Distributed Cognition at Three Months: Caregiver-infant Dyads in kwaZulu-Natal

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Two Views of Cognitive Science

Until recently most work in cognitive science adopted what has been challenged as an 'Input-Output' (I-O) model (Hurley 1998). Conflating brain and person, cognitive processes are presented as problems or tasks that are independent of affect, perception and action. Using a narrow concept of causation together with the belief that, somehow, mind is realised at a 'level' of the brain, I-O models have had thirty years of hegemony. In spite of their interdisciplinary claims, this kind of cognitive science deems the study of mind independent of much anthropology, linguistics and psychology. Specifically, the problem solving and task analyses of I-O models make talk, culture and everyday behaviour too concrete for analysis. Instead emphasis is placed on principles, rules and networks that generate mathematically specified output and patterns. For the internalist, the resulting descriptions *are* cognitive models. They illustrate, for example, how 'mind' processes sentences or calculates chess moves.

Cognitive internalism is in retreat (e.g. Hutchins 1995; Churchland 1995; Clark 1997; Thelen & Smith 1994; Hurley 1998; Rowlands 1999).

Above all, brains are not symbol-processors and human activity, like that of other living things, is a biomechanical process driven by neural and bodily events. Far from 'containing' minds, our bodies use experience to act in complex circumstances. Research programmes, then, turn to 'distributed cognition' (see Spurrett in this volume). Cognitive processes occur not just inside brains, but also *between* body and world. Abandoning I-O models makes redundant—not computation—but reliance on top-down analysis. By way of illustration, Hendricks-Jansen (1996) turns to 'vision' in the horseshoe crab. While its neural systems have long been computationally modelled their function remains mysterious until evolutionary history is considered. Indeed, for forty years, it was unnoticed that the crab's eyes provide a million times more information about (some) objects at high tides at midnight. Its computations, far from implementing 'vision', direct attention to crab-sized-objects-moving-at-crab-rates-at-one-metre-in-dark-waters (Barlow 1990). Like horseshoe crabs, humans too rely on historically derived biomechanical processes. Our cognitive powers, then, must be explained both neurally and, as argued by Nagel (1961), Sloman (1978) and Hendricks-Jansen (1996), with respect to their history.

What of Babies?

Cognitive internalists are not interested in babies. When asked, say, about language acquisition they appeal—not to observables but—to computational systems (see Pinker 1994; Cowley 2001a)[2]. Conversely, within a framework of distributed cognition, babies are of special interest. In place of 'competencies' or developmental stages, theorists examine how their worlds impinge on their brains and behaviour. Body-world activity is thus necessary, but not sufficient, to becoming minded. Examining its history throws light on how cognition is both derived and transformed by joint activity. Further, in a cultural environment, this process is irreducible to norms or developmental landmarks. Much development is shaped by factors that affect individual babies, brains, actions and perceptions. It is stressed

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[2] Remarkably, this does not apply only to generativist theory. Even Halliday considers learning to talk as coming to make choices between items from a neural meaning base (Halliday & Matthiessen 1999).

that babies differ both in developmental time and across sociohistorical settings.

In this paper I illustrate the distributed approach with respect to individual and cultural differences in the fourth month. The observations are incompatible with seeing a child as a bounded system subject to specifiable inputs and outputs. Rather, what is focused is how infants can provoke responses at a person level. For, when we see a baby as, say, 'wanting to play' or 'being uncomfortable', response is deeply influenced by the baby's neural and bodily activity. Biomechanical systems control baby behaviour to invite judgements that shape interindividual co-ordination. What happens is intentional activity that arises as infants, drawing on sub-personal systems, set up, influence and alter the course of social events. Although the description may seem unusual, this view is consistent with what is known of early 'intersubjective' behaviour (Bateson 1975; Stern 1977; Trevarthen 1977; Kaye 1982). Indeed, it may be that distributed cognition takes debate beyond questions of origins (e.g. Burman 1994; Bråten 1998) to consideration of developmental effects. Below, therefore, once primary intersubjectivity has been introduced, I outline how, in kwaZulu Natal, events loop between persons. Stressing variability, I conclude with why cognitive differences matter in Africa.

