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Do children with autism use the Speaker's Direction of Gaze (SDG) strategy to crack the code of language?

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Abstract

Normal toddlers infer the referent of a novel word by consulting the speaker's direction of gaze. That is, they use the Speaker's Direction of Gaze (SDG) strategy. This is a far more powerful strategy than the alternative, the Listener's Direction of Gaze (LDG) strategy. In Study 1 we tested if children with autism, who have well-documented impairments in joint-attention, used the SDG or the LDG strategy to learn a novel word for a novel object. Baldwin's (1993a,b) methodology was adapted for use with clinical samples for this purpose. Results showed that while 70.6% of children with mental handicap passed the test by making the correct mapping between a novel word and a novel object, via the SDG strategy, only 29.4% of children with autism did so. Passing entailed identifying the novel referent when the experimenter's gaze was discrepant to that of the child. Thus, the majority of children with autism failed to use the SDG strategy, and their reliance on the LDG strategy led to mapping errors. Since the subjects were matched for language ability, this group difference cannot have been due simply to the effects of language delay.

In Study 2 a group of normal children, whose chronological age (24 months old) was equated with the verbal mental age of the two clinical groups in Study 1, was tested using a similar procedure. This was in order to check if the SDG strategy is seen in 24 month olds, since previous studies had only tested this up to 19 months old. Results showed that 79% of this normal group passed the test by making the correct mapping between a novel word and a novel object, using the SDG strategy. Taken together, the results from both studies suggest that children with autism are relatively insensitive to a speaker's gaze direction as an index of the speaker's *intention to refer*. This result is consistent with previous findings showing that children with autism are relatively 'blind' to the mentalistic significance of the eyes. Discussion centers on how the absence of an SDG strategy might disrupt specific aspects of language development in autism.

Consulting speakers' gaze to crack the language code

How does the young toddler, aged 12-18 months, crack the code of language? Given the classical problem that a novel word the child has just heard could refer to any one of the objects present in the current environment (Quine, 1957), how does the toddler come to make the correct mapping of word to object, and avoid the massive confusion that would ensue from mismapping errors? Recent studies by Baldwin, Tomasello and their associates (Baldwin, 1991, 1993a, 1993b; Tomasello, 1988; Tomasello and Barton, in press; Tomasello, 1995) suggest that a key strategy that normal children use to narrow down the possible search space of likely objects that a speaker might be currently referring to is the *speaker's direction of gaze*. Thus, if a speaker says "Dog!", while looking at a dog, upon hearing this word for the first time the child infers that since the speaker's gaze is currently directed towards the hairy thing on the rug, *that* is what is being picked out (rather than the armchair next to it, or the mantelpiece above it, etc.,). For shorthand, we shall refer to this as the Speaker's Direction of Gaze (SDG) strategy.

Note that if a child did not use the SDG strategy, they would be thrown back on the alternative, namely, assuming that a novel word uttered by a speaker refers to the object that they (the listener) are currently looking at. For shorthand, we refer to this as the Listener's Direction of Gaze (LDG) strategy. The LDG strategy, if utilised indiscriminately, would often lead to children making mapping errors, in which a word is mistakenly linked to an incorrect object. This is because, in everyday speech, parents naturally produce labels for objects other than those at the center of children's attention (Collis, 1977). It would seem that by about the age of 18 months, the normal toddler uses the LDG strategy only when they have reason to believe that the speaker is indeed engaged with them in jointly focusing on the same object (Baldwin, 1995).

Clearly, using the SDG strategy is not the only strategy the young toddler uses to crack the code, since they also seem to expect language to be constrained in other ways. For example, they behave as if they assume by default that a word will ordinarily refer to a whole rather than part of an object (the "whole object constraint" [Markman, 1989, 1992]); and that each object will have just one label (the "mutual exclusivity constraint" [Markman, 1989, 1992). But the SDG strategy seems to be one important strategy that toddlers use.

Is the SDG strategy innate?

