1. **Title of the envisaged research:** Parenting beyond pink or blue: What's the brain got to do with it?

2. **Applicant(s) (co-promotor(es):** Dr. Joyce J. Endendijk

3. **Promotor(es):** Prof. dr. Anneloes L. van Baar

4. **Department:** Clinical Child and Family studies

5. **Description of the research idea:**

Gender is one of the most important organizers of social life[1]. From the moment a child is born, it shapes how children are parented and talked to, and parents' reactions to the child's behaviors, activities, and play styles; processes referred to as parental gender socialization[2]. My own research demonstrated that gender socialization often happens unconsciously, and its underlying processes can therefore be captured best with neuroscientific measures[3]. It is important to understand the underlying processes, because traditional gender socialization has been associated with gender-inequality and the development of traditional gender-stereotypes in children[4] as well as gender differences in child problem behavior[5]. Knowledge about the underlying neural mechanisms of gender socialization can be translated into strategies for parents to treat boys and girls more equal (e.g., focusing on monitoring or control of stereotypes[6]), which subsequently ensures optimal development of both boys and girls. More broadly, the neuroscience of stereotypes can inform interventions aimed at reducing inequality in society[6]. Therefore, the goal of this project is to explain mothers' and fathers' observed gender socialization practices with their preschool-children (3-5 years old) from their neural responses to gendered child stimuli. We focus on preschoolers, because at this age parents play the most important role in children's gender socialization[7].

6. **Research problem:**

There is very little research on the underlying processes of gender socialization, possibly because it happens in subtle and implicit ways[2]. Furthermore, in the literature on gender socialization there is an ongoing debate whether gender socialization is elicited by the gender and behavior of the child (i.e., child-driven effect) or whether parents use gender socialization to actively shape boys and girls toward the behavior deemed appropriate for their gender (i.e., parent-driven effect).

7. **Research questions:**

Using a within-family multi-method design, we examine whether:

1) mothers' and fathers' brains respond differently to daughters versus sons (example experiment[8])
2) mothers' and fathers' brains respond differently to boys and girls that confirm versus violate gender expectations regarding (a) toy preferences, (b) emotion expression, and (c) problem behavior (for example experimental task, see [9,10])
3) these differences in parents' brain responses relate to various aspects of gender socialization with their own children, and whether brain activity mediated the effect of child gender on parenting.
4) these differences in parents' brain responses relate to differences in the behavior of their sons and daughters.

8. **Methods:**

For the first and second aim, we use electro-encephalography (EEG), which has the potential to track fast processes underlying relatively unconscious behavior, due to their millisecond temporal resolution. For

the second aim, we focus specifically on those child behaviors that are known to be encouraged differently in preschool boys and girls[11]. For the third aim, we observe gender socialization practices that are known to differ between boys and girls, i.e., encouragement of gender-typical activities, toys, and behaviors[12,15], emotion socialization[16], play style (e.g., rough-and-tumble play, pretend play, cognitive play[17]), and negative control[18]. In my previous research[5,10,12,19], we successfully demonstrated gender differences in these behaviors with parent-child reading of manipulated books, free play without toys, and a don't touch task. For the fourth aim, parents report on the toy and activity preferences, emotional development, and problem behavior of their sons and daughters.

9. Rationale and approach:

We aim to include 100 families (based on power calculations with anticipated medium effect sizes from previous studies with similar designs[3]; 50% families with girls). Families will be recruited via social media (i.e., Facebook), parenting websites (e.g., oudersonline.nl, jmouders.nl), child care centers and BSO's, and via platforms that bring together researchers and participants (i.e., proefbunny.nl). This strategy has proven to be successful in one of our previous studies with a similar design[3]. The experimental paradigms and observation tasks used are extensions or adaptations of previously validated tasks and therefore a pilot study is not planned. Participating families will be invited to the lab for the EEG tasks and observation sessions. A PhD student will be responsible for the EEG data collection and a research assistant will be responsible for the observation sessions. When one parent takes part in the EEG tasks, the other parent takes part in the observation sessions with his/her children. Parents are asked to fill out the questionnaires in the EEG lab on a computer.

10. Institutional environment:

This project fits with the research agenda of the department of Clinical Child and Family Studies, because of its focus on parental gender socialization in the family context. Furthermore, gender socialization has been related to boys expressing more externalizing behavior problems, such as aggression, and girls expressing more internalizing behavior problems, such as sadness and anxiety. As such the project also fits with the departmental research focus on the development of child problem behavior. However, the project is also multi-disciplinary in nature by combining expertise from neuroscience, social psychology, and pedagogical sciences. The faculty of social sciences of Utrecht University is ideally suited to carry out this project, because of its excellent lab facilities (EEG and observation labs).

