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Comprehension of Affect in Context in Children with Pervasive Developmental Disorders

Deborah Fein,* Dorothy Lucci,† Mark Braverman‡ and Lynn Waterhouse§

Abstract—Fifteen children with Pervasive Developmental Disorders (PDD) (mean age 12.7 years) were compared to mental age matched normal children on matching a context to its appropriate emotion. PDD children were slightly but significantly impaired on this task relative to a non-social task equated for difficulty. Both matching tasks were highly correlated with cognitive variables; the social matching task alone was correlated with social skill level, and neither task was correlated with ratings of social deviance. Results are discussed in terms of the demands of social cognitive tasks, the magnitude of social cognitive findings, control group selection and individual differences.

Keywords: Affect, pervasive developmental disorder, comprehension

Deficits in social behavior and social cognition are universally regarded as typical and pathognomonic of the Pervasive Developmental Disorders (PDD) (American Psychiatric Association, 1980, 1987). There has been increasing interest in specifying more precisely the social deficits shown by these children. Deficits in social cognition (relative to performance on comparable non-social cognitive tasks) are of particular interest because they may constitute support for the idea that PDD children have primary deficits in processing social information.

A variety of social cognitive deficits have been found in children with PDD; most studies focus on the autistic subgroup. Autistic children have been reported to be deficient in recognizing action sequences and contexts that would typically be associated with people of a particular age or sex (Hobson, 1989). In a series of studies (Baron-Cohen, 1988, 1989a,b; Baron-Cohen, Leslie & Frith, 1985, 1986; Leslie & Frith, 1988) investigators have presented evidence that autistic children have deficits in a

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*University of Connecticut and Boston U. School of Medicine
†R.E.A.D.S. Collaborative
‡Harvard Medical School
§Trenton State College

Requests for reprints to: Dr D. Fein, Boston University School of Medicine, Laboratory of Neuropsychology, 85 East Newton Street, M-9, Boston, MA 02118-2389, U.S.A.

specific aspect of social cognition—that of attributing beliefs and other mental states to other people—a deficit they characterize as impairment in the autistic child's "theory of mind".

A contrasting idea is put forth by Hobson (1989) and by Fein, Pennington, Markowitz, Braverman and Waterhouse (1986), who suggest that deficits in affective functioning may underlie the social cognitive impairments in autistic children. They suggest, as part of this impairment, a deficit in the autistic child's attention to, or ability to decode, the emotions of others.

Hobson (Hobson, 1986a,b; Hobson & Lee, 1989; Hobson, Ouston & Lee, 1988a,b, 1989) has reported autistic children to be impaired in their comprehension of facial, vocal and bodily affect, and their associations of such expressions with each other. The Hobson series, however, failed to clarify this issue completely, since the non-social control tasks were in all cases easier than the emotional tasks; in most cases, the autistic and non-autistic children performed at or near ceiling on these non-social tasks.

We recently reported (Braverman, Fein, Lucci & Waterhouse, 1989) that a sample of children with PDD were found to be mildly but significantly deficient in matching emotional expressions and in comprehending affect terms, relative to normal children matched for non-verbal mental age (MA) and relative to their own performance on a non-social control task (matching objects) which *was* equated for difficulty level with the emotions task. There were individual differences as well: the children with PDD who were deficient on matching emotional expressions (about half the group) tended to be somewhat more socially impaired than the children with PDD whose emotion matching scores were comparable to their MA, and children with classic autism were more likely (12/18) to show affect processing deficits than non-autistic PDD children (3/10). There were no MA or IQ differences between the children with and without specific affect deficits.

These findings were recently replicated by Ozonoff, Pennington and Rogers (1990), using the same materials, who also found deficits in affect matching when autistic children were compared to young normal children matched for non-verbal mental age. These investigators also found the autistic children deficient in matching faces for identity rather than emotion, which in our study was a non-significant difference in the same direction. MacDonald *et al.* (1989) also found autistic adults with superior non-verbal IQs to be deficient in recognition of unfiltered emotional speech (but not in two conditions of filtered speech), and in naming emotions, relative to normal adult controls.

