

# Imitation and ‘theory of mind’ competencies in discrimination of autism from other neurodevelopmental disorders

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## Abstract

Several studies have reported imitative deficits in autism spectrum disorder (ASD). However, it is still debated if imitative deficits are specific to ASD or shared with clinical groups with similar mental impairment and motor difficulties. We investigated whether imitative tasks can be used to discriminate ASD children from typically developing children (TD) and children with general developmental delay (GDD). We applied discriminant function analyses to the performance of these groups on three imitation tasks and tests of dexterity, motor planning, verbal skills, theory of mind (ToM). Analyses revealed two significant dimensions. The first represented impairment of dexterity and verbal ability, and discriminated TD from GDD children. Once these differences were accounted for, differences in ToM and the three imitation tasks accounted for a significant proportion of the remaining intergroup variance and discriminated the ASD group from other groups. Further analyses revealed that inclusion of imitative tasks increased the specificity and sensitivity of ASD classification and that imitative tasks considered alone were able to reliably discriminate ASD, TD and GDD. The results suggest that imitation and theory of mind impairment in autism may stem from a common domain of origin separate from general cognitive and motor skill.

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Imitative deficits in autism spectrum disorder (ASD) are well documented. A recent review that considered 21 studies (Williams, Whiten, & Singh, 2004) revealed that the majority found imitative deficits in the ASD groups compared to other groups, with a highly significant combined effect ( $p < 0.00005$ ).

Despite this wealth of research, the specificity of imitative deficits to ASD is still debated. Many studies have demonstrated imitative deficits in ASD compared to groups of developmentally delayed children. However, other studies have also found a relationship between verbal mental age and imitative performance in ASD children (Roeyers, Van Oost, & Bothuynne, 1998; Stone, Ousley, & Littleford, 1997), with verbal mental age accounting for 11% of imitative performance in one study (Smith & Bryson, 1998). The relationship between imitation and verbal mental age suggests that imitative deficits observed in ASD can be partially accounted for by general developmental delay and may thus be shared with other clinical groups exhibiting developmental delay.

Imitative deficits observed in ASD might be secondary to other co-morbid traits typical of ASD. For example, children with autism often have praxis deficits that are likely to affect their imitative performance. A study that compared ASD with dyspraxic children revealed ASD-specific imitative deficits in spite of the fact that the dyspraxic children had more severe motor difficulties (Green et al., 2002). However, a recent study suggested that a generalized praxis deficit could account for imitative deficits in ASD (Mostofsky et al., 2006). Children with autism also display problems in planning of motor actions. For example, using a task where children had to place a bar on a support, Hughes (1996) observed that compared to controls, children with autism had marked problems in planning a comfortable action using information from sensorial feedback. Hence, difficulties in planning an efficient goal-directed sequence of actions might underlie imitative deficits, but similar difficulties are likely to be common to other clinical groups with motor problems. Because imitative deficits are associated with developmental delay and motor problems that are also common in other clinical groups, it is still an open question whether imitative deficits are a specific feature that could help in discriminating ASD children from typically developing children and from children in clinical groups with global developmental delay and motor problems.

In this study, we investigated if imitative performance could contribute to the reliable discrimination of ASD from a group of children with typical development (TD) and a group of children with general developmental delay (GDD). We took a multivariate approach, running discriminant function analyses to investigate which combinations of variables can most reliably discriminate the individuals of different groups, and in turn predict group membership of individuals. Rather than directly matching the groups, our strategy was to exploit the multivariate approach of the discriminant function analysis to investigate associations between indicators of intellectual development (verbal tests), motor abilities and other variables, including imitation performance. Variables considered for predicting group membership included three imitative tasks, a dexterity test, a theory of mind battery, a motor planning test and a test of verbal abilities (BPVS–II). Our goal was to test whether imitative performance can be reliably included among the indicators that discriminate children with ASD from other children. Secondarily, we wanted to investigate the contribution of imitation performance in correctly classifying ASD, TD and GDD children.

We selected imitative tasks where children with autism display more difficulties. ASD children seem to be able to copy meaningful actions or functional actions performed on objects, probably because similar actions can be copied using well-rehearsed actions or because objects “afford” specific actions (Williams et al., 2004). Conversely, ASD children seem to have more severe problems in imitating non-meaningful gestures, gestures that do not involve objects and

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