NEW MONITORING

GUIDELINES TO DEVELOP INNOVATIVE ECEC TEACHERS CURRICULA

NeMo

Pre-primary Teachers Training Course on Pre-linguistic observation Methodology

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GUIDELINES TO DEVELOP INNOVATIVE ECEC TEACHERS CURRICULA

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Credits

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NeMo Digital Tool EN:
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1. The state of the art: three criticalities

The prevalence of Autism Spectrum Disorders (ASD) in Europe is 12.2 per 1,000 (one in 89) children, and the diagnosis of ASD is usually provided around the age of two and a half years , usually following a developmental delay in the child's linguistic skills.

The infant does not talk/verbally communicate and, consequently, the caregiver becomes worried and asks for help: later, s/he will recognize that s/he could have already seen many signs of non-typical behavior. Indeed, as our NeMo project (https://site.unibo.it/nemoproject/en) aims at showcasing, clear signs of impairments and atypicalities that can lead to ASD can be seen and read much earlier by looking at embodied and prelinguistic interactions between infants and caregivers.

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NeMo Project and NeMo methodology start from 3 criticalities:

1

28 months (or worse) for the detection of developmental disabilities is too late, since neuroplasticity is higher during the secondary intersubjectivity window (9-18 months) and it has been shown that an early intervention is more effective if compared to a standard «post-ADOS» average one (for an overview, see Franz and Dawson 2019);

2

Screening tests cannot be conducted by a neuropsychiatrist for every single baby born in the world;

3

Screening tests' settings, arguably, lack some sense of reality compared to an n 'in the wild' test, where the infant interacts with the people he usually interacts with and does the things he usually does. so we have an «ecological validity» issue here (see Lewkowicz 2001), that has also been discussed also in reference to the significant increase of ASD diagnoses within recent years.

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2. NEMO PROJECT

The aim of the NeMo project is to detect non-typical interactions that can lead to a diagnosis of ASD earlier than usual , so that infants can be observed and monitored.
Therefore, NeMo has developed an observation methodology which is easy to follow also by non-experienced observers, such as caregivers, family members and pre-primary teachers. Indeed, the NeMo Methodology – developed by the University of Bologna – basically operates with three substitutions:

a

A substitution in the age of the infant, since it observes 9-18-month-old infants.

b

A substitution of the neuropsychiatrist with a caregiver, case in point: pre-primary teachers.

c

A substitution of the laboratory and highly grammaticalized screening tests' settings with real-life (European pre-primary centres), anticipated by a comprehensive and semiotic analysis of home videos shot through smartphones by parents.

Our methodology aims to help ECEC teachers detect clear signs of possible future disorders of social skills, which may later lead to a diagnosis of ASD, through the observation of prelinguistic interactions between caregivers and infants.

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3. A step back: ASD and SCREENING TESTS

In order to get closer to the aim of having a non-competent observer detect a non-typical interaction, an overview of predominant ASD signs and the limits of screening tests have to be considered.
According to the latest version of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5, 2013), autistic disorders are conceived as part of a spectrum, whose specificities consist in two main categories:

- Persistent deficits in social communication and social interaction across multiple contexts, as manifested by the following areas of concern (currently or historically):
i) Deficits in social-emotional reciprocity;
ii) Deficits in nonverbal communicative behaviours used for social interaction;
iii) Deficits in developing, maintaining and understanding relationships.

For the sake of brevity, we can call this domain Social Affect.

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3. A step back: ASD and SCREENING TESTS

Restricted, repetitive patterns of behaviours, interests or activities as manifested by at least two of the following areas, currently or historically:

- **Stereotyped or repetitive motor movements, use of objects, or speech;**
- **Highly restricted, fixated interests that are abnormal in intensity or focus**
- **Insistence on sameness, inflexible adherence to routines, or ritualised patterns of verbal or nonverbal behaviour;**
- **Hyper- or hypo-reactivity to sensory inputs or unusual interest in sensory aspects of the environment.**

Despite biomedical advances, there are currently no medical tests or biological markers for identifying autism. Therefore, based on the categories provided by DSM-5, the aim of ASD screening tests is to detect anomalous behaviours, providing hints to help detect potential ASD cases.

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3. A step back: ASD and SCREENING TESTS

Several screening tests used to detect ASD in infants can be differentiated according to three main features:

1) Goal of the test

a) "intended to screen at a population level, that is, all children regardless of their risk level for developmental disabilities, including ASD" (Towle and Patrick 2016: 2). The ITC (Infant-Toddler Checklist) and the ESAT (Early Screening for Autistic Toddlers) are examples of Level 1 screening tests.

b) "applied to children at risk, such as those who have come to the attention of their parents or paediatrician in order to see if they are more likely to have ASD than another type of delay or disability" (Ibid.). For instance, at a genetic level, an infant who is the brother or sister of an already diagnosed ASD child will be evaluated with a Level b test. The STAT (Screening Tool for Autism in Two Years Old) is an example of a Level b screening test.
Tests such as the M-CHAT (Modified Checklist for Autism in Toddlers), are used for both Level a and Level b.
The most reliable screening tests constitute what is defined as the Gold Standard, composed by ADI-R and ADOS tests, whose high level and balance between sensitivity and specificity determine that these tests are used as tools that contribute to an ASD diagnosis.

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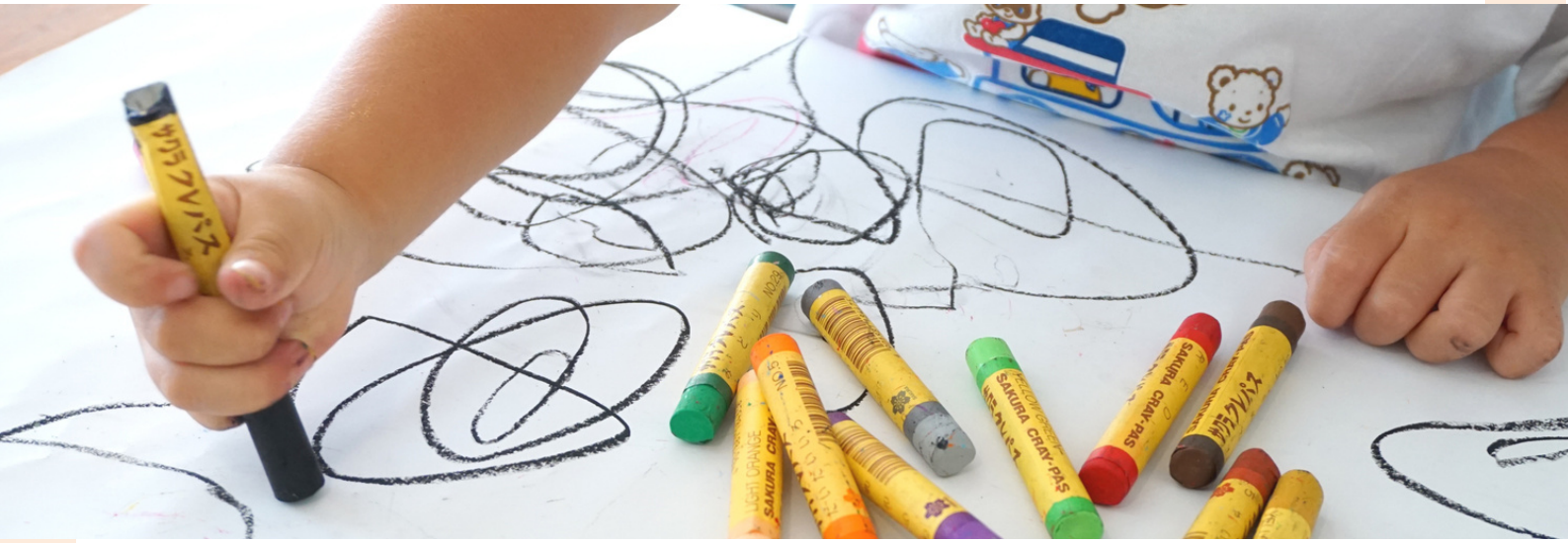
3. A step back: ASD and SCREENING TESTS

2) Types of administration of the test.

We can find screening tests based on questionnaires which are administered to, or directly compiled by, the infants' caregivers. For the simplicity and rapidity of administration, the M-CHAT is one of the most used questionnaire-type screening tests.
We find tests such as the ADOS (Autism Diagnostic Observation Schedule), in which the infant is directly observed interacting with the experimenter.
We also find mixed texts, such as the ADI-R, whose evaluation is obtained through both a questionnaire administered to the caregivers, and the direct observation of the infant.



3) The scoring criteria

Screening tests present different scoring criteria and cut-off levels through which it is determined if the infant is a potential ASD case. These cut-off levels are reached through the evaluation of the infant's behaviours or through the answers to the related questions. Thus, the scoring system and cut-off levels strictly depend on the design of the questions and of the available answers.

