

RUNNING HEAD: ENGAGING WITH THE SELF

ENGAGING WITH THE SELF:

MIRROR BEHAVIOUR IN AUTISM, DOWN SYNDROME AND TYPICAL DEVELOPMENT

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Abstract

Children with autism achieve mirror self-recognition appropriate to developmental age, but are nonetheless reported to have problems in other aspects of a sense of self. We observed behaviour in the mirror in 12 pre-school children with autism, 13 pre-school children with Down syndrome and 13 typically developing toddlers. Reliable differences in reflecting actions, social relatedness and positive affect towards themselves, and an absence of coy smiles differentiated the children with Autism from the others. The children with Down syndrome showed the highest interest in their own faces. These differences were largely independent of mirror self-recognition, supporting arguments for a dissociation between interpersonal and conceptual aspects of self. Mirror behaviour may be a subtle but easily elicited measure of problems in the sense of self.

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In developmental psychology the mirror has become synonymous with the identification of the self, mirrors being used to identify children's recognition of the visual self (Lewis & Brooks-Gunn, 1979), of space in relation to the self (Mitchell, 1992), and the likelihood of self-conscious affective behaviour (Amsterdam, 1972; Lewis, Sullivan, Stanger & Weiss, 1989). But mirrors can also symbolise and allow a relation with, the Other. They can reflect the self back as the Self, as an Other, or as seen by an Other (Kernberg, 2006) or, indeed, as just another reflection. How one reacts to the self in a mirror allows us to study the extent to which the self is perceived and presented as a social being.

Self and other have been seen as mutually constitutive (Maclaren, 2008) with problems in the development of one necessarily reflected in problems in the other (Hobson, 1990). These arguments are strengthened by neurophysiological findings that common brain areas are involved in perceiving the actions of (Gallese, 2001) and processing information about, self and other (Iacoboni, 2006). However, there is an apparent dissociation between the two in disorders such as autism. Children with autism pass the mirror self recognition test (MSR) - a respected measure of a concept of self (Gallup, 1970; Lewis, Sullivan, Stanger & Weiss, 1989) - at a developmental age-appropriate level (Neuman & Hill, 1978; Dawson & McKissick, 1984; Spiker & Ricks, 1984; Ferrari & Matthews 1983). However, they show serious problems in their ability to relate to others (Dawson & Adams, 1984; Lord, 1993; Mundy, Sigman, Ungerer & Sherman, 1986; Hobson, 1990; 1993). They also show serious problems in other aspects of the self: in the awareness of pain and discomfort (Wing, 1996; although see Nader, Oberlander, Chambers & Craig, 2004), in responses to self as a person rather than as an object (Ritvo et al., 1971), in problems with showing self-conscious affects

(Neuman & Hill, 1978; Dawson & McKissick, 1984; Kasari, Sigman, Baumgartner, & Stipek, 1993; Bauminger, 2004; Hobson, Chidambi, Lee & Meyer, 2006).

What does this dissociation mean? Criticisms of the MSR relate not only to its adequacy as a stable indication of visual self-recognition (Loveland, 1984, 1993; Mitchell, 1993, 1997; Suddendorf, 1999) but more importantly, to the narrowness of visual self-recognition as a measure of a sense of self (e.g., Neisser, 1988, Loveland, 1993). Loveland suggests that we cannot conclude from age-appropriate success in MSR that children with autism have no problem with a sense of self. Rather, she argues, it is more likely that MSR only presupposes and demonstrates what Neisser (1993) calls an ‘ecological self’, i.e., the ‘self-who-is-located-here’ (Loveland, 1993) rather than an ‘interpersonal self’, i.e., the self-who-exists-in-relation-to-persons (including to the self as a person). The dissociation, therefore, may exist between different aspects of self: between self perceived or conceived as a body in space, and self perceived or conceived as a psychological or social entity.

