What's in a child's face? : effects of facial resemblance, love withdrawal, empathy and context on behavioral and neural responses

Heckendorf, E.

Chapter 1

General introduction

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Humans are social creatures, and as such, social interactions crucially affect our subjective well-being and happiness (Helliwell, 2003; Helliwell & Putnam, 2004; Pichler, 2006). Many factors, including verbal and non-verbal communication skills, emotion regulation abilities, and face processing capacities, may affect how effective we are in interacting with others. Face processing enables individuals to determine another person's gender, emotional state, and their degree of familiarity with another person. As a consequence, humans are able to adjust their behavior quickly based on who they are interacting with. However, individual differences may exist in how people process, and, ultimately, react to faces. Differences in temperament, the context in which a face is perceived, and (childhood) experiences with others may for instance influence how people react to faces. In the current thesis, the potential influence of some of these factors on the neural processing of and behavioral reactions to (child) faces, are discussed.

Processing of familiar and unfamiliar faces

Previous research has shown that newborns are already able to discriminate between their mother's and a stranger's face (Bushnell, Sai & Mullin, 1989; Bushnell, 2001; Field Cohen, Garcia & Greenberg, 1984; Walton, Bower & Bower, 1992), suggesting that basic face processing abilities are innate to some degree. Face processing capacities further develop through infancy, childhood and adolescence (see Pascalis et al., 2011) until face processing expertise is reached in adulthood, reflected by adults' capacity to remember hundreds of different faces over a long period of time, and their ability to distinguish between highly resembling faces (Bahrick, Bahrick & Wittlinger, 1975).

Face processing is a complex process that involves multiple brain areas, and several factors, such as individuals' degree of familiarity with another person, may also affect how people react to a particular face (see for a review Natu & O'Toole, 2011). The core face processing areas include the occipital face area, the fusiform face area (FFA), and the posterior superior temporal sulcus (STS). The occipital face area encodes information about the different parts of faces, such as eyes and mouth, and reacts to small changes in physical facial features (Liu, Harris, & Kanwisher, 2010; Nichols, Betts, & Wilson, 2010; Pitcher, Walsh, Yovel, & Duchaine 2007). Subsequently, more complex processing

of facial features occurs in the lateral fusiform gyrus (FFA), associated with analyzing the invariant features of faces, such as gender and identity, and in the posterior STS, involved in the processing of the changeable features of a face, such as facial expressions and eye gaze (Andrews & Ewbank, 2004; Andrews & Schluppeck, 2004; Grill-Spector, Knouf & Kanwisher, 2004; Kanwisher & Yovel, 2006, Gobbini & Haxby, 2007; Yovel & Kanwisher, 2005).

In addition, brain areas involved in social and cognitive functions, such as Theory of Mind (e.g. anterior cingulate cortex), also show enhanced activity in response to faces, especially more familiar faces (Gobbini & Haxby, 2007). In reaction to familiar faces, enhanced activity is also frequently seen in brain areas involved in the retrieval of another person's biographical information, such as the anterior temporal cortex, brain areas related to the retrieval of memories of shared experiences (e.g. precuneus and cuneus), and brain areas associated with emotional responses to stimuli, including faces, such as amygdala and insula (Dubois et al., 1999; Gobbini, Leibenluft, Santiago, & Haxby 2004; Leibenluft, Gobbini, Harrison, & Haxby 2004; Schwartz et al., 2003; Sugiura et al., 2001). Thus, more familiar faces generally evoke enhanced activity in a more widespread network of brain areas than less familiar or unfamiliar faces, probably induced by the accumulation of experiences and social interactions people have with (highly) familiar individuals over time (Balas, Cox, & Conwell 2007).

Facial resemblance and kinship

Face processing also enables individuals to identify genetic relatives based on facial resemblance (Alvergne, Faurie, & Raymond, 2009; Bressan & Grassi, 2004; Kaminski, Dridi, Graff, & Gentaz, 2009; Lieberman, Tooby, & Cosmides 2007; Maloney & Dal Martello, 2006). Humans may favor individuals that facially resemble themselves over individuals that do not, because of the suspected genetic relatedness. In previous research, adult participants' were for instance more willing to cooperate with adults that facially resembled themselves (DeBruine et al., 2011; Krupp et al., 2008). In addition, facial resemblance increases 'parental' responses, like the willingness to invest in a child (Bressan, Bertamini, Nalli, & Zanutto, 2009; DeBruine, 2004; Platek et al., 2004). Editing children's pictures to make them facially resemble the participants may therefore offer an opportunity to simulate an 'own child' in individuals without children of their own. The suggested biological relatedness

implied by the child's facial resemblance with the participant may trigger caregiving reactions in participants without children of their own.