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The problem with the features composing the screening tests (i.e., a list of signs, skills and activities) is that an Ordinary Observer (OA), such as a caregiver or a pre-primary teacher, cannot really handle all that work/information. The first task/goal has thus been «simplification». This took several years of work. Simplification means that all of this must be summed up in a small number of things to look for, so that a caregiver can easily detect them. Of course, semiotics has been the main tool used in order to accomplish that (see Paolucci 2012, 2021, 2022; Fusaroli, Paolucci 2011).

However, the hardest part of this work has been removing all of the semiotic technicalities and ending up with something that can be told like a love story. And the «love story» is the following: if the infant attunes to the caregiver, he is essentially a typically-developing infant; if he does not, then the infant should be monitored, since infants that do not attune to their caregivers during their interactions usually receive a diagnosis of ASD, or a diagnosis of another neurodevelopmental impairments, at a later stage.

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So, what is attuning?

This can also be framed in a very simple way: attuning is adapting yourself to the other, the fact that the way you move, behave, or feel takes into account the way the other moves, behaves
or feels. This is why it is like a love story: we all loved the people that took into account the way we move, act and feel and did not love the people who do not take into account the way we move, act and feel.
The main thing, that makes the system very simple, is that you only must look at the attunement between the infant and the caregiver during their interaction.

So, what can be attuned in an interaction?

Three things that give rise to three dimensions: A) the bodies; B) the doing; C) the feelings, a sensorimotor, a behavioural and an emotional dimension.

Sensorimotor dimension (the bodies)

Behavioral dimension (the doing)

Emotional dimension (the feelings)

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4.1. SENSORIMOTOR DIMENSION:

A) THE BODIES

As far as the bodies are concerned, a typical interaction resembles something like a good dance. What do we usually do when we dance? In dancing, your body attunes to the body of the other in a harmonious way and your body adapts to what the other is doing. The contrary is equally easy to understand: when there is disharmony between two people – for instance when lovers are angry after arguing – each body moves according to its own separate instructions.

For instance, i) she is on one side of the couch with the telephone, ii) he is on the other side with the remote control (or vice versa). **If during a doing together, the body of the infant seems to move according to its own instruction, without attuning to the body of the other, the interaction may not be typical, and this could be a sign of possible future ASD impairment.** It is important to stress that the way bodies behave during an interaction is extremely revelatory and puts into question our ordinary distinction between the body and the mind, and the correlated idea that ASD involves mainly mindreading and communication problems (see Paolucci 2019, 2020).

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4.1. SENSORIMOTOR DIMENSION:

A) THE BODIES

Neuroscientists found a special class of neurons that came to be known as '**peripersonal neurons'** (PPNs). These neurons monitor the space that surrounds our bodies (which extends as far as we can reach), now called 'peripersonal space' (PPS). Today, awareness of such differences can inform how we detect, respond to, and help children with autism.

A classic finding in experimental neuroscience is that **tool-use** can increase the size of our PPS! This is because our 'area of interaction' is now bigger thanks to the tool. If I use a hoover, the amount of space I can influence is larger.
However not only tool-use can make our PPS expand. Co-operating with another person does too! Studies have found that when two people **co-operate** (e.g., during a game), their PPS will expand to incorporate the other person. This makes sense because, when we interact with another human being, how we relate to surrounding space must change to accommodate them and reflect the change they bring to our situation. We have the power of two in some sense and must be able to navigate our surroundings with the body of another person accounted for. Indeed, Teneggi et al. (2013) found that, following co-operation, the PPS of both of the co-operators will increase to include one another.

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4. NeMo METHODOLOGY.

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4.1. SENSORIMOTOR DIMENSION:

A) THE BODIES

Deficits in this automatic capacity could have negative consequences for intersubjectivity. It appears that children with ASD are somewhat enclosed within their own spatial boundaries. The normally fluid and permeable borders of PPS in social situations remain fixed in place. Objects that fall within this strong spatial boundary are really 'mine' and may not show up as shared items. This of course has nothing to do with selfishness: this is merely how they appear to the brain due its spatial configuration.

Children with ASD often do not seem to account for the presence of others or automatically include them in their bodily play. While the child may enjoy interacting with objects, he/she will clearly exhibit preferences for this activity to be fully on his/her own terms. Finally, some scholars (e.g., Noel et al. 2015) have pointed out that finding ways to weaken this sharp self-other boundary could be therapeutically promising and help infants with ASD increase their ability to interaction and co-ordination with others.

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4. NeMo METHODOLOGY.

A TOOL FOR THE ORDINARY OBSERVER

44.1. SENSORIMOTOR DIMENSION:

A) THE BODIES

In order to maximise the revelatory power of the information collected so far on sensorimotor studies, NeMo methodology focuses on four different dimensions (for the extended version and rating system please refer to the NeMo Manual and the NeMo Tool you can find in "NeMo: Pre-primary Teachers Training Course on Pre-linguistic observation Methodology") :

A1) The space.
This category takes into account the distance between subjects, the moving towards/away from each other, the way the infant moves into the space and also measures the typicality with which the infant approaches – or moves away from – caregivers or other infants.

A2) The body of the other (Bodily Attunement).
This category measures the extent to which the infant appears to adapt his body to caregivers or other infants during physical encounters. A sign of potential alarm occur in that the infant would fail to adjust his/her own bodily posture and movements in a way that aligns with that of another person's movements.

A3) The infant's own body.
This category measures the style of the infant's overall bodily posture and style of movement, including during non-interactive situations. A sign of potential alarm could be present if the infant produces repetitive bodily motions that often manifest in the form of hand-waving/flapping, rubbing, rocking or pacing.

A4) Degree of attention to the motor sanction of the caregiver.
A sanction should be interpreted as every kind of evaluation (positive or negative) produced by the caregiver with words, actions, sounds and gestures that are used to reinforce the infant's actions and reactions.
A sanction is usually used to motivate, boost and help the infant to orient his/her performance. As far as «the bodies» are concerned, this category measures how attentive to, and anticipatory of, the infant is regarding the bodily movements of caregivers.

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4. NeMo METHODOLOGY.

A TOOL FOR THE ORDINARY OBSERVER

4.2. BEHAVIORAL DIMENSION:

B) THE DOING

As far as the doing is concerned, this is probably the most evident and easily observable dimension of the system. ASD infants usually carry on 'in their own business' in a way so that it may appear as if they have no interest in interacting with the caregivers.

Of course, we are not saying that they don't care – probably they do – but it looks like they do not, maybe because it is difficult for them to interact properly, so they prefer to quit[1]. When you are not good at something you usually do not want to do it, because it reminds you of your own inadequacy.

From soon after birth, human infants engage in "protoconversations" with their caregiver (Threvarten, 1979). Protoconversations are social and intersubjective interactions in which the parent and infant focus their attention on one another in ways that serve to express and share basic conversation.

Tomasello (2000) specifies that they can be interpreted as intersubjective until infants understand others as subjects of experience – which they will not do until nine months of age.
Indeed, around this age, a new set of behaviors begins to emerge that is not dyadic but triadic in the sense that it involves a coordination of their interactions with objects and people, resulting in a referential triangle of child, adult and the object or event to which they share attention.

[1] For a discussion on this topic, connected to Social Motivation of ASD, see Paolucci 2021.

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4. NeMo METHODOLOGY.

A TOOL FOR THE ORDINARY OBSERVER

44.2. BEHAVIORAL DIMENSION:

B) THE DOING

At around nine months of age infants seemed to display a new understanding of action-outcome relations.
The new behaviors that evidenced this new understanding are (a) the use of multiple behavioural means towards the same goal and (b) the recognition and use of behavioural intermediaries in the pursuit of goals.
This new level of understanding is witnessed in mutual actions between child and caregiver that, in some cases definable as alarming, might lack.

Also the «doing» dimension is divided into four categories (for the extended version and rating system please refer to the NeMo Manual, the NeMo Tool and the NeMo European pilots' reports you can find in "NeMo: Pre-primary Teachers Training Course on Pre-linguistic observation Methodology"):

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4. NeMo METHODOLOGY.

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4.2. BEHAVIORAL DIMENSION:

B) THE DOING

B1) The doing together.
This category measures the degree to which the infant can spontaneously partake in shared activities with success. For a case of potential alert to be noticed, it is important to judge whether or not the infant can fluently partake in activities which are not strictly planned and/or structured.

B2) The mutual gaze while doing together.

This category measures the frequency and style through which the infant makes eye contact with his/her caregiver or another infant during a joint activity. These are natural behaviours used by infants for communicative and pragmatic purposes. If the infant would avoid or look for and/or respond to the other's gaze repeatedly, rarely or just sometimes, we could talk about a situation of potential alert.

B3) Joint attention.

The category measures the extent to which the attentional focus of infant and caregiver appear to «synchronise» with one another during a game or shared task. For instance, if the caregiver elicits the infant's attention as to focus on a toy, in order to partake in a shared activity, the infant will look at the toy and will probably invite the caregiver to play together. On the contrary, a sign of potential alert could be present if the infant would display difficulties in attuning his/her attentional focus to that of his/her caregiver's, and/or would communicate less frequently with others, both verbally and non-verbally, during shared tasks and games.

