Research in Developmental Disabilities 34 (2013) 3822–3832

Contents lists available at ScienceDirect

Research in Developmental Disabilities

Understanding goals and intentions in low-functioning autism☆

Eszter Somogyi [a,*], Ildikó Király [b], György Gergely [b], Jacqueline Nadel [c]

[a] Department of Cognitive Psychology, Eötvös Loránd University, Izabella u. 46, H-1064 Budapest, Hungary
[b] Cognitive Development Center, Department of Cognitive Science, Central European University, Nádor u. 9, H-1051 Budapest, Hungary
[c] Centre Émotion, UMR 7593, Pavillon Clérambault, Hôpital de la Salpêtrière, 47, Boulevard de l'Hôpital, 75013 Paris, France

ARTICLE INFO

Article history:
Received 22 March 2013
Received in revised form 23 July 2013
Accepted 30 July 2013
Available online 7 September 2013

Keywords:
Autism
Understanding goals
Intentionality
Deferred imitation

ABSTRACT

We investigated ability to understand goals and attribute intentions in the context of two imitation studies in low-functioning, nonverbal children with autism (L-F CWA), a population that is rarely targeted by research in the domain. Down syndrome children (DSC) and typically developing children (TDC) were recruited to form matched comparison groups. In the two sets of simple action demonstrations only contextual indicators of the model's intentions were manipulated. In the Head touch experiment the model activated a button on a toy by pushing it with the forehead, whereas in the Hidden box experiment the model used a ball with a magnet to lift a box out of its container. Both actions were unusual and non-affordant with regards to the objects involved, none of the children in the baseline condition produced them. L-F CWA imitated the experimenter exactly, regardless of the model's intention. TDC showed appreciation of the model's intention by imitating her actions selectively. DSC reproduced only the intentional action as often as they imitated the experimenter exactly. It is concluded that L-F CWA attributed goals to the observed model, but did not show an appreciation of the model's intentions even in these simplified, nonverbal contexts.

Children interpret and predict others' actions on the basis of the mental states they attribute to the actor. Autism is associated with a specific cognitive deficit in inferring and representing mental states, as documented by seminal studies showing difficulties with false belief tasks (Baron-Cohen, 1995; Baron-Cohen, Leslie, & Frith, 1985; Leslie & Thaiss, 1992; Perner, Frith, Leslie, & Leekam, 1989; Sodian & Frith, 1994) and with pretend play (Wing, Gould, Yeates, & Brierley, 1977). Mental states, however, vary in nature; beliefs, desires, goals, intentions, emotions as well as perceptions have been proposed in literature (Frith, Morton, & Leslie, 1991; Luo, 2011; Premack & Woodruff, 1978; Saxe, Carey, & Kanwisher, 2004; Vivanti et al., 2011). Goals, for instance may be considered as mental states that are more 'transparent' or observable in behaviour than beliefs and desires, at least under a broad mentalising theory (Hamilton, 2009). Still, relatively few studies have investigated goal understanding in autism and most of these studies have involved high-functioning children with autism (H-F CWA). One of the aims of this study therefore was to assess goal understanding on the other end of the autistic spectrum, in low-functioning children with autism (L-F CWA). A further issue with existing reports is that they do not distinguish in all cases between an understanding of a goal as an internal state and the understanding of the visible outcome of a goal directed action, without inferring an intentional mental state. Therefore the other aim of our study was to better

☆ This research was funded by the Co-tutelle Scientific Exchange Programme of the French Government and was also supported by a grant from the Hungarian Science Foundation (OTKA) to the 3rd author (OTKA Grant #: NK 83997).
* Corresponding author. Tel.: +36 205856003.
E-mail addresses: somogyi.eszter@ppk.elte.hu, esomogyi@gmail.com (E. Somogyi).

0891-4222/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.ridd.2013.07.039

control this possibility by using imitation paradigms where the children's responses may indicate for us the different intentional mental states they attribute to the model across the experimental conditions.

1. Goal understanding in high-functioning autism

Studies that explored goal understanding in H-F CWA show that although understanding beliefs and desires is clearly impaired, the ability to read another person's intended goals is preserved. In fact, there are not many direct tests of whether individuals with autism understand action goals, but much information can be gathered from studies of imitation and experiments that explored how they interpret the actions of animated figures. We shall first review these two groups of studies.

