

# Beyond the Point: A Basic Guide to Literature on Pointing Abilities in Children with Autism

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## ABSTRACT

Research on core behavioral features of autism spectrum disorder (ASD) has always been a challenging endeavor. Amongst these features pointing abilities have often attracted attention of researchers. Traditional studies on pointing tended to rely mostly on the distinction between imperative and declarative pointing, but research has gradually recognized the importance of developmental trajectories and the relevance of other skills in the acquisition of pointing in children with ASD. The present study aims to offer a basic review of the literature on pointing in children with ASD, in order to explain these changes in research focus and to pinpoint relevant aspects of pointing that have emerged across time which may be of relevance for future studies.

**KEYWORDS:** Children, Autism, Pointing, Development, Gestures, Performatives.

## 1. Introduction

Autism spectrum disorder (ASD) (encompassing Autistic Disorder/Autism, Asperger syndrome and Pervasive Development Disorder-Not Otherwise Specified) is a neurobiological developmental disorder, characterized by deficits in social reciprocity, verbal and nonverbal communication and high frequency of repetitive/stereotypic patterns of behaviors and interests (DSM-IV-TR, American Psychiatric Association, 2000).

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To date, consecutive surveys have shown that ASD affects around 6:1000 children under six years of age (Chakrabati & Fombonne, 2005). Even if in the last years research has stressed a progressive increase in prevalence estimates, this phenomenon is mostly due to revisions in the definition of ASD and improved awareness, rather than to changes in incidence (Fombonne, 2003). Exact causes of ASD are yet unknown, however genetic factors play a strong role (Volkmar et al., 2004). Unlike other syndromes (e.g. Down syndrome, Williams syndrome), whose genetic underpinnings have been clearly described (Korenberg et al., 2000; Hattori et al., 2000), an ‘autism gene’ is far from being available and genetic research focus has shifted to analyzing either small subsets of individuals sharing a genetic risk or considering links between number of affected genes and specific behavioral features (Geschwind, 2011; Sanders et al., 2011). Consequently genetic descriptions are important, but may in no way replace assessments of behavioral outcomes, which are very relevant for families, educators, therapists and individuals with ASD themselves, in understanding strengths and challenges of this syndrome (Charman et al., 2011; Lord & Jones, 2012). Age of diagnosis may vary, but is usually around 3 years of age (Stone et al., 1999). There is currently no known cure for autism, but research shows that early diagnosis and intensive therapeutic interventions may positively alter developmental trajectories (Charman & Howlin, 2003). Therefore research efforts are focused on defining core behavioral features of ASD, which may guide genetic research, aid early diagnosis and suggest appropriate therapeutic interventions.

However, the quest to identify indicative and consistent behavioral signs has always proven to be a huge challenge for researchers and clinicians alike. Not only due to the high variability (at both individual and group levels) characterizing ASD, but also to non-linear developmental changes, which take place in core symptoms. For example, repetitive behaviors are less observable in very young children and in high-functioning adolescents and adults, while more evident in preschool or school-age children (Volkmar et al., 2004; Lord & Jones, 2012). Furthermore, research on ASD has recently focused on the problem of onset, which is extremely relevant in examining how and when early behavioral signs of autism may emerge. Various studies had highlighted two divergent patterns of onset. The more common early onset pattern, stating that children with autism display unusual behaviors in orienting to name, gaze to faces, joint attention and affective sharing from 2 years of age, even if some early signs may be detected at 1 year of age. On the other hand, the regressive

pattern of onset, which involves about 20% of the population, stresses that between 1 and 2 years of age, children with autism show loss of various communicative behaviors. Furthermore, parent reports have documented a third phenomenon called ‘stagnation’ (i.e. a lack of gain of specific skills, for example the acquisition of one or two words, but then no further word development) occurring around 18 months (Siperstein & Volkmar, 2004, see Ozonoff et al., 2010 for a review).