A parent's caregiving system is particularly activated when the child is in (potential) danger or distress (George & Salomon, 2008). Similarly, a participant's caregiving systems may be activated when a child that facially resembles the participant is threatened or in danger. Protective behaviors and related changes in brain activity may even be evoked when individuals are not consciously aware of a threat (Bowlby 1988; Bakermans-Kranenburg & Van IJzendoorn, 2017). Thus, threatening stimuli may be processed preconsciously to some degree (Almeida, Pajtas, Mahon, Nakayama, & Caramazza, 2013; Morris, Öhman & Dolan, 1998; Whalen et al., 1998). In Chapter 2 of this thesis, we investigate whether subliminally presented threatening primes evoke the expected changes in amygdala activity (a brain region related to the processing of emotional, especially threatening information [LeDoux, 1998]). We simulate genetic relatedness by morphing a picture of a child's face unfamiliar to the participant with the participant's own face. In addition to effects of facial resemblance in brain areas involved in face processing and social cognition (see above), we would therefore expect stronger (neural) protective responses when threatening primes precede child faces that resemble the participant's face compared to child faces that do not resemble the participant's face (since self-resembling, but not non-resembling child faces are expected to evoke caregiving reactions). The studies presented in this thesis provide a 'proof of concept' with the aim to get first insights in the neural processes related to protective caregiving reactions, and are therefore based on a homogenous sample of young-adult female participants without children of their own.

Individual differences: empathy and love withdrawal

When a (self-resembling) child is threatened or in danger, individuals' (neural and behavioral) reactions may also be influenced by their levels of empathy. Empathy describes the ability to experience and understand the emotional states of others (Eres, Decety, Louis, & Molenberghs, 2015), and can be divided into a cognitive perspective-taking (i.e. understanding what the other feels), and an affective (i.e. feeling what the other feels) aspect. High empathy in children is generally related to a range of positive outcomes, such as higher levels of prosocial behavior, and lower levels of aggression (Findlay, Girardi & Coplan, 2006; Hastings, Zahn-Waxler, Robinson, Usher, & Bridges, 2000;

Miller, Eisenberg, Fabes, & Shell, 1996), and empathic concern (an aspect of affective empathy) in adults seems to drive (costly) altruistic behaviors (Batson, Ahmad, Lishner, & Tsang, 2002; Feldman-Hall, Dalgeish, Evans, & Mobbs, 2015). Thus, individuals that score high on empathic concern may respond stronger and may be more likely to engage in altruistic behavior when observing a child that is threatened or in danger.

Generally, individuals may be more likely to behave empathically and altruistically towards in-group members than towards out-group members (Cikara, Bruneau & Saxe, 2011; Levine, Prosser, Evans, & Reicher, 2005). In the context of the current thesis, the self-resembling child faces represent an in-group member (due to the implied close genetic relatedness), whereas the non-resembling child faces may be considered an out-group member (i.e. no [close] genetic relatedness with the participant implied). In previous research, participants' self-reported scores on empathic concern were related to anterior insula activity, which was more enhanced for in-group members than for out-group members. Anterior insula activity and associated scores on empathic concern also predicted how likely participants were to help other individuals in distress (Hein, Silani, Preuschoff, Batson, & Singer, 2010).

In addition to individuals' levels of empathy, reactions to self-resembling child faces, may also be affected by individuals' own childhood experiences with caregivers. Early experiences with caregivers may shape an individual's beliefs about relationships with and responses to significant others, such as close family members (Mikulincer, Shaver, Gillath, & Nitzberg, 2005), and may possibly also affect their reactions to self-resembling child faces, because of the suggested genetic relatedness. In general, relationships with early caregivers may have a profound impact on children's development. Insecurely attached children (generally associated with insensitive caregiving), score for instance lower on academic and social skills, and have on average more externalizing problems than securely attached children (Groh, et al, 2014; Groh, Fearon, Van IJzendoorn, Bakermans-Kranenburg, & Roisman, 2017; Kerns & Brumario, 2016; Williford, Carter & Pianta, 2016).