Brief suggestive evidence to support this interpretation comes from two studies on MSR in autism. Neuman & Hill (1978) tested seven 5 to 11 year-olds with autism who showed similar proportions of interest in their mirror images to control infants, a variety of movements ‘to see if the image responded’ but no embarrassed or self-conscious reactions. Dawson & McKissick (1984) compared fifteen 4 to 6 year-olds with autism with typically developing infants from a previous study (Lewis & Brooks-Gunn, 1979) and found that lower percentages of children with autism vocalised to their own images, or directed behaviour to the mirror rather than to their own faces and none showed any ‘coy or silly behaviour’. However, from these studies we do not know at what targets children with autism do choose to look in the mirror, the proportion of different actions that they perform to themselves, or how the distribution of these preferences might overlap with those of children who are matched in terms of developmental delay and chronological age.

The mirror also puts the onus entirely on the viewer for *initiating* interaction. The ability to initiate is key to establishing joint attention (Nichols, Fox & Mundy, 2005) and possibly also mutual

attention (Reddy, 2003). Problems in autism with the initiation of declarative attentional engagements (Mundy et al 1986, 1994; Dawson, Toth, Abbott, Osterling & Munson, 2004) as well as with automatic mimicry of facial expressions (McIntosh, Reichmann-Decker, Winkielman, & Wilbarger, 2006) may sharpen the difficulty in engaging with the self. We would expect, in sum, that children with autism would show profound disturbances in social relatedness to the self in mirrors.

In the present exploratory study we compare social behaviour in mirrors and its relation to MSR in three groups of children: preschool children with autism, preschool children with Down syndrome (DS) and typically developing toddlers (TD). Children with DS also show developmental delay and developmental age-appropriate abilities in MSR (Mans, Cicchetti & Sroufe, 1978), reliable interest in the mirror (more than typically developing infants, Loveland, 1987), but unlike children with autism, no problems with the development of an interpersonal self. In TD toddlers the middle of the second year differentiates passers and failers on the MSR, and may be a critical time for investigating shifts in interest in the self (Nielsen et al 2003) and shifts in affect towards the self (Amsterdam, 1972; Amsterdam & Greenberg, 1977; see also Dixon, 1957) and thus provides opportunities for exploring, across the three groups, the relationship between MSR and social behaviour to the self. We explore three aspects of mirror behaviour: interest in looking at self rather than at other things, interest in relating socially with the self rather than testing reflections or just watching, and positive affect towards the self in the mirror.

Method

Participants and recruitment

The analyses of mirror behaviour in this study were conducted on a sample of 12 children with autism, 13 children with DS and 13 TD toddlers, all of whom were part of two larger studies of TD infants and pre-school children with autism and with DS. Parents of the children with autism were contacted through professional diagnostic clinics and organisations associated with the National

Autistic Society and through independent playgroups for children with special needs. Each child in the autism group had received a previous clinical diagnosis of autism from different clinicians in the National Health Service. These children were diagnosed at one of two different diagnostic centres in the south of England. In the absence of confirmatory diagnostic assessments, semi-structured interviews with parents and home observations were conducted to support previous clinical diagnoses. The parents of the children with DS were contacted with the help of the Portsmouth Down syndrome Trust and through independent playgroups and nursery schools. TD infants were recruited through GP surgeries. All families in the present study were white Caucasian, culturally British and of middle or low SES. None of the children in the three groups had any visual or motor impairments that could interfere with an ability to look in the mirror or demonstrate self-recognition through face-touching.

Matching and Demographic details

Table 1a shows the characteristics of the children in the three groups. The two groups of preschool children were matched on chronological age (CA) and Developmental Age using the Mental Development Index of the Bayley Scales of Infant Development (BSID-II) which combines both cognitive and language items and on Language Production (including signs) using the MacArthur Communicative Development Index (CDI). The TD toddlers were selected from the larger longitudinal study when they were given the mirror sessions: eleven were filmed at 17 months and two at 24 months. They were significantly different from both the other groups in CA but not in Developmental Age or Language Production (see Table 1a). Table 1b shows characteristics of MSR Recognisers and Non-Recognisers in each group: Developmental Age differentiated them in the Autism and DS groups, and CA in the Autism group; Language Production did not differentiate them in any group.