B4) Degree of attention to the behavioral sanction of the caregiver.
This category measures the degree to which the infant perceives, is aware of, and can react appropriately to, context-relevant actions and / or gestures made by the caregiver.
A potentially alerting situation could occur if it was the case that the infant would miss the overall meaning of an action, game or task, or fail to understand nonexplicit instructions.

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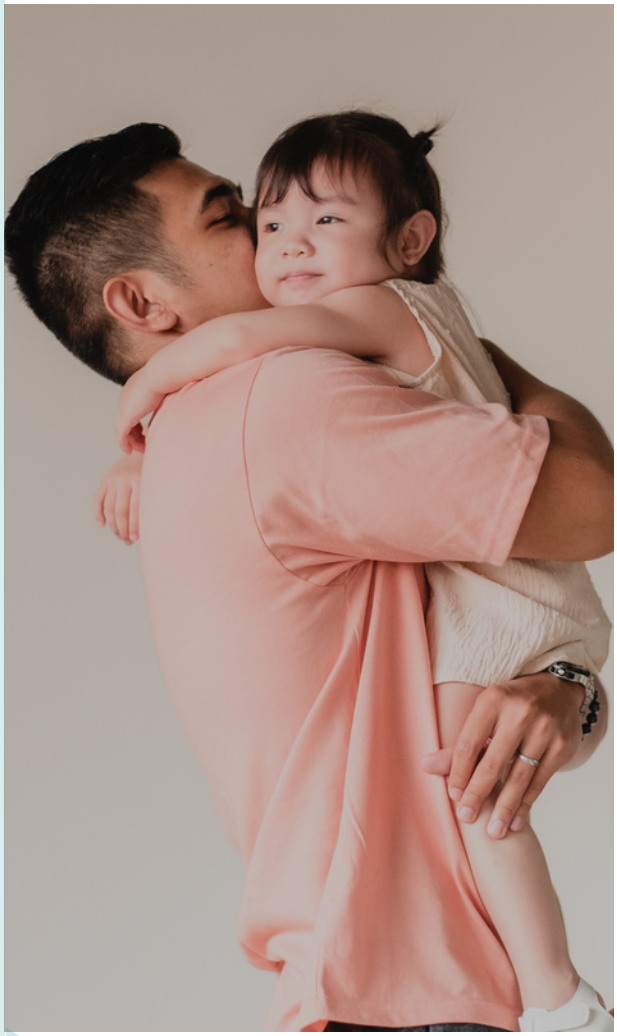
4.3. EMOTIONAL DIMENSION:

C) THE FEELINGS



As far as the emotions are concerned, in an ordinary interaction, **behaviours and feelings change according to a change in the emotions of others.** If someone gets angry, the person who e interacts with him/her takes into account their anger and perhaps changes his/her behaviour and mood accordingly. ASD children usually do not take these factors into account or have difficulties in doing so.

Of course, we are not saying that infants must be happy when the caregiver is happy, or sad when s/he is sad. This is not an attunement at all. **Attuning does not mean feeling the same emotion:** it is neither empathy nor emotional contagion. **It simply means the taking into account the emotions of the others.** For instance, a typically developing infant may see that the parent is angry and can decide to attune to that anger simply by continuing to disobey him, because he wants/wishes to disobey. This is a choice, but it is also an attunement, because he attunes in his own way. Instead, ASD infants may simply look of not taking any change in the caregiver's emotions into account.

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4.3. EMOTIONAL DIMENSION:

C) THE FEELINGS

Trevarthan and Hubley (1978) have provided **a definition of intersubjectivity** that can be operationalized: "a deliberately sought sharing of experiences about events and things." The level of sharing is witnessed by several **mutual actions** that manifest the quality of attunement between the child and caregiver. In turn, behind the expressed actions, an emotional dimension is continuously scaffolding and developing/ developing and scaffolding the actions.
Stern argues the possibility of talking about **"affective attunement"** as the performance of behaviors that express the quality of feeling of a shared affective state without imitating the exact behavioral expression of the inner state [1].

[1] D. N. Stern, The interpersonal world of the infant: a view from psychoanalysis and developmental psychology; 1985; Libri Karnac

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4.3. EMOTIONAL DIMENSION:

C) THE FEELINGS

The need to separate "attunement" from other affective phenomena that have been called **"affective matching" or "affective contagion"** is that the later involves the automatic induction of an affect in one person from seeing or hearing someone else's affect display, so it is out of our enquiry.

By contrast, Stern finds three dimensions that define attunement; namely, intensity, time, and shape. If the first two are quantitative dimensions, the correspondences in kinetic shapes would occur across vision and audition as well as across vision and touch in a synesthetic way. The point of this discussion about the unity of the senses is that the capacities for identifying cross-modal equivalences that make for a perceptually unified world are t**he same capacities that permit the mother and infant to engage in affective attunement** to achieve affective intersubjectivity.

Several studies on intersubjectivity led us to propose the following items to evaluate the level of emotional attunement between a child and a caregiver (for the extended version and rating system please refer to the NeMo Manual, the NeMo Tool and the NeMo European pilots' reports you can find in "NeMo: Pre-primary Teachers Training Course on Pre-linguistic observation Methodology"):

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4.3. EMOTIONAL DIMENSION:

C) THE FEELINGS

C1) The feeling together.

This category measures how the infant and caregiver adjust their emotional states in response to one another.
Close attention must be paid to whether or not the infant becomes happy when the caregiver is happy and/or can then adjust this happiness if the caregiver subsequently shows subtle signs of displeasure. In fact, usually both the infant and caregiver continually adapt and adjust their emotional states in response to that shown by the other in a spontaneous, fluid and dynamic way.

C2) The emotional gaze.

This category measures the frequency with which infants and caregivers make eye contact with each other outside of task-related contexts. Infants will frequently and spontaneously make eye contact with caregivers or other infants and adults, even outside of situations related to games and tasks, in a communicative function.
A potentially alerting situation could be occurring if the infant seems uninterested in meeting the gaze of another person or communicating through eye contact, and/or may even appear to avoid it.

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4.3. EMOTIONAL DIMENSION:

C) THE FEELINGS

C3) The facial expressions.

This category measures the extent to which the infant spontaneously imitates or reacts to the facial expressions of their caregivers and pays attention to how the facial expression of the infant (e.g., smiling, laughing, scowling, surprise) matches that expressed by the caregiver, as well as how the infant's own expression changes in direct response to that expressed by the caregiver.

A potentially alarming situation could occur if the infants appeared unaware of the meaning behind the caregiver's facial expression, or appeared unsure of how they should emotionally react in response to it.

C4) Degree of attention to the emotional sanction of the caregiver.

This category measures how generally attentive to the emotional «requests» of the caregiver the infant appears to be. An alarming situation could occurr if the infant is reported to display less interest in

the emotional states of others and thus fail to respond to solicitations to experience emotions when their caregivers would like them to. For instance, when interacting with infants with ASD, the caregiver may continually appear to try to elicit emotional states in the infant which are not fulfilled, with the infant carrying on with his own business.

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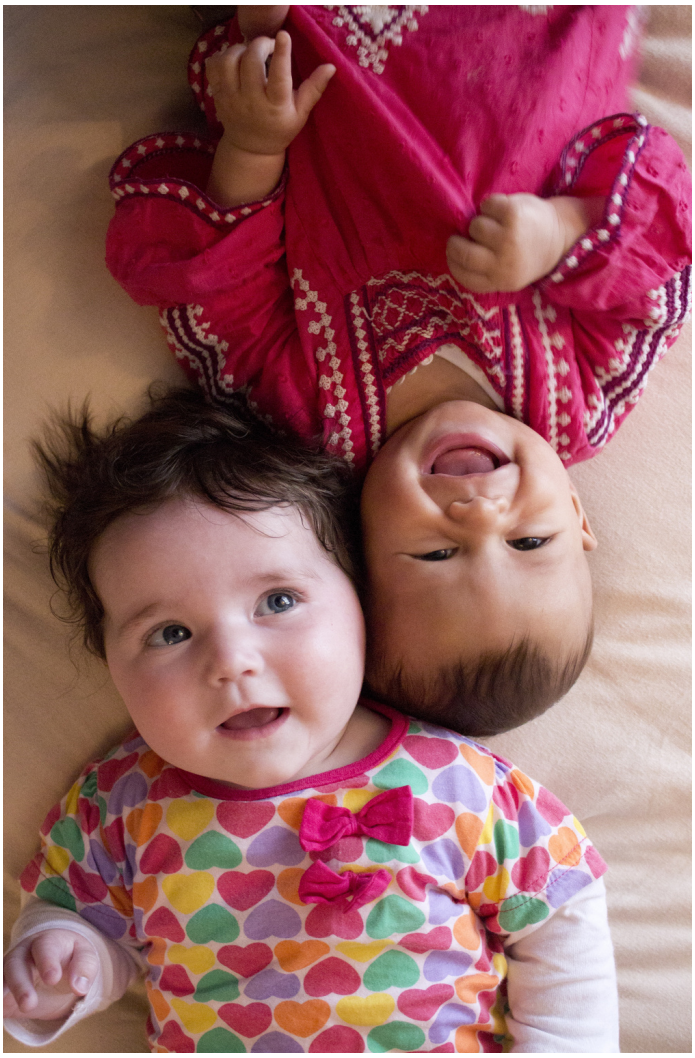
5. Conclusions



Over the course of the NeMo project, the observation methodology outlined above has been delivered to 5 teams of pre-primary teachers coming from 5 different European countries (Italy, Sweden, Spain, Slovenia and Cyprus).

