developed artificial transformation and use of material objects. Both require more ‘social intelligence’, which led to the spread of large human communities over the world and the development of emotional regulations beyond the family and well-known acquaintances. The ‘social brain hypothesis’ is being tested by anthropology of communities of living humans, with different levels of technology and different community sizes, and by archeological evidence of the past 2.5 million years to determine the coevolution of the use of material and emotional resources in social cooperation.⁴²

Moving Artfully to Celebrate Community

Song and instrumental music with dance must have had a special place in the evolution of the new modern human way of life, as in all living cultures.^{13,23,43–45} John Blacking has written that, ‘the chief function of music is to involve people in shared experiences within the framework of their cultural experience’ (Ref 46, p. 48). The first musical instruments date to around 40,000 BP, and there is evidence that they were designed for carnivals of song and dance. From around this time, *H. sapiens* carved symbols apparently for ritual use and created delicately drawn art to celebrate imaginative narrations.

We suggest that one of the most significant (and understudied) emotions that drives the arts is social affiliation, an emotion of strong reward value. This is tied in with our view that one of the most important functions of the arts is to create and reinforce a sense of social unity so as to promote cooperation and cohesion within social groups (Ref 47, p. 52).

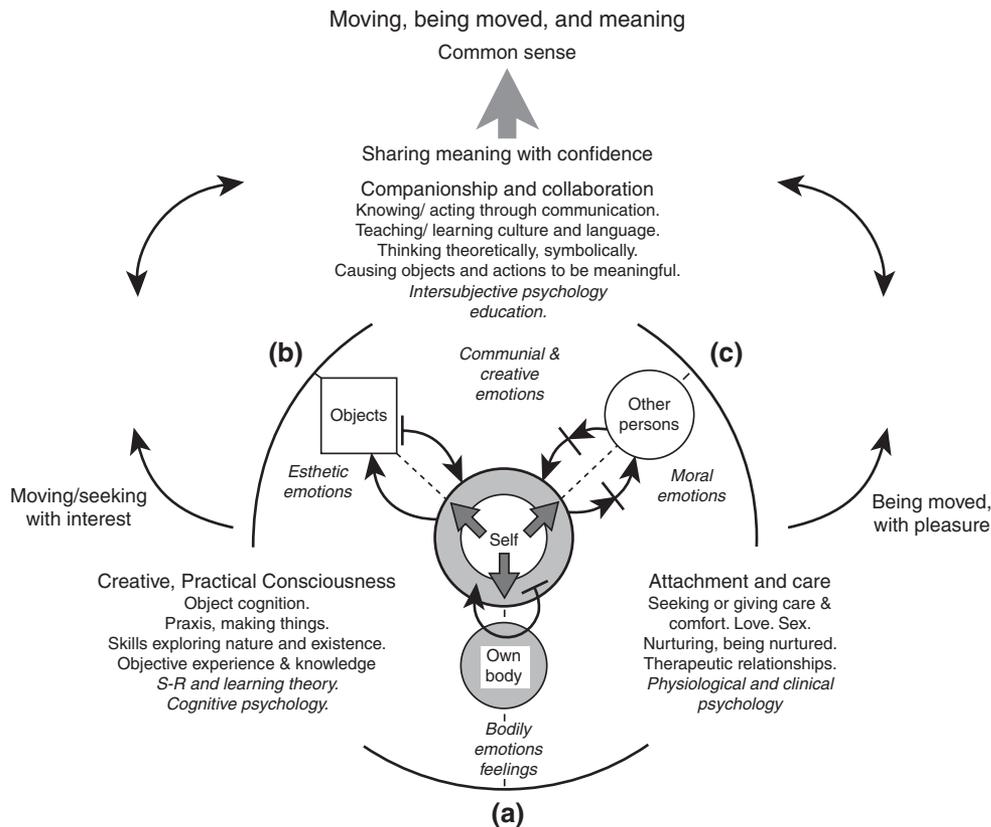


FIGURE 1 | The motives of a human SELF and its BODY, which is motivated to engage with physical OBJECTS in the world, and with other PERSONS. Emotions evaluate the pleasure of discovery with objects, esthetically, and morally in affectionate attachments or friendships with persons. Different motives lead to complex experiences of shared meaning and the development of common cultural understanding. All life functions develop, and their study gives rise to different domains of psychology.

Abstraction of Meaning from Action: Teaching Culture to the Social Brain

The word ‘culture’ from Latin ‘colere’, ‘tend, guard, cultivate, till’ (*Online Etymological Dictionary*, <http://www.etymonline.com/>), referred to a life sustained by agriculture, the husbandry of crops, and live stock. This requires development of vigorous motor skills and cooperation. Symbolic and propositional thought may be carried out in the human head with minimal motor activity. It has grown prodigiously since the days of Descartes, Leibniz, Newton, and Locke, with calculations or ‘mathesis’ implemented by eyes moving with fingers, or even by the concentrated immobility of Rodin’s ‘thinker’. Now it is taken on by the robotic ingenuity of thinking machines called computers that simulate talk in symbols or moving pictures on a small screen to which even an infant can now have access. This digital technology may confuse our appreciation of the powers of the human body and mind to think and evaluate imagined actions in more polymodal and active imaginary contexts, upon which the creation and use of any computational machine depends.

Perhaps with apprehension of where mathematics was leading, away from the pleasure of imagined action, Einstein declared to the mathematician Jacques Hadamard that his own mathematical invention was ‘sensations of bodily movement’ and that he did not enjoy putting it in symbolic notation. Hadamard⁴⁸ asked physicists and mathematicians, including Gauss, von Helmholtz, Poincaré, and others, about their thought processes, and he confirmed with their responses the conviction of his own mathematical thinking as introspective and wordless, with intuitive grasp of whole solutions. He repudiated the notion that cognitive construction depends on reasoning with language.

To understand what is lost to inventive imagination with emphasis on rational abstraction, it is particularly informative to pay attention to the motor extravagance, and waywardness, of infant and toddler play, and how well this playfulness of movement nourishes the beginnings of cultural participation, before speech and before schooling in literacy and mathematics. In relation to thinking, it is relevant that childish movements demonstrate exceedingly complex serial ordering of movements, which is the feature of motor activity that Karl Lashley⁴⁹ proposed, in 1951, as the natural source of linguistic syntax, before Chomsky’s theory of a ‘universal grammar’ as a separate component of the human brain, a Language Acquisition Device.⁵⁰

A natural symbolic culture, using artfully conceived objects modified by manipulation as

decorations or charms, may have begun in Paleolithic times before *H. sapiens*. If so, we can conclude that imaginative and sacred art came before more elaborate technology, turning tools into machines, and led to a use of marks and articulate sounds to refer to absent objects and actions.^{4,9,14} The science of how the human-embodied brain was adapted for elaborate expressive emotional self-expressive behavior as in dance and song before speech and language concludes this is so.^{13,51,52} The richly conceived vocal celebrations of groups of young children at play before they can talk supports this, too,⁵³ as does the esthetics of children’s playful constructions and representations.⁵⁴

The Neurobiology of Shared Comfort and Joy—To Escape Exclusion

Nigel Osborne has more than 20 years’ experience as a skilled musician helping war-traumatized young people recover the pleasure of self-expression and conviviality in song and playing of musical instruments.⁵⁵ He has studied the ways music engages with the vital functions of the body that constitute the human spirit. He gives a first-person account of a recent experience of the power of this ‘bio-psycho-social’ approach in India, using the traditional strength of Indian music to animate the emotions of handicapped children.

It is June 2013. I am working in Tamil Nadu with a group of children with a wide range of additional support needs. In most cases, these needs are profound and include cerebral palsy, Down’s syndrome, autism, and acute cephalic disorders.

I have arranged the children in a circle and have just arrived at Rajesh and Iravan. Iravan is mobile. Rajesh has little movement or apparent awareness and rarely vocalizes in any way.

I have brought Prakriti Dutta, one of the best female *dhrupad* singers in India, to the workshop and I have invited Arapi, a brilliant young member of staff of the Center, a temple dancer, to lead movement work. We are singing in a fire raga; *Gujari Todi* in the Hindustani tradition and *Shubhapantuwarali* in South Indian practice. I sustain a vocal drone—a single hypnotic note with which I hold a prospective empathetic attention from the children, but which is also likely to drift in and out of the children’s awareness. It is usually *Sa*, the Indian equivalent of the Western *Do*. Prakriti improvises an *alap* or introductory melody that reveals the *raga*. *Ragas* are the equivalent of European scales, but there are many more of them, associated with emotions, feelings, seasons, times of day, the five elements, etc. and there are sophisticated patterns and protocols of movement within the *raga*. Arapi makes the graceful arm and foot movements of

the *bharatanatyam* dance tradition that relate to the *raga*. At one point, Iravan quite unexpectedly begins to improvise with Prakriti in the *raga*—absolutely correctly. No one knew he could do this. This would already be enough revelatory excitement for one day.

