An Exploratory Study: The Existence of Independent Emotions of a Fetus

Dr. Mariana Cerqueira and Dr. Luis Delgado

Abstract: Many brilliant authors have discussed and theorized the beginning of human mental life. Emotional experience is only one layer of someone's psyche. In this study, the authors explore if the fetus in the third trimester could experience emotions independently from their mothers. The authors focused on changes in the autonomous nervous system reflected in mothers' and fetuses' heart rates and heart rate variability as physiologic measures of emotional experience. Emotions were elicited through music to which fetuses and their mothers were exposed depending on the experimental group they belonged. The data was retrieved from Ninety-three participants randomly distributed into three groups. This study found that fetuses seemed to have experienced their mothers' emotional atmosphere and had distinct emotional experiences with their mothers.

Dr. Cerqueira graduated from medical school in 2008 from Faculdade de Ciências Médicas da Universidade Nova de Lisboa, and in 2014 she completed her masters in clinical psychology at ISPA-IU, also in Lisbon. Dr. Cerqueira did an internship with a Hospital Mental Health department for Early Childhood as a clinical psychologist trainee and conducted leading-edge Heart Rate Variability research in Fetal Psychology at the OBGYN department of Hospital Beatriz Ângelo, in Lisbon. Currently, Dr. Cerqueira is a second-year doctoral student at the Graduate School of Professional Psychology at the University of Denver, where she is specializing in Infant and Early Childhood Mental Health and Substance Use Disorder, as well as a fellow on the Colorado OUD/SUD Training (COST) program, designed to address the Opiate Use Disorder needs of low-income Coloradans. Dr. Cerqueira has been providing bilingual perinatal, infant, and early childhood mental health services to Coloradan's children and families through the Caring for yoU and Baby Clinic and MotherWise WiseWellness clinic. In addition, Dr. Cerqueira has been working with the Latinx community providing services in different settings with the goal of exploring the application of culturally and linguistically sensitive interventions while addressing the barriers to services. **Luís Delgado, Ph.D**., is an Assistant Professor in Clinical and Health Psychology atInstituto Superior de Psicologia Aplicada- Instituto Universitário (ISPA-IU)in Lisbon, Portugal. He is the author of several papers and books regarding psychoanalysis and creativity. Dr. Delgado's research atApplied Psychology Research Center Capabilities & Inclusion centeredon projective assessment in the clinical setting and psychodynamics and creativity.

Theoretical Background

Parents and health care practitioners alike often wonder when humans start experiencing emotions. According to several researchers (Dalgleish & Power, 2000; Leventhal & Scherer, 1987; Strongman, 1998), emotions are innate and biologically determined, manifested in early development (Ekman, 1992), and can be characterized by an automatic response to stimulus developed before birth. Parents often can attribute certain personality traits and emotional experiences to their fetus's behavior. Huotilainen (2010) refers to the existence of cognitive abilities in the womb that include emotions. Prenatally, fetuses can distinguish specific patterns in the emotional speech of the mother (Mastropieri & Turkewitz, 2001), identify their mother's speech when it is recorded life, and differentiate languages (e.g., German, Japanese, English) (Kisilevsky & Hains, 2010). Furthermore, after half of the second semester, fetuses frequently respond to external stimulation, discriminate between stimuli, learn (Huotilainen, 2010; Sandman, 2010), and exhibit emotions (Huotilainen, 2010).

Various facial expressions have been observed in newborns (Dalgleish & Power, 2000) and fetuses above the end of the second semester of gestation. (De Vries et al., 1985; Emory, 2010; Horimoto et al., 1990; Koyanagi & Kreibig, 2010; Petrikovsky et al., 1999; Petrikovsky et al., 2003). These facial expressions are like those observed in adults (Andonotopo & Kurjak, 2006; Kurjak et al., 2006; Hata et al., 2010). Several authors have mentioned facial expressions' transcultural characteristics as mirrored by their universality (Eckman, 1992; Higgins, 2006; Izard, 1994; Lazarus, 1991; Scherer et al., 2002; Sievers et al., 2012; Trehub, 2000). Therefore, the presence of facial expressions in fetuses could further corroborate the assertion made by several researchers (e.g., Huotilainen, 2010) that fetuses experience emotions.

Jung and Freud theorized about the existence of a prenatal mental life (Milakovic, 1967, as cited in Emory, 2010). Freud (1926) defended that prenatal life and early childhood were more in continuity than some researchers believed. According to Winnicott (1988), birth promotes amnesia of prenatal experiences as a reflex of the *caesura*. Therefore, the existence of a prenatal mental life (Winnicott, 1988) or an embryonic psyche (Bion, as cited in Zimmerman, 1995) seems to have crucial importance to the behavior patterns observed in adulthood (McCarty, 2012; Freud, s.d., as cited in Bion, 1989). The ability to differentiate types of emotions, and the relative emotional magnitude of prenatal experiences, can influence how someone responds to emotions as an adult (Mastropieri & Turkewitz, 2001) and leads to certain behavior that mirror the memory of prenatal events (e.g., DeCasper & Spence, 1986; Hepper, 1991). Winnicott (1988) further argued that "when the fetus achieved term, they already are a human being in the womb, capable of having experiences and accumulating body memories and organizing defensive mechanisms to cope with trauma" (pg. 143). Similarly, Bion (1989) perceived the symptom as the surfacing of a prenatal memory into the conscious mind. Different authors and researchers postulate about the existence of prenatal memories. McCarty (2006) affirms that the human being is a conscious sentient being from the beginning of life. That would imply the expression of emotion in the preborn.

