Mimicry as a tool for early screening of Autism Spectrum Disorder

Mimetismo como ferramenta para o rastreamento precoce do Transtorno do Espectro Autista

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**Abstract**

This is a theoretical paper in which we address the question of mimicry, one type of imitation behavior, in the first year of life through a phenomenological perspective. We conceptualize imitation in the first year of life with an emphasis on intentionality and argue that there are two types of imitation phenomena in infants: non-intentional and intentional imitation. As a conclusion, we generate the hypothesis as to whether mimicry could be used to the screening of Autism Spectrum Disorders so that it does not rely solely on questionnaires or expensive structured interviews.

**Keywords**: Mimicry; Screening; Early detection; Autism Spectrum Disorders; Phenomenology.

**Resumo**

Abordamos, neste artigo teórico, a questão do mimetismo, um tipo de comportamento de imitação, por meio de uma perspectiva fenomenológica. Analisamos a imitação no primeiro ano de vida com ênfase na intencionalidade e argumentamos que existem dois tipos de fenômenos de imitação em bebês: imitação não intencional e imitação intencional. Como conclusão, levantamos a hipótese de que o mimetismo poderia ser usado para a triagem de Transtornos do Espectro Autista de forma que não dependa apenas de questionários ou entrevistas estruturadas de difícil acesso.

**Palavras-chaves**: Mimetismo; Rastreamento; Detecção precoce; Transtorno do Espectro Autista; Fenomenologia.
Introduction

Although Autism Spectrum Disorders (ASD) prevalence seems to be the same around the world (Elsabbagh et al., 2012), the vast majority of research on ASD has been carried out in high-income countries (Durkin et al., 2015). Advancements in early diagnosis of ASD have been put forward by biomarkers such as eye-tracking measures of social attention (Bradshaw et al., 2019). Nonetheless, the costs associated with it tend to perpetuate inequality in the screening of children for early interventions in low-income countries. In order to develop an autism surveillance program in low-income countries, a low-cost and feasible tool that could be used by front line health care workers would be the ideal instrument. Such a tool is important for primary care services to detect ASD earlier and plan for early intervention. The design and implementation of a screening program for ASD is beyond the scope of this paper. Our aim is to conceptualize mimicry as an early marker for altered social development in infants.

Interpersonal synchrony, imitation and mimicry are considered prosocial behaviors (Lakin et al., 2003). Imitation is a behavioral match in interpersonal coordination (Hove and Risen, 2009), an essential pro-social behavior to social-communicative function and it is expected to be present since the first steps of development (Bandura, 1969; Rochat, 2012; Meltzoff and Moore, 1977; 1983; 1989; Meltzoff 1988; Dijksterhuis and Bargh, 2001). Imitation parameters could be useful to assess infants who diverge in early stages of interpersonal response (Pauknner al at., 2014). Imitation can be pre reflexive, unconscious; its neurobiological underpinnings may lie on the mirror neurons (Gallese et al., 1996; Gallese et al., 2004; Dimberg et al., 2000; Carr et al., 2003; Preston and De Waal, 2002). Imitation can be also conscious, intentional (an element to fulfill the needs of whoever performs the action), and self-initiated, encompassing self-awareness that the self is the one who is the author of the action (Haggard and Clark 2003). The conscious and intentional imitation is contingent on the ability to recognize the boundaries between the self and the other (Piaget 1999, 2000).

Intentional and non-intentional imitation

If we take in consideration the descriptions of Jean Piaget (1999, 2000) as well as of other important developmental theorists such as Bowlby (1951), Stern (1985), Mahler (1968), we can consider the end of the first semester of life as a benchmark to delimitate when infants will perceive themselves as separate from others. After this realization, an interpersonal relationship is truly possible as there is I and you (Gallese, 2014). This form of interpersonal
relationship *I-you* brings intentionality to the equation. Therefore, after the 6th month of life, in addition to the ability to imitate unintentionally (mimicry), comes the ability to imitate others intentionally (Piaget 1999, 2000) and both phenomena will continue throughout life.

Based on the ability to recognize the self and the other as separate entities, we propose the definition of two types of imitation phenomena. The "Intentional Imitation" (*II*) occurs when infants can consider their own selves as separated from others in an interpersonal relationship *I-you*. This allows for an infant at this stage of development to appreciate that there is some intentionality in the relationship. Once a boundary is drawn between the self and another, it becomes possible for one to imitate another with an intention such as the intention to draw a response from another (Hamlin, 2007). Thereafter, infants will reproduce actions knowing that this imitation in itself has an impact in the social world (Tomasello and Carpenter, 2005). Imitation from now on implies an understanding of intentions and is not limited to an unconscious, unintentional reproduction of another person’s muscle movement (Call and Carpenter, 2002). Therefore, *II* can only appear when infants can perceive themselves as separate from others what occurs after the first semester of life as cited above.

