The obscure object of desire: ‘Nearly, but clearly not, like me’: Contingency preference in normal children versus children with autism

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The author describes the central role of contingency detection in early socioemotional development. It has been proposed (Gergely & Watson, 1999) that infants are innately equipped with a complex perceptual mechanism, the “contingency detection module,” which functions to establish the primary representation of the bodily self as well as the later orientation toward reactive social objects. According to the “contingency switch” model, the target value of the module that is initially genetically set to preferentially explore perfectly response-contingent stimulation is “switched” at around 3 months toward a preference for less-than-perfect social contingencies. It is hypothesized that the primary cause of childhood autism is a genetic defect, due to which the normal process of switching contingency preference at around 3 months does not take place. Preliminary results from an experimental study to test this model are reported. The study contrasts the preferential reactions of normal children and children with autism to perfect versus imitative (high-but-imperfect) contingencies. The results provide support for the contingency switch hypothesis of the etiology of childhood autism. (Bulletin of the Menninger Clinic, 65[3], 411–426)

A number of studies have demonstrated that young infants are very sensitive to the contingent relationships between their motor responses and consequent stimulus events (Bahrick & Watson, 1985; Field, 1979; Lewis & Brooks-Gunn, 1979; Lewis, Alessandri, & Sullivan, 1990; Papousek & Papousek, 1974; Rochat & Morgan, 1995)

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Watson, 1972, 1994). For example, Watson (1972) has shown that 2-month-old infants increase their rate of leg kicking when it results in a contingent stimulus event (the movement of a mobile), but not when they experience a similar, but noncontingent, event. Furthermore, after experiencing their contingent control over the mobile’s movements, these infants exhibited social smiling and cooing when the mobile was presented. This indicates not only that very young infants are able to detect response-stimulus contingencies, but also that the experience of causal control over a stimulus event is generally positively arousing for them.

How do young infants perceive response-stimulus contingencies so efficiently? Based on Watson’s extensive studies (1979, 1985, 1994), we have recently proposed (Gergely & Watson, 1999) the existence of an innate “contingency detection module” that analyzes the conditional probability structure of the contingent relations between responses and stimulus events. Briefly, this analytic device applies two independent mechanisms: One (called the sufficiency index) is looking forward in time, registering the conditional probability of an upcoming stimulus event as a function of an emitted response, while the other (called the necessity index) is testing backward in time, monitoring the relative likelihood that a stimulus event was preceded by a given response. The two separate indices estimate two aspects of the contingency relation that can vary independently of each other, providing a scale of different magnitudes of contingent relatedness (Watson, 2001).

Although much of the evidence has come from studying purely temporal contingency relations, there are, in fact, three separate and independent bases of contingency: temporal, sensory relational (relative intensity), and spatial (similarity of spatial distribution or pattern) (Watson, 1984). We have argued (Gergely & Watson, 1999) that the contingency detection module is an analytic device that at its input end monitors for and registers all three parameters of response-stimulus contingencies in parallel and computes as its output an overall value indicating the estimated degree of causal relatedness between responses and stimuli. There is converging evidence that infants use all three informational bases in detecting contingency (see Gergely & Watson, 1999, pp. 103–107).

Developmental functions of the contingency detection module: Differentiation of the self and orientation toward the social world

By differentiating among varying degrees of contingencies, the contingency detection module can identify those stimulus events that are
the necessary sensory consequences of the infant’s motor responses (and as such belong to the self) versus those stimuli that emanate from external sources (Bahrick & Watson, 1985; Watson, 1994).

For example, Bahrick and Watson (1985; see also Rochat & Morgan, 1995; Schmuckler, 1996) seated young infants on a highchair in front of two monitors so that they could freely move their legs. One monitor presented the video-recorded live image of the subject’s moving legs, providing a stimulus that was perfectly contingent with the infant’s responses. The other monitor presented a previously recorded image of the infant’s legs, which was, therefore, not contingent on the baby’s present leg movements. It was found that in 3-month-old infants, the distribution of preference was significantly bimodal: One subgroup showed preference for the perfectly contingent image, while the other preferred the noncontingent image.