Cognition in Africa

Cognitive internalism sustains the vague thought that adult humans are basically the same regardless of class, creed or cultural origin. While consistent with neo-liberal ideology, the view throws little light on the interactional events that dominate our social worlds. To come to terms with these, we must stress how persons vary and change. Applied to development, as Thelen and Smith (1994) argue, internalist approaches obfuscate *what* develops and *how* this occurs. Overplaying biological maturation and/or cultural learning, theorists take a cavalier view of community and individual differences while, inadvertently, treating what is Western as normal. From a distributed perspective, by contrast, it is posited that cognitive effects are a consequence of behavioural variability. Thus the coupling of body and world is seen as a profoundly historical phenomenon whose cognitive and social consequences affect communities, groups, and individuals. Joint action, therefore, provides insight into both how an infant's world becomes human

and, equally, how feeling, acting and thinking take on a local flavour. Indeed, it may be of special importance to consider how and when children adopt and reject aspects of their sociohistorical heritage.

The project reported has an overall goal of designing culturally appropriate measures of dyadic interaction. This paper, however, deals, not with applications, but descriptive and theoretical issues. It stresses that, at three months, babies from kwaZulu Natal manifest linguistic, ethnic and socioeconomic diversity. While this may make readers uncomfortable, I believe it is more dangerous to ignore the social and cognitive implications of diversity. Indeed, viewing child development in terms of developmental milestones often flies in the face of empirical observation. In spite of intraspecific similarities, bodily, neural, cultural and physical influences promote variability within and between individuals. As persons, moreover, we often value group patterns more than universal ones. Effective parenting and preschool education, then, should not be designed independently of local values, beliefs and practices. Since feeling, perceiving and acting emerge in interindividual activity, the distributed view has implications for, among other things, language policy, education and health.

Our distributed view of child development is emerging in an African setting. While this paper deals with kwaZulu Natal, our descriptive tools are to be used widely in southern Africa. Thus, instead of positing universals or using ethnographic particularities, we work between these levels. Rather than code movements or what caregivers *say*, we use an analytical level that ties these to interindividual events. Since joint activity is a cognitive resource, poverty, malnutrition and disease not only affect caregivers' thinking and actions but this also impacts on how babies behave. Of course, this does not mean that baby activity does not also reflect infant health and socioeconomic status. Rather, these and other factors, themselves have a considerable part in shaping caregiver and cultural beliefs and practices. Thus, in certain circumstances, optimal practices may be ones that strike Western eyes as distinctly African.

A Distributed Approach to Primary Intersubjectivity

The third and fourth months of an infant's life manifest what, following Trevarthen (1977; 1979), is called 'primary intersubjectivity' (Bateson 1975; Stern 1977; Kaye 1982; Bråten 1998). Today it is beyond dispute that,

behaviourally, this phase is marked by closely meshed, affectively charged infant-caregiver activity. At one level, the label identifies the consequences of a qualitative change in interaction that allows caregivers and infants to enact an interactional 'dance'. Rhythmical bodily movements, mutual gaze and facial expression are accompanied by delicately modulated vocalization reminiscent of waltzing or falling in love (Stern 1977). For infant and caregiver alike, this is a social breakthrough. Accordingly we ask about its origins, its cultural shaping and, especially, its cognitive consequences.

From a distributed point of view, it matters where and when primary intersubjectivity emerges. While having a specific neural basis (see Trevarthen at al. 1999; Cowley in preparation), I stress how it functions between people. Given its public face, I focus on variability that arises as shifting caregiver behaviour dovetails to suit the child's doings. While the child, like a Tetris player (see Spurrett in this volume; Blair & Cowley in this volume), seeks to fit the world to her needs, her partner has wants, beliefs and values. In short, a caregiver's actions are themselves intentional. Further, as these may serve goals that jar with the child's needs, conflicting interests shape events. Joint activity arises from the child's attuning, adult response and, of course, real-time reaction to the events. With van Gelder (1998), the co-ordination uses—not internal representations but—feedback control and the dynamics of the interindividual activity. The coupling of infant and caregiver is seen—not in terms of signals and messages but—as driving and driven by how a child's brain-body system responds to prompts and demands. Although occurring on Vygotsky's (1978) 'intermental' plane, there is no reason to posit that this cognitive activity is internalized. Since it is neurally based, the motorcentric activity itself is sufficient to produce cognitive effects.

Elsewhere I have described how, responding to Zulu forms of expression, a three-month infant comes to grasp that its mother *wants it to fall silent* (Cowley *et al.* in preparation). Rather than represent the wish, the child *does* what is wanted. What Kirsh and Maglio (1992) call 'perceptual activity' develops as the dyad learns to manage events in accordance with changing circumstances. Adjusting to the encultured other (see Cowley et. al. in preparation) allows the child to develop *de facto* expectations. Further, the adjustment serves the caregiver's interests by providing ways of prodding the infant to meet *her* wishes. Thanks to dual control (Cowley in