Among behavioral features, pointing ability has often been analyzed in both past and present research on ASD. One of the major frameworks for ASD diagnosis lists among possible impairments in social interaction “lack of spontaneous seeking to share enjoyment, interests, or achievements with other people (e.g. by a lack of showing, bringing, or *pointing out* objects of interests)” (DSM-IV-TR, American Psychiatric Association, 2000 p.70, italics added). Furthermore, the main tool in diagnostic evaluation, the Autism Diagnostic Observation Schedule (ADOS) evaluates, in its novel edition which includes toddlers (i.e. children from 12 months onwards) the production of pointing towards an object that is at least 2 inches away and that occurs without touching the object (within language and communication skills) and level of pointing understanding (within reciprocal social interactions) (Lord et al., 2012). To the contrary, the initial draft of the new edition of the DSM, scheduled to appear in May 2013 and currently under revision, does not explicitly refer to pointing, but rather to non-verbal behavior and gestures (DSM-V, American Psychiatric Association, 2013).

Therefore the aim of this paper is to provide a basic guide to major breakthroughs and defeats met by studies considering pointing in children with ASD from the seventies to date, in order to understand how impairment in pointing has been considered as a relevant behavioral feature. Furthermore, analyzing how pointing has been studied may also allow us to suggest which aspects of this skill should be subject to further analysis so as to aid the construction of future research paradigms.

## 2. Brief overview of pointing in typically developing children

The first, necessary step will be to clarify what ‘pointing’ means, in relation to the literature on ASD and to introduce a few relevant categories that allow different types of pointing to be distinguished. Secondly, a brief description of

pointing in typical development will be presented in order to better understand findings related to ASD.

Pointing is a gesture used to direct one's own or someone else's attention at, to or upon something, commonly used during social interactions. In its most common form pointing is described as a gesture in which "the index finger and arm are extended in the direction of the interesting object, whereas the remaining fingers are curled under the hand, with the thumb held down and to the side" (Butterworth 2003, p 9). However, this is a definition of children's index finger pointing, and many other forms of pointing may exist. For example, pointing may be performed using other body parts (e.g. head and/or eye movements, lip-protruding, etc.) or specific features of pointing (e.g. hand shape, movement, etc.) may be modified to convey further information (e.g. moving the index finger while pointing may be used to depict the characteristic movement of the object which is being pointed out)(Kendon, 2005; Enfield, 2001; Kendon & Versante, 2003). However studies on pointing in children with ASD refer only to index finger pointing, and often provide a rather vague definition of this motor act and do not allow us evaluating if other features (e.g. hand shape, movement, etc.) are exploited by children with ASD.

In relation to pointing function, some distinctions are often made in the literature on ASD. The first and most important distinction is between imperative and declarative pointing. This distinction was clearly made by Bates, Camaioni & Volterra (1975) in a paper describing communication development and starting from Austin's (1962) distinction of speech acts as locutionary, illocutionary and perlocutionary. Within development the child is observed to go through an initial perlocutionary stage, during which the child's bodily states manifest in some form of overt behavior produce an effect, intentional or non-intentional, on adults (e.g. a child's crying may be taken by an adult to indicate hunger). Then an illocutionary stage kicks in, requiring the intentional use of a conventional signal (verbal or non-verbal) to carry out a function (e.g. pointing out the presence of an object or an event). Finally the child enters a third locutionary stage, distinguished by speech onset (Bates, Camaioni & Volterra, 1975).

During the illocutionary stage the same non-verbal action can be made to convey different illocutionary forces. For example when a child points towards a cookie, she may be performing an imperative act (e.g. "I want the cookie") or a declarative one (e.g. "Look, a cookie!"). Both performatives (imperative and declarative) appear first on the "plane of action" (i.e. as actions) within non-

verbal behavior, amongst which pointing gestures emerge, and contribute to building ready-made schemes later exploited by words and propositions.