But then the beautiful miracle happens that make this work so enormously rewarding: Rajesh starts to sing; not just to vocalize with the occasional uncontrolled emotional outburst, but to SING—sustained notes circulating around the lower pitches of the *raga*, beautiful, radiant, full of inner life.

The Indian support staff burst into tears.

All music of the world, like all human beings, carry their biological, evolutionary history within them. But Indian music is a particularly interesting case. Within the Indian musical tradition, the simplest and most fundamental of utterances probably related to our earliest development as human beings, both individual and evolutionary, progress organically to the most sophisticated of culturally determined structures. The experience of Indian music is a living testimony to our human biology of culture.

It is possible to hypothesize that the *Sa* drone sustained vocally throughout the piece, close to the children's bodies and ears, exists at the threshold of what Tulving calls the *anoetic* and *noetic* forms of consciousness, between what may be unconscious but affectively intense and cognitive 'knowing'.⁵⁶ It is a continuous, comforting presence like the sound track of the womb, but it is also the sustained, timeless utterance of a human voice and therefore a potential source of affective communication. In biological terms, sound events of this kind may be registered in a fundamental consciousness involving the auditory cortex, with cutaneous inputs, conceivably processed in subcortical areas such as the Periaqueductal Grey (PAG) in the core of the midbrain, the foundation, according to Panksepp and Solms, of the sensorimotor Self, the Id, which receives input from all the emotional systems.^{57,58} The development of this core emotional system in young children, and growth of the Ego or 'social Me', is associated first with early maturation of the autonomic nervous system and then with the development of skills of social engagement by expressive movements of voice and hands as described by Porges.⁵⁹

The *alap*, or introduction to the *raga*, which Prakriti sings at the beginning of the session, carries the evolution organically from the *anoetic* deeper into the *noetic*. This is the threshold where 'communicative musicality' unfolds.⁶⁰ Some of the simplest of vocal structures may act as precultural

triggers, activating largely *anoetic* neural substrates, like the wail of a separation cry associated, once again, with the activation of paleocortical regions.⁶¹ But in the *alap*, Prakriti also builds more complex structures and narratives. In the theory of communicative musicality, these sounds and groupings of sounds may be understood as the intersubjective communication and sharing of states of mind, body, and intentionality essential for the survival of early human societies. They have their substrates in neurotransmission and neuroendocrine systems, for example, in the release of dopamine or activation of the hypothalamic–pituitary–adrenal (HPA) axis associated with the body's reaction to stress⁵⁵ and once again are associated with maturation of the autonomic system and vagal regulation leading to self-regulatory and social skills and attachments.^{59,62} It is at this threshold that Rajesh is vocalizing at a point somewhere between intuitive communicative musicality and musical performance. The tears of joy of the staff welcome Rajesh into an unexpected space of musical and emotional communication and sharing.

Just as music evolves organically from the *anoetic* to the *noetic*, it proceeds to the *autonoetic*, where conscious awareness, memory and fantasy, and the abstraction of perceptions and cognitions may occur. Here, communicative musicality crystallizes into the fully formed musical culture of *ragas* and *tals* (rhythmic structures), composition, improvisation, and performance. This activity also has its biology, in the activation of neocortical systems and limbic and subcortical structures such as the pre-motor cortex and the amygdala.⁵⁵ This is the threshold at which Iravan is singing. His spontaneous competence is almost certainly due to a combination of a great deal of listening to and saturation in Indian music and the motivational and intersubjective circumstances of the occasion.

The experience of Indian music offers to children with additional support needs and to all human beings an unbroken organic progression through the human biology of culture from primal consciousness, subcortical structures, and the putative 'id'⁵⁸ through the subcortical and limbic systems associated with communicative musicality to the limbic and neocortical structures related to fully formed musical culture and to possible locations of the 'ego'.

The experience of music offers an unbroken link between these biological systems of evolving human self-consciousness and a model for a healthy, integrated education of emotion, cognition, imagining, and creativity.^{8,63}



FIGURE 2 | A 4-day-old girl shows intent regard for her grandmother, who is speaking to her, and an expressive body, with an attentive mouth and asymmetric hand gestures.

THE MOTIVES OF CULTURAL LEARNING IN EARLY CHILDHOOD

Intentions to Communicate

The first intelligence of a child is *motor intelligence*, the natural wisdom of the human body seeking joy in its vitality.⁶⁴ It is distinctively human at birth, in its extravagant mobility and subtle powers of communication and selective attention to human company.^{65–68} Motor intelligence of a newborn infant exhibits an aware Self—coherent regulation of limbs and senses projecting action into a body-related space in highly expressive ‘musical’ ways.⁶⁹ It is regulated by an inner vitality with its own rhythmic sense of present ‘felt’ time and of intended progress through narrative cycles of energy in an imagined and remembered *world of self-related actions*. And it communicates well with the movements of an attentive care.

Movements of newborn infants are adapted for sympathetic engagement with the rhythmic expressions of motives and feelings of other persons who seek intimate communication (Figure 2). The baby can imitate any gestures and facial and vocal expressions and can act to provoke imitations from others.⁷⁰ These subjective and intersubjective talents are prepared for in prenatal development of the anatomy of a human body and brain and are made evident by the sensitive actions and emotional expressions of the fetus with the elaboration of cerebral systems readied for engagement with an outside world that will include other persons (Figure 3).

Evidence from neuroscience indicates that primate brains communicate by a process of ‘mirroring’ that picks up the purposes of other individuals’ actions

to use objects. A ‘motor cognition hypothesis’ is proposed as the foundation of social intelligence, which operates by imitation of ‘motor knowledge’ implicit in other’s actions.⁷¹ This differs from cognitive neuroscience explanations of executive functions and propositional representations of thoughts and feelings in other minds as ‘theories of mind’ acquired by sensory information uptake and empirical concept-building. But neither theory gives sufficient attention to innate emotions, esthetic and moral feelings, which, with their sequencing in learned ritual displays, and music, for sharing vitality dynamics, giving authenticity to even the most practical and rational acts of meaning.⁶⁶ The popular theory of ‘empathy’ as a capacity to feel others’ emotions is also unable to explain how cooperative impulses are guided by complementary or ‘sympathetic’ emotions. The powers of the human social brain are founded on emotions that regulate well-being inside the body as well as shared motor activities in relationships of all levels of intimacy (Figures 1 to 4)

The knowledge of the spontaneous behaviors, narrative awareness, and affective sensibilities of young infants and of age-related developments before language that has been gained in the past 40 years provides a basis for a richer natural science of the innate motives for cultural learning, social collaboration, and mental health in human communities. It is also necessary to comprehend the intersubjective powers of language, the essential motives, and feelings of its grammar and semantics.

Developments in the first 2 years of a child’s life lead in infancy to a growing awareness of how to choose and use objects and to communicate affectionately with companions in play. These events prove a program of growth for epigenesis of new ways of engaging with the world that leads the intentions of the child to master cultural meanings (Figure 4; Table 1). By 2 months, a baby has sufficient visual and auditory awareness and expressive capacities to take part in the rhythmic narrative of a ‘protoconversation’.^{60,72,73} In the next few months, ritual body games and songs are shared self-conscious imitation of actions and vocal signs playfully.^{69,74,75} Then, there develops a more cheeky self-awareness of 7 and 8 months, which Reddy interprets as an intuitive ‘knowing of other minds’, with prideful perception of favorite companions and mistrust or shame with strangers.⁷⁶ This Hobson calls *The Cradle of Thought*.⁷⁷ Then, after 9 months, playful sharing of objects as toys becomes cooperation in tasks where learned conventions of signing in ‘proto-language’, how to use tools for clothing and support of the body, for ‘drawing’ and musical ‘playing’, for using books, and for eating a meal, are passed on, motivated by a desire to share knowledge and skills.^{11,74,78–81}