One’s motor actions produce stimuli that are necessarily perfectly response-contingent (as in the case of double touch, or watching one’s hands as one is moving them), while the perception of stimuli emanating from the external world typically shows degraded levels of response contingency. Therefore the detection of contingency between efferent (motor) activation patterns and consequently perceived stimuli may serve as the original criterion for distinguishing the self from the external world (Bahrick & Watson, 1985).

Interestingly, however, Bahrick and Watson (1985) found that, in contrast to 3-month-old infants, 5-month-old infants showed a clear preference for looking at the noncontingent image. This aversion to looking at the perfectly contingent display raises the question of what levels of contingency might be preferred over noncontingency after 3 months. Watson (1979, 1985) examined infants’ reactions to different magnitudes of contingencies varying between less than 1 but greater than zero (in terms of conditional probability). He found that between 4 and 6 months, infants have great difficulty with contingency magnitudes that are less than .5. At the same time, they also failed to engage contingencies that approached a magnitude of 1 on both indices (i.e., on both necessity and sufficiency). Therefore Bahrick and Watson proposed that their sample of 3-month-old infants were in developmental transition from a preference for perfect contingency to a preference for high-but-imperfect contingency. Thus, after 3 months, infants seem more motivated to explore high-but-imperfect degrees of response-stimulus contingencies than they are to explore perfect contingencies.

Based on such data, Watson (1994) proposed that during the first 2–3 months the initial target of the contingency detection module is genetically set to seek out and explore perfectly response-contingent
stimulation. The hypothesized evolutionary function of this initial attention bias is to develop a primary representation of the bodily self as a distinct object in the environment by identifying those stimuli that are the necessary sensory consequences of the body's motor actions and over which the infant exercises perfect control.

Furthermore, it was hypothesized that at around 3 months, the target value of the contingency analyzer in normal infants is "switched" to a preference for high-but-imperfect contingencies. Note that this level of contingent stimulation is characteristic of the infant-directed reactive behaviors of well-attuned social objects. This maturational change functions, therefore, to orient the infant toward the exploration and representation of the social world as presented by the (necessarily less-than-perfectly response-contingent) parental environment.

The obscure (social) object of desire: 'Just like me' or 'Nearly, but clearly not, like me'?

Recently, Meltzoff and Gopnik (Meltzoff, 1990; Meltzoff & Gopnik, 1993) proposed that early imitative interactions may provide the basis from which babies learn to pay special attention to conspecifics. This learning arises when the caregivers imitate their infants, as opposed to when the babies imitate their caregivers. Meltzoff and Gopnik propose that infants may use their innate cross-modal capacity to map the caregiver's visual movements onto the proprioceptive feelings of their own movements that the parent is imitating, thereby generating a "just like me" experience in the infant. They suggest that the caregiver's movements become attractive (attention capturing) precisely because they are perceived (via the mapping) to be very much like the baby's own. In this view, the more "like me" the infant experiences an object's behavior through cross-modal mapping to be, the more attracted he or she will be to that object.

To test this hypothesis, Meltzoff (1990) applied a preferential interaction paradigm in which 14-month-old infants were faced with two adult models, one of whom imitated as best as she could the child's object-related behaviors, while the other always performed a temporally contingent, but dissimilar (spatially noncontingent) action. Meltzoff found that the infants looked and smiled more at the adult who mimicked them than at the one whose actions were only temporally contingent with theirs.

The "like me" hypothesis would seem to clearly predict that the more faithfully the other's imitative actions reproduce the infant's behavior, the more attractive it will be for the baby. By contrast, as we
have seen, our contingency-based model assumes (Bahrick & Watson, 1985; Gergely & Watson, 1999; Watson, 1994) that after 3 months of age the target setting of the contingency detection mechanism of the normal human infant is switched toward seeking out high-but-imperfect degrees of contingency. This predicts a preference for highly but imperfectly contingent imitative displays over perfectly contingent ones, while the opposite prediction follows from the “just like me” hypothesis.