The SDG strategy appears to develop spontaneously, without explicit training or instruction from parents. Parents do not announce to their infant to "look where I look when I utter a novel word" (since they wouldn't understand this anyway), nor do they teach their child to do this, as far as we know. It is likely that the SDG strategy as a linguistic tool arises from a more basic strategy, gaze-monitoring, which may have been shaped by natural selection directly. That is, the SDG strategy is probably not innate, but its source, gaze-monitoring, probably is, since gaze-monitoring in the extra-linguistic context has high survival value (Baron-Cohen, 1994, 1995a,b). It can tell you if another animal has selected you as its target, and can thus act as an `early warning system' against an attack from a potential predator or rival. It can also act as a cue that another animal has prosocial designs upon you (they might want to groom you, or mate with you, or communicate with you), which would be worth knowing. Another animal's gaze direction can act as a source of information about the environment - maybe the other animal has spotted something important out there that you have not seen (a food source, a potential predator or mate, etc., [Whiten, 1991]). Finally, who an animal is looking at is an index of social status among primates (Chance, 1956), so monitoring another animal's gaze-direction is a rapid way of identifying who to defer to, and therefore how to avoid the conflict that would ensue from inadvertently upsetting the social hierarchy. The evolution of gaze-monitoring is discussed in detail elsewhere (Baron-Cohen, 1994, 1995a,b).

Gaze-monitoring: one facet of joint attention

In the human case, gaze-monitoring is part of the toddler's repertoire for establishing *joint attention* (Bruner, 1983). Joint attention behaviors are those behaviors that result in two individuals' focus of attention targeting the same object or event. Toddlers spontaneously produce joint attention behaviors from 9-14 months of age (Butterworth, 1991; Scaife and Bruner, 1976), and these include not only gaze-monitoring, but also the production of pointing and showing gestures - the "protodeclaratives" (Bates, Camaioni, and Volterra, 1975). This whole system, again, appears to have a strong innate component, in that the timing of development of joint attention seems to be universal. Cross-cultural differences, to the extent that they have been studied, have not been found (Bates, Benigni, Bretherton, Camaioni, and Voterra, 1979). This is suggestive evidence for a maturationist/genetic account, paralleling other universal developmental milestones such as walking (12-18 months), or first tooth loss (5-6 years).

A second clue that joint attention may be innate comes from studies of children with the neuropsychiatric condition of autism. Autism has a strong genetic basis in most cases (Bolton and Rutter, 1990). Such children show little if any joint attention (Loveland and Landry, 1984; Sigman, Mundy, Ungerer, and Sherman, 1986; Baron-Cohen, 1989a; Leekam, Baron-Cohen, Perrett, Milders, and Brown, in press; Phillips, Baron-Cohen, and Rutter, 1992), and a complete absence of joint attention at 18 months of age is predictive of a diagnosis of autism (Baron-Cohen, Allen, and Gillberg, 1992; Baron-Cohen, Cox, Baird, Swettenham, Drew, Nightingale, Morgan, and Charman, 1996). One possibility, then, is that there is a neurocognitive mechanism which normally allows the development of joint attention, and which is specifically impaired in autism. (See, for example, the proposal of SAM, the Shared Attention Mechanism [Baron-Cohen, 1994, 1995a,b])[1].

Autism as a window into language learning

To study how the normal child uses the SDG strategy to solve the puzzle of speakers' reference, we set out to assess children with autism as they hear a novel word. We reasoned that if the SDG

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[1] Baron-Cohen (1994) suggested that understanding gaze-direction is one of the earliest markers of the child's recognition of *intentionality*, in that gaze is directed to something other than itself. In this respect, the deficit in autism in understanding the significance of gaze can be seen as part of the broader deficit in understanding intentionality - or in employing a theory of mind (Baron-Cohen et al, 1985; Baron-Cohen, 1989b,c; see Baron-Cohen, Tager-Flusberg, and Cohen, 1993). In the same vein, the joint attention deficit has been proposed as a precursor to the theory of mind deficit in that monitoring a person's attention is an example of monitoring a person's mental state (Baron-Cohen, 1989a,d, 1991).

strategy is the normal method for cracking the language code, then since children with autism show little if any gaze-monitoring, such children would be forced to use the less efficient LDG strategy, which should predict a high rate of mapping errors in their word learning.