Table 1a. Characteristics of participants: Mean (SD) {Min-Max}

	Autism	DS	TD
N (boys, girls)	12 (10, 2)	13 (8,5)	13 (5, 8)
CA (months) ***	47.92 (6.6){36-56}	42.77 (7.7){31-56}	18.46 (2.73){17-25}
DevAge (BSID-II)	15.83(4.17){11-26}	18.46 (4.41){9-25}	18.69 (2.75) {15-25}
LangProduction (CDI)	14.48 (7.1) {8-28}	18.89 (4.39) {13-26}	16.61 (3.36) {13-23}

Table 1b. Characteristics of MSR Recognisers and Non-Recognisers: Mean (SD) {Min-Max}

	Autism		DS		TD	
	Recognisers	Non-Recognisers	Recognisers	Non-Recognisers	Recognisers	Non-Recognisers
N (boys, girls)	8 (7,1)	4 (3,1)	10 (7,3)		8 (4,4)	5(1,4)
CA (months)	51.5 (3.55)*	40.75 (5.25)	44.8 (7.33)	36.0 (5.0)	19.25 (3.28)	17.2 (.45)
DevAge (BSID-II)	17.5 (4.07)*	12.5 (1.73)	20.0 (3.37)*	13.33 (3.79)	19.38 (3.34)	17.6 (.89)
LangProduction (CDI)	15.44 (8.67)	12.58 (1.41)	19.70 (4.11)	16.2 (5.03)	16.95 (3.91)	16.06 (2.56)

Procedure

Two visits about two weeks apart were made to the home of each child, during which psychometric tests (the BSID-II and the MacArthur CDI) were administered and a Mirror Session filmed. At a suitable time during the home visit when the child's mood was pleasant a wall mirror with a light plastic frame, oval-shaped, 24 inches by 15 inches, was placed against a suitable wall or piece of furniture and the child was invited to attend to it. The arrival of the mirror was often sufficient and no more than a "Look" was required to draw the children to it. After about two minutes of free interaction time with the mirror (ensuring that the children did look at themselves at least twice for at least three seconds duration), the parent (previously primed to the task) called the child away ostensibly in order to wipe their noses and placed a sticky-backed red dot on the front of the face. The

location of the dot on the face varied but did not appear to influence test success: In the Autism and DS groups fourteen parents placed the dot on the cheek (nine passed the test) and eleven on the forehead (eight passed the test). In the TD group nine parents placed the dot on the nose (four passed the test) and four on the cheek (all passed the test). In all cases the children were observed before return to the mirror to ensure that they had not detected the dot, and were then allowed back to the mirror for another two minutes.

Coding From the mirror session prior to the MSR test we extracted for each child from 30 seconds to a maximum of 60 seconds of attention to specific targets *in* the mirror, excluding segments where the camera angle prevented accurate coding as well as segments where the child was not looking in the mirror. The primary coder was blind to the hypotheses of the study. Coding started with the identification of *bouts of attention* by first playing the tape at normal speed and then moving it frame by frame to fix start and end times from a timer strip superimposed on the videotape (in milliseconds). Bouts began with gaze in the mirror to any target, and ended when gaze shifted to a different target or away from the mirror. Following a period of training, reliability of coding was determined by the primary coder and first author separately coding mirror sessions for 10 children, amounting to about 25% of the data. The two coders agreed on the identification of 87% of bouts of attention in the mirror; 8% of those identified by the first author were identified as more than one bout and 5% omitted by the primary coder. The reliability of further codes was conducted only on the agreed bouts (see Table 2 for details).