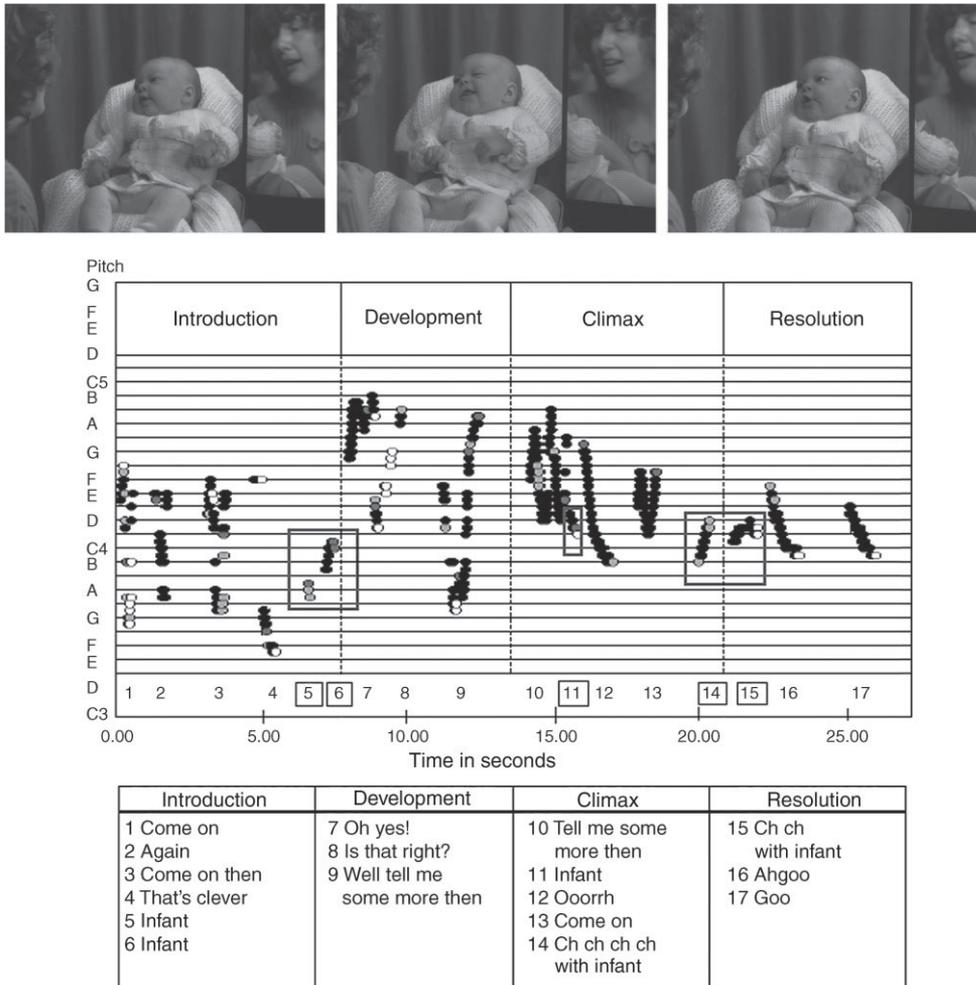


FIGURE 3 | A 6-week-old baby takes part in a protoconversation with her mother, in a recording room at Edinburgh University. They share the rhythm and expressive tones of vocalizations, taking turns with closely coupled utterances, which are numbered, that change in excitement, making a 'narrative', with 'introduction', 'development', 'climax', and 'resolution'. These stages of the story are reflected in the content of the mother's speech. The pitch plot of their voices explores the octave above Middle C. The baby's responsive sounds are shown in boxes.

At 1 year, a child may utter no sound that can be called a word. By 4 years, most have between 600 and 1000 words. For many linguists and teachers, this is the start of human communication. But a child is an active and alert communicator in uniquely human ways from birth and is attentive to the sounds people make when they use speech and increasingly interested in the actions they perform as they speak. The infant soon participates intimately and creatively in chats and games with the family, communicating interests, intentions, and feelings. This preverbal communication employs movements of the whole body, but especially of the head and eyes, hands, and voice. Its relationship with speech and the coded messages of language has been made clear by detailed analysis of the rhythms, expressive forms, and narrative sequences of neonatal imitation, protoconversations, and action games and

songs that develop through the first year. A special human talent for sharing emotional appreciation of actions, experiences, and imaginative discoveries and memories in storytelling ways is seen to be germinating from impulses to move the human body with feeling.⁶⁴

LEARNING TO TALK AND MAKE NEW PLAYMATES WITH A GROWING BRAIN

In the next few years, steps to fluent mastery of linguistic grammar, both the semantics and syntax of talk in the parental community, follow rapidly, animated by growth spurts of the body and the cerebral cortex (Figures 5 and 6). At 2 to 5 years of age, children everywhere show, with accelerating mobility, a determined self-assertion in the use and

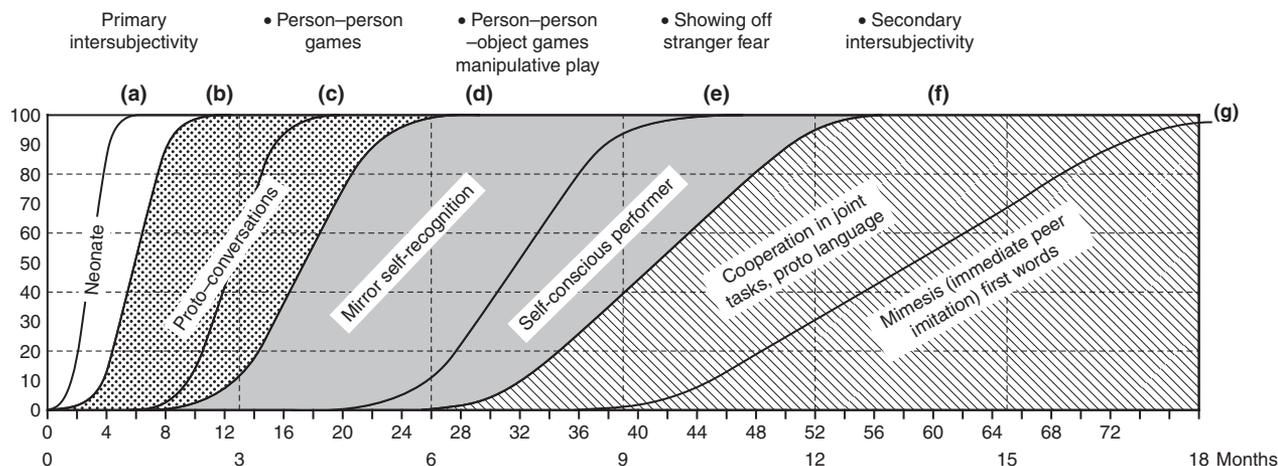


FIGURE 4 | Developments over the first 18 months of infancy chart the growing collaboration with a mother revealed by analysis of natural play, with each other or with objects. See Table 1 for a summary of the growth of sensory and motor abilities and developments in communication.

TABLE 1 | Developmental Changes in the First 18 Months of Infancy

Cognitive and Somatic Developments	Developments in Communication
A: Regulations of sleep, feeding, and breathing Innate ‘pre reaching’	Imitation of expressions. Smiles to voice
B: Pre-reaching declines. Swipes and grabs	Fixates eyes with smiling protoconversations Mouth and tongue imitations Distressed by ‘still-face’ test
C: Smooth visual tracking, with strong head support. Reaching and catching	‘Person–person’ games, mirror recognition
D: Interest in surroundings increases. Accurate reach and grasp. Binocular stereopsis Manipulative play with objects	Imitation of clapping and pointing ‘Person–person–object’ games
E: Babbling, persistent manipulation, rhythmic banging of objects. Crawling and sitting, pulling up to stand	Playful, self-aware imitating. Showing off. ‘Stranger fear’
F: Combines objects, ‘executive thinking’ Categorizes experiences. Walking	Cooperation in tasks; follows pointing Declarations with ‘joint attention’ Proto-language. Clowning
G: Self-feeding with hand	Mimesis of purposeful actions, uses ‘tools’ and cultural learning. May use first words

communication of what they know.^{82,83} By 5 years of age, a normally developing child is a fluent talker in the home and in the familiar immediate community is and able to participate in many meaningful and spoken activities in different relationships and both natural and artificial environments with rich and beguiling imagination. And in the years between 2 and 5, when there is the opportunity, participation in playful peer culture also flourishes.⁸⁴ This is the period when child-centered nursery education fostering the creativity of toddlers’ fantasy play and the use of imitation in groups, the first function of which is to make memorable stories to share.⁸⁵ Memory and language grow to enrich an imagination already strong in identities, reference, and histories.^{15,86}

By 8 years of age, children in very different cultures, from pre-industrial to digital, provided their curiosity and memory is guided by responsive

and cooperative teaching, cooperatively, develop a responsible decision-taking maturity within their social world that, in the next few years, prepares them for the challenges of adolescence. This is a second accelerated period of physical and psychological development in which new relationships with new motives start to write an entirely new chapter in the personal narrative history of each girl and boy, preparing them for bearing and educating their own children with the aid of parents and grandparents (Figure 6).