preparation) each nudges the other to what, given needs and culture, counts as 'acceptable'. Just as with slide-rules and navigation charts (Hutchins 1995:61f), the world is both a source of memory and a means of extending cognitive powers. In another setting, I have highlighted parallels between these events and the encultured learning of the bonobo, Kanzi (Cowley & Spurrett in press). His cognitive powers extend beyond the body as his actions are constrained by human lexigrams or word-symbols together with movement and sound. Kanzi's understanding of English (Savage-Rumbaugh *et al.* 1998) thus derives from fitting his concerns to talk and computational/ lexigram constraints. Although impossible without cross-specific neural parallels, his encultured cognition also reflects cultural beliefs and values. As Cowley and Spurrett (2003) stress, his repertoire is 'North American'. Savage-Rumbaugh *et al.* (1998:74) put it that he learns, 'not through speaking, but by coming to understand what others say'. Kanzi serves his interests by fitting behaviour to social constraints and human expectations. If the parallel holds, human infants meet their needs, not through computers and lexigrams, but by using vocalization and body movement. In Cowley's terms (in press), 'utterance-activity' is the cognitive resource that meshes infant doings with those of caregivers. Thanks to neural selectionism (Edelman 1992; Deacon 1997), it provokes neural re-organization that allows actions to be managed in line with cultural constraints. Competitive neural processes allow perceptual attunement that triggers and/or inhibits affectively charged action (Cowley in preparation). While partly speculative[3], this view of brains clarifies how interindividual dynamics help infants to hear and see what caregivers expect.

Utterance-activity guides a child's movements and, given encultured expectations, allows caregivers to shape infant action. As in Tetris (see Kirsh & Maglio 1992; 1994; Blair & Cowley in this volume), the environment is simplified by two-way activity. For a caregiver, as infant behaviour becomes coherent, her actions get simplified to fit emerging understanding. Her utterance-activity shapes neural tasks so that the child

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[3] For a detailed model, see Trevarthen et al. (1999). While my concern is merely to link this with a literature on how brains develop, Trevarthen is a neurophysiologist who is especially concerned with the details of neural functions.

acts, inadvertently, to elicit cultural patterns. As dialogue develops, these doings shape the child's neural organization. While re-representing the known, utterance-activity serves to regulate action. As brains loop, actions gain 'coherency' (see Cowley 2001b), or set up emergent patterns allowing caregivers to encourage and repress behaviour. Infants set off events such as, for example, 'play', 'showing respect' or 'wanting to get out of a chair'. The dyad acts as a self-organizing system (see Kaye 1982; Horowitz 2000) that uses joint affective, epistemic and perceptual resources. While neural constraints matter, they are mediated by utterance-activity under real-time control. Both parties contextualize (see Harris 1997; Cowley 2001b), or use past experience to exploit current events in ways that, potentially, impact on future action.

While compatible with descriptions of 'primary intersubjectivity', the above account takes a distributed perspective. Traditionally the term was used ambiguously to refer to joint activity, a developmental period, and hypothetical internal mechanisms. At the relevant age, it identifies both the 'innateness of behaviours' and postulated 'motives to find and use the motives of other persons' (Trevarthen 1998:16). Thus it uses both pre-speech and brain-based capacities for mirroring behaviour (see Bråten 1998). While concurring that it uses dedicated brain mechanisms (see Trevarthen 1979; Trevarthen *et al.* 1999) I stress its proximal and developmental functions. Thus, intersubjective behaviour is a cognitive *resource* that brings babies into contact with other body-brain systems. In spite of a 3 month old's immaturity, this gives infants amazing interpersonal dexterity. Just as caregivers assess and manage them, babies use caregivers to achieve real-time effects. Co-ordination and harmony thus co-occur with conflicts of interest (see Trivers 1972; Hrdy 2000) and the imbalance, I suggest, makes primary intersubjectivity crucial to developmental change. Joint activity is a cognitive mechanism.

When primary intersubjectivity was first discovered, those responsible sought, naturally enough, to explain how the baby's behaviour was possible. Given that its nature cannot be specified without video technology, its functions were described generally. In contrast to Piagetian models, it was linked to attachments and shown to have a universal basis (see Trevarthen 1979; 1988). Disagreement, at that time, focused on ultimate questions as some argued it was prefigured in brain processes (Trevarthen

1979; 1998) and others sought to derive it from social learning (see Stern 1977; Kaye 1982). This dispute belongs to the past. Today all accept its importance to relationships and infants are known to have many innate perceptual and action biases (e.g. Mehler & Dupoux 1997; Karmiloff & Karmiloff-Smith 2001). Further, there is a new emphasis on capacities for imitation or mimesis (e.g. Piaget 1953; Donald 1991; Tomasello 1999; Nadel & Butterworth 1999). Outside social constructionism (e.g. Burman 1994), few see these developmental biomechanics as downplaying culture. Rather, Trevarthen's central claim is widely accepted (see Bråten 1998): individuals exploit special neural mechanisms to shape interaction while learning the skills and 'sense' of a culture (Trevarthen, 1998). Compatible as this is with selectionist brain change and Trevarthen *et al.*'s (1999) 'innate motive formation', the behaviour can engender big developmental effects (see Cowley in preparation b). Indeed, if joint action shapes brain-body systems, the process must have a large part in enculturating the infant's brain.