In particular, on the “plane of action”, pointing is observed to gradually emerge, among other skills, as a way of attracting adults’ attention upon specific events/objects in the environment. In fact, starting from a very young age (between 7 and 12 months) children gradually display behaviors aimed at showing-off (i.e. they perform exaggerated or unusual actions so as to gain or retain adults’ attention)(Reddy, 2003). These behaviors are a prelude to successive acts of showing and giving involving objects, which in turn lead to pointing (Camaioni, Volterra & Bates, 1976). Initially, children may be seen using pointing when alone or without searching for the adult (e.g. while examining a picture book). These occurrences of pointing-for-self, also termed referential pointing (Goodhart & Baron-Cohen, 1993), slightly precede pointing-for-others, possibly emerging from early motoric explorations of objects (Bates, Camaioni & Volterra, 1975). Later on, the child may point to an object, then point to the mother and again point to the object, outlining a sequencing of acts (Camaioni, Volterra & Bates, 1976). Similar sequences, performed also by coordinating motor acts and gaze patterns (e.g. checking with gaze to see if the adult is looking, pointing and then checking again) will later characterize full-blown pointing. Another type of pointing should also be listed alongside imperative, declarative and referential pointing, that is informative pointing. This is the type of pointing that is used in providing information to another person, for example on the location of an object (Liszkowski et al., 2009).

All these actions (i.e. showing-off, showing, giving, pointing-for-self, pointing-for-others), contribute to building occurrences of joint attention between child and caregiver, and play a relevant role in social development (Trevarthen & Hubley, 1978). Joint attention can be defined as the ability to “use definite procedures (e.g. showing a toy) to coordinate attention between interactive social partners with respect to objects or events in order to share an awareness of the objects or events” (Mundy et al., 1986, p. 657).

As other non-verbal behaviors, full-blown pointing has been linked to specific motor patterns that emerge very early in development and motor antecedents of pointing production have been observed in infants before the first year of life. For example, index finger extensions without an outstretched arm movement seem very relevant as they appear during mother-infant interactions at 2 months (Fogel & Hannan, 1985; Masataka, 2003), while

pointing to explore proximal objects by poking them is present at 9 months (Bates et al., 1979). However, consistent use of the type of index finger pointing described above emerges around 11 and 12 months, often accompanied by vocalizations (Carpenter, Nagell & Tomasello, 1998; Leung & Rheingold 1981). In particular, soon after 10 months infants produce forms of pointing toward proximal objects, while pointing toward distal objects seems to emerge only later at 13 months (Butterworth 2003). The distinction between proximal/distal pointing is therefore important, as the former appears earlier and is comparatively easier than the latter. Understanding of pointing slightly precedes production and requires accuracy in bridging the gap between the observed pointing hand and a pointed out target. This ability emerges between 6 to 12 months, but is strongly influenced by context, e.g. target distance (Morrisette, Ricard, & Decarie, 1995) or movement (Grover 1988). By 12 months typically developing children have usually acquired both the understanding and use of pointing (Behne et al., 2012).

Other skills, which accompany the pointing gesture, continue to change well after pointing has emerged. This is the case for timing of visual checking, i.e. timing of gaze oriented towards the other person in order to check if he/she is paying attention to the pointing gesture. Visual checking may occur before, during or after pointing and at 12 months typically developing children mainly check immediately after pointing, while at 14 months the opposite tendency starts to emerge (i.e. checking before pointing) and by 16 months visual checking before pointing surpasses both checking during and after pointing (Franco & Butterworth, 1996).

Pointing is not only related to other joint attention and motor skills, but also linked to language. In fact, during early stages of child language, speech and gesture are primarily interrelated through deictic gestures, which support establishing joint attention situations in which language will eventually emerge (Capirci et al., 2005). Furthermore, pointing onset has been traditionally considered a predictor of the appearance of first words and the amount of pointing at 12 months allows to predict speech production rates at 24 months (Bates et al., 1979; Pizzuto & Capobianco, 2005; Camaioni et al., 1991). Furthermore, research on developmental disorders has shown that some populations use gestures to compensate for speech difficulties (e.g. children with Down syndrome) (Caselli et al., 1998).

This brief overview of pointing in children with typical development will allow to us better understand studies on pointing in ASD.

### 3. Initial observations on pointing behavior in children with ASD

The first studies on pointing abilities in children with autism appeared in the early seventies. Their main scope was to extend previous observations on language deficits in autism by considering non-verbal communication.

One of the first studies used retrospective parent questionnaires to compare the behavior of children with autism between 2 and 5 years of age with four control groups (i.e. aphasic, partially blind or deaf, Down syndrome or typically developing). The authors found that children with autism were impaired in both the understanding and use of pointing (Wing & Wing, 1971). Comparison with children with Down syndrome, highlights the fact that children with autism, contrary to other populations, do not use gestures to compensate for speech difficulties.