The countries were selected to test the validity and efficiency of the methodology for teachers dealing with different educational guidelines at a national level (belonging both to unitary (0-6) and split systems (0-3 | 3-6).

The 5 teams then applied the methodology over pre-primary centres at a local level by evaluating children-caregivers interactions in real life.

For a complete report on the local pilot experiences, feedback, NeMo manual and tools, we invite you to consult "NeMo: Pre-primary Teachers Training Course on Pre-linguistic observation Methodology".

Summing up the project's impact, the NEMO monitoring tool has been evaluated as useful for orienting teachers' observations in a well-organized fashion, and as easy to share with colleagues and with parents. Confrontation regarding the observations with the infants' parents could lead to programmingfocused activities and/or those involving other professionals.

With humbleness and enthusiasm, we share the NeMo research, methodology and tool to European pre-primary teachers, educational policy makers as well to as the wider research community with the sound belief – supported with evidence – that this project has spread outwards and will disseminate a better understanding of developmental disorders and their potential warning signs to the Early Childhood Education and Care systems in Europe, enhancing ithe capabilities to detect, care and manage children with ASD.

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NEW MONITORING

GUIDELINES TO DEVELOP INNOVATIVE ECEC TEACHERS CURRICULA

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NeMo
New Monitoring Guidelines to develop innovative ecec teacher's curricula

Manual for the tool:
Recommendations, clarifications and explanations

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1. Introduction and scoring procedure: when and how to use this manual

Dear reader,
As a teacher involved in the education and the caring of infants, on a daily basis you commit yourself to the primary and fundamental responsibility of assisting in the development of future generations.
This manual has been designed with the purpose of helping teachers effectively recognize signs of potential alert situations, which may lead to an early detection of Autism Spectrum Disorders (ASD) through observing their behaviour during an interaction. An interaction presenting a series of specific lacking behaviours can also be a sign of other related developmental disorders, so it is very important to detect it as soon as possible. The aim of the NeMo methodology is to assist in achieving an early diagnosis of ASD which can improve both the infant's and their family's quality of life. To do this, we ask you to observe and rate the infant's activities while they interact with you or with one of your colleagues.

During the scoring procedure, we kindly suggest that you pay careful attention *to the interaction* between the infant and caregiver as they engage together in everyday activities like eating, playing, sharing objects, moving around together, etc. An interaction with an infant affected by Autism Spectrum Disorder (or other developmental disorders) will seem compromised, as both the caregiver and infant will seem unable to establish a reciprocal connection. On the contrary, a neurotypical infant (not ASD) and a caregiver will together structure and explore a kind of path, while attuning their actions, their bodies and their emotions together.

The tool, structured as *12 items*, has been divided into *three main dimensions*: i) A: "*The bodies*" (*Sensorimotor* dimension); ii) B: "*The doing*" (Behavioural dimension); iii) C: "*The feeling*" (*Emotional* dimension). *Each one of these dimensions is further divided into 4 fields* (4 items per each dimension), so that you can rate them on a numerical scale. These dimensions and fields are fully explained in the manual. Every item concerns a specific *field* with associated behavioural clues to search for. Each can be rated *from 1 to 8*, where 1 stands for the presence of specific behaviours and competences and 8 stands for their absence or impairment. As you will read in the instructions provided, this schema divides the scoring possibilities into groups of *two* (1-2; 3-4; 5-6; 7-8). Depending on the severity of the condition and on the anomalies detected, the schema divides each field a range of possible concern – from 1-2, *no concern*, to 7-8, *severe concern.*

We kindly ask that you conduct at least *two evaluations per week for two weeks* on an infant. *Then, repeat the same operation* (two evaluations per week for two weeks) *on another infant*, rating, if possible, *4 different activities* that s/he performs. Of course, this is not mandatory and, as you become more skilled, you can evaluate more infants at the same time. Please always use a separate questionnaire for each infant that is evaluated. The assessment should take around 10/15 minutes to complete.

2. NeMo Methodology: dimensions of analysis

This section provides an in-depth description of the most important features of *each field comprising the 3 dimensions* used in the NeMo methodology: *Sensorimotor*, named *The Bodies* (A), *Behavioural*, named *The Doing* (B) and *Emotional*, named *The Feeling* (C).

A – *The Bodies*:

A1 – The space

This category takes into account the infant's competence in inhabiting the space, approaching or moving away from caregivers, objects or other infants. Research has frequently noted that infants with Autism Spectrum Disorders will often interact differently with others in regards to the other's personal space when compared with Typical Development (TD) infants. Moreover, infants with ASD may appear as if they fail to notice the presence of others who are nearby and may also seem to actively resist physical closeness or being touched. They will also remain either too close to others or will retain an excessive distance from them. More, ASD infants usually prefer to interact with toys or other objects, if compared to people, so they inhabit the space accordingly, appearing more interested in coordinating their movements to play (usually alone) with their toys, instead of aligning with another person's movements.

A2 – The body of the other (Bodily Attunement):

This category measures the extent to which the infant appears to adapt his body to caregivers or other infants and to coordinate with them during physical encounters. For example, the infant may turn his whole body to the direction that the caregiver points toward, or may physically react to the voice of a caregiver calling him, and could coordinate his/her movements to the other's movements as to bring forth the occurring physical interaction, for instance during a peek-a-boo session. In general, TD infants will adjust his/her own body to the movements of the caregiver like in a dance, in which one's own body attunes to the movements of the other body. By contrast, ASD infants usually fail to adjust their own bodily posture and movements in a way that aligns with that of another person's movements. ASD infants will often interact in a way that appears rigid, controlled, inattentive and inflexible, avoiding the other's attempts to engage with him/her.. Such "unattuned" bodily interactions may appear as if the infant is resisting physical interaction or is anxious or unsure about his role in the situation.

A3 – The infant's own body (Bodily awareness):

This category measures the style of the infant's overall bodily posture and style of movement, including during non-interactive situations. In fact, usually infants are able to coordinate their motor movements and posture, balancing the head, trunk, hands, arms and legs movements to

start or continue any kind of activity (e.g. spreading their arms while crawling as to reach a toy or the other's body). On the contrary, a sign of potential alert could be present if the infant would produce repetitive bodily motions that often manifest in the form of hand-waving/flapping, rubbing, rocking or pacing. These movements are known as "stimming" (self-stimulating). Furthermore, ASD infants will often assume a posture which appears significantly stiff and rigid, sometimes while also engaging in stimming behaviours. Motor disturbances such as impaired crawling, lack of integration between the upper body (which is generally looser) and the lower part (generally more rigid) may also be present. ASD infants could also present a weaker muscular tone. Please, rate with a high number here if you see some of these signs.

A4 – Degree of attention to the motor sanction of the caregiver:

A sanction should be interpreted as every kind of evaluation (positive or negative) produced by the caregiver with words, actions, sounds and gestures that are used to reinforce the infant's actions and reactions. A sanction is usually used to motivate, boost and help the infant to orient his/her performance.

As far as "the bodies" are concerned, this category measures how attentive to, and anticipatory of, the infant is regarding the bodily movements of caregivers. Particular focus should be placed on the 'end' of an action or where an action requires a *specific* reaction from the infant. This is most frequently observed when (but not limited to) the infant prepares for their own body to be picked up or hugged by the caregiver. Unlike the more general and open-ended behaviours that are measured in A2, a sanction requires a specific bodily reaction from the infant. Whereas TD infants will often naturally observe the movements of their caregivers and adjust their own bodily posture and movements in preparation, a sign of potential alert could be occurring if the infant would show a markedly reduced ability to react appropriately to the actions of others. Furthermore, TD infants often mimic the bodily actions of caregivers even outside of strictly interactive contexts, whereas these mimicking behaviours are often absent or significantly reduced with ASD infants.

B – *The Doing*:

B1 – The doing together:

This category measures the degree to which the infant can spontaneously partake in shared activities with success. For a case of potential alert to be noticed, it is important to judge whether or not the infant can fluently partake in activities which are not strictly planned and/or structured. Therefore, this criterion measures how well the infant performs during interactive contexts, such as their ability to fulfil their role within an interactive game or task, with special attention paid to situations in which the task/game suddenly changes, or a new element is introduced and the infant must fluently adapt to it. Please, rate with a high number

here if the infant is not regulating his/her doing according to the springing up of a new event or a new "doing together" request.