Trevarthen's theory of innate motive formation prefigures the distributed view. Like Bråten (1988), he saw cognitive mechanisms as functioning dyadically and, for this reason, as coming to exploit external structure. Although intersubjectivity was encultured action (Trevarthen 1988), little weight was given to its developmental function. Instead of examining its part in cognitive spread, theorists debated its origin. Since the '80s, however, more attention has been given to how infants become encultured. For cognitive internalists, this has been attributed to universal grammar (Pinker 1994; Jenkins 2000), symbolic reference (Deacon 1997), cultural learning (Tomasello 1999), and, of course, social construction (e.g. Shotter 1993; Burman 1994). Yet, if cognition is distributed between body and world, innate motive formation provides a more plausible explanation. In place of universal mechanisms, neural biases are likely to promote learning that is species-specific, social *and* individual. Further, real-time motive formation is needed if adults are to exploit cultural processes in adjusting to a child's (or bonobo's) changing needs. By so doing jointly organized action can spread between individuals as, in real-time, each adjusts to the other's doings.

Culture at Three Months?
The research reported below began with investigation of cultural style in the

caregivers of three month old children. Examples come from a small sample, 18 dyads, for each of whom a single interaction was recorded. Asking how infants were 'permeated' by culture, we set out to capture the baby's perspective. We thus sought cultural contrasts which, in principle, might be perceptually salient. This led to development of an observation system that describes lived intersubjectivity in three populations. Since baby behaviour was not expected to have cultural properties, we initially focused on the jointness of the activity. Further, since one of the team was familiar with Indian and Zulu styles, we began with dyads from these historically designated groups.

To avoid undue Western influence, our Zulu data was drawn from an informal settlement, Briardene, where an NGO was carrying out development work. After explanation and recruitment (in isiZulu), caregivers and infants of 14 weeks were invited to an educational centre[4]. Once there, the infants were placed and video-recorded in a suitable chair while, together with caregivers, they engaged in 5 minutes of dialogical activity. Given expectation of payment, all made the effort to meet our wishes. In two visits, we made videotapes of interactions with 6 dyads. The next data set came from a health-centre in Phoenix, an 'Indian' township in the Durban area. While living above the poverty level of squatters, the sample also represents an underprivileged and uneducated economic group. Since two infants cried or went to sleep, this data was replaced by the first 6 adequate five minute recordings. Later, a middle class sample of the same number of 'White' dyads were recruited and videos of their interactions added to the study. Given our interest in variability, we made these recordings in their homes. This method of data collection is well suited to capturing different ways in which infants enter the cultural process.

Method

Our first challenge was methodological. Rather than describe kinetic aspects of dialogical interaction in universal terms (by contrast see Fiori-Cowley & Murray 1996), we sought to capture behaviour that might be salient to infants. From the start we excluded 'global' criteria used in judging, say, if

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[4] We were not able to make all recordings in the 15th week. Thus 14 weeks is the mean age: no infant is under 13 weeks or over 15 weeks.

caregivers are empathetic, controlling, or intrusive. While all groups have more (and less) intrusive or empathetic caregivers, in different settings, the 'same' behaviour has a different social value. This is because, above all, judgements are affected by circumstances, language and culture. Accordingly, we sought to describe style in ways bringing out how infants live engagements with caregivers. Thus we broke with descriptions serving goals like examining relationships (Stern 1977), the self (Stern 1985), mechanisms (e.g. Trevarthen 1979; 1998), or the impact of depression (Murray *et al.* 1996; Murray & Cooper 1997). For different reasons, these approaches exclude culture-based variation by the following means:

• Data is analysed round macro features like engagements and time-outs (Stern 1977)

• Analysis examines microbehaviours in real-time (Trevarthen 1979; Kaye 1982).

• Analysis relies on qualitative description of attunement behaviour (Stern 1977)

• Using mezzo level scales, cultural differences are eliminated by appeal to word-based markers of quality (Fiori-Cowley & Murray 1996; Murray *et al.* 1996).