The Meaning of Play

It is interesting that we say we ‘play’ music, but we do not play talking or knowing about ‘what’ or ‘how’—more seriously informative activities. Nevertheless, as all experienced teachers know, the inventiveness of play contributes to everything we

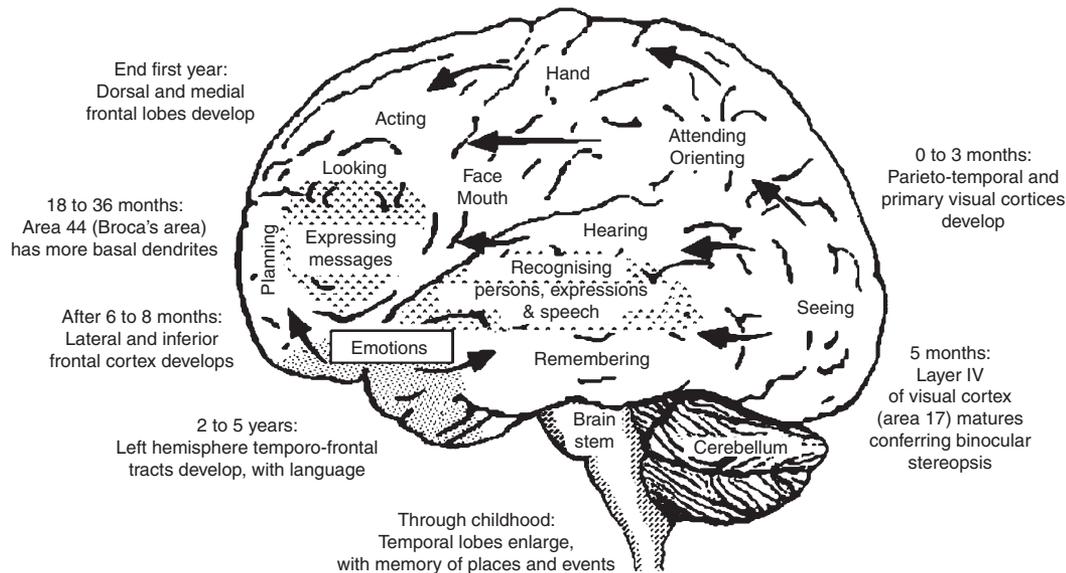


FIGURE 5 | Growth of regions of the left hemisphere in infancy and early childhood, all of which are important in communication and cultural learning.

wish to achieve for ourselves, in our family, and in the busy world of our community and its industry and culture. What the anthropologist Victor Turner, in his book on *From Ritual to Theatre*, called ‘the human seriousness of play’ contributes to all our valued occupations, including those practical ones we call science and technology that build our world and its machines, and the conventions of thinking in mathematics and philosophy.⁸⁷ And all play has the storytelling vitality of music and poetry, even when it is a concentrated private pleasure of quiet occupation in an absorbing task, enjoying the silent flow of thought and watching the cleverness of moving fingers. Inner experience needs moving with feeling and that is what ‘musicality’ defines. Play is part of animal nature, always eager to learn by imitating.

Human children’s play is a fundamental activity of body and mind that serves the learning and understanding of cultural practices.⁸⁸ Anthropological comparisons of hunter-gatherer cultures reveal that in those that did not establish hierarchical settlements with large populations and stores of food, but sustained small intensely cooperative and egalitarian groups probably represent the life conditions and social practices of *H. sapiens* for most of the past.⁴⁰ Children’s play, left to develop spontaneously among the children themselves, practices the moral obligations of such a society.⁸⁸

Play from Which Learning Comes

The Greek developmental psychologist Giannis Kugiumutzakis, a pioneer in the study of the imitative communications of newborns and an expert in ancient

Greek philosophy, has found a correlation between the administrative or technical and rational complexity of a culture and the belief that young children should be coerced from play and made to learn skills according to a curriculum or scale of formal meanings. This has led to a constant effort by educational reformers to give more generous recognition to the natural abilities of the child to learn meaning from other person’s expressions of purpose, interest, and feeling.

Aristotle’s notion that humans imitate by their nature has been confirmed by developmental research of the last thirty years. Were one, however, to ask Aristotle if this innate nature of imitation could be manifest at birth, I would expect his answer to be negative, not just because innate potentialities are perfected by habit, but because the Aristotelian neonate would have no positive emotions to express to a parent, and no capacity to discriminate his or her self from the other (Nicomachean ethics, 1161b). The latter claim has been made explicit at the beginning of our century. According to Baldwin, Freud, Piaget, and Vygotsky, the neonate lacks the necessary perceptual ability to observe other’s behavior as a model. The assumed state of an initial ‘adualism’ excludes, by definition, imitation at birth.

About 200 years after Aristotle, however, this conflicting claim was made by the Stoic Hierocles: upon birth, all animals, man included, perceive their own limbs and organs and are ‘conscious’ of their proper functions, not derived from experience or rational inference. For Hierocles, all animals have innately ‘not just ... a perception of themselves,

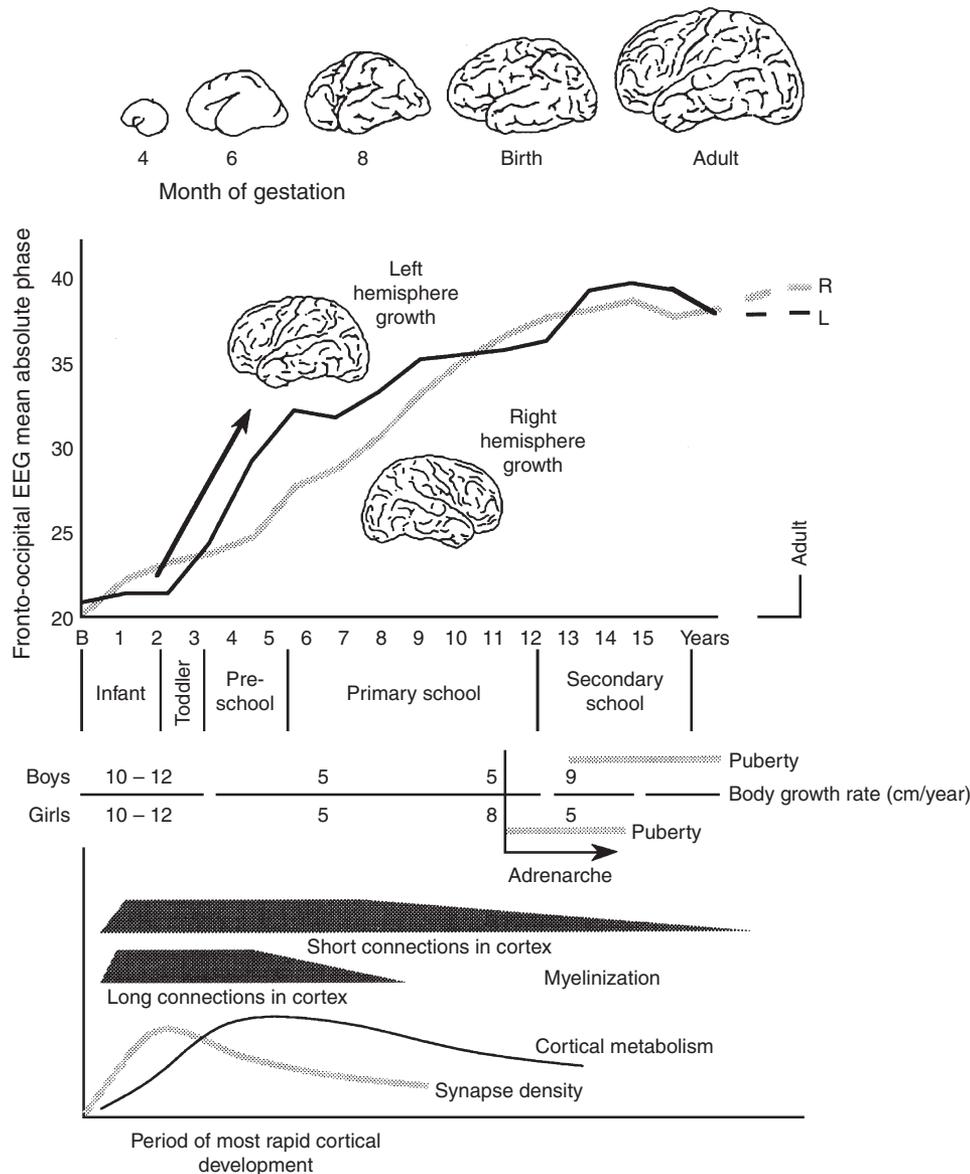


FIGURE 6 | Development of the brain from before birth and growth rates of the cerebral hemispheres from birth to adolescence and through schooling, showing alternating periods of rapid growth in right and left cortical regions involved in sharing relationships and experience of the natural and artificial worlds. Note the surge of the left hemisphere from 3 to 5 years, when vocabulary is learned and two periods where the right hemisphere is ascendant, in infancy and in early adolescence, when new affective relationships are formed. Girls develop through these changes earlier than boys, particularly in puberty.

but also of themselves in relation to other animals'. Hierocles' observation of the initial dualism was ignored for more than 2000 years. Now it appears to be supported by relevant developmental research of recent decades ... By logical and psychological necessity, initial dualism is a precondition for human imitation at birth (Ref 89, pp. 63–64).