Subsequent research partially confirmed initial results, but also showed a discrepancy between pointing comprehension and production in autism; comprehension being less impaired than production. In fact, children with autism produced very concrete actions to obtain their goals (e.g. pushing an adult's hand on a tap when wanting to drink), later demonstrating "slow and imperfect evolution of the symbolic gesture of pointing" (Ricks & Wing, 1975, p 202), which could be improved through therapeutic intervention (Webster et al., 1973).

The first study to introduce functional distinctions in studies on pointing in autism, was performed by Curcio (1978) with the aim of evaluating if observed variability in non-verbal communication of autistic children may be due to sensorimotor functioning. This often-cited study analyzed pointing production and comprehension in an older group of children with autism (range 4 to 12 years), specifically assessing proto-declarative and proto-imperative pointing. Results showed that in children with autism pointing occurs rarely (5 out of 12 children with autism) always in the imperative and never in the declarative mode. In explaining his results Curcio implicitly modifies the definition provided by Bates and colleagues of imperative/declarative pointing, which he takes respectively as indicating: a need-fulfilling function and the function of drawing adults' attention to the existence/properties of an object. This change in definition contributed, as shall be seen, to detach imperative pointing from acts aimed at gaining adults' attention.

Summing up, initial studies on pointing in children with autism highlighted an impaired profile and lack of pointing to compensate for speech. More

importantly two discrepancies were introduced: between production and comprehension (pointing production being more impaired) and between imperative and declarative pointing (the former being less impaired than the latter).

#### 4. The eighties: different theoretical approaches to pointing

The first four studies considering pointing abilities in children with autism appeared in the 10 years between 1971 and 1980; the rate at which new studies appeared tripled in the 6 years between 1984 and 1990. This increased attention towards pointing was not dictated by an increment in the number of studies dedicated to overall gesture behavior (see Sparaci, Lasorsa & Capirci in preparation), but resulted from a specific interest in pointing. Two different theoretical approaches to pointing emerged, which may be termed: the joint attention (JA) approach and the theory of mind (ToM) approach.

The JA approach was focused on explaining more complex language deficits, as stemming from failures in the acquisition of early developing joint attention skills in infancy or early childhood. Studies starting out from this hypothesis evaluated pointing behavior in autism together with other behaviors scaffolding joint attention (e.g. showing, reaching, giving, gaze orientation etc.), to confirm or discard a bottom-up approach to the acquisition of social communication skills.

The ToM approach aimed instead at explaining deficits in social cognition present in autism, explained as following from impaired theory of mind abilities. Within this view, impaired social interactions originate from a lack of meta-cognitive skills, that in children with typical development are implemented in dedicated and independent mental modules allowing the ascription to others of mental states, such as intentions, beliefs and desires, to understand their behavioral outcomes (Baron-Cohen, Leslie, & Frith, 1985; Leslie, 1987). Studies on pointing in autism within this approach tended to analyze pointing *per se* and often referred to the imperative/declarative distinction.

A study by Loveland and Landry (1986) best exemplifies the JA approach. This work compared the behavior of young children with autism (mean age 5;8 years) to an equivalent group of children with Developmental Language Delay (DLD), matched for nonverbal mental age and mean length of utterance. The



authors analyzed joint attention skills among which was the comprehension of attention-directing gestures (i.e. pointing and showing) in the presence or absence of speech. They expected children with autism to have more difficulties in gestural joint attention behaviors and to produce only a restricted repertoire of gestures and less pointing than children with DLD. Results showed that both groups possessed the same gesture repertoire, but they differed when the developmental level of produced gestures was considered. In other words, the likelihood that a child with autism would produce pointing towards distant objects was extremely low, but to achieve a similar goal he might instead produce more simple proximal behaviors (i.e. touching and taking). Comprehension was less impaired especially when gestures were produced in the absence of speech. This early study allowed to suggest that communicative disorders present in autism may extend beyond linguistic functions and originate in impairments in joint attention skills, such as pointing. In fact, the authors stressed that by acquiring joint attention children with typical development are able to achieve appropriate strategies and techniques, that in turn support an appropriate use of language within social contexts (i.e. strategies and techniques that support language pragmatics) (Loveland & Landry 1986, p. 346).