On the other hand, there are a variety of recent studies that report non-significant differences on emotion tasks, including failures to replicate some of the studies cited above. Most notably, Prior, Dahlstrom and Squires (1990) found a deficit in only one of three theory of mind tasks administered to autistic children, and found performance on all tasks to be strongly related to developmental level; they also failed to replicate some of Hobson's emotion task results. On our matching tasks described above (Braverman *et al.*, 1989), no significant group differences were found when the autistic children were matched to young normal children on verbal, rather than non-verbal, mental age, and this finding was replicated by Ozonoff *et al.*(1990). These investigators also administered a modification of Hobson's matching emotional sounds

to emotional faces, and a sorting by identity and emotions task, to autistic and young normal children matched for verbal MA and found no group differences. Finally, Szatmari (1986), Van Lancker, Cornelius and Needleman (1991) and Hertzig, Snow and Sherman (1989) found individuals with autism or Asperger's syndrome did not differ from controls on a variety of affect comprehension tasks.

A specific social cognitive task that goes beyond the simple matching or labelling of emotions, and that may better reflect real-life functional deficits, is the child's ability to understand the *context* in which a given emotion is appropriate or usually expressed. This would appear to demand a deeper level of understanding of the meaning of the emotion, compared to the ability simply to recognize and label a particular facial expression. Recognition and labelling might be particularly sensitive to training effects, or might represent a more biologically preprogrammed ability, whereas the context's task calls upon the child to comprehend a simple social interaction or event and extrapolate the emotional expression that one would expect to see associated with it. Four research reports using tasks of this kind presented contradictory findings: Hobson (1986a) found children with autism to have a significant deficiency on matching emotions to pictured contexts when compared to normal children matched on non-verbal MA, but not when compared to retarded controls. However, methodological limitations in that study force caution in interpreting the findings. The schematic and videotaped facial expressions of emotion were not successful enough in representing the emotion to normal adults pretesting the material; only one context was used for each of the four emotions yielding only a small sample of behavior; one and possibly two of the four contexts were not accurately judged by normal adults, and performance on the non-social control task was at ceiling levels for all groups. A replication (Prior, *et al.*, 1990) of this study found no group differences between the children with autism and verbal MA matched controls. MacDonald *et al.* (1989) asked autistic adults and non-verbal-IQ-matched normal adults to match photographs of a context (e.g. mother and baby playing) with photographs of a facial expression, and found the autistic individuals deficient on this task (but no non-social control task was used). Finally, Ozonoff *et al.* (1990) used the context–affect matching task developed by us and described below and found that, as on other tasks mentioned above, findings depended on the control group used: when the autistic children were matched to non-verbal MA controls, there were significant group differences, but when matched to verbal MA controls, there were no significant group differences. In the Ozonoff study, however, the context–affect matching task was harder for all subjects than the equivalent non-social task; this was presumably because their normal control groups had *mean* ages of 3 and 4 years; the situation task was developed for children aged 3–0 to 8–11. Thus, the Ozonoff samples (especially the verbal MA matches) may have been too young, as a group, for the task.

How does one make sense of these contradictory findings, in the social cognitive literature in general and the emotion–context matching studies in particular? The most important factor seems to be the selection of control group. In general, studies that use verbal MA matched controls show no significant group differences, and studies that use non-verbal MA matches show significant differences or strong trends. Investigators usually justify their selection of a matching variable by analysis of the demands of their experimental task; those that postulate a strong perceptual component

in the comprehension of facial expression tend to use non-verbal matching tasks, while those who believe that the tasks are strongly verbally mediated tend to use verbal matching procedures. It seems more important, however, that autistic children usually have uneven cognitive profiles, with performance measures higher than verbal measures. Therefore, as pointed out by Ozonoff *et al.* (1990), the effect of matching on a non-verbal task is to select a higher IQ (or older) control group than when one matches on a verbal task. For example, in the MacDonald *et al.* (1989) study, non-verbal matched autistic and normal controls had non-verbal IQs of 118 and 120, respectively, but verbal IQs of 84 and 109. If autistic children are as impaired on social cognitive tasks (on average) as they are on language tasks, then non-verbal matching will produce an apparent deficit in the autistic group, while verbal matching will produce no group difference. This implies no necessary causal connection between the language and the social deficits, merely that they are of the same magnitude.

Second, studies differ in their analyses and conclusions. Since group differences tend to be consistent in direction, but small in magnitude, selection of statistical tests and interpretation of marginal results can dramatically alter conclusions.

Third, since the group differences are small in magnitude, it might be expected simply from error of measurement that some studies would find significant differences and others would not.