The other type of imitation, defined in this article as "Non-Intentional Imitation" (*NII*) refers to the imitation phenomenon that occurs without a conscious intention to imitate, without intentionality in the act, being limited to an unintentional copying behavior (Call and Carpenter, 2002). Consequently, there is no need to perceive the other as separated to the self in order to *NII* to happen. The *NII* can occur in any moment of life and examples of it encompass the tongue protrusion observed since birth (Meltzoff and Moore, 1977; Field et al., 1982; Massen, 2017). If, by definition, mimicry is an unintentional reproduction of another person’s muscle movement, mimicry can be considered a paradigm of a *NII*.

As we postulated above, the first semester of life is characterized by a period when the infant cannot experience a boundary between the self and another, which makes intentional behavior impossible. So, in this period of time, the imitation phenomenon is restricted to its unintentional form (*NII*). After the second semester of life, the imitation phenomenon acquires the ability to also perform its intentional form (*II*) in parallel with *NII*.

**Mimicry**

Mimicry is a specific imitation phenomenon restricted to unintentional reproduction of another person’s muscle movements at any age (Want and Harris, 2002), for example when
adults match postures, gestures, prosody and syntactic constructions (Chartrand and Bargh, 1999). According to Hess and Fischer (2013), mimicry can be considered a social behavior and is related to the roots of empathy (Chartrand and Bargh, 1999; Sonnby–Borgström, 2002; Lakin et al., 2003; Hove and Risen, 2009). Empathy occurs when the other person is experienced as another but, at the same time, as similar. An important component of similarity is the common experience of actions, grounded in our lived bodily pre reflexive experience, establishing an embodied interindividual link. “Whenever we look at someone performing an action, beside the activation of various visual areas, there is a concurrent activation of the motor circuits that are recruited when we ourselves perform that action. Although we do not overtly reproduce the observed action, our motor system becomes nevertheless active as if we were executing that very same action that we are observing.” (Gallese, 2003, 174).

Such behavior can be observed since the first days of life as follow. Isomura and Nakano (2016) demonstrated that infants in the first semester of life respond to emotional expression on others by activating facial mimicry. Paukner at al. (2014) demonstrated neonatal imitation in one-week-old infant monkeys. Nagy et al. (2014) used an easy and feasible imitation test in order to show that neonates learn and imitate some gestures.

ASD is associated to altered brainstem function, limiting expressive movements of the eyes, face, and vocal muscles, which affects early development of preverbal social skills (Rodier and Arndt, 2005; Teitelbaum et al., 1998). We found few studies with preliminary data indicating that mimicry can be impaired in autistic subjects. Impaired imitation abilities have been observed in children over 24 months of age diagnosed with autism in a case-control study of 32 subjects (Carpenter et al., 2005). According to another case-control study, mimicry seems to be impaired in autistic teenagers and adults (McIntosh et al., 2006). Autism is associated with a deficit on spontaneous mimicry in children such as while passively observing certain movements on others (Oberman et al., 2009; Cattaneo, 2007). For instance, typically developed children activated mylohyoid muscles (which promote the movements that lower the jaw and raise the tongue for reaching-to-grasp-to-eat) when they watch another person eating, but in autistic individuals there was no anticipatory activation (Cattaneo et al., 2007).

In this paper we will argue that the assessment of mimicry can be used as a tool for screening of children with a high risk to develop autism. However, in order to use mimicry for this purpose, we still have one open question: what is the best moment during the first year of life to assess mimicry? Is there a golden period to use mimicry as a screening tool? The question
of timing is pertinent because mimicry is present throughout life and, most importantly, because autistic individuals with impaired mimicry can show normal responses when explicitly instructed to copy the expression, a behavior called emulation (McIntosh et al., 2006; Hamilton, 2008; Edwards, 2014). Autistic children can copy a behavior, but they fail to spontaneously initiate it (McIntosh et al., 2006).

Mimicry as a screening tool for ASD

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impairments in social interactions and communication and by the presence of restricted and repetitive behaviors (American Psychiatry Association, DSM-5, 2013). Although the diagnosis should be made with caution in children less than 18-month-old, early interventions make the greatest impact in those with ASD (Dawson et al., 2012; Dawson, 2009).