Further research with this type of approach confirmed reduced frequency of pointing in specific social contexts (Landry & Loveland, 1989) and showed which joint attention behaviors were spared (i.e. reaching or giving) and which were impaired (i.e. pointing, showing or checking) compared to both chronological and mental age controls (Mundy et al., 1986).

Following these observations subsequent studies started to suggest that measures of gestural joint attention could be useful for both diagnostic and therapeutic purposes. In fact, initial attempts were made to use these measures in discriminating children with autism from other populations (Mundy, Sigman, & Kasari, 1990), while training methods were assessed to enhance pointing vs. instrumental acts (Carr & Kemp, 1989).

During the same period the ToM approach to pointing emerged in a pivotal paper by Simon Baron-Cohen, changing the theoretical background of studies mentioning the imperative/declarative distinction. In fact, shortly after Curcio's initial observations further research had supported the existence of dissociation among imperative/declarative pointing in children with autism (Wetherby & Prutting, 1984) even at older ages (Attwood, Frith, & Hermelin, 1988). Therefore, Baron-Cohen chose to specifically evaluate comprehension

and production of imperative/declarative pointing in two groups of children with autism compared to verbal mental age matched controls with Down syndrome and typical development. Comprehension was assessed in children with autism between 6 and 16 years, while production was assessed in children with autism between 3 and 5 years. Results showed that children with autism were impaired in both comprehension and production of declarative pointing in comparison to other groups, but not in comprehension and production of imperative pointing (Baron-Cohen, 1989).

This study explicitly cited the classification proposed by Bates and colleagues and their distinction between proto-declarative and proto-imperative pointing. However, Baron-Cohen considerably changed, the definition of proto-imperative pointing, possibly following in Curcio's tracks. In fact, Bates and colleagues considered both imperative and declarative pointing as illocutionary acts (i.e. intentionally produced signals) with different "forces" (i.e. to request or alternatively to point out an object/event). To the contrary, Baron-Cohen classified proto-imperative pointing as not a specific type of illocutionary act, but as a perlocutionary act, therefore placing it among non-intentional signals and distancing it from proto-declarative pointing which remained an illocutionary act. Within this view, the lack of proto-declarative pointing in children with autism is taken as evidence in favor of impaired ToM skills, as it is described as a precursor of theory of mind skills or better as an "*essentially similar* ability" which in and of itself requires a theory of mind (Baron-Cohen 1989, p 124). To the contrary Bates and colleagues had been more prudent, stating that in occurrences of declaratives it is difficult to be certain of the degree to which the child understands the adult's mental activities and that acts such as showing, giving and pointing serve an attention-maintaining social function, where the child wishes the other to *attend* rather than *assume* (Bates, Camaioni & Volterra, 1976, p. 68). Therefore, affecting the other's overt attention behavior rather than the other's inner assumptions.

Baron-Cohen's work had great influence on subsequent literature and further studies were designed in order to assess the specificity of a declarative pointing deficit in ASD. For example, the fact that adolescents with autism (mean age 13;7) produced referential pointing,<sup>1</sup> while they did not produce

<sup>1</sup> Defined as pointing at or touch-pointing an image in a provided picture book so as name it, indicate its position or distinguish it from others, without orienting gaze towards the experimenter.

proto-declarative pointing,<sup>2</sup> was taken as an indication that pointing impairments in autism were not due to impaired motor skills, but to lack of theory of mind skills (Goodhart & Baron-Cohen, 1993).

It is interesting to note that the authors made little or no reference to the fact that pointing-for-self precedes declarative pointing in typically developing children. In fact, by explicitly stating that the presence of referential pointing cannot be related to later impaired abilities in autism, the authors seem to consider this skill as static and to ignore the fact that it typically precedes declarative pointing. On the other hand, declarative pointing is in turn considered as a skill lacking a developmental history, only related to impaired ToM abilities in autism. In this way the authors lack to consider that presence of pointing-to-self in absence of proto-declarative pointing may be taken to indicate severe developmental delays in gestural production.