Fourth, studies that use non-social comparison tasks tend to use tasks that are inappropriate in difficulty; often, such tasks show ceiling effects for all groups, and cannot offer meaningful comparisons. In studies where the autistic group is lower on all tasks than the controls and where the controls but not the autistic group are at ceiling levels on the non-social task, a spurious group by task interaction is obtained.

Finally, some studies examine group means alone. Prior *et al.* (1990) argues cogently that from 1/5 to 1/2 of the autistic subjects in each sample can perform as well as MA matched normal controls. Examination of individual differences, therefore, for proportion of the clinical group with a demonstrable deficit, and for correlates of such deficit, can help explain group findings.

In the experiment described here, we compared children with PDD to groups of normal children matched for verbal and non-verbal MA, on a task of matching facial expression to social context. The non-social comparison task was designed to be of equivalent difficulty in normal development, the MAs of all groups were in the middle range of performance on the experimental measures, and individual differences were examined.

Method

Subjects

The experimental group consisted of 15 children with PDD, diagnosed according to the criteria of DSM-III-R (American Psychiatric Association, 1987). The sample was recruited from schools for autistic children in Massachusetts and New Jersey. A board-certified child psychiatrist provided a DSM-III-R diagnosis for each child in the study by reviewing all available records and interviewing the child in individual sessions.

One control group consisted of 15 normal children, matched to the children with PDD for sex and performance on McCarthy Draw-a-Design (McCarthy, 1972). The second control group was matched for sex and performance on the Peabody Picture Vocabulary Test-R (PPVT-R) (Dunn & Dunn, 1981). Chronological and MA characteristics of the three groups are shown in Table 1.

Table 1. Subject characteristics

		Autistic (n = 15)	Verbal matched controls (n = 15)	Non-verbal matched controls (n = 15)
CA (in months)	minimum	89	38	39
	maximum	180	80	94
	$\bar{x}$	128.53	60.2	64.73
	SD	30.82	11.87	18.70
Peabody Vocabulary Mental age	minimum	41	38	37
	maximum	93	88	116
	$\bar{x}$	63.6	62.67	75.27
	SD	15.22	14.89	27.92
Draw-a-Design Mental age	minimum	42	42	42
	maximum	114	90	114
	$\bar{x}$	73.6	63.57	74
	SD	27.07	14.74	26.99

Materials and procedures

Two sets of materials, equated for difficulty, were developed to test the child's ability to match different views of objects, and to match a social context to its appropriate affect.

Object matching. This task is described in detail in Braverman *et al.* (1989). Briefly, the child was presented with a photograph of an object such as a light bulb or a T-shirt, and asked to select from an array of four choice photographs the one which represented a different view or condition of the same object (e.g. matching a crumpled to a folded T-shirt).

Context–affect matching. The child viewed a 5 × 7 photograph of an affect-laden context (e.g. a child about to fall off a ladder, a child eating an ice cream cone, a child holding a broken toy, a child pulling a toy away from another child; see Table 2 for list of contexts) in which the face of the child was covered or not visible. Four different contexts represented each of the four affects (happy, sad, angry, scared), for a total of 16 test items, plus four sample items representing one each of the affects, used for training. On a facing page were photographs of a prepubertal girl posing each of the four affects. Instructions were as follows: "Look at what this boy/girl is doing (is happening to this boy/girl). His/her face is covered so you can't see it. If you could see it, how would he/she look? Would he/she be feeling this way or this way or this way or this way" (pointing to choice photographs).

In order to arrive at a final set of stimulus items matched for difficulty, 37 object matching items were initially developed.

Photographs were taken of affect-laden situations as described above. Seven or eight situations representing each of the four affects were developed, for a total of 30 items. A group of 16 normal children ranging in age from 10 to 14 years were asked to sort the stimulus pictures according to the four affect labels. Any picture not correctly sorted by at least 90% of the children was rejected.

Next, facial expressions of the four affects were obtained, posed by a 13 year old girl. Four poses of each affect were pretested by the same group of normal children using a similar sorting procedure and rejection criterion, with the addition that the children were asked to rank order the photographs within each affect according to how "good" a representation of the affect it was. The picture obtaining the highest mean rank from each affect was chosen for the final representation of that affect.