The clinical literature certainly contains anecdotal reports of such mapping errors in the speech of autism. Typically they are called "metaphorical speech" (Kanner, 1973) - though they are far from being genuine metaphors (Baron-Cohen, 1988; Tager-Flusberg, 1993). Thus, in Leo Kanner's (1973) original account of autism, he gives the following example:

> "Peter eater" was another of Paul's "nonsensical", "irrelevant" expressions. It seemed to have no association with his experiences of the moment. His mother related that, when Paul was 2 years old, she once recited to him the nursery rhyme about "Peter, Peter, pumpkin eater", while she was busy in the kitchen; just then she dropped the saucepan. Ever since that day, Paul chanted the words "Peter eater" whenever he saw anything resembling a saucepan. There was indeed, in the playroom, a stove on which sat a miniature pan. It was noted then that Paul, while saying these words, glanced in the direction of the stove and finally picked up the pan, running wildly around with it and chanting "Peter eater" over and over again." (Kanner, 1973, p. 46).

A second class of language error commonly noted in autism is when the child uses his or her own private word to refer to an object, rather than the socially conventional usage. For example, we know of a child with autism who called a toy truck a “sausage”. It is not clear whether such mapping errors are common or not in autism, but note that they are never produced by the normal 18 month old child. In this case, the child's mother explained that the toddler had been playing with a toy truck when the mother said "Tommy, come and eat your sausage". At the time, the child had been looking at his toy truck on the floor, while the mother was facing away, looking at the plate of food on the table. The child had presumably failed to check the mother's direction of gaze, and so had learned the wrong association. He assumed that the object *he* (the listener) was looking at was the object being named. (This is the LDG strategy). Such a mapping error is depicted in Figure 1, and reveals that in some instances, "metaphorical language" and "neologisms" in the speech of children with autism may have a common basis: use of the LDG rather than the SDG strategy, to infer a speaker's intended referent.

insert Figure 1 here

Experimental studies

Such clinical anecdotes are clues that children with autism may not use the SDG strategy to infer a speaker's referent. Ultimately, however, carefully controlled experiments are needed to investigate this issue. The first of these was recently completed (Baron-Cohen, Campbell, Karmiloff-Smith, Grant, and Walker, 1995, Experiment 2). In that experiment, the child was shown two nonsense shapes and was asked "Which one is the *beb*?" (a nonsense word). All children taking part in this experiment obligingly pointed at one of the shapes, effectively guessing. They were then shown a cartoon face of Charlie, which was placed midway between the two nonsense shapes, slightly above them. The experimenter was careful to ensure that Charlie's eyes were pointing towards the shape the child had *not* named as the *beb*. The child was then asked "Which one does <u>Charlie</u> say is the *beb*?". The results showed that 70% of the normal children, and 73% of children with mental handicap, switched their response to indicate the shape that Charlie's eyes were looking at. In contrast, only 5% of children with autism did so. Instead, they asserted that Charlie would say the *beb* was the shape that they themselves had first pointed out. This egocentric error suggests that they may be relatively 'blind' to the significance of a speaker's gaze-direction as a cue to their intended reference.

In Study 1 reported below, we aimed to extend this finding in two ways. First, we wished to examine if the autism-specific deficit in using the SDG strategy during novel word learning could be detected during a live interaction (using real humans rather than a cartoon depiction).

Secondly, and related to this first aim, we wished to apply Baldwin's methodology to the study of autism. This had so far been used solely with normal toddlers. Her method is described next.

Baldwin's test of the SDG strategy during novel word acquisition.

A very clear test of the normal toddler's active use of the SDG strategy in identifying a speaker's referent was reported by Baldwin (1993a,b). In that test, children in three age groups were examined. The age groups were (a) 14-15 month olds (b) 16-17 month olds, and (c) 18-19 month olds. All children were shown two novel objects and heard the experimenter apply a novel label in one of two situations: (i) follow-in labelling, and (ii) discrepant labelling. In both situations, the infant saw the two novel objects, were then given one of these to play with (henceforth "the child's toy"), while the other was placed in the palm of the experimenter's open hand (henceforth "the experimenter's toy").