Negative parenting styles, such as psychological control (i.e. inducing guilt or shame, or making love conditional; Barber 1996) and harsh control (i.e. physical or verbal punishment) are also associated with more externalizing problems in children and adolescents (see Pinquart, 2017). Love withdrawal, an aspect of psychological control, in which the parent's love and affection

become conditional on the child's behavior and success, is associated with enhanced anxiety, depressive symptoms, and lower self-control in children and adolescents (Hill & Bush, 2001; Mandara & Pikes, 2008). The effects of early experiences with caregivers may persist into adulthood. Experiences with psychological control during childhood are for instance related to insecure attachment and fear of failure in adults (Elliot & Thrash, 2004; Swanson & Malinckrodt, 2001). In addition, childhood experiences with parental love withdrawal may affect how young adults process and react to socio-emotional information, such as faces (Huffmeijer, Tops, Alink, Bakermans-Kranenburg, & Van IJzendoorn 2011, Huffmeijer et al., 2013). Thus, negative experiences with early caregivers, including the frequent use of love withdrawal as a disciplinary strategy, may affect individuals' reactions to socially relevant stimuli, such as self-resembling child faces.

Chapter 2 and Chapter 3 of the current thesis focus on the effects of facial resemblance on the neural processing and appraisal of child faces. Neural processing is measured using functional magnetic resonance imaging (fMRI; Chapter 2). Moderating effects of participants' experiences of love withdrawal, and their scores on empathic concern on the neural processing of child faces that differ in their degree of resemblance with the participant's faces are examined (Chapter 2). In addition, participants' appraisal of these child faces with differing degrees of self-resemblance is measured on a range of positive and negative criteria (Chapter 3). In Chapter 3, we also investigate whether love withdrawal moderates participants' evaluations of these child faces, and whether effects of facial resemblance depend on participants' neural processing of facial identity, as indicated by (the level of) FFA activity.

Test-retest reliability

Thorough conclusions can only be drawn from fMRI-research when the acquired data is valid and reliable. However, only a few studies have previously investigated the test-retest reliability of fMRI activity elicited with face processing tasks. In Chapter 4 of this thesis, we therefore examine the reliability of task-fMRI data acquired for the (non-emotional) face processing task used in the studies presented in this thesis, with the aim to investigate whether we can reliably measure changes in brain activity with our face processing paradigm. In case of low test-retest reliabilities, results obtained with our face processing task should be interpreted with caution, particular those relating to individual

differences. Increasing the number of trials of task-fMRI may improve reliability (Bennett & Miller, 2010), and could thus ensure acceptable test-retest reliability of fMRI data. Therefore, we also examine the effect of increasing the number of trials of our research paradigm on test-retest-reliability estimates. In addition, we investigate the influence of participants' handedness on the reliability of participants' fMRI data. Left-handed individuals are frequently excluded from fMRI research, although they represent about ten percent of the human population (Willems, Van der Haegen, Fisher, & Francks, 2014; McManus, 2009). Therefore, including left-handed individuals in fMRI research appears desirable to us, and could be supported by acceptable reliability estimates of fMRI data acquired from left-handed participants.

Aims and outline of this thesis

The general aim of the current thesis is to increase our knowledge of individual differences in the neural processing and appraisal of children's faces that differ in their degree of resemblance with the participant's face. The central question we aim to answer is whether individual differences in early parenting experiences (i.e. love withdrawal), empathy and FFA activity on the one hand, and the context in which the child faces are presented on the other, may affect brain responses to and appraisal of self-resembling child faces. We investigate whether the degree of resemblance of a child's face with the participant's face affects how participants' process and evaluate these child faces. In addition, we examine whether participants' experiences of love withdrawal, current levels of empathy, FFA activity, and the context in which the child faces are presented, moderate the effects of facial resemblance. Figure 1 illustrates the topics that are discussed in the current thesis.