The next step was to select a subset of items from each task. Subjects for this phase of the study consisted of 90 normal children from each of the six chronological age years between 3 and 8–11. (See Braverman *et al.*, 1989 for more detail on subjects and procedures.) Criteria for final inclusion of items were (1) use of items that showed a developmental progression, with a greater and greater percentage of each age group passing the item, and (2) establishing an equivalent mean, range, and distribution of difficulty across tasks. For the final 16-item tasks, object matching had a mean passing for the 90 normal children of 71.19%, sd = 17.17%, and a range across items of 41–93% passing. Context-affect matching had a mean passing of 71.37%, sd = 14.42%, and range of 41–93%.

Table 2. Affect Situations

Sample 1	girl eating ice cream cone	happy
Sample 2	two children fighting over cookies	angry
Sample 3	German shepherd dog approaching boy	scared
Sample 4	boy holding hurt knee	sad
1	boy receiving birthday cake	happy
2	boy looking at broken truck	sad
3	boy hitting girl	angry
4	dog jumping on girl	scared
5	boy with arm in sling	sad
6	boy holding balloon	happy
7	two girls fighting over teddy bear	angry
8	girl falling off ladder	scared
9	girl holding ripped stuffed animal	sad
10	girl pulling other girl's hair	angry
11	girl dropped ice cream	sad
12	boy playing on slide	happy
13	boy on roof of house holding on	scared
14	girl choking a boy	angry
15	boy getting an injection	scared
16	girl petting dog	happy

Procedure. All subjects were tested during regular school hours, in small rooms within their schools. The two matching tests were administered at the same time as additional matching tests reported in Braverman *et al.* (1989). In addition to the matching tasks, children with PDD were given the Stanford-Binet Picture Absurdities (Thorndike, Hagen & Sattler, 1986), the Expressive One-Word Picture Vocabulary Test (EOWPVT) (Gardner, 1979), the McCarthy Draw-a-Design and the PPVT-R. All tasks were typically given in two sessions of 30–45 minutes each for the older control children, and in two to three shorter sessions for the younger normal, and the children with PDD. Snacks were used as reinforcers for many of the children with PDD and for some of the younger normal children, as necessary, to maximize motivation.

Teachers were given the Vineland Adaptive Behavior Scales (Sparrow, Balla & Cicchetti, 1984) and were asked to rate the highest level of play in which the child currently engaged (1 = sensorimotor, 2 = functional, 3 = simple symbolic, 4 = substitution, 5 = imaginary).

Children's overall sociability was rated from a videotaped clinical structured play session (1 = very aloof, 2 = aloof, but responds minimally at times to social bid, 3 = moderately responsive, but minimal initiations, 4 = actively engages examiner; Fein, Lucci, Waterhouse & O'Callaghan, 1990).

As another index of impairment in sociability, the nine social impairment symptoms in an early draft of DSM-III-R (Wing, 1985) were rated for each child by the psychiatrist. These are: (1) absence or impairment of use of eye to eye gaze, facial expression, body posture and gestures to initiate and modulate reciprocal social interaction, (2) absence or impairment of interactive play or sharing of interests, (3) abnormalities of greeting behavior, (4) abnormalities in seeking comfort, (5) abnormalities in giving comfort, (6) impairment of imitation, (7) impairment of ability to make friendships (mutual sharing of interests and emotions), (8) impairment of development of social aspects of pretend play, and (9) impairment of awareness of social rules) were rated for each child by the psychiatrist. The total endorsed (out of 9) was scored for each child.

Results

Between-group comparisons

Performance of the children with PDD was compared to that of the normal control children on the object matching and context–affect matching tasks. Performance on

object matching was identical (PDD $X = 11.60$, sd = 2.69, non-verbal matched normals $X = 11.60$, sd = 2.77, verbal matched normals $X = 11.60$, sd = 2.16). Performance on context–affect matching showed a non-significant difference (PDD $X = 9.67$, sd = 3.62, non-verbal matched normals $X = 11.07$, sd = 4.25, verbal matched normals $X = 10.87$, sd = 2.75). Thus, no comparison between the PDD and either control group was significant.

Within-group comparisons

Since the object and context–affect matching tasks were designed to be of equal difficulty (for normal children), performance of each subject group was compared between the two tasks. For both groups of normal children, as expected, performance on object matching was not significantly different from their performance on context–affect matching. For the children with PDD, this difference was significant ($t = 2.83$, $p < .025$).