The experience of emotions is crucial to human understanding (Dias et al., 2010; Damásio, 2003). Human behavior and psychological functioning are motivated by emotions; thus, emotion constitutes a basic mechanism that regulates life (Arriaga et al., 2010; Strongman, 1998, Dalgleish & Power, 2000; Damásio, 2003).

Emotions can be defined as changes in body states associated with specific mental images (Damásio, 2011), which activate the Autonomous Nervous System (ANS) (Damásio, 2003) and the endocrine system (Strongman, 1998). Emotions are characterized by universality (Eckman, 1992; Higgins, 2006; Izard, 1994; Lazarus, 1991; Scherer et al., 2002; Sievers et al., 2012; Trehub, 2000), spontaneity (Levenson et al., 1992; Strongman, 1998), and they can be automatic and unintentional (Damásio 2011; Feldman et al., 2006). They can motivate certain behavior (Moll et al., 2001), are communicable (Rolls, 1990 as cited in Strongman, 1998), and can facilitate social attachment (Strongman, 1998).

The perception (McDougall, s.d., as cited in Strongman, 1998) of an emotionally competent stimulus (ECS) (Damásio, 2003) triggers emotions in milliseconds (ms) (Zajonc, 1980, as cited in Dalgleish & Power, 2000), and conformity with the autonomic response changing, e.g., the heart rate (HR) in 100 to 400 ms (Hainsworth, 1996 as cited in Kisilevsky & Hains, 2010).

It has been well established that music triggers different emotions (e.g., Juslin & Laukka, 2003; Juslin & Sloboda, 2010; Juslin & Västfjäll, 2008; Konečni, 2008; Konečni et al., 2008, Zentner et al., 2000; Scherer & Zentner, 2001), depending on specific characteristics (Hunter & Schellenberg, 2010; Zentner et al., 2008). For instance, fast rhythm music can trigger joy, and low rhythm can trigger sadness. In other words, different characteristics will influence levels of activation and valence (positive or negative) (Husain et al., 2002). The effects of those characteristics are universal (Balkwill et al., 2004; Balkwill & Thompson, 1999; Fritz et al., 2009; Gabrielsson & Lindström, 2010). It has been shown that preborn can discriminate different sounds, responding with a change in heart rate (Clarkson & Berg, 1983). Only one week after conception, signs of ear development can be observed, which means the sensory systems are functional even before reaching structural maturity (Lecanuet et al., 1992) at 25 weeks (Browne & Graven, 2008).

It seems several researchers agree that there is a prenatal mental life. Most of the findings in prenatal and perinatal research are based on spontaneous memories or memories retrieved by hypnosis, which are then matched with information to which they refer. This study intends to contribute to the body of work in this field with additional empirical fetal psychological data. It aims to explore whether fetuses express emotional responses independently from their mothers in the third trimester. For that purpose, we formulated the following hypothesis:

Hypothesis 1: Fetuses express emotional responses independently from their mothers.

Hypothesis 2: The emotional response of the fetuses will happen according to the emotional solicitation of the stimuli given.

Hypothesis 3: The emotional response can be co-influenced by other variables (e.g., age of the mother and the father, music given to the mother and the preborn, preborn gender, and obstetrical complications).

Method

Sample

The sample was retrieved from Hospital Beatriz Ângelo (HBA) in Loures, Portugal. A total of 205 pregnant individuals participated in this study, and 112 were excluded because of incomplete data. The remaining 93 participants are Portuguese (79.57%), African (6.45%), Brazilian (6.45%), and from other nationalities (6,45%). The average age is 29.71 years, with a maximum of 40 years, a minimum of 17 years, and a standard deviation of 5,44. Most participants are married (45.65%), 30.43% are single, and only 1.09% are divorced. The participants were above 34 weeks and under 40 weeks, with an average of 37.384 weeks and a standard deviation of 1.459. They were distributed randomly into three groups where the mother listened to the same music, inducing a large variability of emotions. In Group 1 or Control Group, fetuses did not listen to any music through the phone placed in the mother's belly. In Group 2, fetuses listen to music that appeals to a calm, relaxing emotional state. In Group 3, fetuses listen to music that triggers the five primary emotions.

Instruments

Cardiotocography (CTG)

Cardiotocography (CTG) gives information about the integrity of the Central Nervous System (CNS) by providing data on fetal and maternal heart rate (HR) and fetal movements (FM). Those physiologic parameters allow the evaluation of fetal well-being before and during labor (Mascaro et al., 2002). This technique is used weekly to monitor healthy women above 36 weeks. We use the Phillips Avalon FM 20.