According to our model (Gergely & Watson, 1999), the contingency analyzer computes the overall degree of contingent relatedness on the basis of the registered values of three independent sources of contingency (temporal, spatial, and relative intensity; Watson, 1984). Therefore, the nonimitative (only temporally contingent) model in the Meltzoff (1990) study would receive a lower contingency value than the imitative model. The latter, however, while clearly showing a rather high degree of contingency, will nevertheless still be significantly lower than perfectly contingent because it is the result of the variably successful imitative efforts of a real-life human imitator. Therefore, our explanation for the looking pattern in Meltzoff’s (1990) study is that the mimicking model provides a high but nevertheless only imperfectly contingent action, which is preferred as such over the simply temporally contingent model, which produces a much lower degree of contingency. Thus we propose that the preference for the temporal-plus-spatial-plus-sensory-relational contingency (generated by the mimicking adult) over the only temporal contingency (of the nonimitating but reactive alternative model) simply indicates that the imitating model provided a contingency magnitude that was closer to the target criterion of best (high-but-not-perfect) contingency of the contingency detection module than was the alternative model.

In contrast to Meltzoff and Gopnik’s “just like me” hypothesis, our contingency-based theory predicts that had the infants been given a choice between a truly perfectly contingent (self-like) display versus a highly but only imperfectly contingent imitative display (such as the one used by Meltzoff), infants (after 3 months) would preferentially attend to the latter. In other words, we predict that infants would be attracted to the “nearly, but clearly not, like me” display rather than the “just like me” display. They would do so because, according to the “contingency switch” hypothesis, rather than preferentially orienting toward a (self-like) perfect contingency, infants after 3 months are committed to engage contingencies that are specifically not self-like (i.e., not perfect).

To test this prediction, we contrasted the effect on young chil-
dren's behavior of the availability of perfect versus imitative feedback of their manual activity (Gergely, Magyar, & Balázs, 1999; Magyar & Gergely, 1998). We tested 32 normal subjects (between 18 and 36 months old) who sat in front of two TV monitors, each displaying the moving image of a schematic hand. The subjects moved a small metal bowl (with a computer mouse hidden inside) freely on the surface of the table in front of them (see Figure 1). On one of the screens

Figure 1. Experimental set-up for preferential-looking study.
they saw the perfectly response-contingent movements of a schematic hand generated by a computer program controlled by the subjects' manual manipulation of the bowl. The second screen displayed a highly but imperfectly response-contingent image of the schematic hand generated by the imitative efforts of an experimenter. The experimenter attempted to faithfully copy the subject's manual behavior by moving a mouse under the visual guidance of the perfect feedback display viewed on a separate monitor in another room. This procedure provided the normal lag and imperfection of a human act of direct imitation. We found that normal children attended more to the imitation-based (highly but imperfectly) contingent image than to the perfectly contingent computer-generated one \((p < .05)\) (see Figure 2). This preliminary study seems therefore to provide support for our

![Chart](image)

**Figure 2.** Looking at perfect versus imitative response-contingent stimulus displays in children with autism and normal children.
hypothesis that normal children are selectively attracted to response-contingent stimuli that are “nearly, but clearly not, like them” rather than to those that are “just like them.”

Contingency perception and childhood autism:
The ‘faulty switch’ hypothesis

In recent years, a number of new hypotheses have been offered concerning the primary causes of autism. These have ranged from global deficits, such as a missing drive for global coherence (Frith, 1989), to specialized modular deficits, such as a missing theory of mind module (Baron-Cohen, 1995; Baron-Cohen, Leslie, & Frith, 1985), a deficient eye-tracking module (Leekam, Baron-Cohen, Perrett, Milders, & Brown, 1997), a deficient attention-switching mechanism (Courchesne et al., 1994), an executive-function deficit (Ozonoff, Pennington, & Rogers, 1991; Russell, 1997), or a deficient imitation mechanism (Meltzoff & Gopnik, 1993), each concentrating on some subset of the complex symptom cluster of this pervasive developmental disorder. Recently, Watson (1994; Gergely, Koós, & Watson, in press; Gergely & Watson, 1999) added to the list of these intriguing theories a conceptually different approach that proposes that the etiology of childhood autism may be related to a genetically based dysfunction of the contingency detection module.