Coding the Mirror Self-Recognition Test

The MSR test was coded according to standard criteria, on the basis of either clear dot or face directed movements of the hands or specific verbal reference to the dot upon seeing the dot in the mirror. Simply looking more at the face was not taken as evidence of self-recognition. The first

author and a coder blind to the hypotheses of the study coded all children on the test independently.

Cases of uncertainty were discussed and 100% agreement reached.

Table 2. Coding of bouts of attention in the mirror

Targets of Attention <i>kappa</i> = .86	<p><i>Own face</i>: Child's gaze focused on their own face.</p> <p><i>Other's face</i>: Child's gaze focused on another person's face in the mirror (usually mother, father or sibling).</p> <p><i>Things</i>: Child's gaze directed to <i>objects</i> (e.g., held in the hand), the <i>room</i> (including the ceiling, furniture or the general background), <i>body parts</i> not including a view of the face (including gaze to specific body parts of other persons).</p> <p><i>Camera</i>: Child's gaze directed to camera (which could have been due to an interest in the camera or the person behind it).</p>
Actions in the mirror <i>kappa</i> = .77,	<p>When more than one action occurred in one bout of attention, the coding gave precedence to the more apparently 'sophisticated' act as sequenced in the categories above (i.e., with watching given the least precedence and performing given the most).</p> <p><i>Watching</i>: Child watches the target with no communicative act or intentional movement of the body or the mirror.</p> <p><i>Reflecting</i>: Child explores reflections in the mirror e.g., by tilting the mirror or moving their own head, or acts mechanically upon the target e.g., moving a car up and down the surface of the mirror or pulling a lip in different directions while peering closely. Stereotypic actions such as rocking were not included unless they were judged to occur specifically in the mirror.</p> <p><i>Social Relating</i>: Child looks at target with a communicative expression or act e.g., a smiling look, gesture or utterance or treats the target in the mirror as an audience for a performance e.g., reciting a nursery rhyme or showing a skill.</p>
Affect	<p><i>Pleasant</i>: Child looks at the target with either a smile or a pleasant expression on the face. <i>Kappa</i> = .79, <i>p</i> < .001</p> <p><i>Smile frequency</i>: Smiles were identified at normal playing speed, and included laughs as well as slight smiles. Judgements of smiles were relative to the normal expression of the individual child. Durations of smiles are not included in this analysis. 90% agreement.</p> <p><i>Coy smiles</i>: Child looks at target with a smile and within the peak of the smile does one or more of the following: averts gaze, averts head, cocks head to the side, sticks tongue out, brings hand or arm up to cover mouth (all initially identified at normal speed). Following independent coding by two coders, all unclear examples were omitted and only coy smiles which both coders agreed upon were included.</p>
Affect change at MSR 100% agreement	<p><i>No change</i>: On discovering the dot on the face the child touches the face or the dot but shows no shift of affective expression from prior to the discovery; the child may show stilling and brief 'frozen' attention.</p> <p><i>Change of affect</i>: On discovering the dot on the face the child shows a shift of affect either becoming more positive or becoming more negative before or after touching the face or dot.</p>

Results and Discussion

Due to concerns about homogeneity of variance we used non-parametric statistics for all measures: the Kruskal Wallis for group comparisons and the Mann-Whitney U test for pairwise comparisons. Given the small sample sizes and the exploratory nature of the study we present exact probabilities as being more informative for future research. There were similar numbers of MSR recognisers in each group: 8 of the 12 in the autism group, 10 of the 13 in the DS group and 8 of the 13 in the TD group passed the test. After the primary analyses comparing the groups on the key variables (Table 3), the potential effects of MSR status were explored in two ways: i) we repeated all the analyses testing group differences on the key variables amongst the matched sub-groups of Passers and ii) we compared Passers and Failers within each group on key variables (boxplots in Figure 1 show distributions on attention, social relatedness and pleasant affect to own face). Mean durations of bouts are given in seconds, but all other durations are presented as percentages. To aid readability in the text below we present variables in italics.