MP3 Readers and Headphones

We used the Memup MP3 Klubby and Zippy MP3 Turtle as MP3 readers. The Sony ZX100 headphones have 24 OHM with 1000 MW and a gold-plated stereo mini with a frequency of 12-22.000 HZ. The sensibility of 100 DB/MW is adjusted to the fetal auditory reactivity above 32 weeks (Kisilevsky et al., 2004).

Music

We used the Ground Truth Data created by Eerola and Vuoskoski (2010, 2012), which consists of 110 extracts from movies soundtracks about 15 seconds long, partly to reduce the mere exposure effect (Zajonc, 1980; see Bornstein, 1989) and the stimuli familiarity or musical preference of the participants (Laurier et al., 2009). It did not diminish the association between the stimuli and the emotional response (Hunter & Schellenberg, 2011; Schellenberg et al., 2008; Szpunar et al., 2004). Those values were between |0.398| and |0.587|. From the data, we used the songs classified in primary emotions (e.g., anger, fear, joy, sadness, and tender). The duration of the songs was adjusted to the CTG, extending each to about 30 seconds, respecting their audio characteristics (e.g., rhythm, pitch, volume). We gathered 20 songs, two per emotion (one moderate and another high intensity), for 12 minutes of music exposure.

The participants had one minute without music exposure to gather information about their physiologic baseline, after which they were exposed to the music stimuli, making a total of 13 minutes in the CTG. That was designed to fit the normal dynamic of the hospital where the CTG routine counted with around 20 minutes of CTG fetal HRV reading.

Accordantly, we selected 12 minutes of Holst's (1991b) *Vénus,* characterized by its slow rhythm, with basic rhythm motives and slight melodic modifications to promote a constant, relaxed, and calm emotional state (Arriaga et al., 2010). It has been shown to have a strong correlation between this music and the desired emotional state.

SPSS

All the data gathered was analyzed through the SPSS Statistic 21.

Procedures

One person collected all the data. While the participants were waiting to do the CTG, they answered a brief questionnaire about demographic, obstetrical, family, and personal medical antecedents. When they started the CTG, we put the two sets of headphones in the mother, one in her ears and the other on her belly. The first minute was without music, and the next 12 minutes were with the music accordingly to their group. Once all the sample data was gathered, the informed consent sheets were separated from the remaining questionnaire. The CTG paper was amplified into an A3 format, from which the HR values were retrieved at 15, 30, and 45 seconds for each 13-minute interval of the experiment.

Results

The statistical analysis of the data is based on an α of 0.05. There were three extreme outliers, which were excluded from the study. The moderate outliers were preserved because their effect is less severe in influencing the results (Marôco, 2011; Coelho et al., 2008). There are 22% missing values referring to maternal and fetal HR, which do not have a random distribution and therefore had to be excluded from the study (Allison, 2001).

Hypothesis 1: Fetuses express emotional responses independently from their mothers.

The average maternal HR was a mean of 93.39, a minimum of 66.24, and a maximum of 144.02. The fetal HR was a mean of 144.36, a minimum of 123.05, and a maximum of 183.85.

The ANOVA one-way results showed similar HR averages in the three groups (Group 1: M= 141.92, SD= 9.42; Group 2: M= 141.74, SD= 9.77; Group 3: M= 142.24, SD= 9.31), with no significant statistical differences between them ($F(2,90) = 0.176$, $p= 0.839$; $h^{2P} = 0.004$, $(\pi) = 0.077$), a very small effect size and potency test. Therefore, our hypothesis was not corroborated.

Hypothesis 2: The emotional response of the fetuses will happen according to the emotional solicitation of the stimuli given.

Fetal HR variability (HRV) extreme outliers were excluded from the analysis. Although 50% of the fetal HRV is similar in the three groups (Group1:19.07; Group 2: 16.69 and Group 3: 15.01), a difference can be seen in the 75 percentile mostly between group 3 (19,3012) and groups 1 (33,525) and 2 (30. 293).

Fetal HRV in Group 1 had an average of 25.43, a median of 19.07, variances of 326.22, a standard deviation of 18.06, a minimum of 8.7, and a maximum of 94.40. Fetal HRV in Group 2 had an average of 22.03, a median of 16.69, variances of 240.80, a standard deviation of 15.52, a minimum of 8.10, and a maximum of 74.71. Fetal HRV in Group 3 had an average of 16.07, a median of 15.01, variances of 58.51, a standard deviation of 7.65, a minimum of 5.70, and a maximum of 41.55.

The one-way ANOVA demonstrated the existence of significant statistical differences in the three groups (F(2,85) = 3.233, p= 0.044; h^{2P} = 0.071, (п) = 0.602), despite the effect size and potency test being very low. The Tukey test showed only statistical differences between Group 1 and Group 3 (T: 9.35 p=0.037; I.C.: 0.476; 18.23). Therefore, our hypothesis was corroborated.