Summing up, in the eighties studies on pointing abilities in children with autism greatly increased and two background approaches began to circulate: the JA and the ToM approach. These approaches differed in many ways. First of all, their initial aim was different. In fact, the JA was meant to explain language deficits while the ToM wished to explain deficits in social cognition. Secondly, they differed in how they analyzed pointing abilities. The ToM approach was more explicitly focused on pointing and its functions rather than on overall JA skills. Thirdly, they considered different age groups. The JA approach usually considered younger children. Finally, they did not consider developmental factors equally relevant towards understanding pointing in children with autism. In fact, developmental factors were almost completely absent in the ToM approach.

##### 5. The nineties: the role of developmental changes and joint attention skills in analyzing pointing

In following years the discrepancy between imperative/declarative pointing highlighted by Baron-Cohen continued to attract research attention. However various studies started to highlight the necessity to correlate deficits in declarative pointing with other factors, i.e. development and other joint attention skills.

<sup>2</sup> Defined as pointing at or touch-pointing an image in a provided picture book so as to show it to the experimenter, while alternating of gaze orientation between the experimenter and the image. This type of pointing could also be accompanied by verbal commands such as: 'Look at this'.

The first longitudinal study on pointing was carried out on four children with autism (from 2 to 4 years of age) to assess pointing comprehension and production in absence of speech and measure the imperative/declarative discrepancy in development. Results showed that imperative pointing was easier for children with autism and emerged at an earlier stage (in all 4 children with autism), while declarative pointing (present in 3 out of 4 children with autism), emerged at a later stage (Camaioni, 1997). However, once again the performance of children with autism was reported to be comparable to 16 months old typically developing children on measures of “using the adult as a too”, e.g. when a child is hungry s/he may physically lead the mother to where the food is rather than point out that place. Children with autism also displayed some conventional gestures (e.g. head shaking, waving bye-bye, handclapping), but these are reported as being performed rather mechanically, appearing linked to the social routines in which they had been initially acquired.

In the same year a cross-sectional study by Stone and colleagues analyzed nonverbal communication in children with autism of the same age-range considered by Camaioni’s longitudinal study. Nonverbal behavior of children with autism was compared to children with developmental delay or language impairment matched on chronological age, mental age and expressive vocabulary. Results indicated that in contrast to previous studies children with autism did not show a discrepancy in the production of imperative vs. declarative distal pointing. What emerged instead was overall reduced production of pointing (i.e. only 2 out of 14 children with autism used pointing and they used it both in an imperative and a declarative way). The authors suggested that children’s chronological age may have determined this result, but also that, since pointing was observed only in children that produced some form of comment, other joint attention abilities may be a “developmental prerequisite for the emergence and continued use of communicative pointing” (Stone et al., 1997).

Soon afterwards, another study analyzed one of these skills, i.e. gaze behavior, and in particular the temporal relationship between gaze checking and pointing. This study considered children with autism between 3 and 7 years of age, subdivided into two groups according to symptom severity, and compared them to two control groups (i.e. children with developmental language disorder and with typical development). Children’s behavior during semi-structured interactions with a caregiver while watching TV or playing

with some blocks was videotaped and scored. Data surprisingly showed no difference in the number of pointing occurrences, but children with high-functioning autism were less likely to visually check before pointing if the caregiver was attending to their behavior compared to other control groups, while in visually checking during and after pointing they were similar to controls (Willemsen-Swinkels et al., 1998). While anomalous gaze patterns are a well known phenomenon in children and adults with autism (Nakano et al., 2010), a specific deficit in checking before pointing had not previously been documented. This is particularly interesting considering that typically developing children have, by this age, acquired appropriate checking behaviors. In fact, this result may indicate that pointing must be considered alongside other skills in order to evaluate its developmental level and communicative power in autism. Furthermore, it appears interesting that results reported in this study derive from spontaneous social actions from the child towards a parent who was given precise instructions to refrain from social interaction, contrary to what happens in most experimental setting, where experimenters are requested to actively engage with children. Possibly familiar settings and lack of excessive stimulation, may be preferable to children with autism who are usually very sensitive to the presence of an excess of perceptual inputs.