11. Relevance:

This project extends previous research in the following ways: First, by examining gender socialization processes *within* families with both a boy and girl. Within-family designs are essential to make sure that differences found in responses to boys and girls are not caused by other factors than child gender[11]. Second, by making direct comparisons between mothers' and fathers' neural responses to gendered child stimuli, in relation to gender socialization practices with their own child. Such direct comparisons are needed, because mothers and fathers differ in their gender socialization[5,12], as well as their neural responses to child stimuli[13]. Third, by linking brain activity to actual gendered behavior in relatively naturalistic settings. Such studies improve the ecological validity and practical relevance of lab-based neuroscientific assessments[14]. Fourth, by examining multiple aspects of gender socialization and its underlying neural processes. This is important because gender socialization is a multi-faceted process[11]. Fifth, by controlling for the possibility that parents' differential brain responses to boys and girls are the result of gender differences in the behavior of their own children. This sheds light on the ongoing debate whether differential treatment of boys and girls is child-driven, parent-driven, or both[11].

12. References:

1. Blakemore, J. E. O., Berenbaum, S. A., & Liben, L. S. (2009). *Gender development.* New York: Psychology Press.
2. Mesman, J., & Groeneveld, M. G. (2018). Gendered parenting in early childhood: Subtle but unmistakable if you know where to look. *Child Development Perspectives, 12,* 22-27.
3. **Endendijk, J. J.,** Spencer, H., van Baar, A. L., & Bos, P. A. (2018). Neural processing of gendered information is more robustly associated with mothers' gendered communication with children than mothers' implicit and explicit gender stereotypes. *Social Neuroscience.* (advance online publication). doi:10.1080/17470919.2018.1468357
4. Turner, P. J., & Gervai, J. (1995). A multidimensional study of gender typing in preschool children and their parents: Personality, attitudes, preferences, behavior, and cultural differences. *Developmental Psychology*, *31*, 759-772.
5. **Endendijk, J. J.**, Groeneveld, M. G., Mesman, J., Van der Pol, L. D., Van Berkel, S. R., Hallers-Haalboom, E. T., & Bakermans-Kranenburg, M. J. (2018). Gender differences in child aggression: Relations with gender-differentiated parenting and parents' gender stereotypes. *Child Development, 88,* 299-316.
6. Amodio, D. M. (2014). The neuroscience of prejudice and stereotyping. *Nature Reviews Neuroscience*, *15*, 670-682.
7. McHale, S. M., Crouter, A. C., & Whiteman, S. D. (2003). The family contexts of gender development in childhood and adolescence. *Social Development*, *12*, 125-148.
8. Mascaro, J. S., Rentscher, K. E., Hackett, P. D., Mehl, M. R., & Rilling, J. K. (2017). Child gender influences paternal behavior, language, and brain function. *Behavioral Neuroscience*, *131*, 262-273.
9. Li, T., Cardenas-Iniguez, C., Correll, J., & Cloutier, J. (2016). The impact of motivation on race-based impression formation. *Neuroimage*, *124*, 1-7.
10. **Endendijk, J. J.,** Smit, A. K., van Baar, A. L., & Bos, P. A. (2019). Boys' toys, girls' toys: An fMRI study of mothers' neural responses to children violating gender expectations. *Neuroimage.* (submitted for publication).
11. **Endendijk, J. J.**, Groeneveld, M.G., & Mesman, J. (2018). The gendered family process model: An integrative framework of gender in the family. *Archives of Sexual Behavior*, *47*, 877-904.
12. **Endendijk, J. J.**, Groeneveld, M. G., Van der Pol, L. D., Van Berkel, S. R., Hallers-Haalboom, E. T., Mesman, J., & Bakermans-Kranenburg M. J. (2014). Boys don't play with dolls: Mothers' and fathers' gender talk during picture book reading. *Parenting: Science and Practice, 14*, 141-161.
13. Atzil, S., Hendler, T., Zagoory-Sharon, O., Winetraub, Y., & Feldman,R. (2012). Synchrony and specificity in the maternal and the paternal brain: Relations to oxytocin and vasopressin. *Journal of the American Acadamy of Child and Adolescent Psychiatry, 51,* 798–811.
14. Derks, B., Scheepers, D., & Ellemers, N. (Eds.). (2013). *The neuroscience of prejudice.* New York: Psychology Press.
15. Lytton, H., & Romney, D. M. (1991). Parents' differential socialization of boys and girls: A meta-analysis. *Psychological Bulletin, 109,* 267–296.
16. Chaplin, T. M., Cole, P. M., & Zahn-Waxler, C. (2005). Parental socialization of emotion expression: Gender differences and relations to child adjustment. *Emotion, 5,* 80–88.
17. Paquette, D., Carbonneau, R., Dubeau, D., Bigras, M., & Tremblay, R. E. (2003). Prevalence of father–child rough-and-tumble play and physical aggression in preschool children. *European Journal of Psychology of Education, 18,* 171–189.
18. **Endendijk, J. J.**, Groeneveld, M. G., Mesman, J., & Bakermans-Kranenburg, M. J. (2016). Gender-differentiated parenting revisited: meta-analysis reveals very few differences in parental control of boys and girls. *PLoS One*, *11*(7), e0159193.
19. Van der Pol, L. D., Groeneveld, M. G., Van Berkel, S. R., **Endendijk, J. J.,** Hallers-Haalboom, E. T., Bakermans-Kranenburg, M. J., & Mesman, J. (2015). Fathers' and mothers' emotion talk with their girls and boys from toddlerhood to preschool age. *Emotion, 15*, 854-864.