Hypothesis 3: The emotional response can be co-influenced by other variables (e.g., age of the mother and the father age, music given to the mother and the preborn, preborn gender, obstetrical complications).

The ANCOVA showed that the fetal HR was co-influenced by the following variables:

Gender of the preborn: (F(1,31) = 0.227; p=0.637; n2p=0.007; (п) = 0.075)

Stimulation: (F(1,31) = 1.819; p=0.187; n2p=0.055; (п) = 0.257)

Age of the mother: (F(1,31) = 0.050; p=0.825; n2p=0.002; (п) = 0.055)

Number of gestations: (F(1,31) = 0.025; p=0.876; n2p=0.001; (п) = 0.053)

Number of abortions/miscarriages: (F(1, 31) = 1,551; p=0.222; n2p=0.048; (п) = 0.227)

Duration of pregnancy: (F(1, 31) = 0.021; p=0.885; n2p=0.001; (п) = 0.052)

Parity: (F(1, 31) = 1.157; p=0.290; n2p=0.036; (п) = 0.181)

Marital status: (F(1, 31) = 0.032; p=0.858; n2p=0.001; (п) = 0.053)

Mother HR: (F(1, 31) = 0.078; p=0.782; n2p=0.003; (п) = 0.058)

The ANCOVA displayed the fetal HRV was co-influenced by the gender of the preborn (F(1, 62): 0.031, p=0.861, n2p <0.001, (п)=0.053), stimulation (F(1, 62): 2,35, p=0.13, n2p = 0.037, (π)=0.326), age of the mother (F(1, 62): 2,272, p=0.137, n2p = 0.035, (π)=0.317) and medication (F(1, 62): 1,371, p=0.360, n2p = 0.708, (π)=0.273).

The nest design (Marôco, 2011) revealed that fetal HRV was co-influenced by the obstetric complications (F(9,18)=1.1; p=0.404; n2p=0.357; (π) = 0.377), personal antecedents (F(7,18) = 1,888; p=0.131; n2p=0.425; (π) = 0.574), age of the mother (F(2,18) = 0.367; p=0.698; n2p=0.39; (π) = 0.1), number of gestation (F(2,18) = 0.827; p=0.454; n2p=0.084; (π) = 0.169), parity (F(2,18) = 1,20; p=0.324; n2p=0.118; (π) = 0.229), duration of the pregnancy (F(2,18) = 0.326; p=0.726; n2p=0.035; (π) = 0.094), maternal HRV (F(2,18) =1,352; p=0.284; n2p=0.131; (π) =0.253), marital status (F(2,18) =0.24; p=0.976; n2p=0.003; (π) =0.0053) and maternal HR (F(2,18) =0.414; p=0.667; n2p=0.044; (π) =0.107). Therefore, our hypothesis was not corroborated.

Obstetrical complication, personal antecedents, and maternal age explained 35.7%, 42.5%, and 39.0% of the total variability of the fetal HRV, respectively. In contrast, the use of medication explained 70.8% of the variability of the fetal HRV.

Discussion

This study explored the existence of emotions in fetuses above 34 weeks independent from their mothers. We analyzed the fetuses' HR and HRV when exposed to different music stimuli. Maternal stimuli were controlled and constant in all the groups.

The results demonstrated a predominant effect of the maternal emotional experience compared to the musical stimuli. The placenta can represent the mother-fetus continuity, an interface between the mother and his preborn circulation (Brolio et al., 2010), where mother and fetus constant interactions lead to gradual and reciprocal biophysics exchanges, which holds a continual process of adaptations (Sá, 2004). Some hormones and neurotransmissions will cross the placenta, affecting the fetuses (Brolio et al., 2010). Sá (2001) defends a pregnant mother to transmit "elements, not only about her biological state but as well about her mental and emotional world" (p.98). Wilheim (2002, as cited in Sá, 2004) argues that a fetus is "an intelligent and sensitive being, with specific and well-defined personality traits, an affective and emotional life, in an empathic and physiologic communication with his prenatal mother, from whom he gathers emotional states and affective disposition towards him...." Verny and Weintraub (1991) defend fetuses' ability to understand their mother's inner emotional state and recommend that pregnant individuals communicate their thoughts and aspirations with their fetuses. In doing so, pregnant parents can deepen their bond with their fetuses (Verny & Kelly, 1982).

This maternal-fetal continuity expresses characteristics of a dual unity (Mahler, 1975) or a symbiotic state (Mahler, 1968, 1974, 1975). The results mirror a nuance of the fetuses' emotional experience, where they experience their mothers' emotions as they can also have independent emotions from their mothers. Therefore, fetuses seem to have lower individuality and psychic autonomy (Mahler, 1974). In this unindividuated state, the fetuses start their life before they can comprehend the whole object and perceive their primary objects as separate from them (Mijolla-Mellor, 2002). Our results point towards a certain degree of individuation, which can reflect a certain degree of awareness of separation (Mahler, 1975) from their mother, which alludes to fetuses' capability of perceiving the whole object as separated from them to a certain degree. These findings contradict Klein's theory that postulates babies start the individuation process in the second semester after birth. Six-months old babies start understanding that their anger and love can be projected to the same caregiver and progressively integrate positive and negative affect and experiences referring to the same object. According to our data, this individuation process started prenatally when the fetus understands itself simultaneously separated and as a continuation from their mothers.