Summing up, in the nineties studies on pointing in children with autism, while starting out from the imperative/declarative distinction, had to reconsider the importance of analyzing developmental patterns and other joint attention skills. Similar claims would soon be explicitly raised in relation to other developmental disabilities; highlighting the relevance of analyzing developmental patterns, rather than supporting theories about independent modules, as if atypical development could be simply explained by describing intact vs. impaired skills (Karmiloff-Smith et al., 2003). Cited studies on pointing in children with ASD contributed towards delineating the complexity of an apparently simple ability.

## 6. A new century: grounding the complexity of pointing skills

By the turn of the century research on pointing in ASD started to consider the imperative/declarative distinction, a useful tool, but unable to capture alone the complexity of pointing in children. In fact, researchers gradually recognized the difficulty of unpacking unique patterns of social

communication displayed by children with autism and defining core impairments across age and development (Lord & Jones, 2012). This was also due to the fact that traditional theoretical constructs proposed as social deficits, such as theory of mind or joint attention, highlighted non-linear developmental patterns (Bowler, 1992; Gillespie-Lynch et al., 2012). Therefore, recent research on ASD has attempted, on one side to better define developmental patterns and on the other to consider for analysis others skills, not directly social in nature, but contributing towards social impairments.

In an attempt to better define developmental patterns in ASD a considerable amount of research has analyzed infant behavior before the age of diagnosis (i.e. before 3 years of age). In particular, this research has prospectively studied infant siblings of children with ASD (i.e. high-risk infants) compared to children without any family history of ASD (i.e. low-risk infants). Behavioral features of high-risk infants have been analyzed either because they have a higher probability of developing ASD (studies within this approach usually subdivide the high-risk group based on later diagnosis and compare infants with ASD to other groups) or because they present what has been termed ‘broader autism phenotype’, i.e. milder impairments in the three primary areas impaired in ASD, that resemble characteristics of ASD and often occur in first degree relatives of persons with ASD (studies on the broad phenotype usually exclude children who later develop ASD from the study sample). Studies on siblings have interestingly shown that during the first years autism appears to be a disorder involving symptoms across multiple domains, that only later result in severe communication impairments, rather than a disorder of the social domain from the start (see Rogers, 2009 for a review).

In fact, a growing number of studies have started to hypothesize that other deficits present in ASD, which may or may not be uniquely social, have an impact on social interactions. For example, recent research, also by employing novel techniques, has stressed the relevance of impairments in the production and understanding of motor actions towards developing understanding of others intentions (Cattaneo et al., 2007; Boria et al., 2009; Vivanti et al., 2011; Sinigaglia & Sparaci 2010; Sparaci et al., submitted).

These novel research trends, i.e. analysis of infant behavior relying on siblings of children with ASD and renewed interest towards other skills, may be traced also within studies on pointing in children with ASD.

In particular, a study on infants with ASD analyzed pointing, showing and giving using parent questionnaires at 9 and 12 months in a group of high-risk

infants and in a comparable group of low-risk infants. The high-risk group was later assessed at 24 months and subdivided into three different groups based on diagnosis: ASD, DLD and typically developing. Results showed that while at 9 months the only gesture that appeared significantly in all groups was extending the arms to be picked up, by 12 months pointing, showing and giving occurrences emerged. At 12 months, infants with ASD differed in overall gesture production only from the low-risk group, but interesting patterns emerged by considering individual gesture types as infants with ASD produced less pointing and showing. In particular, they significantly differed in amount of pointing as compared to typically developing children, but not in comparison to the DLD group. While infants with ASD differed in amount of showing they differed as compared to all other groups. The authors take this data to indicate that showing may be a better predictor of ASD in high-risk infants compared to pointing, which does not allow differentiating between ASD and DLD at 12 months (Clements & Chawarska, 2010). This study is particularly interesting as it evaluates different performatives, attempting to go beyond pointing. However, results could be also taken as indicating an overall delay at 12 months in the development of performatives in children with ASD. In fact, showing is considered a precursor to pointing in typical development, appearing before 12 months and serving to scaffold the emergence of giving and pointing.