In the follow-in labelling condition, the experimenter waited until the child was focused on the child's toy, and then the experimenter looked at the child's toy and uttered the label "*toma*". In the discrepant labelling condition, the experimenter also waited until the child was focused on his or her own toy, but then the experimenter looked at the experimenter's toy, uttering the label "*peri*". Thus in both conditions, the child heard a novel label at a time when they were focused on a novel object. The only difference in the conditions was where the experimenter was looking at the time the label was produced.

Subsequently, the child was shown the two novel objects and asked comprehension questions: e.g., "Where's the *toma*?" and "Where's the *peri*?". If the child selected his or her own toy after the discrepant labelling condition, (i.e., if he or she used the LDG strategy) this would lead to a mapping error, and the child would be scored as failing the test. This could only happen if the child failed to use the SDG strategy: the two are mutually exclusive. If on the other hand the child selected the experimenter's toy after the discrepant labelling condition, (i.e., they used the SDG strategy), this would ensure they avoided making the mapping error. Such a child would be scored as passing the test.

Baldwin's results showed that only the oldest group (18-19 month olds) selected the correct object after both the follow-in and the discrepant labelling, indicating that by this age they instantly use the SDG strategy upon hearing the speaker utter a novel word. In Study 1 reported below, we adapted Baldwin's paradigm for use with two groups of subjects: children with autism, and children with mental handicap but without autism. The children with mental handicap were matched on verbal mental age to control for any effects of language delay, independent of autism-specific factors, that might affect results. We predicted that children with autism would use the LDG rather than the SDG strategy, and as a result would show a high rate of word-mapping errors.

Study 1

Subjects

Two groups of subjects were tested: (i) 17 children with autism (12 males, 5 females), all attending one of two special schools for autism in the London area. They had all been diagnosed using established criteria (DSM-IV, 1994). Their mean chronological age (CA) was 9:2 years, (range = 7:5 - 12:3, sd = 2:3). They were assessed on the Reynell Language Scale (Reynell and Huntley, 1987), and had a mean Language Expression Age of 2:1 years (sd = 1:3), and a mean Language Comprehension Age of 2:3 (sd = 1:1). (ii) The second group of subjects were 17 children with mental handicap (but without autism), all attending a special education school in the London area. They were matched on sex (12 males, 5 females), CA (x = 9:1, range = 7:7 - 12:0, sd = 2:0), Reynell Comprehension Age (x = 2:2, sd = 1:0) and Reynell Expression Age (x = 2:0, sd = 1:4). On none of these did they differ from the group with autism (t tests, $p > 0.05$). The aetiology of their mental handicap was mixed or unknown. The two groups were deliberately selected for having low verbal MAs, since it is only at this level of language development that Baldwin's methodology had previously been used in normal samples.

Method

Each subject was tested individually in a quiet room in their schools. 25% of subjects were videotaped during testing, for later tests of reliability.

Control Pretest

The subject was first shown 2 familiar objects, and was asked "Which one is the (x)?" The familiar objects were drawn from a set of 4: a book, a pencil, a brush, and a glove. If a subject passed these two comprehension questions, then they proceeded to the main experiment. All subjects passed this pretest.

Test

The subject was then presented with 2 novel objects, drawn from a set of 4. All were unusual looking objects purchased from a hardware store. The experimenter then gave one of the 2 objects to the child (the child's toy), and kept the other (the experimenter's toy) in her hand, palm-upward. In the Discrepant condition, the experimenter (a female) waited until the child was looking at the child's toy, and then she looked intently at the experimenter's toy, and uttered the novel word (e.g., "*peri*"). This was repeated a second time. After this, Comprehension was tested as follows: the child was invited to put both objects into a small cloth bag. Then the experimenter asked the child to help her find something in the bag. The child and experimenter both looked into the bag, which contained the 2 novel objects just used, the 2 unused novel objects, and the 2 familiar objects that had been used in the pretest. The experimenter then looked at the child and said "Can you help me find the *peri*?".