This degree of emotional independence is mirrored in the difference observed between group 1 and group 3. Fetuses' emotional experience is more varied and distinct from their mothers when they listen to music triggering the five primary emotions. When fetuses are not exposed to music or constantly listen to music that triggers a calm and relaxed emotional state, they experience less emotion variety. This can point to a small effect of the music on fetuses' emotional response. The shared emotional space between a mother and fetus plays a bigger role in fetal HRV. When the mother and fetus listen to the same music (appealing to a wide range of emotions), thus sharing the same emotional sphere, fetuses' emotional experience is less varied, whether they are directly exposed to the same music or not. However, there is some dissonance between the mothers' and fetuses' emotional experiences in the latter experimental condition.

HRV often signals health and well-being. The presence of an emotional dissonance could mirror the fetus undergoing a certain degree of distress (Righetti, 1996, as cited in Sá, 2004). The psycho-affective development of a person depends on the mother's affective availability (Wilheim, 2002, as cited in Sá, 2004) and the asynchronies between the maternal emotional experience and the stimuli. Surrey (1985) pointed toward a decreased awareness of self when there is a disconnection in a person's affective early relationship. Affective monitoring seems important for the development of self (Emde, 1983) because the emotional development of self-awareness is influenced by natural biofeedback given by the parents during the interactions where affective regulation occurs (*theory of parental affect-mirroring* - PAM) (Gergely & Watson, 1996).

It would be interesting to understand more concretely what type of emotional experience the unborn had and if it was the same as their mother or different, and if it was high or low valency and activation. Further research is needed to understand the emotional impact of sharing their mothers' emotional space in fetuses, along with other assessments for the influence of other variables.

McCraty and Tomasino (2006) said that the type of rhythm of the HR, coherence (soft sinus-like curves) or not, can determine the presence of positive emotions (e.g., appreciation), and express higher emotional stability, mental acuity, and physiologic efficiency that is not related to how big or low the HRV is.

An HRV coherent rhythm pattern expresses a balance between sympathetic and parasympathetic modulation of the autonomous nervous system (McCraty & Tomasino, 2006). It will be pertinent to understand and evaluate what type of HRV rhythm patterns were in the group where the HRV was lower. It seems the fetus in this experimental condition had a wider range of emotional experiences than the other experimental conditions.

A higher HRV is observed when only the fetus is not subject to musical stimuli. Fetuses might be more accustomed to being only exposed to their mothers' emotional elicitations, thus responding with healthier HR and expressing a variety of emotions, which is also representative of the musical stimuli given to the mothers in this condition. It would be interesting to analyze the type of HRV mothers and their fetuses in this condition and compare them.

Furthermore, the mother-fetus (emotional and physiologic) continuity implies that any reaction the fetus has would manifest in discrete changes in HR. It would be important for this data to be reanalyzed through more modern and sensitive methods (Engelman, 1971), which will also allow for an evaluation of HR's characteristics. For example, one could analyze the synchronism between mothers and their unborn children. It could be interesting to clarify if the emotional state of a fetus can reflect on his mother's experience or if only the maternal emotional experience can influence the fetus.

Other variables can co-influence HR and HRV. It is unknown how this influence occurs; some variables can increase the HR and HRV while others can decrease the HR and HRV. It seems then important to clarify the dynamic of those influences.

The use of more sensitive methods to detect small differences in the HR and HRV is central to better understanding the fetus's experience and its relationship with their mother's experience. Such methods would prevent some of this study's limitations, manual HR extraction from the

CTG graphic, which has the possibility of human error and the inability to realize a finer retrieval of the data.

Conclusion

This research aimed to explore the emotional experience of the fetus, specifically, if fetuses in the third trimester had independent emotions from their mother. According to our results, it seems to exist a certain degree of maternal–fetus differentiation. Interestingly, the fetuses do not seem to react directly to the emotional elicitation of the stimuli provided. Instead, they reacted more to the synchronism or asynchronism of their emotional experience with their mothers. It is paramount to replicate these findings and use automation methods that would provide more fine evaluations of the maternal and fetal HRV.

References

Allison, P. (2001). *Missing Data.* Thousand Oaks: Sage Publication.

Andonotopo, W., Kurjak, A. (2006). The assessment of fetal behavior of growth restricted fetuses by 4D sonography. *Journal of Perinatal Medicine, 34*, 471-478.

C, W., Stanojevic, M., Kurjak, A., Azumendi, G., & Carrera, J. M. (2004). Assessment of fetal behavior and general movements by four-dimensional sonography. *The Ultrasound Review of Obstetrics & Gynecology*, *4*(2), 103-114.