Correlations of matching task scores with other developmental variables

Correlations of scores (number correct) on the object and context–affect matching tasks with other developmental data available on the PDD and normal children are shown in Table 3. It can be seen that available measures of abnormal sociability (variables 1 and 2) did not correlate significantly with either matching task. Development of normal social skills, on the other hand (variable 3) showed association with context–affect matching but not object matching, and play (variable 4) showed a trend in the same direction. All mental age and developmental measures (variables 5–10) correlated highly with both tasks, for both groups. CA is only weakly related to matching task performance for the children with PDD (because of the range of IQs), but is strongly related for the normal children. The two matching tasks are related to each other for both groups. Except for CA, correlations available for both PDD and normal children are quite similar. Not shown in Table 3 are correlations

Table 3. Correlations of object and context–affect matching scores with other developmental measures

	PDD ($n = 15$)		*Normal* ($n = 30$)	
Variables and ranges	Object (6–16)	Context (5–15)	Object (6–16)	Context (6–16)
1. Sociability (1–4)	.24	.10		
2. Social impairment symptoms (3–9)	.34	.24		
3. Vineland Socializ. raw score (33–90)	.19	.54*		
4. Highest play (2–5)	.18	.38		
5. Vineland Comm. raw score (55–105)	.61†	.76‡	Not given	
6. Vineland Daily Liv. raw score (62–118)	.63†	.88‡		
7. EOWPVT raw (47–90)	.60†	.80‡		
8. S-B Absurdities raw score (1–22)	.75‡	.70‡		
9. PPVT raw (31–89)	.67‡	.79‡	.66‡	.70‡
10. McCarthy Draw-a-Design raw (3–18)	.66‡	.83‡	.71‡	.63‡
11. CA (89–180 mos.)	.42	.57*	.79‡	.67‡
12. Object matching		.58*		.46†

*$p < .05$, †$p < .02$, ‡$p < .01$.

for children with PDD between Vineland Socialization and the two measures of abnormal social behavior: as one would expect, Vineland Socialization is negatively correlated with abnormal sociability ($r = -.57$, $p < .05$) and shows a trend with number of social impairment symptoms ($r = -.42$, $p < .1$); the two measures of abnormal social behavior correlate highly with each other ($r = .79$, $p < .01$).

Individual differences

All subjects were classified by whether or not they showed a significant (3-point, 18–24 month equivalent) deficiency in context–affect matching relative to object matching. Three of 15 non-verbal matched normal children, and 8/15 children with PDD showed such a deficiency (Fisher's exact test $p = .05$). For the verbal matched children, 5/15 showed the deficiency (ns). Thus, compared to non-verbal matched, but not verbal matched, controls, more children with PDD showed the deficit, suggesting a marginally significant tendency for deficient performance to occur disproportionately among the children with PDD.

Within the PDD group, children with specific deficits on context–affect matching were compared to those without such deficits. There were no significant differences on CA, global sociability, highest level of play, number of social impairment symptoms, Vineland Communication, Socialization, Daily Living or Stanford–Binet Absurdities. The children with PDD deficient on context–affect matching were lower than their PDD peers without such a deficiency on three cognitive tests (*PPVT-R*, raw score for deficient children $X = 51.38$, sd = 10.42, raw score for non-deficient children with PDD $X = 69.29$, sd = 18.87, $t = 2.14$, $p < .05$; *McCarthy Draw-a-Design* raw score for deficient children $X = 7.0$, sd = 3.96, non-deficient children with PDD $X = 12.71$, sd = 5.65, $t = 2.12$, $p < .05$; *Expressive One-Word Picture Vocabulary* raw score for deficient children $X = 61.5$, sd = 6.0; non-deficient children $X = 75.43$, sd = 4.32, $t = 4.72$, $p < .001$).

Children with PDD were rated as meeting DSM-III-R criteria for autism ($n = 10$) or as having PDD-NOS ($n = 5$). There were no significant cognitive score or CA differences between these groups. Within group comparison of the two matching tasks showed a non-significant difference for the PDD-NOS group (context–affect matching $X = 10.6$, sd = 4.45; object matching $X = 11.2$, sd = 1.79) but a significant difference for the autistic group (context–affect matching $X = 9.3$, sd = 3.16; object matching $X = 11.8$, sd = 3.12, $t = 3.48$, $p < .005$). With regard to individual children, 6/10 of the children with autism, and 2/5 of the children with PDD-NOS had an affect–context score 3 or more points lower than object matching score (ns).