Chapter 2 focuses on participants' neural responses to child faces that differ in their degree of resemblance with the participant's face, both in neutral and threatening contexts. Moderating effects of love withdrawal and empathy are examined to explore associations between participants' experiences with love withdrawal, their levels of empathy and their neural processing of facial resemblance. In Chapter 3, we focus on participants' appraisal of these child faces. More specifically, we examine how participants' evaluations of the different child faces on a range of negative and positive criteria are affected by children's degree of resemblance with the participant's face. In addition, we explore how experiences of love withdrawal and the extent of neural face

processing (i.e. FFA activity) moderate participants' appraisal of these child faces. Thus, we aim to increase our insight in correlations between brain (FFA activity) and behavior (appraisal of the different child faces). Chapter 4 focuses on the test-retest reliability of the fMRI data acquired during the face processing paradigm we used to examine the effects of facial resemblance on participants' brain activity. We estimate reliability of fMRI activity in several regions of interest for different numbers of trials, and we examine the influence of participants' handedness on the reliability of participants' fMRI data. In Chapter 5, we discuss our findings, elaborate on the limitations of the studies, and discuss implications for future research.

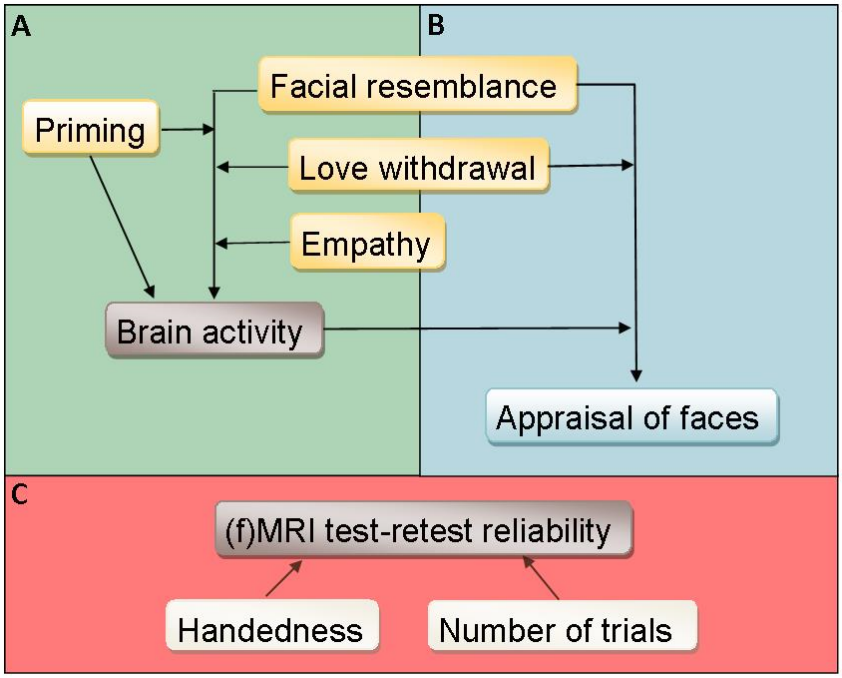

Figure 1. Graphic representation of the topics presented in the current thesis. In Chapter 2 (A), we examine the processing of subliminally presented threatening primes, their effects on neural responses to child faces that either resemble or do not resemble the participant's face, and moderating effects of empathy and experiences of love withdrawal. In Chapter 3 (B), we investigate the influence of the degree of resemblance of children's faces with the participant's face on participant's positive and negative appraisal of the child faces, and moderating effects of love withdrawal and participants' neural processing of facial identity (FFA activity). In Chapter 4 (C), we examine the test-retest reliability of the face processing task included in this thesis, and potential effects of handedness and the number of trials on reliability estimates.

References

Almeida, J., Pajtas, P. E., Mahon, B. Z., Nakayama, K., and Caramazza, A. (2013). Affect of the unconscious: Visually suppressed angry faces modulate our decisions. *Cogn. Affect. Behav. Neurosci.* 13, 94–101. doi: 10.3758/s13415-012-0133-7

Alvergne, A., Faurie, C., & Raymond, M. (2009). Father-offspring resemblance predicts paternal investment in humans. *Animal Behaviour*, *78*(1), 61-69. doi: 10.1016/j.anbehav.2009.03.019

Andrews, T. J., & Ewbank, M. P. (2004). Distinct representations for facial identity and changeable aspects of faces in the human temporal lobe. *Neuroimage*, *23*(3), 905-913. doi:10.1016/j.neuroimage.2004.07.060