B2 – Mutual gaze while doing together (caregiver and infant looking at each other):

This category measures the frequence and style through which the infant makes eye contact with his/her caregiver or another infant during a joint activity. These are natural behaviours used by infants for communicative and pragmatic purposes. If the infant would avoid or look for and/or respond to the other's gaze repeatedly, rarely or just sometimes, we could talk about a situation of potential alert. For instance, reduced or absent eye contact and a noticeable lack of attention to the faces of other people are both indicators of possible alarming situations. Thus, if during a co-operative game or task the infant pays significantly more attention to backgrounds than to other people, and/or seems to avoid making eye contact, this could be an indication of a possible ASD impairment.

B3 – Joint attention, exploratory behaviour and communication with caregiver:

The category measures the extent to which the attentional focus of infant and caregiver appear to 'synchronise' with one another during a game or shared task. For instance, if the caregiver elicit the infant's attention as to focus on a toy, in order to partake in a shared activity, the infant will look at the toy and will probably invite the caregiver to play together. On the contrary, a sign of potential alert could be present if the infant would display difficulties in attuning his/her attentional focus to that of his/her caregiver's, and/or would communicate less frequently with others, both verbally and non-verbally, during shared tasks and games. In these cases we would thus witness the infants as if they were "in their own world", which can manifest in their markedly reduced communicative, exploratory and eye-gazing behaviours.

B4 – Degree of attention to the behavioral sanction of the caregiver:

This category measures the degree to which the infant perceives, is aware of, and can react appropriately to, context-relevant actions and/or gestures made by the caregiver. In a way similar to A4, we are here observing how the infant attends to the caregiver's behaviour as it relates to engaging in shared games and tasks and how much attention he/she pays to the reactions and evaluations of the caregiver regarding his own behaviours. For instance, during a meal, if the infant refuses to eat and the caregiver continues to insist that the infant should eat, how much does this influence the infant's behaviour?

A potentially alerting situation could occur if it was the case that the infant would miss the overall meaning of an action, game or task, and/or fail to achieve the desired result *after a series of encouragements, instructions and motivations*. Furthermore, ASD or

developmentally impaired infants are often less responsive to gestures that make other infants feel good and help the interaction along, such as positive words and gestures (e.g. pointing, a thumbs up or pat on the back) which can hinder their ability to learn and form social bonds.

C – *The Feeling*:

C1 – Caregiver and infant mutually regulating their emotional state (pay particular attention to infant talk by the caregiver):

This category measures how the infant and caregiver adjust their emotional states in response to one another. Pay close attention to whether or not the infant attunes his feelings to the feelings of the caregiver. This does not mean that he has to become happy if the caregiver is happy: the infant may also want to disobey. Simply try to notice if the infant takes into account the emotional state of the caregiver and, if he does not, please rate with a high score here. In fact, usually both the infant and caregiver continually adapt and adjust their emotional states in response to that shown by the other in a spontaneous, fluid and dynamic way. Keep also in mind that the caregiver using so-called "infant talk" often has the power of grasping the infant's attention, so do not overestimate an infant's capacity for emotional regulation if the caregiver introduces a sudden change from "normal-talk" to attention-grabbing "infant-talk".

C2 – Mutual gaze while interacting not immediately related to the doing (caregiver and infant looking at each other); i.e. infant looking directly at (or just above?) the camera:

This category measures the frequency with which infants and caregivers make eye contact with each other outside of task-related contexts. Infants will frequently and spontaneously make eye contact with caregivers or other infants and adults, even outside of situations related to games and tasks, in a way that seems natural and spontaneous. This eye contact usually has a communicative function and helps the overall quality of the interaction. A potentially alerting situation could be occurring if the infant would seem uninterested in meeting the gaze of another person or communicating through eye contact, and/or can even appear to avoid it. Please remain aware that, if you are rating a video recorded by a human being that does not appear in the recording, then the infant will often appear to look directly at, or just above, the camera if they make eye contact with the recorder of the video.

C3 – The emotional facial expressions (with particular attention to smiles) showing emotional attunement:

This category measures the extent to which the infant spontaneously imitates or reacts to the facial expressions of their caregivers. Instead of observing the overall emotional state as in

C1, pay greater attention to how the facial expression of the infant (e.g., smiling, laughing, scowling, surprise) matches that expressed by the caregiver, as well as how the infant's own expression changes in direct response to that expressed by the caregiver (e.g., does the infant become sad if the caregiver appears suddenly displeased?).

Usually infants appear naturally and spontaneously predisposed to mirror the emotional expressions of their caregiver. On the contrary, a potentially alerting situation could be occurring if the infants were more likely to remain unaware of the meaning behind the caregiver's facial expression, as well as how they should emotionally react in response to it.

C4 – Degree of attention to the emotional sanction of the caregiver:

This category measures how generally attentive to the emotional 'requests' of the caregiver the infant appears to be. An alerting situation would be occurring if the infant was reported displaying less interest in the emotional states of others and thus fail to respond to solicitations to experience emotions when their caregivers would like them to. For instance, When interacting with infants with ASD, the caregiver may continually appear to try to elicit emotional states in the infant which are not fulfilled (i.e., attempting to make the infant feel excitement) or the caregiver may experience visible frustration when the infant does not respond contextually to their emotional state (such as anger at the infant's misbehaviour) and the infant may carry on with his own business anyway.

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3. Administration and rating: recommendations on learning how to compile and vote the interactions

This section will help you by providing a few important remarks concerning the scoring criteria. It will cover: i) *how* the behaviours observed during the compilation should be considered (**Note A**); ii) *how the rating schema of 1-8 is structured* and what this inner structure means (**Note B**); iii) *when* and *how often* has the tool to be administered (**Note C**).

Note A: *How to consider the observed behaviours*

The more that you notice odd behaviours or unexpected trouble in the infant's daily behaviours and habits, *the higher you should rate the interaction*. The atypicality of these behaviours should be interpreted thusly:

:

i) *Quantitatively*: the lacking or seemingly anomalous behaviours occur more frequently and repeatedly and/or the expected behaviours are found to be absent more and more frequently;

ii) *Qualitatively*: the behaviours seem more pronouncedly anomalous, compromising the fluidity, harmony and shared dimensions of the interaction, and/or the expected behaviours increasingly lack their features.

Note B: *What the levels of scoring mean*

i) *Scoring 1 or 2* implies a *lack of concern* about the motor, behavioural and emotional condition of the infant. The infant *will act properly*, responding to the attempts of the caregiver to engage with him/her and attempting to engage with the caregiver.

ii) *Scoring 3 or 4* implies a *mild concern* regarding the motor, behavioural and emotional condition of the infant. The infant *will act slightly less appropriately* and may seem *unable or uninterested* in engaging with the caregiver; the infant may also *show some kind of minor* oddity and/or unexpected difficulty in the sensorimotor, behavioural and emotional capacities required for a positive interaction. In this case, you will notice that some expected behaviours may be lacking, though nonetheless the overall development of the interaction is not compromised. For instance, after some attempts made by the caregiver at eliciting the infant's attention (who may just seem distracted), he/she eventually starts interacting with the caregiver. That is, in scoring 3 or 4, you will notice an interaction that is not completely fluid (as in 1 or 2) but contains slight anomalies which could be due to the infant being busy, distracted, tired etc.

iii) *Scoring 5 or 6* implies a *moderate concern* about the condition of the infant. The infant *will seem clearly unable or uninterested* in engaging with the caregiver, and will show some

kind of anomalies in the sensorimotor, behavioural and emotional capacities required for the current activity. Thus, *his/her behaviours will hinder* the development of a shared path of actions and interactions. This is an important step for the scoring criteria, because from 5 to 8 you will judge the behaviours and interactional skills of the infant as infant as signs of a potentially alerting situation. The higher the score that you give, the more it will reflect some kind of inappropriate, deficient and/or worrying behaviour.

iv) *Scoring 7 or 8* implies a *severe concern* about the condition of the infant. The infant *seems clearly uninterested, blind and deaf to other people's attempts to engage them in a shared activity, and shows significant impairments* in the sensorimotor, behavioural and emotional capacities required for the current activity. His/her behaviours appear *inappropriate and avoidant, preventing* the development of a shared path of actions and interactions.

Note C: *Scoring instructions and recommendations*

If *you are unsure if the behaviours are evaluable*, please feel free to fill the rating box with a question mark "?" and press the "next" button. Filling the box with a question mark will allow you to directly skip to a brief description of the ranking's main features.

If you still feel unsure after having read the tutorial, if you are not sure if the behaviours are evaluable and/or you find them not detectable, score "not readable" (n/r).

However, *from the second attempt on*, after having read the explanations of the parameters and having been helped by the training videos, you are kindly asked to score a value unless that particular action is completely undetectable.

When you are sure about the rating you wish to assign to the interaction, please fill the rating box with an "X" and press the "next" button to move onto another question.