TABLE 3 ABOUT HERE

Interest in own face

Table 3 shows three indicators of interest in own face: *attention to own face*, length of *mean bout to own face* and higher mean bouts to own face than *to other targets*. Amongst the three groups, the children with DS showed reliably higher *mean bouts to own face* and *attention to own face* than the other two groups supporting previous findings of a higher interest in their own face than in typical development (Loveland 1987). The children with Autism did not differ from the TD group in *attention to own face*, but they did pay reliably more *attention to things* than either the TD or DS groups. Further, while the children in both the DS and TD groups showed longer *mean bouts to their own faces* than *to other targets*, this was not the case in the Autism group. Together, these two findings suggest that while the children with autism were not inattentive to their own face, their face was just another target to attend to. This was not the case for the other two groups.

Actions to own face

The most important difference between the groups lay in what the children *did* whilst watching their own face. The groups did not differ on percentage of *Watching*, but did differ on *Reflecting* actions and on *Social Relating* actions, with the Autism group reliably higher in the former and lower in the latter. In line with previous findings about social relatedness to others (Dawson & Adams, 1984; Hobson & Lee, 1998) none of the children with autism displayed to themselves the verbal greetings (e.g., saying 'hello' and 'goodbye'), chatting, or performances such as reciting a nursery rhyme or bringing an object to show the self in the mirror which some of the children in the DS and TD groups did. In general the self was not treated as a social partner by the children with autism.

Affect, smiles and coy smiles

Similar to the findings regarding mean lengths of bouts, the groups did not differ in *pleasant affect to other targets*, but did in *pleasant affect to own face*, and in the relative *difference* between pleasant affect to own face versus to other targets. The Autism group was reliably lower in pleasant affect to their own face than the DS and TD groups, and more importantly, unlike these two groups, showed *less* pleasant affect towards own face than to other targets. There were no reliable group differences in the frequency of *smiles* (KW (2) 4.00, $p = .14$). However, there were group differences in the frequency of *smiles initiated whilst looking at the self* (KW (2) 7.54, $p = .023$). Four children in the autism group, 11 in the DS group and 11 in the TD group initiated smiles to self at least once. Whilst looking at themselves before the MSR test 6 children in the DS group showed clear *coy smiles*, but none of the children in the Autism group did (Fisher Exact test $p = .0149$), consistent with previous reports (Neuman & Hill, 1978; Dawson & McKissick, 1984). One child in the TD group

showed several clear coy smiles before the MSR test, to herself, to the mother and to the camera/person. Only one child (in the DS groups) showed a coy smile following the MSR test.

MSR and its relation to interest, actions and affect to own face

The group and pairwise comparisons repeated on the MSR Passers showed one difference from the pattern of findings shown in Table 3: there was a reliable group difference in *Watching* (KW (2) 6.42, $p = .040$) with the TD group higher than the Autism group (U 15.0, $p = .072$) and the DS group (U 12.0, $p = .013$). Apart from this, the two sets of findings were almost identical and due to space limitations will not be repeated here. This similarity suggests that whatever effects the absence of self-recognition may have on children's behaviour in the mirror, after the achievement of self-recognition the differences between groups were strong and reliable.

FIGURE 1 ABOUT HERE

Two principal findings can be seen in Figure 1. First, there was a high range of variance within groups on some variables with overlapping of distributions between groups. Second differences between Passers and Failers in each group were small and unreliable in all key variables: *mean bout duration to other targets, attention to own face, to things, reflecting actions to own face, social relating actions to own face and pleasant affect to own face or to other targets*. However, there were MSR differences on two variables: Failers showed reliably higher percentages of *Watching* own face in the Autism group (U = 3.0, $p = .025$) and DS group (U = 1.0, $p = .018$). Further, in the Autism group, there were lower *mean bout durations to own face* in the Failers (U = 4.0, $p = .042$). A watchful focus on the self could be an indicator of imminent self-recognition in these two groups, consistent with the finding of a short-term developmental alignment between self watching and self-recognition (Nielsen, Dissanayake & Kashima, 2003). Despite their higher displays of *watching* than the other two groups, however, no difference between Passers and Failers was evident in the TD children, possibly because of the cross-sectional sampling of the present study.