Arriaga, P., Franco, A., & Campos, P. (2010). Indução de emoções através de excertos musicais. *Laboratório de Psicologia*, 8 (1), 3-20

Balkwill, L.-L., & Thompson, W. F. (1999). A cross-cultural investigation of the perception of emotion in music: Psychophysical and cultural cues. *Music Perception, 17,* 43–64.

Balkwill, L.-L., Thompson, W. F., & Matsunaga, R. (2004). Recognition of emotion in Japanese, Western, and Hindustani music by Japanese listeners. *Japanese Psychological Research, 46,* 337–349.

Bion, W.R. (1989). *Two papers: The Grid and Caesura*. Karnac Books.

Bornstein, R. F. (1989). Exposure and affect: Overview and meta-analysis of research, 1968–1987. *Psychological Bulletin, 106,* 265–289.

Brolio, M.P., Ambrósio, C.E., Franciolli, A.R, Morini, A.C., Guerra, R.R. & Miglino, M.A. (2010). A barreira placentária e sua função de transferência nutricional. *Revista Brasileira de Reprodução Animal*, .34 (4), p.222-232, consultado a 21 de Agosto de 2014 através de https://cbra.websiteseguro.com/pages/publicacoes/rbra/v34n4/p222-232.pdfq

Browne, J. V., & Graven, S. N. (2008). Auditory development in the fetus and infant. *Newborn and Infant Nursing Reviews*, *8* (4), 187–193.

Clarkson, M. G., & Berg, W. K. (1983). Cardiac orienting and vowel discrimination in newborns: Crucial stimulus parameters. I 54, 162–171.

Coelho, Cunha & Martins (2008). Inferência Estatística. 1ª Ed. Lisboa: Editora Silabo

Dalgleish, T., & Power, M. (2000). *Handbook of Cognition and Emotion*. John Wiley & Sons.

Damásio, A. (2003). *Ao Encontro de Espinosa: As emoções Sociais e a Neurologia do Sentir.* Publicações Europa-América.

Damásio, A. (2011). *O Livro da Consciência: A construção do Cérebro Consciente*. Temas e Debates: circulo Leitores.

De Vries, J. I., Visser, G. H., & Prechtl, H. F. (1985). The emergence of fetal behaviour. II. Quantitative aspects. *Early Human Development, 12* (2), 99-120.

DeCasper, A. J., & Spence, M. J. (1986). Prenatal maternal speech influences newborns' perception of speech sounds. Infant Behavior and Development, 9, 133–150.

Dias, C.S., Cruz, J.F., & Fonseca, A.M. (2010). Emoções: Passado, presente e futuro. *Revista Psicologia, XXII* (2), 11-31.

Eckman, P. (1992). Facial expression and emotion. *American Psychological Association*, *48* (4), 384-392.

Eerola, T., & Vuoskoski, J. K. (2010). A comparison of the discrete and dimensional models of emotion in music. *Psychology of Music*.

Ekman, P. (1992). An argument for basic emotions. *Cognition and Emotion, 6*, 169-200.

Emde, R. N. (1983). The prerepresentational self and its affective core. *The Psychoanalytic Study of the Child, 38*, 165-192. Consultado a 20 de Agosto de 2014 através de http://psycnet.apa.org/index.cfm?fa=search.displayRecord&uid=1986-06008-001.

Emory, E. K. (2010). A Womb with a View: Ultrasound for evaluation of fetal neurobehavioral development. *Infant and Child Development*, *19*, 119–124. https://doi.org/10.1002/icd

Engelman (1971) Proceedings of the second ACM symposium on symbolic and algebraic manipulation. 29-41, https://doi.org/10.1145/800204.806265

Feldman, L., Ochsner, K., & Gross, J. (2006). On the automaticity of emotion. In Bargh, J. (Eds.), *Social Psychology and the Unconscious: The Automaticity of Higher Mental Processes (Frontiers of Social Psychology)*. New York: Psychology press.

Freud, S. Inhibition, symptôme et angoisse (1926), Paris, PUF, 1981.

Fritz, T., Jentschke, S., Gosselin, N., Sammler, D., Peretz, I., Turner, R. & Koelsch, S. (2009). Universal recognition of three basic emotions in music. *Current Biology: CB*, *19*(7), 573–576. https://doi.org/10.1016/j.cub.2009.02.058

Gabrielsson, A., & Lindström, E. (2010). The role of structure in the musical expression. In Juslin, P. & Sloboda, J. (Eds.), *Handbook of music and emotion* (pp. 367–400). Oxford, U.K.: Oxford University Press.

Gergely, G., & Watson, J. S. (1996). The social biofeedback theory of parental affect-mirroring: The development of emotional self-awareness and self-control in infancy. *The International Journal of Psychoanalysis, 77*(6), 1181-1212.