In the Follow-in condition, the experimenter again presented the child with 2 novel objects (the 2 that had not been used in the other condition). The experimenter again gave the child one of the objects (the child's toy), while keeping the other (the experimenter's toy) in her hand, palm-upward. Again, she waited until the child was looking at the child's toy, but then this time she too looked at the child's toy, and uttered a different novel word to that used in the other condition ("*toma*"). This was repeated a second time. Again, after this, the child was invited to put both objects away in the cloth bag. Then, again, Comprehension was tested: the child was invited to help her find something in the bag, which contained the same 6 objects as before. In this condition, the experimenter said "Can you help me find the *toma*?". The whole procedure took less than 10 minutes to run.

Counterbalancing and randomisation

Order of conditions was counterbalanced across the subjects. (Because of the odd number of subjects in each group, counterbalancing was in terms of 8 subjects receiving one condition first, and 9 receiving the other condition first). In addition, the two familiar objects in the pretest were selected randomly from a pool of familiar objects. For the 2 novel objects labelled, for half the subjects one object was the peri, and for the other half of the subjects the toma label was used for this same object. This assignment of labels was similarly counterbalanced with respect to experimental condition. Finally, subjects were assigned to the two orders of condition randomly.

Control Question

After both conditions had been administered, subjects were asked a Preference Control Question, in order to ensure that their responses to the "Can you help me find..." questions were not just reflecting their preferences. This was worded as "Which one do you like best?". There was no consistent relation between children's responses on the comprehension questions and their preferences.

Results

A pass was scored if the child correctly picked the experimenter's toy out of the bag after the discrepant condition, and correctly named it in the post-test. All other combinations were scored as a fail. Results showed that 12/17 children with mental handicap (70.6%) passed the test, while only 5/17 children with autism did so (29.4%). This group difference was highly significant (Chi Square = 4.24, 1df, p = 0.0396). From chance alone, since the probability of picking the correct object by chance alone would be 0.166 (or 1/6), we would expect 16.6% of each group to pass (or 3 subjects out of 17). Therefore, the proportion of each group actually passing was compared to the proportion of each group expected to pass by chance. Analysis showed that while the proportion of children with autism passing did not differ significantly from chance levels (Chi

Square = 0.16, 1df, $p = 0.686$), the proportion of children with mental handicap passing was significantly above chance levels (Chi Square = 7.64, 1df, $p = 0.0057$). The results by condition are summarized in Table 1.

An error analysis showed that the 12 children with autism who failed this test all chose the child's (novel) toy. The passers ($n = 5$) did not differ from the failers ($n = 12$) in either MA or CA (both t tests, $p > 0.05$). Finally, we analysed the number of children correctly identifying the child's novel toy after the follow-in condition. 14 out of 17 (82.35%) of children with mental handicap, and 15 out of 17 (88.23%) of the children with autism passed this. These proportions were not significantly different (Fisher's Exact Probability Test, $p = 0.3324$), but both were significantly above chance (Fisher's, $p < 0.05$).

insert Table 1 here

Reliability coding

Approximately 25% of subjects (4 from each group), randomly selected, were filmed during the experiment, and these tapes were coded by an independent rater, blind to the hypotheses of the study. The raters were not blind to the diagnoses of the subjects, since this was impossible to hide. In all cases it was very clear if the word had been uttered when the child and experimenter were looking in the relevant directions, and which object a child picked out of the bag; thus inter-rater reliability was 100%.