4. Scoring Criteria: description and explanation of the fields of action

This section provides a description and explanation of the 12 fields of the NeMo methodology. This will help you understand *which signs* are significant when scoring 1-2, 3-4, 5-6 or 7-8, so you can better understand *when* and *how* to give a score.

The Bodies (A)

A1 – The space:

1-2: Vote 1 or 2 if for the majority of the interaction, the infant moves towards the caregiver and responds normally when the caregiver moves towards him/her, in a way that seems coordinated and appropriate. For example, if the caregiver walks toward the infant, the infant may move towards the caregiver and perhaps also spread his/her arms, recognising the interactive context. The infant appears well aware of any other people who are nearby and seems to keep an appropriate distance (i.e. the infant does not come too close or stay too far away from others).

3-4: Vote 3 or 4 if sometimes the infant seems distracted or has a slight tendency to avoid and/or to not engage with the other's movements and gestures. The infant may also avoid or fail to move towards the other in order to interact with them. Vote 3-4 if the infant appears unresponsive to the other's movements because he looks tired, busy, distracted by other stimuli or lacking motivation.

5-6: Vote 5 or 6 if for a large part of the interaction the infant shows a clearer tendency to stay away from the caregiver or avoids moving towards him/her. Most attempts to involve the infant in shared movements either fail or appear awkward. The infant seems to prefer activities other than moving towards the caregiver in order to enjoy a shared activity with him/her. He/she appears constantly distracted and/or unfocused.

7-8: Vote 7 or 8 if the avoidant and inappropriate behaviour of the infant severely compromises the capacity for the infant and the caregiver to cooperate and/or play together. To vote 7 or 8, the infant's style of movement must impede the development of a proper interaction: the infant does not seem to care about the presence of others and does not choose to move towards them, instead preferring to remain occupied in other activities or in no activity at all. For the majority of the interaction, the infant produces contextually inappropriate movements.

A2 – The body of the other:

1-2: Vote 1 or 2 if during the interaction the infant coordinates well with the caregivers' movements. The infant is physically attuned with the other as shown by their anticipation of the other's gestures and actions. The infant is able to produce and orient his/her own actions towards that of the other, giving rise to a harmonic and fluid physical interplay. E.g. when the caregiver spreads his/her arms (e.g. to express joy), the infant responds to this gesture with a matching response; for example, the infant spreads their arms too. The infant may also respond with a different gesture that serves to help the interaction. For example, if the caregiver wishes to lift the infant up, the infant visibly prepares to be picked up, or perhaps he/she drops a toy they were previously holding to help the caregiver complete the interaction with greater ease.

3-4: Vote 3 or 4 if the infant seems to be somewhat detached from the physical dynamics of the interaction, so that even if he/she is sufficiently involved in the interaction and reactive to the caregiver, he/she still has to be stimulated a couple of times before responding to the caregiver's gestures. Also, the infant may sometimes produce gestures which are not perfectly attuned to the others' in terms of intensity, purpose or coordination. As with A1, vote 3-4 if this lack of consistency of perfectly attuned gestures may be due to contextual reasons like the infant being distracted, busy or not predisposed to the present kind of interaction.

5-6: Vote 5 or 6 if the infant shows clear bodily impairments when coordinating with the caregiver. Often and repeatedly, the infant produces unattuned, anomalous and contextually inappropriate bodily gestures/actions. For example, when the caregiver is approaching him/her, the infant seems uninterested in engaging with the caregiver, and this is evident in the infant's body movements. In fact, he/she could show difficulties in understanding, anticipating and coordinating with the caregiver, instead continuing his/her own path of bodily movements and/or seeming uninterested to the other's attempts to interact.

7-8: Vote 7 or 8 if the infant shows clear and severe impairments with regards to coordinating their body with the caregiver in the form of a coherent and harmonic flow of bodily interactions, compromising the rise or development of the interaction. The infant's motor competences and desire to engage and coordinate with the other are visibly lacking, therefore damaging the overall fluidity of the interaction. Instead of coordinating with the caregiver's movements, the infant could: i) produce uncoordinated movements, showing difficulties in interacting with the caregiver; ii) produce restricted, repetitive and apparently meaningless movements; iii) avoid the other's movements, remaining still or focused in his/her own movements.

A3 – The infant's own body(bodily posture, muscular tone etc.):

1-2: Vote 1 or 2 if the infant is able to move his/her body (arms, legs, abs and trunk, head, fingers etc.) in a coordinated way, balancing the weight of his/her body and its different parts. Pay particular attention to the coordination between the upper and the lower parts of the body (ASD infants can "loose" their legs). The posture of the infant should also appear somewhat fluid and relaxed. Furthermore, to rate 1 or 2, the infant should not show any restricted, repetitive, contextually inappropriate, dysfunctional and counter-interactive physical behaviours (e.g. hand flapping, tiptoeing, head and body back and forth movements, mouth fixations, etc.).

3-4: Vote 3 or 4 if you notice some slight and/or infrequent sensorimotor difficulties. For instance, you may notice the infant has an occasional difficulty in: a) staying on his/her own legs; b) crawling; c) staying supine; d) staying prone; e) "owning" the lower part of the body; f) moving his/her legs and trunk and/or balancing the weight of the body, in order to engage an activity. Furthermore, you may notice a few rare, slightly repetitive sets of movements that may be due to developmental factors (every infant has their own path of sensorimotor development) or to contextual factors. As a result, the infant might require the caregiver to make a couple of attempts before he/she starts interacting with him/her. For instance, apparently having mild difficulty in staying on his/her own legs, the infant does not immediately respond to the caregiver's attempts to play with him/her.

5-6: Vote 5 or 6 if you notice clearer and more concerning signs of sensorimotor impairment that occur frequently and intensely, compromising the development of the interaction. You will clearly notice that the infant will have problems in: a) staying on his/her own legs; b) crawling; c) staying supine; d) staying prone; e) moving his/her legs and trunk and/or balancing the weight of the body in order to engage in any other activity. Also, you will notice instances of restricted and repetitive behaviours (e.g. hand flapping, tiptoeing, head and body back and forth movements, mouth fixations, etc.) that appear unusual and/or contextually inappropriate and may also compromise the infant-caregiver interaction.

7-8: Vote 7 or 8 if you notice several examples of severe sensorimotor impairment or the presence of repetitive gestures, movements and postures that will severely compromise the infant's ability to partake in other activities (i.e., the infant might repetitively push a button and perform no other action). Specifically, the infant will have clear problems in: a) walking; b) crawling; c) staying supine; d) staying prone; e) moving their legs and trunk and/or balancing the weight of the body in order to engage any other activity. Also, you will notice the constant and anomalous presence of restricted and repetitive behaviours (hand flapping, tiptoeing, head and body back and forth movements, mouth fixations, etc.) that occur not only when the infant is being stimulated, but also without any apparent reason.

A4 – Degree of attention to the motor sanction of the caregiver:

1-2: Vote 1 or 2 if for the entire or for the majority of the interaction, the infant spontaneously responds to the caregivers' movements when they are used to physically express the caregiver's intentions. These movements elicit a natural response from the infant, having both a pragmatic function (e.g. picking the infant up) as well as an emotional function (e.g. expressing joy and love). E.g. the infant comprehends and physically anticipates the caregiver's movement to pick him/her up in order to help facilitate the outcome.

3-4: Vote 3 or 4 if sometimes you have the impression that the infant's responses to the caregiver's movements - used to express their intentions and practical aims - appear slightly inappropriate, anomalous or deficient. That is, you have the impression that sometimes the infant is unable to anticipate the movements and gestures of the other and/or does not find them interesting. However, after a couple of attempts made by the caregiver, the infant will correctly respond to their attempts at physical interaction. As usual, you should vote 3 or 4 if his/her apparent lack of interest could be due to contextual factors like distraction, tiredness, confusion or boredom.

5-6: Vote 5 or 6 if you notice that the infant's responses to the caregiver's motor sanctions and movements are clearly inappropriate, anomalous or deficient. On several occasions, the infant seems "blind" to the overall purpose and to the practical and interactional nature of the motor sanction, impeding the development of a fluid and harmonious interaction. E.g. the infant does not physically anticipate the caregiver's movement aimed at picking him/her up in order to help facilitate the outcome, or, if s/he does, s/he "loses" her/his own body, showing miscoordination between the upper part of body and the legs, resulting in a loose body.

7-8: Vote 7 or 8 if the infant's responses to the caregiver's motor sanctions appear severely inappropriate, anomalous or deficient. The infant will appear unable to anticipate the movements and gestures of the other and/or does not appear to find them interesting. Not only are the behaviours of the infant deficient, they also heavily compromise the overall development of the interaction. Instead of responding positively to the caregiver's motor sanction, the infant will display either no response or an adverse response to the caregiver. For example, the infant will not understand and will appear unable to physically anticipate the caregiver's attempts to interact with her/him, or, if she/he tries, it will result in failure, showing bodily difficulties in coordination and a general lacking of bodily "intelligence". Instead of producing the responses seen in 1-2 scoring criteria, he/she will never help to facilitate the outcome of an action and may appear completely uninterested in the caregiver (or will appear as actively resist the caregiver's attempts to engage him/her).

