

## PRoF Award abstract – Call 2015

### **NpTPII: Neurophysiological trajectories of parent-infant interaction. Development and processes of change upon intervention promoting positive parenting**

#### **1. Research Outline**

Acronym	NpTPII
Project name in English	Neurophysiological trajectories of parent-infant interaction. Development and processes of change upon intervention promoting positive parenting
Pitch (1 sentence)	The aim of this study is to analyze the synchrony in neural and physiological activation in parent-infant dyads in interaction and to evaluate the evolution of such interactions following a video-feedback treatment to promote positive parenting.
Executive summary (max. 10 lines)	
This research aims to evaluate neural mechanisms and physiological responses associated with specific behavioral characteristics of the interaction in parent-child dyads from different populations: non clinical (G1), sub-clinical (G2) and clinical, due to mother's (G3) or child's characteristics (ASD; G4). The couples will be longitudinally observed to evaluate evolutionary trajectories and possible differences between dyads. An intervention to promote positive parenting will be proposed to support mother- and father-child interaction and to observe the improvement introduced by the intervention. In this sense, this research establishes essential scientific objectives contributing to the development of knowledge in this field, but it will bring central clinical consequences concerning to the implementation and verification of a specific model of intervention to support parenting.	

## 2. Cause and context of the research

Parent-infant dyadic relation, in particular mother-child one, is the first and most important infant's social interaction. It shapes underlying neural mechanisms responsible of its either typical or atypical development. At one hand, the efficacy of such relationship depends on peculiar children's characteristics, such as facial expressions and morphology, and communicative signals (e.g., cry, laugh gaze, gestures) that activates appropriate caregiving behaviors in adults (Bornstein, 2002; Bornstein et al., 2008; Esposito et al., 2013; Doi et al., 2012). On the other hand, adult sensitive responsiveness to infant's signals contributes to the quality of adult-child interaction (Sander, 2000; Sroufe, 2000; Trevarthen and Aitken, 2001; Tronick, 2005). Such reciprocal regulation suggests that there might be a biological predisposition in establishing reciprocal relation aimed at offspring protection and care provided by an adult able to interpret and respond appropriately to infant's needs, by virtue of evolutionary adaptive meaning of such dyad, i.e., offspring and species survival. Still little is known about neural substrates and functional mechanisms underlying influences of adult's ability to read its infant's cues and to respond coherently with them. Most of neuroimaging studies in this field focused on infants' faces expressions as crucial source of emotional and communicative signals that adults use to shape their interactions with infants. Caria and colleagues (2012), by using functional magnetic resonance imaging, showed that infants' faces uniquely activate several brain systems in mothers that had previously been related to adults' preparation for responding to and communicating with infants as well as caregiving (e.g., Glocker et al. 2009; Kringelbach et al. 2008; Ranote et al. 2004; Swain et al. 2007), including the lateral premotor cortex, supplementary motor area, cingulate cortex, anterior insula, and thalamus. Similarly, by using Electroencephalography (i.e., EEG) technique, Esposito and colleagues (2015) showed that mothers' brain delta, theta and gamma cortical oscillations differentiate between own and unfamiliar infants' faces within 100 ms of exposure to infant face. In line with these studies, a wide range of researches have analyzed emotional regulation as one of the components of sensitivity and responsiveness associated with parenting. Furthermore, it has been shown that maternal emotion dysregulation is associated with the quality of mother-infant dyad such as it is inversely related to emotional availability (EA) during mother-infant interactions in non-clinical mothers of 4- to 5-month-old infants (Kim et al., 2012) and that greater mother-infant EA was associated with greater right frontal EEG asymmetry (Kileen et al., 2012). A deeper exploration of such issue would be of great importance because it can drive new intervention strategies of attachment insecurities and their associated regulation deficits parenting behaviors so that further neuroscientific explorations in this direction appear critical in shedding new light to a comprehensive and valid framework of socially motivated behaviors. Critically, there is a lack of neuro-imaging studies in ecological situations: the current project will pioneristically attempting to override such limitation. Using wireless EEG in real social interactions will allow us to investigate individual differences in attachment style and the quality of parent-infant interaction in a mechanistic fashion. The use of EEG in this context has a twofold

advantage: (i) it is suitable for investigating neural activity in real interactions and (ii) it allows to track the time-course and, consequently, the segmentation of processes involved in parent-infant interactions.