Earlier I argued that at around 3 months there is a genetically based transition in the preferred target setting of the innate contingency detection mechanism. During the first 2–3 months, infants are preferentially engaging perfect contingencies typically provided by cyclic repetitions of body-centered activities (see Piaget’s [1936/1952] primary circular reactions). I hypothesized that the self-generated perfect contingencies provide an important source of self-calibrating information (Watson, 1994), leading to the progressive differentiation of the self and the construction of the primary representation of the body-schema. In the long run, however, selective evolutionary pressure is for adaptation to the external environment, and so the infant must shift orientation from self-based perfect contingencies to environment-based contingencies. This shift is accomplished by resetting the target magnitude of the contingency detection module from perfect to something discriminably less than perfect at about 3 months of age. At this time, the infant’s preference shifts from engaging self-stimulation to engaging stimulus consequences of action on the environment that typically provide less than perfectly contingent effects. As a result, in normal infants after 3 months the preferential engagement in primary circular reactions
is progressively replaced by producing and attending to secondary circular reactions (i.e., by exploring the external stimulus consequences of acts on the environment). Furthermore, the infant-induced reactions of responsive social objects, such as affect-reflective mirroring interactions (Gergely & Watson, 1996, 1999) or repetitive game-like interactions (Watson, 1972), provide optimal, highly but imperfectly response-contingent stimulation that approximates best the preferential target value of the contingency detection device after 3 months. This functions as the basis for the infant’s emerging orientation toward and exploration of the social environment and forms the basis for the establishment of the representations of relationships with primary attachment figures.

Our proposal concerning the etiology of childhood autism is a simple one: We hypothesize that in autistic individuals the normal shift at around 3 months (triggered by maturation or experience) in the target value of the contingency detection module does not take place (or not by enough). As a result, children with autism continue to invest in perfect contingencies throughout life. This tragic devotion to lifelong perfection-seeking can be seen as underlying a wide range of the symptoms characteristic of childhood autism: (1) stereotypies, (2) executive function problems, (3) aversion to social objects, (4) inattention to faces and lack of social responsivity, and (5) lack of social understanding.

1. Stereotypies. Children with autism often exhibit characteristic behavioral rhythmicities and stereotypic motor activities, as well as intolerance to variation in routines. These central features of the disorder can be seen as a direct consequence of the fact that the target setting of the contingency detection module remains in its original position of seeking out perfect contingencies. The preference for invariance and the repetitive engagement in primary circular reactions generate close to perfect response-stimulus contingencies, whereas the high-but-imperfect contingencies provided by responsive social interactions remain too low in contingency value to engage the autistic child’s attention.

2. Executive function problems. Perseveration with habitual routines and difficulty in inhibiting circular reactions may contribute to the difficulties that children with autism show in carrying out complex, planned, goal-directed activities. They can also be expected to be less motivated to plan and perform action outcomes involving conditional (less than perfect) contingencies, especially when competing habitual action alternatives with clearly predictable, perfectly contingent outcomes are available.
3. Aversion to social objects. To be able to predict the behavior of social objects, one needs to learn about the significance of dispositional behavioral cues that are displayed in a contingency matrix that is by necessity lower than perfect. We hypothesize that children with autism will show a deficit in attending to and processing such facial and gestural dispositional cues. This deficit will render the behavioral variation of social partners largely unpredictable to children with autism, which will be anxiety provoking and will lead to aversion to and avoidance of social interaction.

