The musical key to babies' cognitive and social development[1] [2]

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In today's world, filled with myriad parenting methods and high-tech toys that promise to enhance infant development, it is easy to overlook how fundamental is the time-honoured practice of music for all children—starting pre-birth. Music is crucial for babies in every developmental sense: with regards to communication and language; emotional and social well-being, and even motor skills. But it is only relatively recently that science has begun to elaborate in more detail the true extent of its significance.

Keywords: music, development, impact, babies, toddlers

INTRODUCTION

Over the past decade or so, neuro-scientific studies have established that newborn babies are born with all the key components of musical understanding, such as recognizing intervals (Stefanics, et al., 2009) and consonance (i.e. whether a piece of music is 'in tune' or not, Perani, et al., 2010); identifying where the beat of a song lies (Winkler, et al., 2009); whether a chord is in a major or minor key, based on Western musical harmonic conventions (Virtala et al., 2013), and soon demonstrating implicit knowledge of complex harmonic music-syntactic regularities (Jentschke, et al., 2014).

Being musical is part of our human design (Mithen, 2009; Welch, 2005) and our musical development begins pre-birth (Woodward, 2019). Hearing is normally functioning before birth in the final trimester of pregnancy (Lecanuet, 1996) and the newborn enters the world already having experienced sounds from the maternal culture and able to perceive and discriminate tiny differences in voiced sound (Eimas, et al., 1971). The human brain has specialist areas whose prime functions are networked for a wide variety of musical processing, but also linked into other areas of the brain related to major areas of functioning, such as movement, language and emotional experience (Patel, 2012).

Therefore, a child at birth already responds to music. Contrast this to other methods of communication, such as language and pictures: these are not in the range of comprehension of a newborn. A baby's caregivers instinctively understand this, which is why all around the world, it is found that adults spontaneously adapt their 'infant-directed speech' into a higher-pitched, more melodic and more emotionally expressive form of communication (also known as 'motherese', 'parentese') (Saint-Georges et al, 2013; Trehub & Gudmundsdottir, 2019). In other words, as humans, we already know intuitively to emphasize the musical elements of speech (i.e. using

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expressive prosodic contours, pitch glides and a prevalence of basic harmonic intervals – 3rds, 4ths, 5ths, octaves) because these are sounds to which babies universally respond.

BABIES, MUSIC AND LANGUAGE DEVELOPMENT

There is strong evidence that babies, in fact, develop their language skills and vocabulary in a way that is mediated by the musical aspects of speech (Brandt, et al., 2019; Cross, 1999; Chen-Haftek, 1997). In this manner, music paves a way for linguistic development. It is also found that when babies engage in weekly, age-appropriate music lessons, they develop communication skills to a much higher degree than infants of the same age who undertake other activities (Gerry, et al., 2007). Passive music listening alone does not produce the same effect. Moreover, active music making is a form of relationship-building in which parents and other caregivers engage to a degree spontaneously: singing to a baby, bouncing them on your lap to a rhythmic jingle, and clapping to them— these are all common and beneficial forms of musical engagement between a caregiver and a small child (Trehub & Gudmundsdottir, 2019; Pitt & Welch, 2022).

In the ancestral environment, where most of human neurobiological development took place, music-type behaviours were likely to have played a much larger part in everyday activities than they do in 21st century Western society. Leading evolutionary researcher, Robin Dunbar from the University of Oxford, concludes, based on existing evidence, that pre-humans already made music (sang and engaged in making rhythms) 500,000 years ago, whereas our species only developed language 200,000 years ago (Dunbar, et al., 2007). The baby's linguistic development mimics this progress from music to language in microcosm. These days, our parenting culture is very focused on words; a baby's first words are often recorded and talked about to anyone who is willing to listen, and milestones of vocabulary development are keenly watched. Consequently, it is relatively easy to ignore the fact that it is musical features of the maternal sound culture that pave the way for optimising this aspect of development.