This hypothesis is strengthened by another study on the broader autism phenotype, evaluating social engagement and nonverbal communication, which highlighted in high-risk infants a significant delay in language development by 14 months and significantly fewer giving and pointing gestures with or without eye contact compared to low-risk controls. Lower non-verbal performance was also correlated to less social engagement measured at 4 months (Yirmiya et al., 2006). Another study on the broad phenotype confirmed overall reduced production of social gestures and particularly of distal gestures (i.e. gestures that do not involve touching the object, for example distal pointing) in high-risk infants between 18 and 25 months. While this same study showed no differences in high-risk infants' amount of gaze shifts or in gaze/point following (Toth et al., 2007).

Furthermore, two longitudinal studies on children diagnosed with ASD have recently highlighted unusual developmental trajectories of pointing in toddlers with ASD. In particular a longitudinal study assessing toddlers with ASD at 2 and 3 years, showed that scarce occurrences of index finger pointing

increased in frequency with age, but gaze switches remained scarce and there was an increase over time of developmentally early forms of joint attention, e.g. ‘bringing to dump’ an object beside the adult (Drew et al., 2007).

Recently another study used both cross-sectional and longitudinal data to define developmental trajectories in production and comprehension of nonverbal skills, including imperative/declarative pointing and showing, in children with autism. Cross-sectional data, collected in a group of children with ASD between 3 and 6 years and in matched controls, showed that both imperative and declarative pointing emerged before showing, while overall pointing and showing emerged in children with autism when their expressive language age was well above 20 months, contrary to controls that had already acquired these skills at an earlier stage. The longitudinal data, collected on a group of children with ASD between 3 and 4 years, reported no occurrences of showing, while occurrences of pointing only partially confirmed previous results, as in two thirds of the sample pointing emerged when expressive language age was above 20 months, while in remaining children it appeared earlier (Paparella et al., 2010).

These results suggest that children with ASD may not acquire performatives (e.g. showing and pointing) in the same sequence as typically developing children. Not only showing emerges after pointing, but the timing of the appearance of showing and pointing is notably later than expected.

In relation to studies analyzing other skills, not strictly-speaking social skills, but which may influence social interchange, it is important to cite a recent study dedicated to gaze performance of children with ASD during the observation of pointing actions.

In this study gaze patterns of children with autism, children Pervasive Developmental Disorder and typically developing children at 6 years of age were analyzed using an eye-tracker device while observing short videos of an adult looking, pointing or looking and pointing at an object. Authors showed reduced accuracy only in the autism group, while latency was correlated to verbal IQ in all groups (Falck-Ytter et al., 2012). As gaze performance plays an important part in understanding pointing, results may be taken to show not only that inappropriate gaze patterns may differ within ASD, but also that these patterns are linked with other social communicative skills.

Summing up, recent studies highlight unique developmental patterns in the acquisition of pointing skills in infants with ASD, also with the aid of studies considering high-risk groups. Furthermore, novel techniques are being used



to evaluate other skills, traditionally considered not uniquely social, which may however influence the acquisition of social pointing abilities.

## 7. Conclusion

This short guide to literature on pointing skills in children with ASD has described the rise and fall of different approaches from the seventies to date.

This review allows suggesting an initial explanation for changes and revisions made in criteria for diagnosis in relation to pointing in children with ASD, i.e. the passage from explicitly mentioning performatives (i.e. giving, showing and pointing) in diagnostic criteria, to mentioning non-verbal behavior and gestures in general. As detailed above, even if occurrences of performatives are reduced in ASD, various studies have shown that they are not completely absent and that their reduced number may be due to differences in developmental patterns, which are difficult to identify.

Another important aspect that emerging from this review is how the imperative/declarative distinction, while retaining its usefulness in behavioral descriptions, has to be enriched in order to retain its value.

Summing up, studies on pointing impairments in ASD have allowed researchers to highlight unique developmental patterns in the acquisition of early skills, which later influence social interactions. Considering recent literature on the role of the motor system in specific social skills (see Rizzolatti & Sinigaglia 2010 for a review), future studies may consider other motor skills that accompany pointing and analyze how children with ASD modulate specific motor features of index finger pointing.

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