4. Inattention to faces and lack of social responsivity. There is evidence that the power of faces to attract attention and elicit smiling increases markedly at around 3 to 4 months in normal development. Watson (1972) proposed that the face acquired special ethological potency for eliciting smiling and drawing attention by virtue of its association with high-but-not-perfect contingency, as exemplified in repetitive game-like face-to-face interactions. In this view, the failure of an infant with autism to modify contingency seeking from a target of perfect to high but not perfect undermines the infant’s capacity to engage in the early interactional games that normally would generate the special social potency of the face to capture attention and elicit smiling.

5. Lack of social understanding. Inferring actions of others based on attributed dispositional and intentional mental states implies sensitivity to the behavioral cues (such as facial expressions or gaze direction) that indicate such internal states in others. Note that such discriminative cues enter into conditional probability relations with consequent actions that are typically less than perfect and may therefore be missed by children with autism. This fact, together with the inattention to facial cues, may help explain the profound difficulties that children with autism have in reading other peoples’ minds.

This view of childhood autism as relative “blindness” to less-than-perfect contingencies is admittedly highly speculative. Until now we have had no direct evidence to indicate that children with autism remain seekers of perfect contingencies. However, a recent extension of our preferential-looking study (Gergely et al., 1999; Magyar & Gergely, 1998) to include autistic subjects has provided new evidence that children with autism react to response-stimulus contingencies significantly differently than do normal children. Our study showed that normal children preferentially orient toward a highly but imperfectly contingent (imitative) feedback of their manual actions when compared to a perfectly contingent computer-generated feedback (see
Figure 2). We have also tested 16 children with autism on the same task and found the opposite effect: The autistic subjects spent significantly more time looking at the perfectly contingent computer-generated feedback than at the imitative, human-generated feedback display ($p < .02$) (see Figure 2).

This result suggests that, unlike normal children, children with autism are drawn to preferentially engage perfectly response-contingent stimuli in a situation in which competing highly-but-imperfectly contingent imitative social stimuli are equally available. This finding does not imply that children with autism cannot detect the high-but-imperfect imitative contingency. In fact, they may well do so, but because the perfectly contingent alternative matches the target setting of their contingency detection module better, they end up engaging the perfectly contingent stimuli, while remaining relatively inattentive to the imitative social contingency.

As a matter of fact, it seems perfectly compatible with the “faulty switch” hypothesis that the genetically based difficulty in resetting the target value of the contingency analyzer is not an all-or-none matter, but rather a matter of degree. One may speculate that the width of the “contingency window” below perfection that children with autism are motivated to attend to may vary as a function of the severity of the disorder, being perhaps slightly larger in high-functioning autistic individuals (e.g., those with Asperger’s disorder). Consequently, one may expect to find individual variability among children with autism in their level of difficulty in processing information that is presented through less-than-perfect social contingencies. To the degree that this is the case, high-functioning autistic children may be relatively less subject to the debilitating consequences of failing to process social information presented in lower-than-perfect contingencies than are low-functioning children with autism.

This hypothesis would predict that at least some children with autism show a certain degree of sensitivity and responsiveness to being imitated. This responsiveness would be expected insofar as the imitative contingency they are exposed to falls within the narrow window of close-to-perfect contingencies that they are drawn to attend to. In line with this hypothesis, several studies have reported that some children with autism do, indeed, react to being imitated with an increase of positive attention to the experimenter or an increase in the duration of the activity being imitated (e.g., Dawson & Adams, 1984). Nadel (in press) summarizes a set of studies wherein she found that children with autism exhibit active signals of attention to being imitated, such as looking at the experimenter’s body part involved in the imitative motor activity, waiting for the experimenter’s
imitation, and reinitiating when the experimenter did not imitate. She also reports significant individual variation in reactivity to being imitated in a study with a group of low-functioning children with autism. While 10 children exhibited systematic looking back and forth between the imitating experimenter's object and their own manipulated object (with a mean rate of one gaze switching in 10 seconds), another group of six subjects seemed to show no reaction to being imitated (with a mean rate of one gaze switching in 90 seconds). In another study, Nadel et al. (2000) presented eight low-functioning nonverbal children with autism with a modified version of the Still-Face paradigm. Each subject entered a room in which a motionless, still-faced stranger sat on a sofa. The children with autism ignored the stranger during this first still-face period and proceeded to engage in object manipulation using pairs of identical objects placed at different locations in the room. Then the stranger got up and started to imitate all the autistic subject's actions, using one of the two identical objects that the autistic child was manipulating. After this period of imitation, the stranger went back to the sofa, sat down, and became motionless, putting on a still-face again. Nadel et al. found that during the imitative phase, the autistic subjects reacted to being imitated by increasing the number of looks at the stranger, by exhibiting positive social gestures, and by touching the stranger. Even more interesting is the fact that during the second still-face period, the children with autism did not ignore the stranger anymore (as they did during the first still-face phase). Instead, they exhibited a variety of behavioral reactions toward the experimenter in an attempt to reengage her, including positive gestures such as touching (caressing and embracing) and imitating her (e.g., sitting next to her motionless for a while). Eventually they showed signs of negative affect, indicating their frustration at not being able to make the stranger come “alive” again.