On the other hand, it is possible to argue that music has been alienated from everyday use, with the invention of recording technology. It is a common misconception for people, even music teachers, to believe that only a small minority of people are 'musical' in the first place (Welch, 2001; Sloboda, 2000; Sloboda, et al., 1994). In general, the neuroscientific findings on the musical abilities of newborns have not attracted wide media coverage.

MUSIC AND EMOTIONAL DEVELOPMENT

But it is not just language and communication for which music is useful; engaging with music is also an emotional experience, and babies and young children are no exception. A striking example of this is the finding by the Italian music educator and early childhood specialist, Johannella Tafuri. Parents and caregivers commonly struggle with trying to comfort a distressed baby, but Tafuri reported that when babies were sung to, they calmed down, with a 94.5% success rate (Tafuri, 2009). This is linked to the moderation of cortisol (the stress hormone), with maternal singing either arousing the infant by raising cortisol, or reducing distress by lowering cortisol (Shenfield, et al., 2001). (Similar effects are reported in studies of choral singing and emotion (e.g., Kreutz, et al., 2004). Tafuri reported that playing recorded music was also relatively successful in 78.4% of instances, but it is notable how much better a baby was likely to respond when the music that they encountered was presented live by the adult in front of them.

Studies have shown that music is a crucial way to help a small, pre-verbal child manage their emotions. As mentioned above, not only can a distressed baby be stopped from crying via soothing singing, but, likewise, a placid baby can be actively engaged via music (Saarikallio, 2009; Robb, 2000). The emotional benefits also extend to social benefits. Scientists have measured the 'helpfulness' of 14-month old babies after two conditions, one where they were bounced to a regular beat of music, compared to another where they were bounced asynchronously while listening to unpredictable beats. After the two types of bouncing experiences, babies had the opportunity to help the experimenter by handing over desired objects. It was found that when babies experienced predictable beat bouncing, they tended to exhibit 'helpful' behaviour 61% of the time, compared to only 25% after non-rhythmic bouncing (Cirelli, et al., 2012). This implies that music making can build empathy and social cohesion, and also that social facilitation as a fundamental component of musical behaviour is found early in development.

'THE MOZART EFFECT'

When discussing the power of music to effect other kinds of behavioural benefit, it is necessary to account for the media storm that followed publication of the so-called 'Mozart Effect' in the 1990s when it was claimed that listening to Mozart before taking an IQ test raised the test scores of adult participants for the duration of 15 minutes (Rauscher et al., 1995). The Mozart Effect has remained as a popular notion about music and babies, despite the fact that many studies since have moderated and, in some cases, challenged its existence. Even its original researcher, Francis Rauscher, has stated that there is no evidence to support the claim that listening to classical music CDs improves children's spatial-temporal reasoning – or any other aspect of intelligence (Rauscher, 2002). Nevertheless, there is evidence that this type of music can have a positive effect on human physiology and pathophysiology, such as on cardiovascular parameters (Trappe, 2012) and that exposure can improve weight gain in preterm infants by reducing resting energy expenditure (Lubetzky, et al., 2010).

So, did something go wrong with The Mozart Effect? With regards to the original study, it was discovered that the short-term IQ increase had nothing to do with Mozart or music, but was due to the relative advantage that the music-listening group had in relation to the control group who had to sit in uncomfortable silence before taking their test (Thompson, et al., 2001; Nantais & Schellenberg, 1999). Yet, the appeal of The Mozart Effect is easy to see: in our society focused on the prestige of experts and the effectiveness of passive consumption, what would be better than to be able to press a button and make your child a genius simply by listening to a prestigious composer? Unfortunately, this is unlikely to happen, just as if you sat a child in front of a video to watch sports, you could expect them to get fitter. To develop physically, a child needs to move; to develop musically, a child needs to be actively making music in some form.