Andrews, T. J., & Schluppeck, D. (2004). Neural responses to Mooney images reveal a modular representation of faces in human visual cortex. *Neuroimage*, *21*(1), 91-98. doi: 10.1016/j.neuroimage.2003.08.023

Bahrick, H. P., Bahrick, P. O., & Wittlinger, R. P. (1975). Fifty years of memory for names and faces: A cross-sectional approach. *Journal of experimental psychology: General*, *104*(1), 54. doi: 10.1037/0096-3445.104.1.54

Bakermans-Kranenburg, M. J. & Van IJzendoorn, M. H. (2017). Oxytocin and Human Sensitive and Protective Parenting. *Current topics in behavioral neurosciences.*

Balas, B., Cox, D., & Conwell, E. (2007). The effect of real-world personal familiarity on the speed of face information processing. *PloS one*, *2*(11), e1223. doi: 10.1371/journal.pone.0001223

Barber, B. K. (1996). Parental psychological control: Revisiting a neglected construct. *Child development*, *67*(6), 3296-3319. doi: 10.1111/j.1467-8624.1996.tb01915.x

Batson, C. D., Ahmad, N., Lishner, D. A., & Tsang, J. (2002). Empathy and altruism. In *The Oxford handbook of hypo-egoic phenomena*.

Bennett, C. M., & Miller, M. B. (2010). How reliable are the results from functional magnetic resonance imaging?. *Annals of the New York Academy of Sciences*, *1191*(1), 133-155. doi: 10.1111/j.1749-6632.2010.05446.x

Bowlby, J. (1988). "Attachment, communication and the therapeutic process", in *A Secure Base Parent-Child Attachment and Healthy Human Development,* (London: Routledge), 137-157.

Bressan, P., and Grassi, M. (2004). Parental resemblance in 1-years-olds and the Gaussian curve. *Evol. Hum. Behav.* 25, 133–141. doi: 10.1016/j.evolhumbehav.2004.03.001

Bressan, P., Bertamini, M., Nalli, A., & Zanutto, A. (2009). Men do not have a stronger preference than women for self-resemblant child faces. *Archives of sexual behavior*, *38*(5), 657-664. doi: 10.1007/s10508-008-9350-0

Bushnell, I. W. R., Sai, F., & Mullin, J. T. (1989). Neonatal recognition of the mother's face. *British Journal of Developmental Psychology*, *7*(1), 3-15. doi: 10.1111/j.2044-835X.1989.tb00784.x

Bushnell, I. W. R. (2001). Mother's face recognition in newborn infants: Learning and memory. *Infant and Child Development, 10*(1-2), 67-74. doi: 10.1002/icd.248

Cikara, M., Bruneau, E. G., & Saxe, R. R. (2011). Us and them intergroup failures of empathy. *Current Directions in Psychological Science, 20*(3), 149-153. doi: 10.1177/0963721411408713

DeBruine, L. M. (2004). Resemblance to self increases the appeal of child faces to both men and women. *Evolution and Human Behavior, 25*(3), 142-154. doi: 10.1016/j.evolhumbehav.2004.03.003

DeBruine, L. M., Jones, B. C., Watkins, C. D., Roberts, S. C., Little, A. C., Smith, F. G., & Quist, M. C. (2011). Opposite-sex siblings decrease attraction, but not prosocial attributions, to self-resembling opposite-sex faces. *Proceedings of the National Academy of Sciences, 108*(28), 11710-11714. doi: 10.1073/pnas.1105919108

Dubois, S., Rossion, B., Schiltz, C., Bodart, J. M., Michel, C., Bruyer, R., & Crommelinck, M. (1999). Effect of familiarity on the processing of human faces. *Neuroimage, 9*(3), 278-289. doi: 10.1006/nimg.1998.0409

Elliot, A. J., & Thrash, T. M. (2004). The intergenerational transmission of fear of failure. *Personality and Social Psychology Bullitin.* 30(8), 957–971. doi: 10.1177/0146167203262024

Eres, R., Decety, J., Louis, W. R., and Molenberghs, P. (2015). Individual differences in local gray matter density are associated with differences in affective and cognitive empathy. *Neuroimage* 117, 305–310. doi: 10.1016/j.neuroimage.2015.05.038