The present proposal is aimed at 1) investigating behavioral and underlying neural mechanisms of adult-infant interaction with 6 to 36 months old infants; 2) determining developmental trajectories of both neural and behavioral response patterns during dyadic interaction in non-clinical parents in order to identify typical developmental patterns of interactions; 3) comparing non-clinical dyads with either clinical and sub-clinical in order to evaluate reciprocal contribution in dyadic interaction by either the adult or the infant; d) establishing possible either short- or long-term changes in neural and behavioral response patterns during interaction following an intervention of parenting support offered by means of video-feedback technique sessions interleaved by adult-infant interaction sessions. Recently, authors developed video-feedback interventions shaped on the basis of specific adult-infant interactions, such as, for instance, children with autism (Poslawsky et al., 2014), maltreating parents (Moss et al., 2014) aimed at improving their parenting abilities. One of the goals of the present proposal is to use a video-feedback intervention able to improve sensitive responsiveness in parents to the specific needs of their children and to monitor the intervention through the analysis of its short- and long-term changes on both behavioral and neural dimensions. Several EEG studies associated increases in occipital theta power, gamma phase synchronization and in frontal alpha asymmetry with emotion regulation processes (e.g., Ertl et al., 2013; Goodman et al., 2012; Kang et al., 2014; Uusberg et al., 2014). We then expect modulations of these brain oscillations before and after the intervention as a function of the quality of adult-infant interaction in both non-clinical and clinical or sub-clinical dyads undergoing the experimental intervention aimed at improving parenting behaviors. EEG would be continuously recorded in parents during real semi-structured interactive situation with their children by using an advanced EEG wireless system (i.e., “MOVE”) that allows participants to move freely. Additional EEG recordings at rest will be added before and after the interactive situation in order to measure a baseline activity for each parent. EEG for each phase will be decomposed in its frequency bands with Fast Fourier Transforms. Frequency bands will be monitored as a function of parent-infant interaction and of individual psychological and behavioral characteristics of both parents and infants. Modulations in frequency band synchronizations would be investigated also as a function of individual attachment styles, interactive phases, and of the parental role (mother vs. father). Psychophysiological responses of both adults and infants would also be monitored, such as heart rate variability and respiratory *sinus arrhythmia* (RSA). Particular attention would be focused on correlations of adults’ brain oscillation and heart rate and infants’ RSA with behaviors observed during interactive situation. The present research project would include 4 samples: (G1) non-clinical dyads; (G2) sub-clinical dyads on the basis of specific mothers’ symptoms evaluations; (G3) dyads with clinical parent (depressed mothers); (G4) dyads with clinical infant (infants with diagnosis of Autistic Spectrum Disorder, ASD). G4 would be

matched to G1, G2 and G3 for infants' mental age. All infants would be firstborns. The circumstance of the great investment of new parents in their young infants, accompanied by close and consistent mother–infant and father-infant interaction in the first months, provide an opportunity to evaluate first exposure to parenting behaviors characteristics.

The present proposal is defined on a longitudinal level according to the following steps:

**T1.** A group of mother-child and father-child dyads of non clinical population will be observed during an interaction session at child's six months of age. It will be evaluated: behavioural characteristics of interaction through the use of the Emotional Availability Scales (EAS, Biringen, 1991) some observational codes for the evaluation of the synchrony, adult's cerebral activity and adult and child's physiological responses will be also evaluated

**T2.** Each dyad will be tested, due to the following protocol:

- (a) Parents' characteristics evaluation: the following instruments will be administered to both parents: AAI (George, et al. 1985) for the evaluation of adult's model of attachment, SCL-90 (Derogatis, 1983) and EPDS (Cox et al., 1987) for the evaluation of parental symptomatology, Parental Stress Index (PSI, Abidin, 1983) for evaluating parents' levels of stress in managing child, QUIT (Axia, 2002) for evaluating child's disposition;
- (b) Evaluation of behavioural characteristics of adult-child interaction through the use of EAS during and interactive semi-structured situation, subdivided in different phases: free game, structured game, separation and reunification with the parent.
- (c) Recording of electrical activity and of psychophysiological responses: parents' EEG will be monitored during interactive sessions using a specific EEG cap endorsed in the "MOVE" system; parents heart rate will be monitored through Holter. Infants' RSA would be monitored in concomitance.