ENCOURAGING MUSIC MAKING

How is it possible, then, to encourage active music making in babies and small children? There are many ways to do so. Singing to a child and playing musical games with them is crucial, because not only are you engaging the child in a way that is—at the same time—musical, social and personal, but you are also leading by example, demonstrating that it is socially acceptable to sing and make music. It is important not to worry about being musically 'expert'. The important thing is to explore sounds and sound patterns with the child, using the voice and anything else that comes to hand, and to

share musical items from the maternal music culture, such as nursery rhymes (e.g., using web-based materials, including YouTube, for support as necessary). Remember that rhythm is equally as important as pitch, so rhythmic chanting, exploring lyrics and making up rhymes will engage the child musically, especially if they can be encouraged to imitate and join in as they get older. The key to success is exploration and repetition; these will build knowledge and understanding through practice, and by recognising that—as adults—we are senior learners (cf Jerome Bruner) and able to share in and learn from the infant's musical learning journey (see Trehub & Gundmundsdottir, 2019). For example, data analyses of a longitudinal study of Australian children found higher frequency of shared home music activities contributed small but unique variance to measures of children's vocabulary, numeracy, attentional and emotional regulation, and prosocial skills (Williams, et al., 2015).

In recent years, an additional approach that has been acquiring more and more confirmation for its nurturing potential is quality music education for babies and toddlers. Child-centred, age-appropriate methods (such as the Hungarian Kodaly, the Finnish Musiikkileikkikoulu and the Japanese Suzuki, and many others) have been successful in helping babies to develop communication skills and increase their emotional well-being, even above and beyond babies who only get exposure to music at home (Gerry, et al., 2012). For example, a longitudinal German study of one- and two-year-olds compared the musical behaviours and development of a group of children participating with their parents in a special weekly music programme to an equivalent 'control' group in a day care setting (Gruhn, 2002). After 40 weeks, there were marked differences between the two groups (notwithstanding individual differences) with higher ratings for the special programme infants in the quality of their physical movements to music and in their imitation of rhythmic patterns.

These are not the only benefits when a parent and their baby or toddler go to a regular music class together: the parent-child relationship also improves (Walworth, 2009; Nicholson et al., 2008). This benefit has important implications for the healthy psychological development of babies and implies that, in an ideal world, every baby should have the opportunity to engage in a weekly musical class and be supported towards longer-term, positive health effects.

Yet another way to enhance the musical development of babies and very young children is to expose them to a wide variety of music and musical vocabularies on a regular basis. 'Musical vocabulary' refers to musical concepts at an experiential level, not in terms of naming them. A child need not learn to name different elements, but it is suggested that their musical development would be optimised if they could get to experience these through songs and other musical activities. It is worthwhile, therefore, to develop a suitably varied music collection for an infant. New recording technology has made this kind of endeavour easier than ever before, as long as listening to music is not passive, but active, such as involving movement as part of the listening activity, or taking the musical example as a starting point for improvisation.

Babies are curious and are likely to be open to all types of music. For example, very young babies appear to make sense of complex time signatures (underlying rhythmic structures) better than babies aged one year or older (Hannon, et al., 2011) unless the one year olds have experienced such rhythmic complexity throughout their first year of life; in which case, they retain this early ability. This is comparable to the development of the mother tongue (Eimas et al., 1971). A newborn is open to learning any language that they are exposed to, but by the time a baby is one year old, they have already learned to be selective: they direct their attention only to sounds of their mother tongue and away from sounds of other (non-native) languages, unless the home is multi-lingual (Christophe & Morton, 1998).