Discussion

This study tested if children with autism use the normal strategy of inferring a speaker's intended referent by consulting the speaker's direction of gaze, when the speaker used a novel word in the presence of two novel objects. That is, do they use the Speaker's Direction of Gaze (SDG) strategy? We found that while 70.6% of children with mental handicap correctly learned the mapping between a novel word and a novel object, under conditions when the novel word was uttered while the experimenter and the child were looking at *different* objects (so-called "discrepant labelling"), only 29.4% of children with autism did so. Instead, the majority of them used the alternative Listener's Direction of Gaze (LDG) strategy: they assumed that the novel label referred to the object they (the listener) had been looking at at the time the label was uttered, rather than referring to the novel object the speaker was looking at at the time it was uttered. Use of the LDG strategy thus led them to commit an egocentric mapping error. This was not due to a general failure to pick up word-object associations, as the children with autism performed at a high level in the "follow-in labelling" condition. This confirms our prediction about autism, and the role that the joint attention deficit may play in disrupting language learning in this group.

However, a possible confound in interpreting these findings is that the SDG strategy has only been demonstrated in normal 18-19 month olds, and the subjects with autism had verbal MAs with a mean of around 24 months. Although unlikely, it is possible that in normally developing children with a verbal MA of 24 months the SDG strategy diminishes. If this were the case, the group with autism might simply be showing an MA appropriate pattern. We suspect this is unlikely simply because the mental handicap group had an equivalent MA, and yet did show the SDG strategy. Nevertheless, in order to check this possibility, we carried out a second experiment.

Study 2

Subjects

The subjects were 24 normally developing toddlers, selected on the basis that their CA matched the mean verbal MA of the clinical groups in Study 1 (x = 24.4 months, sd = 3.3 months, range = 20-30 months). They were all full-term at birth, showing normal development, were of monolingual background, and had no history of serious ear infection. These factors were checked since they can affect rate of language development.

Method

Children were first given the opportunity to play freely in the testing room at the University of Oregon (Psychology Department), in order to become acquainted with the experimenter and the surroundings. After about 10 minutes the child was then seated at a table opposite the experimenter, with the parent seated some distance away. As in Study 1, each child received one trial of follow-in labelling, and one trial of discrepant labelling, the label being uttered twice in each trial. Order of condition was counterbalanced across children, as was assignment of toy pairs to conditions, assignment of target toys to condition, and assignment of novel labels to target toys across conditions. The method for both conditions exactly matched that of Study 1, and so is not repeated here.

In the Comprehension Test, the procedure differed marginally from that in Study 1, in that the two novel toys were placed inside a pouch, together with just the two familiar toys. This means that, whereas in Study 1, the subject had to select the object from an array of 6, in Study 2 the selection was from an array of 4. This was because piloting with young normal subjects suggested that an array of 6 objects contained too much distraction. The experimenter showed the child the pouch, saying "I'm gonna hide the (x)". Then, as the child peered into the pouch, the experimenter said "See the (x)? Go get the (x)". The Naming Question was not asked with the normal group because many of them were unable to comprehend the force of the question. After the child had selected one of the toys from the pouch, the experimenter said "Did you find it?", in a pleasant but neutral tone, then dumped the remaining toys out of the pouch. After the child played with the toys for a short time, the four toys were again hidden in the pouch. The experimenter then asked the child to find one of the familiar objects in the pouch. Because there was no Naming Question, this whole procedure was repeated using a new hiding place (a cosmetics container), in order to be confident that the child had not picked out the object correctly by chance alone. Assignment of novel and familiar toys to the right versus left side in the pouch or cosmetics container was counterbalanced.

Results and Discussion

A pass was defined as the child correctly choosing the experimenter's novel toy out of a choice of two novel toys, on at least one trial, after the Discrepant Labelling condition. Using this criterion, 19 out of 24 (79%) of the subjects passed. If we assume chance performance was 50% (since the child had to choose between 2 objects on each Comprehension Test), this is a significantly higher proportion of children passing than one would expect from chance alone (Chi Square = 18.88, 1df, $p < 0.00005$). In addition, 17/24 (74%) passed the Follow-In Labelling Condition, which again was significantly better than chance (Chi Square = 12.19, 1df, $p < 0.0005$). Since this is in line with previous studies using younger subjects, we can conclude that the SDG strategy persists at least until the age of 24 months of age in the normal case, or until a verbal MA equivalent of this. We now turn to the General Discussion of these two studies.