Discussion

Results indicate no significant differences on the context–affect task between children with PDD and normal children matched for verbal or non-verbal performance. The PDD group as a whole showed a significantly higher performance on the non-social comparison task than on the context–affect matching task; these tasks were of equal difficulty for both control groups. This within group difference was attributable to the performance of the 10 autistic children within the PDD group. The object matching

task was strongly correlated only with cognitive measures. The context–affect matching task was also strongly correlated with cognitive tasks, moderately correlated with social skill level, suggestive but not significant of a relationship to play, and not correlated with ratings of social abnormality. Thus, understanding of the appropriate contexts of emotions, as measured by the current experimental task, shows a small relative impairment in PDD and especially in autistic children, and shares variance with social skills and especially with measures of cognitive level. This is supportive of the claim of Prior *et al.* (1990) that performance on at least some social cognitive tasks is highly correlated with cognitive level and is consistent with several other studies (Braverman *et al.*, 1989; Dawson & Fernald, 1987) in showing an association between performance on social cognitive tasks and level of social skill. Unfortunately, the Vineland was not given to our normal controls, so this relationship is unknown for the normal children. The current study is consistent with Hertzig *et al.*, 1989 (but not Dawson and Fernald, 1987) in failing to find a significant relationship between social cognitive performance and socially deviant behavior.

More variance was explained by cognitive level and less by socialization and play measures for the present task than for the affect matching task reported in Braverman *et al.* (1989). This is seen in differences between correlations in the two studies, and in the fact that Braverman *et al.*, unlike the present study, found trends for socialization and play to differ in children with and without social cognitive deficits. Examination of the task demands sheds some light on this greater contribution of general cognitive level to the present task. The "simple" face and affect matching tasks require the child to comprehend the concept of matching variants of a single thing (person, emotion, object), to sustain attention, to scan all choices, to point or otherwise indicate a choice, in addition to the specific perceptual processes involved in recognizing a person, object or emotion. The context–affect matching task used in the present study demands these and additional cognitive processes: the child must perceive and comprehend a complex picture involving social situations, adopt a somewhat hypothetical attitude (what *would* the child be feeling), possibly involving more of a "theory of mind" than simple matching of facial expressions, verbalize or visualize the appropriate response, then search the choice photographs, matching each to the internally held correct response. Thus, the findings that most of the children with selective difficulty on this task fell into the category of PDD with lower MA may be explicable in terms of both their low social skill level and their difficulty with the complex cognitive demands of the task. Although the cognitive level of the children with PDD accounted for as much variance on the context–affect tasks as on the object matching task, their absolute *level* of performance on the social task was lower, suggesting an additional difficulty either with the social content or the task demands described above. In contrast, normal children with MAs adequate to support the object matching task had no additional difficulty with the task demands of the context–affect matching task.

Findings also confirm the importance of the control group selected; the proportion of children with PDD with relative deficiency on the social cognitive task was greater than the proportion of non-verbal, but not verbal, matched control children.

The question might be raised as to whether the present findings support the validity of the distinction between autism and PDD-NOS. The within-group differences

(significant task differences for the autistic and not the PDD-NOS children) support the idea that the autistic children have more severe deficits in social cognition. However, the failure to find a significant disproportion of children with social cognitive deficits in the autistic group suggests a fuzzy boundary between the two groups, and is consistent with the idea that there is a rather arbitrary dividing line on a continuum of severity.

As with virtually all other social cognitive studies reported thus far, effects, although sometimes reaching statistical significance, are surprisingly small. It is possible that more natural social cognitive tasks, involving dynamic and rapidly changing social information, would reveal more striking deficits, but it does suggest that social cognitive deficits, at least in the simple form measured by static and unimodal tasks, do not form the "core deficit" for autistic children.

The pattern of correlations suggests an important dissociation between socially deviant behavior and the acquisition of normal social skills. The two independent ratings of social deviance correlated highly with each other, supporting their validity. Each showed small to moderate negative correlations with acquisition of normal social skills, reaching statistical significance but explaining a relatively small percent of the variance in normal social development. The social cognitive performance of the children with PDD was correlated with acquisition of normal social skills but not with social deviance, suggesting the social cognitive impairment may reflect their general delay in acquisition of social skills, and not their clinically autistic social behavior.

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