And now there is a growth of scientific understanding that human intersubjective cognition with the brain processes that mediate it by regulating the expressive and instrumental use

of the body is adapted for second person self-other awareness and collaboration in intelligence, animated by affectionate attachments and joyful companionship in fantasy and ritual^{76,90} and that the structures of body and brain to regulate this enrichment of the social brain are in formation before birth.⁶⁴

As Bruner says in *The Culture of Education*,⁹¹ formal schooling may be at odds with the spontaneous learning of cultural meanings and practices that occurs out of school, in the community of experience.

...it is surely the case that schooling is only one small part of how a culture inducts the young into its canonical ways. Indeed schooling may even be at odds with a culture's other ways of inducting the young into the requirements of communal living. Our changing times are marked by deep conjectures about what schools should be expected to "do" for those who choose to or are compelled to attend them – or for that matter, what schools *can* do, given the forces of circumstances. Should schools aim, to simply reproduce the culture, to "assimilate" (to use a word now considered odious) the young into the ways of being little Americans or little Japanese? Yet assimilation was the unexamined faith even as recently as the beginning of the century. Or would schools, given the revolutionary changes through which we are living, do better to dedicate themselves to the equally risky, perhaps equally quixotic ideal of preparing students to cope with the changing world in which they will be living? And how shall we decide what that changing world will be and what it will demand of them? These are no longer abstract issues: we live with them daily, and they form the substance of the educational debates that reverberate everywhere in the world (Ref 91, Preface p. ix)

It is clear since modern industrial and scientific cultures established their dominance in the past 300 years, compelling communities to expand their populations and to impose uniform laws, built environments, and fixed systems of mobility and exchange of wealth, there has been a need to constantly compromise between the plans of the official executives and administrators and the local democratic or spontaneous needs of communities and their families.

Over the centuries in which national cultures have evolved, educational reformers have had to insist on letting natural gifts, for learning in action and in playful collaboration with peers and other natural teachers, have more authority. They have had to remind the planners of formal education that they are regulating powers in human nature of which they have little understanding. They are not applying a particular desired culture of practice to a receptive surface, or filling facts into an empty vessel. They are cultivating a natural adaptive growth of shared understanding and cultural meaning, and a 'communicative musicality' of active interpersonal awareness.

This principal of human communication of projects and understanding through the medium of the expressive rhythms and tonal values that animate experience of all texts, the *Languages Within Language* of Ivan Fónagy, cannot be denied.⁹² These ancient powers of life underly the static, formal, cause-effect efficiency of abstract rational or 'positivistic' formulations in science, technology, law, and economics, and it is needed to unpack their meaning

and make effective use of them, as many philosophers reflecting on the modern world at different stages of its development have clarified. 'We may cite Husserl, Mead, Wittgenstein, Bakhtin, Vygotsky, Gibson and above all Merleau-Ponty, all of whom believe the Self is intentional in its awareness, with emotions that bring us into a community, giving each one of us a sense of being in a life time we can share, and a sense that one is a recognized person with individual character' (Ref 93, p. 453). Before these, Adam Smith in his *Theory of Moral Sentiments* clearly made interpersonal feelings of 'sympathy' foundational for all cooperation, including industrial and commercial.

THE CHILD SHALL LEAD THE WAY: WORK IN DIVERSE MODERN CULTURES

To examine how natural motives engage in cultural projects and may be changed by them, as human brains may be by effort and experience through their long development beginning in infancy, we draw on evidence from recent educational projects aimed to understand and support children's creative learning and cultural identity.

Transmitting Values of the Community and the Ancestors

First, we cite the success of a movement in New Zealand to protect the use of Māori language in Māori communities that lead to the development of a preschool curriculum, the communitarian principles of which have become widely respected and adopted in other countries. The New Zealand Government's early childhood curriculum Te Whariki⁹⁴ is 'specifically for Māori immersion services in early childhood education and establishes, throughout the document as a whole, the bicultural nature of curriculum for all early childhood services' (Lyall Perris, Acting Secretary for Education, Ref 94, p. 7).

The principles are explained as follows. 'The curriculum is provided by the people, places, and things in the child's environment: the adults, the other children, the physical environment, and the resources. The curriculum integrates care and education and includes both specifically planned experiences and activities and interactions that arise spontaneously. The early childhood curriculum has been envisaged as a *whàriki*, or mat, woven from the principles, strands, and goals defined in this document. The *whàriki* concept recognises the diversity of early childhood education in New Zealand. Different programmes, philosophies,

structures, and environments will contribute to the distinctive patterns of the *whàriki* (Ref 94, p. 11).

It is prefaced by a quotation from a book by educational psychologists who define early childhood as: 'a period of momentous significance for all people growing up in [our] culture... By the time this period is over, children will have formed conceptions of themselves as social beings, as thinkers, and as language users, and they will have reached certain important decisions about their own abilities and their own worth' (Ref 94, p. 1.). These developmental practitioners were stating how children 'form conceptions of themselves' as motivated human beings, not how such conceptions are taught.

Te Whariki grew from a determined movement to save the ancient and musical Māori language, and to revive the transmission of values of the Māori culture by grandparents sharing traditions with grandchildren. The following describes the original aims of this movement, *Te Kōhanga Reo*, and the belief in the *kaupapa* that children lead the way to the culture.

'The language still has a fragile hold in Māori society as a whole, but every year now there are several thousand young children entering the education system already fluent in the language and *tikanga* (customs) of their ancestors. ... *Te Kōhanga Reo* (language nest) without question has flourished on the realisation that all members of the *whānau* (extended family) are extremely significant and valuable in the lives of the *mokopuna* (grandchildren). They provide a climate that is caring, joyful and secure where the *mokopuna* learn their language and values. This results in children and *whānau* who are more confident and proud. Since its inception the *Kōhanga Reo* movement has been hailed as one of the most exciting and powerful national initiatives undertaken by Māori people. It has had an impact on New Zealanders, on the government of this country and indeed on the international scene. This success is due to belief in the *kaupapa*, the unconditional commitment required of the people and the knowledge that 'the child shall lead the way' (Ref 95).

Music of Talk for Classroom Collaboration

A comparable situation exists in the United States where minority Hispanic children lose touch with their parent's culture, its inclusive philosophy, and its musical sharing of feeling in learning. In Los Angeles, Fred Erickson, a musician and Professor of Anthropology of Education at the University of California, Los Angeles, has studied the musical intonation of teacher's speech and children's responses from recordings made in a kindergarten/first-grade

classroom with groups of children 6 to 7 years old; of the teacher reading a book, and of a mathematics lesson about notions of set and set property, distinguishing and grouping objects by shape and color.⁹⁶ He notated musical scores to illustrate how the rhythms, loudness, and pitch of the speech conveyed different interpersonal messages and emphasized actions and significant elements of the narrative, or task. He applied this method to analyze the music of a teacher's speech in second project in a bilingual Spanish-English nursery and first-grade school, where Mexican immigrant children were introduced to Arabic numerals and to the Spanish words for the numbers from one to ten, or were learning key concepts in the physics of matter, energy, and motion, and making a classroom-sized roller coaster to explore kinetic and potential energy. The students were asked to attach cards, which they had labeled either 'potential' or 'kinetic' in English and in Spanish, at the locations along the rollercoaster at which each kind of energy was maximized as a ball rolled through the rollercoaster. When doing so, their behavior was regulated and expressed in musical forms.

From these and other studies, Erickson concluded that, 'When teachers and students share a similar implicit musical signaling system for the coordination of attention and action in talk, they tend to understand one another clearly and to have positive feelings toward one another. When the mutual signalling system is not working well and interactional stumbles happen ... negative affect and misunderstanding often occur. Thus, ... our capacity to think with and feel with one another seems to be tied to our capacity to dance and sing in smooth, predictable rhythm with each other in our talk. This is especially evident in our sharing of action and experience with young children in ways that support their pride in acting and knowing.^{69,96,97} When neo-Vygotskian perspectives on social interaction as the site of learning in 'intent participation'³⁴ are combined with a 'musicality of social interaction' perspective, it becomes apparent that such matters as engagement between teacher and learner in the 'zone of proximal development' have as a necessary condition the establishment of mutual musicality in their talking and listening activity. In other words, mutual musicality can be considered as a foundation for the opportunity to learn in the classroom, as elsewhere' (Ref 96, p. 461).

Respecting Trans-Cultural Feelings of Cooperation for Learning in Class

The above ideas about the value of expressive and relational motives of young children for early education, and of the problems that arise when 'the mutual

signaling system is not working well', were applied in a test study of the communication and cooperation elicited by two teachers who had been given different training, one being guided in how to adapt to bicultural education of young children.⁹⁸ In one classroom, the teacher had cross-cultural teacher training in a program called Bridging Cultures (BC) developed by Greenfield and colleagues.⁹⁸ This program provided teachers with insight into the reasons for cultural miscommunication and conflict in the classroom. Latino immigrant families from Mexico and Central America move from a 'collectivistic' ancestral and home culture into an 'individualistic' host society and educational system, with resultant cross-cultural value conflict.