Although there was no effect of MSR on *pleasant affect to self* in any group, the *frequency of smiles initiated to self* tended to be higher amongst Passers in the Autism and DS groups (Autism: $U=8.0$, $p = .10$; DS: $U=4.5$, $p = .069$). All the 4 children who initiated smiles to self in the Autism group were Passers; one in the DS group and 5 in the TD group were Failers. Of the 8 Passers in the Autism group none showed any *change of affect* upon seeing the dot on the face, remaining either positive or neutral (one child stilled and stared briefly). However, 7 of the 10 Passers in the DS group showed a distinct change of affect, most becoming less positive. In the TD group there was a mixed pattern with 3 showing no change 2 becoming more positive and 3 becoming more negative. The absence of negativeness following the perception of the dot on the face in the Autism group is intriguing and suggests that their need for environmental order may not extend to their face.

Language Production: Although the 3 groups were matched on productive language we further explored correlations between language and *social relating* in each group and found different patterns of correlation in each group. In both the developmentally delayed groups language ability tended to correlate with *social relating* and *pleasant affect to own face*, suggestive of a cluster of ‘communicative’ variables (Autism: ρ with *social relating* actions to self = .47, $p = .13$, and with *pleasant affect to self* = .76, $p = .0045$; DS: ρ with *social relating* actions to self = .54, $p = .054$ and ρ with *pleasant affect to own face* = .74, $p = .0038$). In the TD group all correlations with Language production were low (below .35) and unreliable (probabilities above .20); the absence of a similar communicative cluster suggests that in normal development social relations not only predate language production, but remain independent of it. Intriguingly, while in the Autism group, language production related negatively to *attention to things* ($\rho = -.63$, $p = .027$), it correlated positively in the DS group ($\rho = .50$, $p = .082$), a difference which yields a Z score of 2.81, $p = .005$).

Gender: There were no gender differences on any of the key variables.

Implications and Conclusions

Autism and social relatedness to the self: Difficulties in interpersonal relatedness in autism appear to extend to difficulties in relatedness with the self, supporting arguments about a reciprocal relation between a sense of self and a sense of other (Hobson, 1990; McLaren, 2008). In typical development the affordance of the face is almost unavoidably social, with direct gaze attracting attention from birth (Farroni, Mansfield, Lai and Johnson, 2003) and acting as an ostensive signal (Senju & Csibra, 2008). In autism, perhaps particularly in mirrors where there is no one else to initiate engagement and no other social behaviour to highlight interpersonal cues this affordance may be even less potent in inviting interaction. Engaging with the self can also provide opportunities for learning about expressions and interaction. Given the enjoyment that typically developing children and children with some other developmental disorders derive from such engagement, the loss of this opportunity in autism might potentially contribute to further impairments in the development of a sense of self.

MSR and social relatedness to self

The strong group differences in social relatedness and positive affect to self and the absence of within-group MSR differences suggest that the cognitive skills involved in achieving visual self-recognition are not responsible for the children's interest in treating the self as a social partner. On the other hand, in the Autism and DS groups recognition did reliably reduce the amount children Watched their own face, suggesting that in groups with developmental delay a complex relationship may emerge between self-recognition and behaviour to the self. These findings suggest a partial dissociation between MSR and affective self-consciousness (Hobson et al, 2006, Izard & Hyson, 1996; Reddy, 2000). Responses to the interpersonal aspects of oneself appear to be independent of MSR in autism, in DS and in TD and are neither, a) necessarily present with visual self-recognition nor, b) dependent on visual self-recognition for their emergence. Social relatedness to the self may, therefore, offer a sensitive index of the interpersonal quality of the presented self, of *how* one sees the self.

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