Hata, T., Dai, S.Y., & Marumo, G. (2010). Ultrasound for evaluation of fetal neurobehavioural development: from 2-D to 4-D ultrasound**.** *Infant and Child Development, 19* (1), 99–118. https://doi.org/10.1002/icd.659

Hepper, P. G. (1991). An examination of foetal learning before and after birth. *The Irish Journal of Psychology*, *12*(2), 95-107.

Higgins, K.M. (2006). The cognitive and appreciative import of musical universals. *Revue internationale de philosophie, 4* (238), 487-503.

Horimoto, N., Koyanagi, T., Satoh, S., Yoshizato, T., & Nakano, H. (1990). Fetal eye movement assessed with real-time ultrasonography: are there rapid and slow eye movements? *American journal of obstetrics and gynecology*, *163*(5), 1480-1484.

Hunter, P. G., & Schellenberg, E. G. (2010). Music and emotion. In M. R. Jones, R. R. Fay, & A. N. Popper (Eds.), *Music perception* (pp. 129– 164). New York: Springer.

Hunter, P. G., & Schellenberg, E. G. (2011). Interactive effects of personality and frequency of exposure on liking for music. *Personality and Individual Differences, 50,* 175–179.

Huotilainen, M. (2010). Building blocks of fetal cognition: emotion and language. *Infant and Child Development*, *19*(1), 94–98. doi:10.1002/icd.658

Husain, G., Thompson, W. F., & Schellenberg, E. G. (2002). Effects of musical tempo and mode on arousal, mood, and spatial abilities. *Music Perception, 20,* 149–169.

Izard, C.E. (1994). Innate and universal facial expressions: Evidence from development and cross-cultural research, *Psychology Bulletin, 115* (2), 288-299.

Juslin, P. N., & Laukka, P. (2003). Emotional Expression in Speech and Music. *Annals of the New York Academy of Sciences*, *1000*(1), 279-282.

Juslin, P. N., & Laukka, P. (2004). Expression, perception and induction of musical emotions: A review and a questionnaire study of everyday music listening. *Journal of New Music Research, 33,* 217–238.

Juslin, P. N., & Sloboda, J. (Eds.). (2010). *Handbook of music and emotion.* Oxford, U.K.: Oxford University Press.

Juslin, P. N., & Västfjäll, D. (2008). Emotional responses to music: The need to consider underlying mechanisms. *Behavioural and Brain Sciences, 31,* 559–621.

Kisilevsky, B. S., & Hains, S. M. J. (2010). Exploring the relationship between fetal heart rate and cognition. *Infant and Child Development*, *19*, 60–75. https://doi.org/10.1002/icd

Kisilevsky, B.S., Hains, S.M.J., Jacquet, A.Y., Granier-Deferre, C., & Lecanuet, J.P. (2004). Maturation of fetal responses to music. *Developmental Science, 7* (5), 550–559. https://doi.org/10.1111/j.1467-7687.2004.00379.x

Konečni, V. J. (2008). Does music induce emotion? A theoretical and methodological analysis. *Psychology of Aesthetics, Creativity, and the Arts*, *2*(2), 115–129. https://doi.org/10.1037/1931-3896.2.2.115

Konečni, V. J., Brown, A., & Wanic, R. A. (2008). Comparative effects of music and recalled life-events on emotional state. *Psychology of Music*, *36*(3), 289-308.

Koyanagi, T., Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: A review. *Biological Psychology, 84*(3), 394–421.

Kreibig, S. D. (2010). Autonomic nervous system activity in emotion: a review. *Biological Psychology*, *84*(3), 394–421. https://doi.org/10.1016/j.biopsycho.2010.03.010

Kurjak, A., Azumendi, G., Vecek, N., Kupesic, S., Solak, M., Varga, D., & Chervenak, H. (2006). Fetal hand movements and facial expression in normal pregnancy studied by four-dimensional sonography. *Journal of Perinatal Medicine*, *31*, 496-508.

Laurier, C., Lartillot, O., Eerola, T., & Toiviainen, P. (2009). Exploring relationships between audio features and emotion in music.

Lazarus, R. S. (1991). *Emotion and adaptation*. New York: Oxford University Press.

Lecanuet, J.P., Granier-Deferre, C., & Schaal, B. (1992). Introduction a lá psychiatrie fetale. Les sistemes sensoriels du foetus. Paris: ESF éditeur.

Levenson, R. W., Ekman, P., Heider, K. & Friesen, W. V. (1992). Emotion and autonomic nervous system activity in the Minangkabau of West Sumatra. *Journal of Personality and Social Psychology, 62*. 972-288.

Leventhal, H., & Scherer, K. (1987). The relationship of emotion to cognition: A functional approach to a semantic controversy. *Cognition and emotion*, *1*(1), 3-28.

Mahler, M. (1968). *On Human Symbiosis and the Vicissitudes of Individuation: Infantile Psychosis*, Vol. 1. New York: International Universities Press.

Mahler, M. (1974). Symbiosis and Individuation - The Psychological Birth of the Human Infant. *Psychoanalytic Study of the Child, 29,* 89-106.