Gratier, Greenfield, and Isaac studied in detail the effect of each teacher's cultural representations and tacit communicative style on interaction in two second-grade classrooms, mainly Latino immigrant children 7- to 8-years old.⁹⁸ The video and acoustic analyses of matched samples of classroom activities revealed a style of talking that is more group oriented in the classroom with the BC-trained teacher and is more individual oriented in the other classroom. The former class showed greater cooperative overlap and chorusing, more student self-selection, less teacher selection and less arm raising, less confirmatory repetition by the teacher, more frequent collaborative completion and more criticism, and less praise. Using both quantitative and qualitative methods, they confirmed greater cultural attunement between teacher and students when they share a common tacit communicative style, with more student participation. As in the work of Erickson, patterns of interactive timing reflected the intersubjective processes of cultural attunement or conflict. They concluded: 'The explicit discourse-driven experiences that the BC program offers, we contend, bring about conscious and implicit shifts in teachers' internal representations that in turn become observable in the micro-patterns of social classroom behavior'.

There are clear parallels in this work on classroom dialogue and the research on different motivational styles of communication between mothers and infants, which, in spite of strong innate values in both the playful and sociable mind states of the developing child, and the complementary impulses for care and companionship in the parent, is also influenced by cultural beliefs of the capacities of an infant for feeling, knowing, and intending with an adult and the need for deliberate 'upbringing' and 'socialization'. It is also influenced by the emotional well-being of the mother. Gratier has made cross-cultural studies of the musicality and narrative style of maternal speech with infants and the effects

of migration of the mother to an alien culture, which reduces the self-confidence and sympathetic intuitions of a new mother.^{99–101} She has also applied microanalysis of vocal melodies to compare 'motherese' of happy mothers with those suffering from post-natal depression or bipolar psychosis.¹⁰² 'The fine-grained acoustic analysis of spontaneous vocal interaction between mothers and infants opens spaces for understanding how expression unfolds within shared temporal frames to sustain both a sense of belonging and a sense of adventure' (Ref 102, p. 322).

Children's Musical Culture and Its Importance for Collaborative Learning and Personality

The research on communication of infants, which we have described, demonstrates that we are born with rhythmic powers of expression and that we are adapted to use these in intimate engagements with the affections and playfulness of companions. Musicality of older children's playful communication out of class, the generation of 'children's musical culture', was studied in Oslo, St Petersburg, and Los Angeles by the Professor of Musicology at Oslo University, Jon-Roar Bjørkvold.⁵³ Watching and listening as a 'participant observer', he took notes on the vitality and imaginative creativity of lively human bodies of nursery-school children, in their movements of song and dance, how the songs tell stories of life and traditions in the particular community, displaying some universal features of emotional signaling for social contact and play, and he revealed the effects of ambitious cultural constraints to train and regulate both practical and social behaviors on childish self-expression, conviviality, and invention.

Comparing Norway, a small social democracy, rich in oral traditions and not a major power, and the Soviet Union of 1985, a one-party state with Lenin's picture in every kindergarten, remembering war with guns and tanks as toys, emphasizing patriotism in literature, dance, song, and painting, he observed that, 'part of the price of superpower competition was the shortening of carefree, playful childhood' (Ref 53, p. 59). With a tradition of great classical musicians and accelerated socialization into adult music, the Russian child's play had less fluid song formulas and standard songs than the play of a Norwegian child, who went to school at a later age. Universal song forms were confirmed, but control of expression was strict, with less teasing. However, 'for Russian children, as for Norwegian children, play is the most important cultural arena, ... from which bridges can be built to other selves, to the perceived world,



FIGURE 7 | The 6-year-old girls experiment with musical instruments and dancing, making their own creative projects, some inspired by well-known stories or the media.



FIGURE 8 | Emily's dancing as a Good Fairy, and Polly and Hope as Bad Fairy and Evil Bird.

and even to the still unknown' (Ref 53, p. 97). In Russia, children as well as music are important, and it was granted that children need 'independence' and 'group activity'. The Russian poet Kornei Chukovsky celebrates the spontaneous poetry of utterances made by children as inventive 'linguistic geniuses' in his inspiring book *From Two to Five*.⁸⁴

In the 1980s, the United States, a superpower and key player in world affairs, militarily and economically, had great inequalities of wealth, health, and 'intelligence'. Bjørkvold found that children, starting school at 5 years, were taught the value of the American spirit and patriotism, and, again,

there were many war toys. As in Russia, there were special programs for gifted children, and training for engineering and science was privileged. Child culture was not recognized by an educational system looking to select learning that will have application in a planned adult world of work and recreations and to apply it early. The message of Bjørkvold's book is that the spontaneous pleasure of musical play, a natural force for learning and for making relationships, can be imprisoned by plans in ambitious and competing nation states to teach conventions of communication and productive work, or to train exceptional skill in art and science.



FIGURE 9 | Sleeping Beauty and her Prince after the show and the final bow.

Stimulating Creative Performance and Self-Confidence of Personality Among 5-to-6-Year-Olds

In a project by Robin Duckett of the Sightlines Initiative in Newcastle-upon-Tyne in 2010, two musicians worked with school staff in an Infant and Nursery School, County Durham, encouraging a group of eight 5-year-old girls to create a performance based on Sleeping Beauty, making their own story, performing the music and dances, and making the costumes and props. These children were already good friends fond of inventing stories, making props and assuming appropriate roles, expressing their different personalities or musical identities,¹⁰² adapting ideas from traditional fairy stories or media (Figures 7 to 9).

They worked over 5 months with the children to record and document in drawing their expression in music and dance, with the additional aim of encouraging their educators to value creative music-making by the children. They decided to make a new story based on Sleeping Beauty, which became 'Awakening Beauty'] and started by composing a song about it. (see the Sightlines website. www.sightlines-initiative.com To find 'Awakening Beauty' go to 'On-line Store', then 'Videos and DVDs', and choose 'The Drama of Sound').

At first, when asked if the characters sang, they cleverly imitated familiar tunes. To stimulate invention, they were asked to talk about and describe

their feelings, making movements to show emotions and drawing them. They were offered instruments, drums, and stringed and wind instruments with different tones to 'play' the full range of their feelings. Then they wanted to dance—first to the 'happy' plucked string melodies, moving gracefully. Then, angry music was made with one energetic dancing leader of the musicians, who used her whole body.

Now they came up with the story of the princess who danced with good fairies who was then put to sleep by wicked fairies and rescued by a Prince. They made a big picture of the castle as background, chose and decorated their clothes vividly, and composed the story with songs. Drums were chosen for the wicked fairies and the good fairies danced to the music of swanee whistle and ocarina. One girl who chose to be a good fairy was particularly graceful and joyful. Two energetic ones worked together as evil characters, inventing big dramatic gestures and whole body movements (Figure 8).

Duckett reports, 'We gave the children lots of time and space to act out different parts of the story. They were highly engaged and needed very little direction from us. The children's eyes and body positions show how energised and motivated they all were. ... On the day of the performance all the children were extremely excited! The whole school came to watch them, plus their parents and some other visitors' (Figure 9).

REFERENCES

1. Trevarthen C. What young children give to their learning, making education work to sustain a community and its culture. *Eur Early Child Educ Res J* 2011, 19:173–193.
2. Comenius JA. The School of Infancy, 1633. In: *Essays on Educational Reformers* (trans. D. Benham, London, 1858). Quoted by Quick RH. London: Longmans, Green and Co, 1894, 144–145.