FeldmanHall, O., Dalgleish, T., Evans, D., & Mobbs, D. (2015). Empathic concern drives costly altruism. *Neuroimage, 105,* 347-356. doi: 10.1016/j.neuroimage.2014.10.043

Field, T. M., Cohen, D., Garcia, R., & Greenberg, R. (1984). Mother-stranger face discrimination by the newborn. *Infant Behavior and development, 7*(1), 19-25. doi: 10.1016/S0163-6393(84)80019-3

Findlay, L. C., Girardi, A., & Coplan, R. J. (2006). Links between empathy, social behavior, and social understanding in early childhood. *Early Childhood Research Quarterly, 21*(3), 347-359. doi: 10.1016/j.ecresq.2006.07.009

George, C., and Solomon, J. (2008). "The caregiving system: a behavioral systems approach to parenting", in *Handbook of Attachment: Theory Research and Clinical Applications,* 2nd Edn, eds J. Cassidy and P. R. Shaver (New York, NY: Guilford Press), 833–856.

Gobbini, M. I., & Haxby, J. V. (2007). Neural systems for recognition of familiar faces. *Neuropsychologia, 45*(1), 32-41. doi : 10.1016/j.neuropsychologia.2006.04.015

Gobbini, M. I., Leibenluft, E., Santiago, N., & Haxby, J. V. (2004). Social and emotional attachment in the neural representation of faces. *Neuroimage, 22*(4), 1628-1635. doi : 10.1016/j.neuroimage.2004.03.049

Grill-Spector, K., Knouf, N., & Kanwisher, N. (2004). The fusiform face area subserves face perception, not generic within-category identification. *Nature neuroscience, 7*(5), 555.doi: 10.1038/nn1224

Groh, A. M., Fearon, R. P., Bakermans-Kranenburg, M. J., Van IJzendoorn, M. H., Steele, R. D., & Roisman, G. I. (2014). The significance of attachment security for children's social competence with peers: A metaanalytic study. *Attachment and Human Development, 16,* 103–136. doi: 10.1080/14616734.2014.883636

Groh, A. M., Fearon, R. M., IJzendoorn, M. H., Bakermans-Kranenburg, M. J., & Roisman, G. I. (2017). Attachment in the early life course: Meta-analytic evidence for its role in socioemotional development. *Child Development Perspectives, 11*(1), 70-76. doi: 10.1111/cdep.12213

Hastings, P. D., Zahn-Waxler, C., Robinson, J., Usher, B., & Bridges, D. (2000). The development of concern for others in children with behavior problems. *Developmental psychology, 36*(5), 531. doi: 10.1037/0012-1649.36.5.531

Hein, G., Silani, G., Preuschoff, K., Batson, C. D., & Singer, T. (2010). Neural responses to ingroup and outgroup members' suffering predict individual differences in costly helping. *Neuron, 68*(1), 149-160. doi: 10.1016/j.neuron.2010.09.003

Helliwell, J. F. (2003). How's life? Combining individual and national variables to explain subjective well-being. *Economic Modelling, 20,* 331–360. doi: 10.1016/S0264-9993(02)00057-3

Helliwell, J. F., & Putnam, R. (2004). The social context of well-being. *Philosophical Transactions of the Royal Society London, 359,* 1435–1446. doi: 10.1098/rstb.2004.1522

Hill, N. E., & Bush, K. R. (2001). Relationships between parenting environment and children's mental health among African American and European American mothers and children. *Journal of Marriage and Family, 63*(4), 954-966. doi: 10.1111/j.1741-3737.2001.00954.x

Hoffmann, M., Lipka, J., Mothes-Lasch, M., Miltner, W. R., and Straube, T. (2012). Awareness modulates response of the amygdala and the visual cortex to highly arousing visual threat. *Neuroimage* 62, 1439–1444. doi: 10.1016/j.neuroimage.2012.05.064

Huffmeijer, R., Tops, M., Alink, L. R., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2011). Love withdrawal is related to heightened processing of faces with emotional expressions and incongruent emotional feedback: evidence from ERPs. *Biological Psychology, 86*(3), 307-313. doi: 10.1016/j.biopsycho.2011.01.003