The assumption that the dysfunctional resetting of the “contingency switch” in childhood autism is a matter of degree that varies as a function of the severity of the disorder leads to a further interesting prediction. This concerns the nature of the higher-order cognitive deficits, such as the “theory of mind” deficit that is specifically associated with childhood autism (Baron-Cohen et al., 1985). Children with autism show a specific impairment in social “mind reading” skills (Baron-Cohen, 1995; Frith, 1989), being unable to infer other people's intentional mental states as evidenced by their failure on a variety of “false belief attribution” tasks. The theory-of-mind-deficit account of childhood autism considers this to be the direct consequence of the presumed genetic impairment of the innate theory-of-
mind module (Baron-Cohen, 1995; Baron-Cohen et al., 1985) that is proposed as the central etiological feature of the disorder. Although the theory-of-mind-deficit account provides a plausible explanation of a range of the cognitive and social deficits associated with childhood autism, it seems to have less to say about such central features of the symptomatology of the disorder as the prevalence of stereotypic and repetitive behavioral routines. Furthermore, the theory-of-mind-deficit account of childhood autism postulates a genetically based lack of the metarepresentational capacity necessary for understanding intentional mind states (Leslie, 1987, 1994). A further potential problem for this theory, therefore, is the fact that only about 80% of verbal children with autism fail the false belief attribution tasks, and a small portion of high-functioning autistic individuals manage even the more complex “second-order” belief attribution tasks as well (Bailey, Phillips, & Rutter, 1996; Happé, 1993). It is still an unresolved question whether the “theory of mind passers” have developed a genuine mind-reading capacity, or whether they make use of some alternative strategy to solve the tasks (Bailey et al., 1996; Happé, 1994).

The “faulty switch” hypothesis of childhood autism differs from the theory-of-mind-deficit account in that it considers the lack of competence in mind reading to be a secondary consequence of the more basic, primary cause of the disorder, namely, the genetically based dysfunction in resetting the target value of the contingency detection module. The consequent difficulty in attending to and processing the less-than-perfectly contingent facial and behavioral cues of other persons that form the basis for attributing intentional mind states to them is seen as the primary cause of the failure to acquire mind-reading skills in children with autism. I have speculated that the dysfunctional resetting of the target value of the contingency detection device toward less-than-perfect contingencies is likely to be a matter of degree in children with autism. Consequently, the width of the window of close-to-perfect contingencies that children with autism can attend to may vary as a function of the severity of the disorder. This hypothesis predicts that high-functioning children with autism will have more chance to detect and learn about the facial and behavioral cues of others that support mental state attributions than low-functioning autistic children. This would occur insofar as such cues are presented in social contingencies that are high enough to capture their attention. Therefore, the fact that the theory-of-mind deficit in childhood autism turns out not to be an all-or-none matter (e.g., some high-functioning autistic individuals do acquire mind-reading skills, even if not perfectly and with significant delay) seems
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to support the predictions of the “faulty contingency switch” account of childhood autism.

References


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