Mahler, M. (1975). *The Psychological Birth of the Human Infant: Symbiosis and Individuation.* New York: Basic Books.

Marôco, J.P. (2011). Análise Estatística com SPSS Statistics. 5ª Ed. Pero Pinheiro: ReportNumber

Mascaro, Calderon, Costa, Bossolan & Rudge (2002). Cardiotocografia Anteparto e Prognóstico Perinatal em Gestações Complicadas pelo Diabete: Influência do Controle Metabólico Materno. Revista Brasileira de Ginecologia Obstetricia, 24 (9).

Mastropieri, D., & Turkewitz, G. (2001). Prenatal experience and neonatal responsiveness to vocal expressions of emotion. D*evelopmental Psychobiology, 35* (3), 204-214.

Moll, J., Oliveira-Souza, R., Miranda, J.M., Bramati, I.E., Veras, R. P., & Magalhães, A.C. (2001). Efeitos distintos da valência emocional positiva e negativa na ativação cerebral. *Revista Brasileira de Psiquiatria, 23* (l), 42-45.

Petrikovsky, B., Kaplan, G., & Holsten, N. (1999). Fetal yawning activity in normal and high-risk fetuses: a preliminary observation. Ultrasound in obstetrics & gynecology: *The official journal of the International Society of Ultrasound in Obstetrics and Gynecology*;*13* (2), 127-30.

Petrikovsky, B., Kaplan, G., & Holsten, N. (2003). Eyelid movements in normal human fetuses. *Journal of clinical ultrasound, 31* (6), 299-301.

Sá, E. (2001). A Maternidade e o Bebé. 2ª Ed. Lisboa: Fim de Século

Sá, E. (2004). Psicologia do Feto e do Bebé. 3ª Ed. Lisboa: Fim de Século

Sandman, C. A. (2010). Human Fetal Heart Rate: a Unique Opportunity to Assess the Fetal Programming Hypothesis. *Infant and Child Development, 19,* 76–79. https://doi.org/10.1002/icd

Schellenberg, E. G., Peretz, I., & Vieillard, S. (2008). Liking for happy- and sad-sounding music: Effects of exposure. *Cognition and Emotion, 22,* 218–237.

Scherer, K. R., & Zentner, M. R. (2001). Emotional effects of music: Production rules. *Music and emotion: Theory and research*, 361-392.

Scherer, K.R., Banse, R., & Walbott, H.G. (2002). Emotion inferences from vocal expression correlate across languages and cultures. *Journal of Cross-cultural psychology, 32* (1), 76-92.

Sievers, B., Polansky, L., Casey, M., & Wheatley, T. (2012). Music and movement share a dynamic structure that supports universal expressions of emotion. *PNAS, 110* (1), 70-75.

Strongman, K. (1998). *A psicologia da emoção* (2ª ed). Lisboa: Climepsi.

Surrey, J.L. (1985). Self-in-Relation: A Theory of Women's Development *This paper was presented at a Stone Center Colloquium on November 16, 1983.* Consultado a 20 de Agosto 2014 através de https://www.jbmti.org/pdf/previews/preview_13sc.pdf

Szpunar, K. K., Schellenberg, E. G., & Pliner, P. (2004). Liking and memory for musical stimuli as a function of exposure. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30,* 370– 381.

Trehub, S. (2000). Human processing Predispositions and Musical Universals. In N. L., Wallin, B. Merker, S. Brown (Eds.), *The origins of Music*. Cambridge: MIIT press.

Verny, T. & Weintraub (2020). Nurturing the Unborn Child: A Nine-Month Program for soothing, stimulating, and Communicating with your baby. OpenRoad Media, p. 213

Verny, T. and Kelly, J. (1982). The Secret Life of the Unborn Child: How You Can Prepare Your Baby for a Happy, Healthy Life. Dell Publishing.

Vuoskoski, J. K., & Eerola, T. (2012). Can sad music really make you sad? Indirect measures of affective states induced by music and autobiographical memories. *Psychology of Aesthetics, Creativity, and the Arts*, *6*(3), 204–213. doi:10.1037/a0026937

Winnicott, D. (1988). *La Human Nature.* New York: Brunner Mazel publisher.

Zajonc, R. B. (1980). Feeling and thinking: Preferences need no inferences. *American Psychologist, 35*, 151-175.

Zentner, M. R., Meylan, S., & Scherer, K. R. (2000). Exploring musical emotions across five genres of music. In *Sixth Conference of the International Society for Music Perception and Cognition (IMPC), Keele, England*

Zentner, M., Grandjean, D., & Scherer, K. R. (2008). Emotions evoked by the sound of music: Characterization, classification, and measurement. *Emotion (Washington, D.C.)*, *8*(4), 494–521. https://doi.org/10.1037/1528-3542.8.4.494

Zimmerman, D. (1995). *Bion: Da teoria a pratica - uma leitura didactica*. Porto Alegre: Artes Medicas