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The Doing (B)

B1 – The doing together:

1-2: Vote 1 or 2 if for the majority of the interaction, the infant appears interested and responsive to the caregiver's indications, suggestions, questions and requests. This will manifest in the infant partaking in a shared interaction or game, with the infant showing a clear desire to involve the caregiver in the shared activity. Similarly, the infant may also explicitly invite the caregiver to partake in an interaction.

3-4: Vote 3 or 4 if you sometimes have the impression that the infant, perhaps due to being distracted or busy, does not always respond to the caregiver's indications, suggestions, questions and requests, so that they sometimes have mild trouble in enjoying a common interaction and/or game. The infant could appear less responsive and/or less interested in taking part in a shared activity. This might be shown by avoiding the other's requests, words, gestures, so that the caregiver has to insist slightly harder to elicit some kind of appropriate reaction from the infant.

5-6: Vote 5 or 6 if you notice frequent and/or clearly inappropriate responses from the infant to the caregiver's indications, suggestions, questions and requests, so that they demonstrate clear problems with structuring a common pathway of interactions. Pay particular attention to the infant carrying on in his own business and/or previous activity, while the caregiver (or someone else) tries to introduce a new activity. Vote 5 or 6 if the caregiver seems to struggle with coordinating her/his actions with the infant in order to play or complete a task and the interaction between them appears awkward or difficult. The infant will avoid and/or react inappropriately (with odd and inappropriate sounds, words and gestures compared to the present type of activity) to the requests and cooperative tasks.

7-8: Vote 7 or 8 if you notice that the infant constantly gives reiterated and/or severely inappropriate responses to the caregiver's indications, suggestions, questions and requests, so that they have clear problems in structuring a common path of interactions. In this case, the infant will seem to be unaware of, uninterested in, or even annoyed by the other's requests. The infant's behaviours can be avoidant, inappropriate, disconnected or even hostile.

B2 – Mutual gaze while doing together (caregiver and infant looking at each other):

1-2: Vote 1 or 2 if for the majority of the interaction, the infant looks to meet the caregiver's gaze or/and responds well to the caregiver's gaze whenever they are involved in a shared game or activity. The infant looks for the other's gaze, responds to it spontaneously, and purposefully initiates eye contact in order to receive information regarding the proper course of the interaction, the specific type of activity needed, a potential need of help, a situation of uncertainty, etc.

3-4: Vote 3 or 4 if you notice that the infant sometimes avoids the other's gaze or does not always purposefully look for it when involved in an activity, instead preferring to focus on other kinds of stimuli (e.g. a toy). Vote 3 or 4 if the gazing activity produced by the infant is not always used to communicate with the caregiver and the infant needs one or a couple of attempts to be made by the caregiver to start making eye contact.

5-6: Vote 5 or 6 if the infant mostly avoids eye contact or does not look to meet the other's gaze while involved in an activity, instead showing some kind of odd and inappropriate gazing patterns. For instance, the infant could prefer to focus on details aside from the caregiver's gaze (e.g. nose, forehead), or their face (e.g. arms, feet), or might focus on surrounding stimuli, even if these stimuli appear to be contextually irrelevant (e.g. lights, parts of objects, or staring blankly). ASD infants frequently: i) do not look to meet the other's gaze or respond to it; ii) rarely use eye contact in a communicative way (e.g. as to coordinate a pattern of action during a shared activity, or to obtain further information about the activity or situation by looking at the caregiver's gaze – for instance, to understand if the situation is safe, etc.).

7-8: Vote 7 or 8 if the infant seems "blind" to the others' gaze during social interactions, completely lacking the natural tendency to look into the eyes of other people. Vote 7 or 8 if the infant never seems to respond to the caregiver's gaze, nor can he/she communicate with others by using his/her eyes. Instead, he/she will frequently focus on details aside from the caregiver's gaze (e.g. nose, forehead), or their face (e.g. arms, feet), or will focus on surrounding stimuli, even if these stimuli appear to be contextually irrelevant (e.g. lights, parts of objects, or staring blankly).

B3 – Joint attention (pay attention both at the beginning and the end of a task), exploratory behaviour and communication with caregiver:

1-2: Vote 1 or 2 if the infant responds to the caregiver's invitations, indications and requests (e.g. words, sounds or gestures) to look for, or focus on, toys and objects in order to help an interaction. One example would include playing with a toy together. Another would be if the infant spontaneously asks for, points towards, indicates and/or shows (with words, sounds or gestures) some object or stimulus (e.g. a toy) in order to solicit the caregiver's attention. In general, be aware that, to rate 1 or 2, it must be clear that a single object (e.g. a toy or tool) can be the focus of attention of *both* the infant and caregiver, and that both infant and caregiver appear to be aware that the other is focusing on the same thing.

3-4: Vote 3 or 4 if you have the impression that sometimes the infant, being busy or distracted, avoids or does not properly respond to the caregiver's invitations, indications and requests (with words, sounds or gestures) to look for, or focus on, objects in order to help an interaction . Additionally, he/she may not always spontaneously ask for, point towards, indicate and/or show (with words, sounds or gestures) some object or stimulus that would otherwise be expected to gain the infant's interest during a particular situation. The infant may still pay attention to the same objects as the caregiver but may appear slightly less interested in such objects or may interact with the caregiver less frequently, only starting to respond to the caregiver after some attempts.

5-6: Vote 5 or 6 if the infant frequently does not respond to the caregiver's invitations, indications and requests (with words, sounds or gestures) to look for, or focus on, objects, or responds to them inappropriately. Additionally, he/she will mostly avoid asking for, pointing towards, indicating and/or showing (with words, sounds or gestures) any object or stimulus as would be expected for that kind of situation. It might appear that the infant is largely uninterested in objects and situations that are of interest to the caregiver, preferring playing or being engaged in his/her own isolated activities.

7-8: Vote 7 or 8 if the infant never responds to the caregiver's invitations, indications and requests (with words, sounds or gestures) to look for, or focus on, objects inappropriately or does not respond at all. Additionally, he/she might lack completely any communicative abilities to use words, sounds or gestures to refer to an object or stimulus as would be expected for the kind of situation. The infant appears completely uninterested in partaking in an interaction with the caregiver and does not display interest in things which interest the caregiver: he/she prefers playing alone, apparently focusing on uninteresting or inappropriate stimuli or objects (e.g. lights, textures, parts of toys, etc.), despite all the attempts made by the caregiver to involve him/her in a shared path of actions.

B4 – Degree of attention to the behavioural sanction of the caregiver:

1-2: Vote 1 or 2 if for the majority of the interaction, the infant is interested in the sanction of the caregiver during and/or after a shared activity. A behavioural sanction should be interpreted as every kind of evaluation (positive or negative in tone) that is used to reinforce the infant's actions. This reinforcement can occur both during or after the infant has performed an action and can be used to motivate, encourage and help the infant to orient their performance and develop relevant skills. When applied correctly, the sanction is so pleasant and functional that the infant may decide to begin any kind of interaction simply in order to receive the positive recognition of the caregiver.

3-4: Vote 3 or 4 if you see that sometimes the infant requires a couple of attempts from the caregiver to respond to the sanction. He/she appears slightly distracted and sometimes unfocused on the caregiver's behavioural sanction, preferring other kinds of stimuli due to contextual reasons: the infant could be busy or distracted and, after one or more attempts, he/she reacts appropriately to the other's sanction.

5-6: Vote 5 or 6 if the infant seems quite clearly uninterested in, or rarely interested in, the behavioural sanction of the caregiver. Often, the infant does not appear to react to the caregiver's words, sounds and gestures and prefers to act on his/her own without interference, even after attempts are made by the caregiver. The infant does not appear to show interest in receiving any motivation from the caregiver, nor will the infant appear to seek the caregiver's instruction to complete an activity.

7-8: Vote 7 or 8 if the infant seems constantly uninterested in the behavioural sanctions of the caregiver; he/she seems "blind" and "deaf" to them. The infant does not react, or reacts improperly to, the caregiver's words, sounds and gestures. Instead, the infant continues to act on his/her own, seemingly without noticing the caregiver's attempts to engage him/her. That is, the infant never reacts to the sanction or always reacts in a contextually inappropriate way; using contextually inappropriate words, sounds or gestures that apparently lack any common and easily understandable communicative purpose.

The Feeling (C)

C1 – Caregiver and infant mutually regulating their emotional state (pay particular attention to infant talk by the caregiver):

1-2: Vote 1 or 2 if for the whole or the majority of the interaction, the infant responds well to the caregiver's emotional words, gestures, expressions, and shows emotion in a contextually appropriate way. The infant will be seen to spontaneously match their emotional state in accordance with the caregiver's state which, in turn, will influence the caregiver's emotional state, allowing an emotional reciprocity and coordination to develop. Examples may include emotional gestures (i.e. arm movements that indicate joy), smiles, and other signs that the infant imitates or responds to in an emotional way. However, do not overestimate the so-called infant talk, the spontaneous kind of "lullaby voice" produced by the caregivers to communicate with infants. These sounds elicit the infant's reactions locally, usually making him/her laugh and/or respond with a similar emotional response also in interactions lacking these reciprocal emotional dynamics.