**Intervention:** dyads belonging to clinical populations considered and dyads that, even belonging to non clinical population enrolled, will show sub-clinic characteristics through the SCL-90 and EPDS evaluation will undergo a support intervention to parenting with children. The treatment protocol will last 6 months (24 weeks) and it will be conducted with the video feedback technique, with a cyclic frequency: every two weeks there will be the parent-child interaction session, and one week will be dedicated to a video feedback session with both parents ((2+1)\*8=24 weeks). Treatment will be conducted by therapists formed in analysing video feedback sessions applied to parents and children of the stage considered. Intervention will be also patterned on the base of data obtained from the EEG signal registration. Intervention will be addressed to an implementation of parent's abilities in understanding needs and care signals sent by children, activating sensitive and responsive behaviours, in line with the idea of support to the quality of adult-child interactive exchanges and, as a consequence, to parenting.

**T3.** At the end of intervention phase, all dyads, both those which undergo treatment and those which will not, will undergo a second experimental session, both considering the administering of questionnaires (except for the AAI) and behavioural and neuro-physiological data observation.

**T4.** Follow up: a follow up session will be conducted after six months from the T3 stage through the use of the Emotional Availability Scales (EAS) applied to a semi-structured interactive session, subdivided in different phases: free game, structured game, separation and reunification with parents, similar to the one applied at T1.

### **3. Innovation results achieved**

The project has the potentiality to help in generating a new profession in Italy with highly integrated competencies in adult-child interactions on one side and neurophysiologic underpinnings of caregiving behaviours on the other. This new role would become the key for designing a specific research and intervention service addressed to the evolutionary age, and in particular, the first infancy (Service 0-3). In light of this, techniques and methods from neuroscience may be used in integration with those from psychodynamic at the different stages of assessment, intervention and verification, among parents and children sub-clinical and clinical samples. This approach would allow to formalize an assessment protocol based on a parallel application of the procedure here described, as observational and investigative psychological methods with neurophysiologic techniques. Thanks to this type of assessment, an in vivo survey of individual's behavioural aspects and, simultaneously, neurophysiologic activation might be possible; characteristics that used to be investigated separately. A neuro-dynamic diagnosis of parenting defined in this way, would guarantee a rigorous collection of scientific data in an ecological context, closer to parent and child's everyday life reality and, at the same time, a planning of integrated models of intervention with, also, biological data. This procedure of assessment would permit to verify the efficacy of treatment, both in terms of observable behavioural data and in terms of variations of neurophysiologic indexes synchrony found in parent and child.

#### **4. Link to the PRoF values**

In a long-term perspective, these data may constitute an important resource to plan models of intervention based on psychopathologic characteristics of parent, child or their reciprocal relation, due to neuro-dynamic constructs and methods. This service could be an excellent innovative center of research and intervention on parenting, and, also, act as a promoter of non-stigmatizing models of interventions specialized for various types of clinical populations. The innovative aspect of this project isn't just its multidisciplinary perspective on hypotheses and methods, but, above all, their application in the clinical field. At the present, indeed, there are no clinical centers in Europe using neurophysiologic instruments for planning and monitoring clinical interventions focusing on first infancy. Such facility would be located at the center of Clinical Services addressed to the Person (CASP) of the University of Padua, project that is under revision of Psychology departments, with the aim to establish by this year a center of excellence of research methodologies, assessment and intervention for different stages of life and different needs (flexibility). This service will guarantee the privacy and the security of the people which will be taken in charge, helping them and not leaving them alone. This is particularly crucial when considering the difficulties shown by territorial services in taking people in charge, and the increasing request in the field of developmental age. Finally, it is important to underline that intervene on the early interactions and parent-child dyads means, in a sense, help the future generations in their future relationship and interactions with their children.

#### **5. Applicable IPR rules**

The idea of this research project follows the IPR rules. My research group has exclusive access to the project until we will conclude this research and we'll have achieved some results. After that, we would like to open the first clinical center in Europe using neurophysiologic instruments for planning and monitoring clinical interventions on the first infancy in the Clinical Services addressed to the Person (CASP) of the University of Padua.

#### **6. Information on the partners**

University of Padua, Department of Developmental and Social Psychology (DPSS). The DPSS of the University of Padua has two laboratories, the Early Infancy Observation Laboratory and the EEG Laboratory (Resp. Dr. Paola Sessa, PhD, Assistant Professor), equipped with instruments and tools for the implementation of this research.

Experts Team: Four of the research group components are trained for the application and the coding of EAS (and have the reliability with the author Biringen, et al., 2014). In addition,



our team is composed by researchers who are, also, therapists, experts in assessment and treatment based on the observations and interventions on early adult-infant interactions; they are also experts in the use of video feedback technique, in support programs to promote positive parenting in at-risk and clinical populations.

### **Addendum: Contact information**

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