General Discussion

In Study 1, we tested whether children with autism used the SDG strategy on hearing a novel word uttered in the presence of two novel objects. The SDG strategy is when the child looks up at the speaker's face, when hearing the novel word, and uses the speaker's gaze direction to correctly infer the speaker's intended referent for the novel word. We found that, whereas 70.6% of children with mental handicap (and without autism) showed this effect, only 29.4% of a group of children with autism did so. Instead, they used the LDG (Listener's Direction of Gaze) strategy: they assumed the novel word referred to the object they themselves had been looking at, at the time of hearing it. This led them to commit an egocentric mapping error. This replicates a finding from Baron-Cohen et al (1995) using a cartoon method, and extends this by showing how, in a real social situation and with a live face, children with autism fail to use a person's eye-direction to infer their intended referent. This is further support for the idea that children with autism are relatively "blind" to the mentalistic significance of the eyes (*ibid*).

It is however important to consider some possible counterarguments to this conclusion. First, might it be that the lack of the SDG strategy in autism[2] was due to the group's verbal MA level? This possibility can be ruled out both by the inclusion of the group with mental handicap in Study 1, and by the group of normally developing 24 month olds, in Study 2. In both cases, these groups had a similar verbal MA to the group with autism, and yet the SDG strategy was strongly in evidence. Secondly, might the lack of an SDG strategy in autism be due to a failure to learn word-object associations? This is also clearly ruled out in that, under the Follow-In Labelling Condition, where an LDG (egocentric) mapping strategy would actually lead to a "pass", the children with autism all learned the association between the novel word and the novel object. Rather, the results are most parsimoniously explained in terms of the child not spontaneously 'decentering' away from his/her current percept, to check the speaker's current percept.

Note that this egocentric error would be predicted not only by the theory of mind/joint attention

[2] We use the phrase "lack of the SDG strategy in autism", while acknowledging that this description of our results goes a little beyond the evidence presented. Strictly speaking, what we have found in the domination of the LDG over the SDG

hypothesis, but also by the executive function hypothesis (Ozonoff, 1995; Russell, 1996), in that executive function is held to involve "disengaging from the salience of reality". We suggest this explanation is unlikely to hold in a general form, however, because there are several experiments in which disengaging from reality is required, yet on which children with autism show no impairment. These include the false photograph task (Leekam and Perner, 1991; Leslie and Thaiss, 1992; Swettenham, Gomez, Baron-Cohen, and Walsh, 1996), the false drawing task (Charman and Baron-Cohen, 1992), the false model task (Charman and Baron-Cohen, 1995), the false map task (Leslie and Thaiss, 1992), and visual perspective-taking tasks (Baron-Cohen, 1989a; Hobson, 1984; Tan and Harris, 1991). There may well be an executive dysfunction in autism (see Bishop, 1992; Baron-Cohen and Swettenham, 1996), but an inability to disengage from reality does not seem to be evident in a strong form. In the final section of this paper, we turn to consider the implications of the present findings for language development in autism.

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strategy. It would require further tests to demonstrate a complete lack of the SDG strategy.

How might a lack of the SDG strategy disrupt language development in autism?

From the outset, we should recognize that if a child lacked the SDG strategy, this would not necessarily disturb all aspects of language. For example, syntactic development may be relatively independent of such social factors (Pinker, 1994). Nevertheless, the SDG strategy might be expected to play a key role in certain aspects of language, such that if a child lacked this, subtle language deficits might be expected. Which kind of deficits?

The first and most likely aspect would be the development of a shared vocabulary. Without an SDG strategy, the child-as-language-learner would be forced to use the alternative LDG strategy (to repeat: assuming that the object the listener is attending to when hearing a new word is the referent). While this might in fact coincide with the speaker's intended referent in the majority of cases (and thus lead the child to acquire a reasonable, shared vocabulary), the LDG strategy would also lead to errors, specifically in those instances where the speaker's focus of attention is different to that of the child. We suggest, then, that the first feature of autistic language that this might explain would be the production of some words being used in *unconventional* ways. In the Introduction, we gave some examples of these, and several clinical accounts include these.