Imitation research shows that CWA, high-functioning or with mild to moderate mental handicap for a few studies, can successfully imitate actions with clear goals, thus showing some understanding of goals. For instance, they reproduce object-use actions (Beadle-Brown, 2004; Charman & Baron-Cohen, 1994; Stone, Ousley, & Littleford, 1997), recognise and reproduce the goal of others' hand actions (Avikainen, Wohlschläger, Liuhanen, Hänninen, & Hari, 2003; Hamilton, Brindley, & Frith, 2007), and also perform well on nonverbal gesture recognition (Hamilton et al., 2007; Smith & Bryson, 1994) or gesture memory tasks (Rogers, Bennetto, McEvoy, & Pennington, 1996). Autistic children's imitation behaviour seems to be driven by goals' saliency, with more imitation in cases where the action has a clear and interesting outcome (a light or sound) compared to cases without an outcome (Ingersoll, Schreibman, & Tran, 2003). Hamilton et al. (2007) add to these results the finding that goal understanding is in fact an island of intact functioning in autism, in contrast to these children's poor performance on theory of mind tasks. In this study, three action tasks were proposed to CWA with moderate mental retardation, assessing goal-directed imitation, mirror imitation and grasp planning. Although CWA did not succeed as controls in the theory of mind tasks, there were no differences between the two groups in goal imitation.

Two studies, also using imitation as a measure, have asked whether H-F CWA expect agents to use the most efficient or rational means possible to reach their goals. Evaluating the effectiveness of an observed means is an important step towards reading others' intentions. Although these investigations are not conclusive regarding the rationality principle (Gergely, Bekkering, & Király, 2002; Gergely & Csibra, 2003), they provide further evidence showing that H-F CWA understand goals. For instance, Rogers, Young, Cook, Giolzetti, and Ozonoff (2010) compared the imitation of functional and non-functional acts on objects (to shake a maraca or to shake a potato masher) and found that CWA imitated the functional acts. They imitated less in the non-functional conditions; however, this does not necessarily mean that they did not understand these goals. Perhaps the children were simply less inclined to imitate in these conditions for two reasons, which we explain here in more detail because they are both relevant regarding the choice of tasks for our present study. Firstly, non-functional acts are less rational in the sense that they do not correspond to the common use of objects (and are therefore more social in nature – as shaking a potato masher may be an invitation to play or to share a pleasant moment). The absence of imitation in these tasks may simply reflect a preference for the imitation of functional actions with objects that highlight means–end relations (shaking a maraca corresponds to the object's function and brings about a salient effect). Secondly, in this particular case, in order to imitate a non-functional action, children need to suppress the action scheme that is activated by the object's affordances and common usage (which, in the case of the potato masher would be to make mashing movements). Perhaps a failure to imitate in these situations also reflects a failure to inhibit the usual action scheme. Studies that similarly report enhanced performance on meaningful imitation compared to meaningless imitation or the imitation of an action's style used pantomime or gestural imitation as measures where again the goal of the action was less manifest in the sense that it did not bring about a salient change in the environment (Hobson & Hobson, 2008; Rogers et al., 1996; Stone et al., 1997). The lack of imitation in the non-functional or meaningless conditions in these studies therefore does not necessarily reflect a failure to interpret actions being that are non-rational with reference to their goals. However, they provide clues regarding autistic children's imitative behaviour and show their preference for imitating goal-directed, functional actions with objects that stress means–end relations.

The second group of studies on goal understanding in H-F CWA examined how they interpret the actions of animated geometric shapes. The results show that they derive the goals of an action from the situation's physical parameters or the agent's kinematic properties just like controls (Abell, Happe, & Frith, 2000; Castelli, 2006; see also Castelli, Frith, Happe, & Frith, 2001 for a neuroimaging study with adults). In Abell et al.'s (2000) study the animations showed two triangles moving around the screen according to one of three conditions, where the different types of motions could be described either in terms of mental states, goal-directed actions or non-deliberate actions (such as random movement). Before each presentation, subjects were cued with character roles; for example, the two triangles were a mother and a child. In this study, H-F CWA gave descriptions of the goal-directed animations (e.g. fighting, chasing) and the random animations (e.g. floating, drifting) that were as accurate as the controls. They used mentalistic descriptions (e.g. tricking, being jealous) less than typical controls, frequently referring to mental states that were inappropriate to the animation. In a similar study by Castelli (2006), children saw a circle at the bottom of a U-shaped valley rolling up and down the slopes and getting closer to (but failing to actually reach) a target (another circle resting at the top of either side of the valley). The task was to decide about the final goal of the moving circle by clicking (with the computer mouse) on one of the five marked locations along the slopes. H-F CWA were as able as controls to infer the agent's intended goal, even though the target was never reached.

All the above studies indicate that goal understanding is indeed an island of intact functioning in H-F CWA. We can see, however, that further investigations involving L-F CWA are needed in order to confirm that ability is generally preserved in ASD. Only one study, by Nadel et al. (2011), explored observational learning in L-F CWA. Results show that they are able form long-term representations of actions involving several sub-goals and can also reproduce these actions if they have an