3. Bruner JS. *The Culture of Education*. Cambridge, MA: Harvard University Press; 1996, Preface p. ix.
4. Renfrew C, Morley I. *Becoming Human: Innovation in Prehistoric Material and Spiritual Culture*. Cambridge, MA: Cambridge University Press; 2009.
5. Trevarthen C. Brain development. In: Gregory RL, ed. *Oxford Companion to the Mind*. Second ed. Oxford, NY: Oxford University Press; 2004, 116–127.
6. Konner M. *The Evolution of Childhood: Relationships, Emotions, Mind*. Cambridge, MA: Belknap Harvard; 2010.
7. Hrdy SB. *Mothers and Others: The Evolutionary Origins of Mutual Understanding*. Cambridge, MA: Harvard University Press; 2009.
8. Narvaez D, Panksepp J, Schore A, Gleason T, eds. *Evolution, Early Experience and Human Development: From Research to Practice and Policy*. New York: Oxford University Press; 2012.
9. Dissanayake E. *Homo Aestheticus: Where Art Comes From and Why*. Seattle, WA: University of Washington Press; 1992.
10. Sebeok TA. *Essays in Zoosemiotics*. Monograph Number 5. Toronto, Canada: Toronto Semiotic Circle, Victoria College, University of Toronto, 1990.
11. Trevarthen C. Signs before speech. In: Sebeok TA, Umiker-Sebeok J, eds. *The Semiotic Web, 1989*. Berlin, Germany: Mouton de Gruyter; 1990, 689–755.
12. Lakoff G, Johnson M. *Philosophy in the Flesh, The Embodied Mind and Its Challenges to Western Thought*. New York: Basic Books; 1999.
13. Donald M. *A Mind So Rare: The Evolution of Human Consciousness*. New York: Norton; 2001.
14. Trevarthen C. Born for art, and the joyful companionship of fiction. In: Narvaez D, Panksepp J, Schore A, Gleason T, eds. *Evolution, Early Experience and Human Development: From Research to Practice and Policy*. New York: Oxford University Press; 2012, 202–218.
15. Donaldson M. *Human Minds: An Exploration*. London: Allen Lane/Penguin Books; 1992.
16. Trevarthen C. Innate moral feelings, moral laws and cooperative cultural practice. In: Sanguinetti JJ, Acerbi A, Lombo JA, eds. *Moral Behavior and Free Will: A Neurobiological and Philosophical Approach*. Morolo, Italy: IF Press; 2011, 377–411.
17. Brandt PA. Music and how we became human—a view from cognitive semiotics: exploring imaginative hypotheses. In: Malloch S, Trevarthen C, eds. *Communicative Musicality: Exploring the Basis of Human Companionship*. Oxford: Oxford University Press; 2009, 31–44.
18. Pagel M, Atkinson QD, Calude AS, Meade A. Ultraconserved words point to deep language ancestry across Eurasia. *Proc Natl Acad Sci USA* 2013 Available at: <http://www.pnas.org/content/early/2013/05/01/1218726110.full.pdf+html>.
19. Atkinson QD. Phonemic diversity supports a serial founder effect model of language expansion from Africa. *Science* 2011, 332:346–349. doi: 10.1126/science.1199295.
20. Pagel M. *Wired for Culture: Origins of the Human Social Mind*. New York: W. W. Norton and Company; 2012.
21. Corballis MC, Lea EG, eds. *The Descent of Mind: Psychological Perspectives on Hominid Evolution*. Oxford: Oxford University Press; 1999.
22. McNeill D. *Gesture and Thought*. Chicago, IL: University of Chicago Press; 2005.
23. Mithen S. The music instinct: the evolutionary basis of musicality. *Ann NY Acad Sci* 2009, 1169:3–12.
24. Wallin NL, Merker B, Brown S. *The Origins of Music*. Cambridge, MA: MIT Press; 2000, 389–410.
25. Merker B. Returning language to culture by way of biology. *Behav Brain Sci* 2009, 325:460.
26. Whitehead AN. *Process and Reality*. The Gifford Lectures 1927–28. New York: The Free Press; 1978.
27. Han S, Northoff G. Culture-sensitive neural substrates of human cognition: a transcultural neuroimaging approach. *Nat Rev Neurosci* 2008, 9:646–654.
28. Domínguez Duque JF, Turner R, Lewis ED, Egan G. Neuroanthropology: a humanistic science for the study of the culture–brain nexus. *Soc Cogn Affect Neurosci* 2010, 5(2–3):138–147.
29. Hewlett BS, Lamb ME, eds. *Hunter-gatherer Childhoods: Evolutionary, Developmental, and Cultural Perspectives*. New Brunswick, NJ: Aldine Transaction Publishers; 2005.
30. Bateson G. *Mind and Nature: A Necessary Unity*. London: Wildwood House; 1979.
31. Lewis EB. Homeosis: the first 100 years. *Trends Genet* 1994, 10:341–343.
32. Stern DL. Evolutionary developmental biology and the problem of variation. *Evolution* 2000, 54:1079–1091.
33. Rogoff B. *The Cultural Nature of Human Development*. Oxford: Oxford University Press; 2003.
34. Trevarthen C. Lateral asymmetries in infancy: implications for the development of the hemispheres. *Neurosci Biobehav Rev* 1996, 20:571–586.
35. Trevarthen C. In: Wright J, ed. “Split Brain”, Article No. 54019. *International Encyclopedia of Social and Behavioral Sciences*. 2nd ed. Oxford: Elsevier; 2013. In press.
36. Bogen JE. The other side of the brain. II. An appositional mind. *Bull Los Angeles Neurol Soc* 1969, 34:135–162.
37. McGilchrist I. *The Master and His Emissary: The Divided Brain and the Making of the Western World*. New Haven, CT: Yale University Press; 2009.
38. Dissanayake E. *Art and Intimacy: How the Arts Began*. Seattle, WA: University of Washington Press; 2000.

39. Gray P. The value of a play-filled childhood in development of the hunter-gatherer individual. In: Narvaez D, Panksepp J, Schore A, Gleason T, eds. *Evolution, Early Experience and Human Development: From Research to Practice and Policy*. New York: Oxford University Press; 2012, 352–370.
40. Dunbar RIM. The social brain: mind, language, and society in evolutionary perspective. *Annu Rev Anthropol* 2003, 32:163–181.
41. Gamble C, Gowlett J, Dunbar R. The social brain and the shape of the palaeolithic. *Camb Archaeol J* 2011, 21:115–136. doi: 10.1017/S0959774311000072.
42. Blacking J. Dance and music in Venda children's cognitive development. In: Jahoda G, Lewis IM, eds. *Acquiring Culture: Cross-Cultural Studies in Child Development*. Beckenham, Kent: Croom Helm; 1988, 91–112.
43. Cross I, Morley I. The evolution of music: theories, definitions and the nature of the evidence. In: Malloch S, Trevarthen C, eds. *Communicative Musicality: Exploring the Basis of Human Companionship*. Oxford: Oxford University Press; 2009, 61–81.
44. Morley I. Rituals and music: parallels and practice, and the palaeolithic. In: Renfrew C, Morley I, eds. *Becoming Human: Innovation in Prehistoric Material and Spiritual Culture*. Cambridge, MA: Cambridge University Press; 2009, 159–175.
45. Blacking J. *How Musical is Man?* Seattle: University of Washington Press; 1973.
46. Brown S, Dissanayake E. The arts are more than aesthetics: neuroaesthetics as narrow aesthetics. In: Skov M, Varshanian O, eds. *Neuroaesthetics*. Amityville, NY: Baywood; 2009, 43–57.
47. Hadamard J. *The Psychology of Invention in the Mathematical Field*. Princeton, NJ: Princeton University Press; 1945.
48. Lashley KS. The problems of serial order in behavior. In: Jeffress LA, ed. *Cerebral Mechanisms in Behavior*. New York: Wiley; 1951, 112–136.
49. Chomsky N. *Aspects of the Theory of Syntax*. Cambridge, MA: MIT Press; 1965.
50. Damasio AR. *The Feeling of What Happens: Body, Emotion and the Making of Consciousness*. London: Heinemann; 1999.
51. Damasio AR. *Looking for Spinoza: Joy, Sorrow, and the Feeling Brain*. New York: Harcourt Brace and Company; 2003.
52. Björkqvold J-R. *The Muse Within: Creativity and Communication, Song and Play from Childhood through Maturity*. New York: Harper Collins; 1992.
53. von Bonsdorff P. Aesthetic of childhood: phenomenology and beyond. *Proc Eur Soc Aesthet* 2009, 1:84–100.
54. Osborne N. Music for children in zones of conflict and post-conflict: a psychobiological approach. In: Malloch S, Trevarthen C, eds. *Communicative Musicality: Exploring the Basis of Human Companionship*. Oxford: Oxford University Press; 2009, 331–356.
55. Tulving E. Episodic memory: from mind to brain. *Annu Rev Psychol* 2002, 253:1–25.
56. Panksepp J, Trevarthen C. The neuroscience of emotion in music. In: Malloch S, Trevarthen C, eds. *Communicative Musicality: Exploring the Basis of Human Companionship*. Oxford: Oxford University Press; 2009, 105–146.
57. Solms M, Panksepp J. The “Id” knows more than the “Ego” admits: neuropsychanalytic and primal consciousness perspectives on the interface between affective and cognitive neuroscience. *Brain Sci* 2012, 2:147–175.
58. Porges SW, Furman SA. The early development of the autonomic nervous system provides a neural platform for social behavior: a polyvagal perspective. *Infant Child Dev* 2011, 20:106–118.
59. Malloch S, Trevarthen C, eds. *Communicative Musicality: Exploring the Basis of Human Companionship*. Oxford: Oxford University Press; 2009.
60. Panksepp J. Affective consciousness: core emotional feelings in animals and humans. *Conscious Cogn* 2005, 14:19–69.
61. Carter CS, Porges SW. Neurobiology and the evolution of mammalian social behavior. In: Narvaez D, Panksepp J, Schore A, Gleason T, eds. *Evolution, Early Experience and Human Development: From Research to Practice and Policy*. New York: Oxford University Press; 2012, 132–151.
62. Damasio AR. *Self Comes to Mind: Constructing the Conscious Brain*. New York: Pantheon; 2010.
63. Trevarthen C, Delafield-Butt J. Biology of shared experience and language development: regulations for the inter-subjective life of narratives. In: Legerstee M, Haley D, Bornstein M, eds. *The Infant Mind: Origins of the Social Brain*. New York: Guilford; 2013, 167–199.
64. Stern DN. *The Interpersonal World of the Infant: A View from Psychoanalysis and Development Psychology*. New York: Basic Books; 2000.
65. Stern DN. *Forms of Vitality: Exploring Dynamic Experience in Psychology, the Arts, Psychotherapy and Development*. Oxford: Oxford University Press; 2010.
66. Trevarthen C. Development of intersubjective motor control in infants. In: Wade MG, Whiting HTA, eds. *Motor Development In Children: Aspects of Coordination and Control*. Dordrecht, The Netherlands: Martinus Nijhoff; 1986, 209–261.
67. Trevarthen C. The generation of human meaning: how shared experience grows in infancy. In: Seemann A, ed. *Joint Attention: New Developments in Philosophy, Psychology, and Neuroscience*. Cambridge, MA: MIT Press; 2011, 73–135.