Secondly, and more speculatively, one might expect that lacking the SDG strategy would slow down the rate of vocabulary development. If it is the case that the normal child "cracks the language code" via the SDG strategy, such that a single utterance of a novel word is correctly mapped on to its referent, vocabulary development will proceed as virtual one-trial learning. In contrast, the young child with autism using the LDG strategy would lead to many false starts, conflicting information, and confusion.

Consider this example. If a child first hears the word "computer" when Daddy is sitting at his desk at home typing away, and the child is looking at his/her toy bricks on the floor, the LDG strategy would lead to the mapping **["computer" = bricks]**. If the same child next hears the word "computer" when Mummy is in her office, and the child is looking at the goldfish tank, the child would search his/her lexical memory, retrieve the item "computer", which would produce the interpretation 'bricks'; but then, not finding any bricks in his/her current perceptual field, the child would delete the mapping **["computer" = bricks]**, and substitute this with **["computer" = goldfish]**. After several more mismappings of this kind, one might expect the child to lose some motivation for vocabulary acquisition, and turn to more predictable aspects of the environment[3]. Since language delay is a defining feature of autism (DSM-IV, 1994), the lack of the SDG strategy may be an important contributory factor in causing this[4]. We recognize, however, that <u>lexical</u> development is not specifically impaired in autism, relative to <u>syntactic</u> development (Tager-Flusberg et al, 1991), so it is likely that other factors are also involved in the cause of their language delay.

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[3] For the LDG strategy user, there is a further strategy available, namely, the Common-Feature (CF) strategy. The child in the above example, on discovering **["computer" = bricks]** and **["computer" = goldfish]** could, using the CF strategy, search for common features of both situations, and eventually correctly deduce that **["computer" = computer]**, since this was the only common feature of the bricks and goldfish situations. However, while the CF strategy would be effective in eventually ironing out mapping errors, it is clearly not as efficient as the SDG strategy, and so should still lead to some delay in vocabulary development.

[4] Frith and Happe (1994) make a related argument that theory of mind deficits may be sufficient to cause language delay in autism. Here we suggest there are specific language learning strategy deficiencies that might cause this.

In closing, we reiterate our view that the lack of the SDG strategy in young children with autism is ultimately part of a joint-attention deficit. In the language domain, it suggests an inability by children with autism to understand that language exists primarily as a means to establish a *joint topic*, with a view to sharing *comments* on the topic. The topic-comment distinction in language is a traditional and fundamental one that is drawn by most theorists. Here we emphasize that identifying a topic can be done socially or privately. To do this socially presumes a capacity for joint attention. Note that topics can also be identified and commented on socially without language. For example, the topic can be identified for the other person by *pointing* with the index finger (or with the eyes) at an object, or by *showing* an object to someone, and commenting can be achieved by *facial expression* (surprise, disgust, fear, etc.). Children with autism not only fail to check the speaker's verbal topic via the SDG strategy, but, as mentioned in the Introduction, they also do not spontaneously produce the declarative forms of the pointing and showing gestures (Sigman et al, 1986; Baron-Cohen, 1989a; Baron-Cohen et al, 1992; Baron-Cohen, Cox, et al, 1996). For these reasons, it is likely that the present results are part of a deeper deficit in sharing a focus of attention both verbally and non-verbally[5].

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[5] Given the importance of joint attentional deficits in autism, we would encourage future studies to include videorecording to enable more fine grain analysis than was possible in the present study.

Table 1: Proportion of each group in Study 1 passing each condition

	Discrepant Labelling	Follow-in Labelling
Autism	5/17 (29.4%)*	14/17 (82.35%)
Mental Handicap	12/17 (70.58%)	15/17 (88.23%)

* $p < 0.04$

Figure Legend

Figure 1: Child and adult (speaker) are both looking at different objects at the time the speaker uses a novel word to name a novel object. From Baldwin (1995).

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