Babies are able to process music, therefore, at a much deeper level than had been previously thought. For example, they remember tunes that they have heard regularly, even after a long break (Trainor & Tsang, 2004; Saffran, et al., 2000). Also, young babies will engage in attempts at singing. Johannella Tafuri, who studied the musical development of babies given regular 'InCanto' music classes with their caregivers at the local conservatoire in Bologna, writes:

The various musical skills developed by the children in the 'InCanto' project are not in fact 'precocious', in the sense that nature has jumped ahead, but in the sense that they were developed earlier than would normally happen to children that do not live in a stimulating environment. Therefore, they should be considered as 'normal', because they show that nature is ready. These considerations allow us to conclude that if the children in the first year of our elementary schools cannot sing in tune, do not keep in tempo, do not respect the rhythm of a song etc., this means that they have been kept in a state of 'musical deprivation'. (Tafuri, 2009: 87)

THE MUSICAL JOURNEY FROM THE WOMB ONWARDS

The musical prerequisites with which babies are born are key markers of an inherent musicality. When these are nurtured appropriately through musical encounters, exploration and play, children will develop musically and also be supported in other aspects of their physical, cognitive, emotional and social development (Hallam, 2014; Welch, 2006; Welch, et al., 2014; Welch et al 2020). What better time to encourage a child's musical journey than from the final months of foetal development onwards?

PRACTICE POINTERS

- Being musical is integral to human design. We are all musical, but we can have unequal access to the development of our innate musicality. So? Music should be an integral part of activities in the home and wider community, from the final weeks of pregnancy, into infancy and toddlerhood. Exploring sound and music will enhance musical and other-than-musical development – social, emotional, cognitive (such as language) and physical.
- Sing and share songs from the maternal culture, improvise, make up songs for parts of the daily routine, explore vocal and instrumental timbres (tone colours), rhythmic patterns and pulse, find space to encourage children's imitation, creativity and exploration in sound. Each of these will enrich a child's all-round development.
- Musical behaviours can be classified into three main groups: pro-active (initiating sounds), re-active (responding to sounds), and inter-active (making sounds with others, sound 'conversations'). Explore how each of these can be part of your daily routines with babies, infants and toddlers.

REFERENCES

Brandt, A., Slevc, L. R., & Gebrian, M. (2019) The role of musical development in early language acquisition. In: M.H. Thaut & D. A. Hodges (Eds.), The Oxford Handbook of Music and the Brain. New York: Oxford University Press: 566–591. DOI: 10.1093/oxfordhb/9780198804123.013.23

Chen-Hafteck, L. (1997) Music and language development in early childhood: Integrating past research in the two domains. Early Child Development and Care, 130(1):85-97.

Christophe, A., Morton, J. (1998) Is Dutch native English? Linguistic analysis by 2-month-olds. Developmental Science, 1(2):215-219.

Cirelli, L.K., Einarson, K., Trainor, L.J. (2012) Bouncing babies to the beat: Music and helping behaviour in infancy. Proceedings of the 12th International Conference on Music Perception and Cognition and the 8th Triennial Conference of the European Society for the Cognitive Sciences of Music, 224.

Cross, I. (1999) Is music the most important thing we ever did? Music, development and evolution. In: Suk Won Yi, (Ed.), Music, Mind and Science. Seoul: Seoul National University Press: 10-39.

Dunbar, R. I., Barrett, L., Lycett, J. (2007) Evolutionary psychology: A beginner's guide: human behaviour, evolution, and the mind. Oxford: Oneworld Publications.

Eimas, P.D., Siqueland, E.R., Jusczyk, P.W., Vigorito, J. (1971) Speech perception in infants. Science, 171:303–6.

Gerry, D., Unrau, A., Trainor, L. J. (2012) Active music classes in infancy enhance musical, communicative and social development. Developmental Science, 15(3):398-407.

Gruhn, W. (2002) Phases and stages in early music learning. A longitudinal study on the development of young children's musical potential. Music Education Research, 4(1):51-71.

Hallam, S. (2014) The impact of actively making music on the intellectual, social and personal development of children and young people: A research synthesis. London: UCL Institute of Education.

Hannon, E. E., Soley, G., Levine, R. S. (2011) Constraints on infants' musical rhythm perception: effects of interval ratio complexity and enculturation. Developmental Science, 14(4):865-872.