Huffmeijer, R., Alink, L. R., Tops, M., Grewen, K. M., Light, K. C., Bakermans-Kranenburg, M. J., & van IJzendoorn, M. H. (2013). The impact of oxytocin administration and maternal love withdrawal on event-related potential (ERP) responses to emotional faces with performance feedback. *Hormones and behavior, 63*(3), 399-410. doi: 10.1016/j.yhbeh.2012.11.008

Kaminski, G., Dridi, S., Graff, C., & Gentaz, E. (2009). Human ability to detect kinship in strangers' faces: effects of the degree of relatedness. *Proceedings of the Royal Society of London B: Biological Sciences, 276*(1670), 3193-3200. doi: 10.1098/rspb.2009.0677

Kanwisher, N., & Yovel, G. (2006). The fusiform face area: a cortical region specialized for the perception of faces. *Philosophical Transactions of the Royal Society of London B: Biological Sciences*, *361*(1476), 2109-2128. doi: 10.1098/rstb.2006.1934

Kerns, K. A. & Brumariu, L. E. (2016). Attachment in middle childhood. In J. Cassidy & P. R. Shaver (Eds.), *Handbook of attachment: Theory, research, and clinical applications* (pp. 349-365). New York, NY: The Guilford Press.

Krupp, D. B., DeBruine, L. M., & Barclay, P. (2008). A cue of kinship promotes cooperation for the public good. *Evolution and Human Behavior*, *29*(1), 49-55. doi: 10.1016/j.evolhumbehav.2007.08.002

LeDoux, J. (1998). Fear and the brain: where have we been, and where are we going? *Biol. Psychiatry* 44, 1229–1238. doi: 10.1016/s0006-3223(98)00282-0. https://doi.org/110.1016/S0006-3223(98)00282-0

Leibenluft, E., Gobbini, M. I., Harrison, T., and Haxby, J. V. (2004). Mothers' neural activation in response to pictures of their children and other children. *Biol. Psychiatry* 56, 225–232. doi: 10.1016/j.biopsych.2004.05.017

Levine, M., Prosser, A., Evans, D., & Reicher, S. (2005). Identity and emergency intervention: How social group membership and inclusiveness of group boundaries shape helping behavior. *Personality and Social Psychology Bulletin*, *31*(4), 443-453. doi: 10.1177/0146167204271651

Lieberman, D., Tooby, J., & Cosmides, L. (2007). The architecture of human kin detection. *Nature*, *445*, 727–731. doi: 10.1038/nature05510

Liu, J., Harris, A., & Kanwisher, N. (2010). Perception of face parts and face configurations: an fMRI study. *Journal of cognitive neuroscience*, *22*(1), 203-211. doi: 10.1162/jocn.2009.21203

Maloney, L. T., & Dal Martello, M. F. (2006). Kin recognition and the perceived facial similarity of children. *Journal of Vision*, *6*(10), 4-4. doi: 10.1167/6.10.4

Mandara, J., & Pikes, C. L. (2008). Guilt trips and love withdrawal: Does mothers' use of psychological control predict depressive symptoms among African American adolescents?. *Family Relations*, *57*(5), 602-612. doi: 10.1111/j.1741-3729.2008.00526.x

McManus, I. C. (2009). The history and geography of human handedness. *Language lateralization and psychosis*, 37-57. doi: 10.1038/nrn3679

Mikulincer, M., Shaver, P. R., Gillath, O., and Nitzberg, R. A. (2005). Attachment, caregiving and altruism: boosting attachment security increases compassion and helping. *J. Pers. Soc. Psychol.* 89, 817–839. doi: 10.1037/0022-3514.89.5.817

Miller, P. A., Eisenberg, N., Fabes, R. A., & Shell, R. (1996). Relations of moral reasoning and vicarious emotion to young children's prosocial behavior toward peers and adults. *Developmental Psychology*, *32*(2), 210. doi: 10.1037/0012-1649.32.2.210

Morris, J. S., Öhman, A., and Dolan, R. J. (1998). Conscious and unconscious emotional learning in the human amygdala. *Nature* 393, 467–470. doi: 10.1038/30976

Natu, V., & O'Toole, A. J. (2011). The neural processing of familiar and unfamiliar faces: a review and synopsis. *British Journal of Psychology*, *102*(4), 726-747. doi: 10.1111/j.2044-8295.2011.02053.x