3-4: Vote 3 or 4 if sometimes you have the impression that the infant does not respond to the caregiver's emotional expressions when he/she would be expected to, and instead appears slightly distracted, busy or attracted by other kinds of interesting stimuli. He/she may have to be elicited a couple of times before responding to, and appearing to be engaged by, the caregiver's various emotional states – e.g. smiling after a smile, laughing after a laugh, laughing and/or smiling while moving towards the caregiver with open arms after he/she spoke gently to the infant.

5-6: Vote 5 or 6 if you clearly notice that the infant frequently fails to respond to the caregiver's emotional expressions when he/she would otherwise be expected to, and/or if the infant seems to respond in an emotionally inappropriate way. To vote 5 or 6, the infant must be emotionally elicited several times before responding, and even then, the infant may appear uninterested in the content of the caregiver's emotions. The infant may also frequently fail to make any kind of appropriate response when a certain type of emotional response would otherwise be expected.

7-8: Vote 7 or 8 if the infant never responds to the caregiver's emotional expressions when a response would otherwise be expected, and/or if the infant always responds in an emotionally unattuned and/or inappropriate way. The infant will clearly appear uninterested in the other's emotional state, as if he/she was blind and deaf to the caregiver's emotional expressions and does not seem to care about producing emotional expressions himself/herself. On the contrary, the infant's attention and emotions are more clearly elicited by surrounding stimuli, particularly objects. Thus, the infant's expressions are clearly inappropriate and are not used in any communicative way. In fact, the caregiver's attempts to interest the infant could even appear annoying for them, causing them to avoid the caregiver or to react negatively to the caregiver's actions.

C2 – Mutual gaze while interacting not immediately related to the doing (caregiver and infant looking at each other); i.e. infant looking directly at (or just above?) the camera:

1-2: Vote 1 or 2 if for the whole or majority of the interaction, the infant spontaneously makes eye contact with the caregiver and responds to the caregiver's gaze in order to create an emotional connection. This may also – but not necessarily – occur while the infant is performing some other action with the caregiver. While the B2 criterion was aimed at detecting a mutual gaze that is used in order to assist a *specific* set of actions and interactions, in this case, observe if the gaze is used to express an emotional state, regardless of any kind of practical aim (even though it can assist it), since making eye contact is often intrinsically meaningful and emotionally pleasant for humans from the first weeks of life.

3-4: Vote 3 or 4 if you have the slight impression that, at certain points of an interaction, the infant does not always respond to the caregiver's gaze when the caregiver looks at him/her, and the infant shows a slight tendency to avoid making eye contact. The infant may require a couple of attempts from the caregiver before successfully making eye contact with him/her. This rare lack of willingness could be due to the infant being distracted by other activities or stimuli. Alternatively, the infant may just require more effort from the caregiver.

5-6: Vote 5 or 6 if you notice that the infant frequently fails to meet the caregiver's gaze whenever the caregiver looks at him/her. Also, note if the infant has the persistent tendency to not initiate eye contact. For instance, the infant could show a tendency to move their gaze laterally (also not focusing on any particular stimulus), focusing on details apart from the caregiver's gaze (e.g. nose, forehead, arms) or focusing on surrounding stimuli, even if they appear to be contextually irrelevant or not meaningful (e.g. lights, parts of objects, or staring blankly).

7-8: Vote 7 or 8 if the infant never (or almost never) responds to the caregiver's gaze when the caregiver looks at them, and/or if the infant never initiates eye contact himself. The infant may still be visually attracted to other types of stimuli aside from the caregiver's gaze and may also be seen to move his/her eyes in a peculiar way. Thus, in a way even more obvious than in the previous scoring-criterion items, the caregiver is unable to make meaningful eye contact with the infant, and cannot recognise emotions nor reciprocally communicate their emotions with the infant.

C3 – The emotional facial expressions (with particular attention to smiles) showing emotional attunement:

1-2: Vote 1 or 2 if, for the majority of the interaction, the infant spontaneously reacts to the caregiver's facial expressions whenever they are used to communicate an emotional state, and/or when the infant produces facial expressions to communicate an emotional state. Generally, the infant's emotional state should develop alongside the caregiver's, influencing each other through mutual expressions. For instance, during a joyful situation, when the caregiver smiles at the infant, he/she responds accordingly with a smile or, the infant smiles spontaneously at the caregiver to express his/her joy and love. At the same time, the infant might appear sad or concerned if the caregiver appears angry or worried, thus matching their facial expression to the situation appropriately.

3-4: Vote 3 or 4 if you have the impression that the infant does not always respond to the caregiver's facial expressions, and/or if the infant has the tendency to not always produce clear emotional facial expressions at the appropriate moments and/or in the appropriate way. E.g., the infant may not always smile back at the caregiver, or she may produce a grimace when it would be more appropriate to smile. However, to vote 3 or 4, these apparently inappropriate or surprising expressions should not occur frequently and may still change during the interaction, thus not compromising its development.

5-6: Vote 5 or 6 if you clearly notice that the infant does not respond to the caregiver's facial expressions when looking towards him/her, and/or if the infant has the tendency to not produce emotional facial expressions directed towards the caregiver at the appropriate moments and in the appropriate way. That is, for the majority of the interaction, the infant does not seem to be driven by the natural tendency to respond to the other's facial expressions. The infant may produce facial expressions unexpectedly and without any contextual reason in a way that lacks any obvious communicative purpose. E.g. the infant i) could smile in the others' direction but without smiling directly at them; ii) could produce no expression at all; iii) could produce other emotional facial expressions without any obvious reason.

7-8: Vote 7 or 8 if for the majority of the interaction the infant does not respond to the caregiver's facial expressions when looking at him/her, and/or if the infant fails to produce and direct emotional facial expressions to his/her caregiver at the appropriate moments, and/or in the appropriate way. Vote 7 or 8 if the infant seems to completely lack interest or motivation in responding to the other's expressions, if she/he repeatedly produces facial expressions unexpectedly in a way that seems to lack any contextual reason or apparent communicative purpose. E.g. the infant i) could smile in the others' direction but without smiling directly at them; ii) could produce no expression at all; iii) could produce other emotional facial expressions without any obvious reason.

C4 – Degree of attention to the emotional sanction of the caregiver:

1-2: Vote 1 or 2 if the infant constantly and spontaneously appears interested in receiving the caregiver's emotional sanction. For instance, if s/he appears happy after receiving praise or appears disappointed or sad after a negative comment, action or emotion connected to his/her behaviour. Usually, for every infant the (positive) emotional sanction is often so pleasant and interesting that it motivates the infant to start any kind of interaction and intersubjective activity just to receive the emotional recognition of the caregiver.

3-4: Vote 3 or 4 if you have the slight impression that sometimes the infant does not respond to the caregiver's emotional sanction because he/she is busy, distracted or prefers other kinds of stimuli. Therefore, being focused on other stimuli, the infant needs the caregiver to stimulate him/her more often with repeated emotional sanctions. However, even if the infant is slightly distracted and does not always respond with expected enthusiasm and fluidity to the other's solicitations as in the previous criterion (1-2), the infant's reactions do not impede the development of the interaction. He/she just needs to be "boosted" slightly more.

5-6: Vote 5 or 6 if you clearly notice that the infant frequently fails to respond to the caregiver's emotional sanction when looking towards him/her, and/or if the infant has the tendency to respond inappropriately. That is, for the majority of the interaction, the infant appears uninterested in the caregiver's emotional sanctions, and usually does not respond to them and/or responds inappropriately (e.g., when the caregiver encourages the infant, he/she cries). The caregiver has to make several attempts before obtaining a reaction, which will frequently be inappropriate. For example, after the caregiver tries to elicit an emotional response by smiling, talking, laughing towards/with the infant, he/she could react by screaming, crying, ignoring or producing non-communicative noises.

7-8: Vote 7 or 8 if the infant, for the majority of the interaction, does not respond to the caregiver's emotional sanctions, and/or if the infant almost always reacts inappropriately, compromising the proper rise or development of the interaction. Vote 7 or 8 if the infant seems to completely lack interest in the caregiver's sanctions and does not appear motivated to respond to them appropriately, if the caregiver is unable to create a space of reciprocal emotions, if the infant lacks the capacity to make any kind of appropriate reaction (appearing blind and deaf to the caregiver's attempts) and/or frequently reacts inappropriately. For instance, after numerous failed attempts by the caregiver to obtain an emotional reaction by smiling, laughing, gesturing or speaking, the infant might react by screaming, crying or producing unexpected noises and/or repeating words or sounds.