Jentschke, S., Friederici, A.D., Koelsch, S. (2014) Neural correlates of music-syntactic processing in two-year-old children. Developmental Cognitive Neuroscience, 9: 200-208. http://dx.doi.org/10.1016/j.dcn.2014.04.005.

Kreutz, G., Bongard, S., Rohrmann, S., et al. (2004) Effects of choir singing or listening on secretory immunoglobin A, cortisol, and emotional state. Journal of Behavioural Medicine, 27(6): 623-635.

Lecanuet, J.P. (1996) Prenatal auditory experience. In: Deliege, I., Sloboda, J. (Eds.), Musical Beginnings. Oxford: Oxford University Press: 3–34.

Lubetzky, R., Mimouni, F.B., Shaul Dollberg, M.D., Reifen, R., Ashbel, G., et al. (2010) Effect of music by Mozart on energy expenditure in growing preterm infants. Pediatrics, 125(1):e24-e28. doi: 10.1542/peds.2009-0990.

Mithen, S. (2009) The Music Instinct. The evolutionary basis of musicality. Annals of the New York Academy of Sciences, 1169:3-12. doi: 10.1111/j.1749-6632.2009.04590.x

Nantais, K. M., Schellenberg, E. G. (1999) The Mozart effect: An artifact of preference. Psychological Science, 10(4):370-373.

Nicholson, J. M., Berthelsen, D., Abad, V., Williams, K., Bradley, J. (2008) Impact of music therapy to promote positive parenting and child development. Journal of Health Psychology, 13(2):226-238.

Patel, A.D. (2012) Language, music, and the brain: A resource-sharing framework. In: P. Rebuschat, P., Rohrmeier, M., Hawkins, J., Cross, I. (Eds.) Language and Music as Cognitive Systems. Oxford: Oxford University Press: 204-223.

Perani, D., Saccuman, M. C., Scifo, P., Spada, D., Andreolli, G., Rovelli, R., & Koelsch, S. (2010). Functional specializations for music processing in the human newborn brain. Proceedings of the National Academy of Sciences,107(10), 4758-4763.

Pitt, J., Welch, G.F. (2022). Music in early education and care settings for communication and language support. In: M. Barrett, G.F. Welch (Eds.), The Oxford Handbook of Early Childhood Music Learning and Development. New York: Oxford University Press. (in press). See pre-print: https://www.researchgate.net/publication/341219685_Music_in_early_education_and_care_settings_for_communication_and_language_support_1

Rauscher, F.H. (2002) Mozart and the mind: Factual and fictional effects of musical enrichment. In Aronsen, J. (Ed.) Improving academic achievement: Impact of psychological factors on education. San Diego, CA: Academic Press: 267-278.

Rauscher, F. H., Shaw, G. L., Ky, K. N. (1995). Listening to Mozart enhances spatial-temporal reasoning: towards a neurophysiological basis. Neuroscience letters, 185(1), 44-47.

Robb, L. (2000) Emotional musicality in mother-infant vocal affect, and an acoustic study of postnatal depression. Musicae Scientiae, 3(1 suppl):123-154.

Saarikallio, S. (2009) Emotional self-regulation through music in 3-8-year-old children. Proceedings of the 7thTriennial Conference of European Society for the Cognitive Sciences of Music (ESCOM 2009). Jyväskylä, Finland. August 12th-16th.

Saffran, J. R., Loman, M. M., Robertson, R. R. (2000) Infant memory for musical experiences. Cognition, 77(1):B15-B23.

Saint-Georges, C., Chetouani, M., Cassel, R., Apicella, F., Mahdhaoui, A., et al. (2013) Motherese in Interaction: At the cross-road of emotion and cognition? (A Systematic Review). PLoS ONE 8(10): e78103. doi:10.1371/journal.pone.0078103.