Early signs of autism can be included in the large group of imitative behaviors encompassing mimicry, imitation, and emulation (Want and Harris, 2002) as follows. Individuals diagnosed with ASD show since early age reduced ability to initiate joint attention to share interests or emotions (Osterling and Dawson, 1994; Bruinsma et al., 2004), excessive mouthing of objects and aversion to social touch (Matson et al., 2008), and weaker interpersonal synchrony in a dyadic interaction (Yun et al., 2012; Hari et al., 2013; Yirmiya et al., 2006). Longitudinal studies have showed that infants later diagnosed with autism begin to statistically diverge from typical development around the 12th month in regard to social reciprocity (Landa et al., 2012; Ozonoff et al., 2010). While typical developing infants show a preference for looking at faces in the first semester of life (Maestro, 2005), infants later diagnosed with ASD show less attention to a person or to a person’s face at the age of 6-month-old (Chawarska et al., 2012).

The ability to look at another face seems to be intact at birth in infants who are later diagnosed with ASD, but it starts to diverge from typically developing infants between the second and sixth month of life (Jones and Klin, 2013). Feldman (2007a, 2007b) had indicated that from an evolutionary perspective, the transition from touch to vision around 2 to 3 months is a shift from maternal behaviors shared by all mammals to relational behaviors that are exclusively human and suggested that parents could accentuate mutual gaze in order to stimulate the emerging social brain. The importance of eye gazing in infant development cannot be overstated given that it is during face-to-face interactions in shared contexts that the
groundwork for social understanding is laid (Jaegher and Di Paolo, 2007; Fuchs and Jaegher, 2009; Gallagher, 2011).

Given that early interventions have been shown to affect the course of autism (Dawson et al., 2012; Dawson, 2009), the American Academy of Pediatrics has recommended that 18-and 24-month-old children be screened for ASD (Johnson and Myers, 2007). However, it is plausible that interventions before 12 months could have a role in mitigating or preventing the developmental delays and autistic behavior patterns even earlier (Rogers et al., 2014; Bradshaw et al., 2014; Estes et al., 2015; Zwaigenbaum et al., 2015) and it could also be more cost-effective than those interventions designed for toddlers (Cidav et al., 2017). Therefore, there is a large interest in the field to identify feasible tools for screening early signs of ASD.

After this brief discussion, we can return to our question: what is the best moment during the first year of life to assess mimicry as a screening tool for ASD? If we consider that II is less affect than NII in ASD, we should look for a period when imitation behavior is restricted to its NII form. Thereafter, we propose that the first semester of life is a golden period to evaluate mimicry as a screening tool for ASD, a period where the mimicry is restricted to NII. A potential bias caused by imitation behaviors with intention is naturally excluded in this period of life. Consequently, the only possible imitation phenomenon in the first semester of life is the NII. Considering mimicry a type of NII phenomenon, it follows that it could be a feasible screening tool for early social behavior.

Particularly in the first semester of life, when imitation is predominantly unintentional and represented by mimicry, the presence or absence of mimicry components (unintentional) can indicate early disruptions in NII. The first semester of life is a golden period to screen for the presence or absence of mimicry. In addition to these theoretical analyses, we have to emphasize that mimicry of facial muscle movements is considered a feasible measure (low-risk, low-cost), and has a long timeline research of reliable scoring options described (Bavelas et al., 1986; Lakin et al., 2008). Also, mimicry can be easily assessed, even at the neonate period (Nagy et al., 2014). The parameters more frequently cited as promising strategies to identify incipient ASD are MRI, EEG and eye metrics (Zwaigenbaum and Penner, 2018). Mimicry could be considered an interesting option to early identification of individuals with high risk of developing ASD, however, to our knowledge, there is no data about mimicry as a screening tool for ASD in first semester of life.
Conclusion

To the best of our knowledge, this is the first attempt to address the different types of imitation phenomena in early development with a compelling argument for the experiential use of it as a marker for ASD. Our article explores the use of facial mimicry as an empirical representation of the imitation phenomenon.

ASD is a disorder characterized by a deviation in interpersonal relationships and earlier in this article, II seems to be less altered than NII in ASD adolescents and adults subjects. Although NII seems to be altered in ASD patients, its assessment in the second semester of life can lead to confusion because it is a period of infant development when the imitation phenomenon encompasses both intentional and unintentional features. In other words, the existence of intentionality towards another in the second semester of life associated with intentional imitation may conceal a deficit in NII. Given that the first semester of life is a period of the development in which a child conceives his/her self as blended to caregiver, that precludes the presence of intentionality in any imitation behavior in contrast to when imitation occurs in the second semester of life. Therefore, a pristine assessment of NII is only possible in the first semester of life which is when the II phenomenon has not emerged yet. Moreover, the assessment of facial mimicry, a type of NII, in the first semester of life could potentially become a feasible and inexpensive tool to be used for the screening of infants with high risk of ASD. This hypothesis should be trialed in community studies to determine its accuracy in detecting infants that deserve preventative interventions for autism.
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