Nelson, C. A., & Ludemann, P. M. (1989). Past, current, and future trends in infant face perception research. *Canadian Journal of Psychology/Revue canadienne de psychologie*, *43*(2), 183. doi: 10.1037/h0084221

Nichols, D. F., Betts, L. R., & Wilson, H. R. (2010). Decoding of faces and face components in face-sensitive human visual cortex. *Frontiers in Psychology*, *1*. doi: 10.3389/fpsyg .2010.00028

Pascalis, O., de Martin de Viviés, X., Anzures, G., Quinn, P. C., Slater, A. M., Tanaka, J. W., & Lee, K. (2011). Development of face processing. *Wiley Interdisciplinary Reviews: Cognitive Science*, *2*(6), 666-675. doi: 10.1002/wcs.146

Pessoa, L., Japee, S., Sturman, D., and Ungerleider, L. G. (2006). Target visibility and visual awareness modulate amygdala responses to fearful faces. *Cereb. Cortex* 16, 366–375. doi: 10.1093/cercor/bhi115

Pichler, F. (2006). Subjective quality of life of young Europeans. Feeling happy but who knows why? *Social Indicators Research, 75,* 419–444. doi: 10.1007/s11205-004-4337-2

Pinquart, M. (2017). Associations of parenting dimensions and styles with externalizing problems of children and adolescents: An updated meta-analysis. *Developmental psychology,* 53(5), 873. doi: 10.1037/dev0000295

Pitcher, D., Walsh, V., Yovel, G., & Duchaine, B. (2007). TMS evidence for the involvement of the right occipital face area in early face processing. *Current Biology*, *17*(18), 1568-1573. doi: 10.1016/j.cub.2007.07.063

Platek, S. M., Raines, D. M., Gallup, G. G., Mohamed, F. B., Thomson, J. W., Myers, T. E., ... & Arigo, D. R. (2004). Reactions to children's faces: Males are more affected by resemblance than females are, and so are their brains. *Evolution and Human behavior*, *25*(6), 394-405. doi: 10.1016/j.evolhumbehav.2004.08.007

Schwartz, C. E., Wright, C. I., Shin, L. M., Kagan, J., Whalen, P. J., McMullin, K. G., & Rauch, S. L. (2003). Differential amygdala response to novel versus newly familiar neutral faces: A functional MRI probe developed for studying inhibited temperament. *Biological Psychiatry*, *53*, 854–862. doi: 10.1016/S0006-3223(02)01906-6

Sugiura, M., Kawashima, R., Nakamura, K., Sato, N., Nakamura, A., Kato, T., ... & to, K. (2001). Activation reduction in anterior temporal cortices during repeated recognition of faces of personal acquaintances. *Neuroimage*, *13*(5), 877-890. doi: 10.1006/nimg.2001.0747

Swanson, B., & Mallinckrodt, B. (2001). Family environment, love withdrawal, childhood sexual abuse, and adult attachment. *Psychotherapy Research*, *11*(4), 455-472.

Walton, G. E., Bower, N. J. A., & Bower, T. G. R. (1992). Recognition of familiar faces by newborns. *Infant Behavior and Development, 15*(2), 265-269. doi: 10.1016/0163-6383(92)80027-R

Whalen, P. J., Rauch, S. L., Etcoff, N. L., McInerney, S. C., Lee, M. B., and Jenike, M. A. (1998). Masked presentation of emotional facial expressions modulate amygdala activity without explicit knowledge. *J. Neurosci.* 18, 411–418.

Willems, R. M., Van der Haegen, L., Fisher, S. E., & Francks, C. (2014). On the other hand: including left-handers in cognitive neuroscience and neurogenetics. Nature Reviews. *Neuroscience, 15*(3), 193. doi: 10.1038/nrn3679

Williford, A. P., Carter, L. M., & Pianta, R. C. (2016). Attachment and school readiness. In J. Cassidy & P. R. Shaver (Eds.), *Handbook of attachment: Theory, research, and clinical applications* (pp. 966-982). New York, NY: The Guilford Press.

Yovel, G., & Kanwisher, N. (2005). The neural basis of the behavioral face-inversion effect. *Current Biology, 15*(24), 2256-2262. doi: 10.1016/j.cub.2005.10.072