Shenfield, T., Trehub, S.E., Nakata, T. (2001) Maternal singing modulates infant arousal. Psychology of Music, 31(4):365-375.

Sloboda, J. (2000) Individual differences in music performance. Trends in Cognitive Sciences, 4(10):397-403.

Sloboda, J. A., Davidson, J. W., Howe, M. J. A. Is everyone musical? (1994) The Psychologist, 7(7): 349-354.

Stefanics, G., Háden, G. P., Sziller, I., Balázs, L., Beke, A., et al. (2009) Newborn infants process pitch intervals. Clinical Neurophysiology,120(2):304-308.

Tafuri, J. (2009) Infant Musicality: New Research for Educators and Parents. [edited by Graham Welch and translated by Elizabeth Hawkins.] Farnham: Ashgate.

Thompson, W. F., Schellenberg, E. G., Husain, G. (2001) Arousal, mood, and the Mozart effect. Psychological science, 12(3):248-251.

Trainor, L. J., Wu, L., Tsang, C.D. (2004) Long-term memory for music: Infants remember tempo and timbre. Developmental Science, 7(3):289-296.

Trappe, H-J. (2012) The effect of music on human physiology and pathophysiology. Music and Medicine, 4(2):100-105. doi: 10.1177/1943862112438106.

Trehub, S., Gudmundsdottir, H.R. (2019) Mothers as singing mentors. In: Welch, G.F., Howard, D.M., Nix, J. (Eds.) ,The Oxford Handbook of Singing. New York: Oxford University Press. 455–470. doi:10.1093/oxfordhb/9780199660773.013.25.

Virtala, P., Huotilainen, M., Partanen, E., Fellman, V., Tervaniemi, M. (2013) Newborn infants' auditory system is sensitive to Western music chord categories. Frontiers in psychology, 4. doi:10.3389/fpsyg.2013.00492.

Walworth, D.D. (2009) Effects of developmental music groups for parents and premature or typical infants under two years on parental responsiveness and infant social development. Journal of Music Therapy, 46(1):32-52.

Welch, G. (2001) The misunderstanding of music. Institute of Education: University of London.

Welch, G.F. (2005) We are musical. International Journal of Music Education, 23(2):117-120. doi: 10.1177/0255761405052404.

Welch, G.F. (2006) The musical development and education of young children. In B. Spodek & O. Saracho (Eds.), Handbook of Research on the Education of Young Children. Mahwah, N.J.: Lawrence Erlbaum Associates Inc.:251-267.

Welch, G.F., Biasutti, M., MacRitchie, J., McPherson, G.E., & Himonides, E. (2020) Editorial: The Impact of Music on Human Development and Well-Being. Frontiers in Psychol. 11:1246. https://www.frontiersin.org/articles/10.3389/fpsyg.2020.01246/full

Welch, G.F., Himonides, E., Saunders, J., Papageorgi, I., Sarazin, M. (2014) Singing and social inclusion. Frontiers in Psychology, 5:803. doi: 10.3389/fpsyg.2014.00803.

Williams, K.E., Barrett, M.S., Welch, G.F., Abad, V., & Broughton, M. (2015). Associations between early shared music activities in the home and later child outcomes: Findings from the Longitudinal Study of Australian Children. Early Childhood Research Quarterly. 31: 113-124. http://dx.doi.org/10.1016/j.ecresq.2015.01.004

Winkler, I., Háden, G. P., Ladinig, O., Sziller, I., Honing, H. (2009) Newborn infants detect the beat in music. Proceedings of the National Academy of Sciences, 106(7):2468-2471.

Woodward, S. (2019) Fetal, Neonatal, and Early Infant Experiences of Maternal Singing In: G.F. Welch, D. M. Howard, & J. Nix. (Eds.), The Oxford Handbook of Singing. New York: Oxford University Press: 431–453. DOI: 10.1093/oxfordhb/9780199660773.013.41