68. Trevarthen C. Musicality and the intrinsic motive pulse: evidence from human psychobiology and infant communication. In: *Rhythms, Musical Narrative, and the Origins of Human Communication*. Musicae Scientiae, Special Issue, 1999–2000, Liège, European Society for the Cognitive Sciences of Music; 1999, 157–213. doi:10.1177/10298649000030S109.
69. Nagy E. The newborn infant: a missing stage in developmental psychology. *Infant Child Dev* 2011, 20:3–19.
70. Gallese V, Rochat M, Cossu G, Sinigaglia C. Motor cognition and its role in the phylogeny and ontogeny of intentional understanding. *Dev Psychol* 2009, 45:103–113.
71. Bateson MC. The epigenesis of conversational interaction: a personal account of research development. In: Bullowa M, ed. *Before Speech: The Beginning of Human Communication*. London: Cambridge University Press; 1979, 63–77.
72. Trevarthen C. Communication and cooperation in early infancy. A description of primary intersubjectivity. In: Bullowa M, ed. *Before Speech: The Beginning of Human Communication*. London: Cambridge University Press; 1979, 321–347.
73. Trevarthen C, Hubley P. Secondary intersubjectivity: confidence, confiding and acts of meaning in the first year. In: Lock A, ed. *Action, Gesture and Symbol: The Emergence of Language*. London: Academic Press; 1978, 183–229.
74. Hubley P, Trevarthen C. Sharing a task in infancy. In: Uzgiris I, ed. *Social Interaction During Infancy: New Directions for Child Development*. San Francisco, CA: Jossey-Bass; 1979, 57–80.
75. Reddy V. *How Infants Know Minds*. Cambridge, MA: Harvard University Press; 2008.
76. Hobson P. *The Cradle of Thought: Exploring the Origins of Thinking*. London: Macmillan; 2002.
77. Halliday MAK. One child's protolanguage. In: Bullowa M, ed. *Before Speech: The Beginning of Human Communication*. London: Cambridge University Press; 1979, 171–190.
78. Trevarthen C. Universal cooperative motives: how infants begin to know language and skills of culture. In: Jahoda G, Lewis IM, eds. *Acquiring Culture: Ethnographic Perspectives on Cognitive Development*. London: Croom Helm; 1988, 37–90.
79. Tomasello M. *The Cultural Origins of Human Cognition*. Cambridge, MA: Harvard University Press; 1999.
80. Tomasello M. *Origins of Human Communication*. Cambridge, MA: A Bradford Book, MIT Press; 2008.
81. Bruner JS. *Child's Talk. Learning to Use Language*. New York: Norton; 1983.
82. Bruner JS. *Acts of Meaning*. Cambridge, MA: Harvard University Press; 1990.
83. Chukovsky K. *From Two to Five*. Berkeley, CA: University of California Press; 1968.
84. Nadel J, Butterworth G, eds. *Imitation in Infancy*. Cambridge, MA: Cambridge University Press; 1999.
85. Donaldson M. *Children's Minds*. Glasgow, UK: Fontana/Collins; 1978.
86. Turner VW. *From Ritual to Theatre: The Human Seriousness of Play*. New York: PAJ Publications; 1982.
87. Trevarthen C. The imaginative and cultural purposes of human play: joy in movement bringing companionship to practical tasks and meaning to social practice. In: Johnson JE, Eberle S, eds. *Handbook of the Study of Play*. Lanham, MD: Rowman and Littlefield; 2014 In preparation.
88. Paley VG. *The Boy on the Beach: Building Community Through Play*. Chicago, IL: University of Chicago Press; 2010.
89. Gallese V. Introduction. Ammaniti M, Gallese V. *The Birth of Intersubjectivity Psychodynamics, Neurobiology, and the Self*. New York: Norton; 2014. In press.
90. Bruner JS. *The Culture of Education*. Cambridge, MA: Harvard University Press; 1996.
91. Fónagy I. *Languages Within Language: An Evolutionary Approach*. John Benjamins: Amsterdam, the Netherlands; 2001.
92. Trevarthen C. Epilogue: natural sources of meaning in human sympathetic vitality. In: Foelen A, Lüdtke UM, Racine TP, Zlatev J, eds. *Moving Ourselves, Moving Others: Motion and Emotion In Intersubjectivity, Consciousness and Language*. Amsterdam, the Netherlands: John Benjamins Publishing Company; 2012, 451–483.
93. Whariki T. *Early Childhood Curriculum*. Wellington, NZ: New Zealand Ministry of Education; 1996.
94. Donaldson M, Grieve R, Pratt C. *Early Childhood Development and Education: Readings in Psychology*. Oxford: Basil Blackwell; 1983.
95. Erickson F. Musicality in talk and listening: a key element in classroom discourse as an environment for learning. In: Malloch S, Trevarthen C, eds. *Communicative Musicality: Exploring the Basis of Human Companionship*. Oxford: Oxford University Press; 2009, 449–464.
96. Hall ET. *The Dance of Life, The Other Dimension of Time*. Garden City, NY: Anchor Press/Doubleday; 1983.
97. Trevarthen C, Malloch S. Musicality and musical culture: sharing narratives of sound from early childhood. In: McPherson G, Welch G, eds. *Oxford Handbook of Music Education*. Oxford: Oxford University Press; 2012, 248–260.
98. Greenfield PM, Quiroz B, Raef C. Cross-cultural conflict and harmony in the social construction of

- the child. In: *New Directions for Child and Adolescent Development*, vol. 87. San Francisco, CA: Jossey-Bass; 2000, 93–108.
99. Gratier M. Expressive timing and interactional synchrony between mothers and infants: cultural similarities, cultural differences, and the immigration experience. *Cogn Dev* 2003, 18:533–554.
100. Gratier M, Trevarthen C. Musical narrative and motives for culture in mother–infant vocal interaction. *J Conscious Stud* 2008, 15(10–11):122–158.
101. Gratier M, Apter-Danon G. The improvised musicality of belonging: repetition and variation in mother–infant vocal interaction. In: Malloch S, Trevarthen C, eds. *Communicative Musicality: Exploring the Basis of Human Companionship*. Oxford: Oxford University Press; 2009, 301–327.
102. Trevarthen C. Origins of musical identity: evidence from infancy for musical social awareness. In: MacDonald RAR, Hargreaves DJ, Miell D, eds. *Musical Identities*. Oxford University Press: Oxford; 2002, 21–38.

FURTHER READING

- Bråten S. *The Intersubjective Mirror in Infant Learning and Evolution of Speech*. John Benjamins: Amsterdam, the Netherlands; 2009.
- Göncü A, Klein EL. *Children in Play, Story and School*. Guilford Press: New York; 2001.
- Gratier M. Expression of belonging: the effect of acculturation on the rhythm and harmony of mother–infant vocal interaction. In: "Rhythms, Musical Narrative, and the Origins of Human Communication". *Musicae Scientiae*, Special Issue, 1999–2000, Liège, European Society for the Cognitive Sciences of Music, 1999, 93–122.
- Gratier M, Greenfield PM, Isaac A. Tacit communicative style and cultural attunement in classroom interaction. *Mind Cult Act* 2009, 164:296–316.
- Kugiumutzakis G. Neonatal imitation in the intersubjective companion space. In: Bråten S, ed. *Intersubjective Communication and Emotion in Early Ontogeny*. Cambridge, MA: Cambridge University Press; 1998, 63–88.
- Maori Language Revival. Available at: <http://www.kohanga.ac.nz/>.
- Pelligrini AD, Smith PK. *The Nature of Play: Great Apes and Humans*. Guilford Press: New York; 2005.
- Siegel D. *The Developing Mind, Second Edition: How Relationships and the Brain Interact to Shape Who We Are*. New York: Guilford Press; 2012.
- Turner VW, Bruner EM, eds. *The Anthropology of Experience*. Urbana, IL: University of Illinois Press; 1986.