Although working at a similar 'level' to Fiori-Cowley and Murray's (1996) global rating scale (GRS), we focused—not on quality but—on community derived joint activity. Starting with transcription and an introduction to the GRS, the researcher was encouraged to use the scale in finding her way into frame by frame analysis by using repeated observation and detailed notes. Alert to what might be salient to babies from two communities, this led to two tier description. While intersubjective engagement was sorted into types, at a lower level, we captured 'culture typical' incidents. To visualise this, a reader can picture a five minute interaction against three kinds of coding (the 5 minutes run from left to right). While 'high level' analysis sorts Stern's engagements from time outs, its 'low level' counterpart shows Trevarthen style microbehavioural events. At our mezzo level, while engagement type is captured by shading, line densities show microbehaviour judged salient by an observer.

Stern

Cowley

Trevarthen
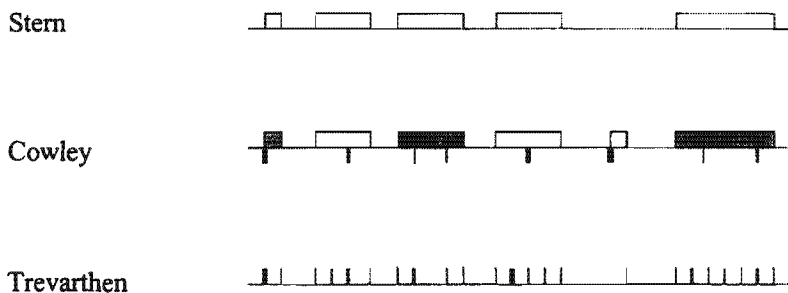
Since mezzo analysis concerns what occurs between caregivers and infants, it brings out intergroup parallels and contrasts. In so doing, we are *not* seeking normative description. First, this would misrepresent settings like those found at both Briardene and Phoenix where one dyad included a caregiver whose historical designation was 'Coloured'. Second, intersubjective behaviour is unlikely to be driven by norms. Rather, we think our analyses could, perhaps, be extended to capture modes of life in a complex 'culture space'. This is because asking what infants and caregivers do differs from investigating cultural or language competencies in that the events are shaped—not by norms but—but by how adult doings impact on infant needs. Necessarily, what happens reflects events that are largely independent of anything usually described in words.

Qualitative complexity

By the time we were familiar with the Zulu data, it was clear that we needed at least two structural distinctions. First, while some interactions involve minimal intersubjectivity as caregivers imitate infant expressions (and vice versa), most feature more complex ways of engaging. Thus, we separated '*moments*' from sustained engagement. Second, while struck by a tendency for caregivers to seek control over infants, we realised this could not be captured by simply opposing this to playful behaviour. Given that controlling behaviour (of various kinds) usually had a short duration, we sought clear criteria that could define other categories. We hoped it might be possible to separate *kinds* of engagement by temporal means.

As soon as we began to work on Phoenix data, however, we noted qualitative contrasts with Briardene. Above all, while we found less close engagement than in the informal settlement, we also found protoconversations akin to Fiori-Cowley's British data set. Given that temporally based distinctions could not capture this diversity, we abandoned the attempt to use such categories. Instead, we systematised recordings on qualitative grounds. Initially, we distinguished interactions dominated by caregivers from those featuring reciprocal action. Where reciprocal, infants mesh with caregiver activity in real-time. This allows for the following categories.

• *Moments* (interchange where, for a short period, one party matches a visible expression by the other).
• *Periods* (lop-sided interchange where the caretaker seeks to influence the infant who is otherwise engaged).
• *Episodes* (joint activity where the caregiver and infant, in real-time, set up a coherent behaviour pattern).

Applicable as they are to all interactions, the system enables us to contrast encounters and capture intersubjective variability. While compatible with Trevarthen's neural biases, the model implies that 'moments' give way to 'periods' and 'episodes'. Caregiver uptake (or lack of uptake) to directed child activity, can thus influence joint action. While some patterns have an innate basis, there are contrasts both within and across groups. In both Briardene and Phoenix, infant up-take often sets off events lacking the playful quality many see as paradigmatically intersubjective. To capture the variability in lop-sided behaviour, we made further distinctions. We stressed that many Briardene episodes feature properties not found in British settings. In kZN, at least, Western style ways of engaging are paced relatively slowly so that infants have 'space' allowing them to act as if leading a dance. In Briardene, above all, many 'episodes' appeared more like events where infants are played like musical instruments. The much vaunted turn-taking' of intersubjective behaviour is often replaced by hectic activity that elicits overlap and vocal chorusing. In place of the reciprocity typical of (some) Phoenix talk, caregivers and infants take complementary roles. Further, once observed in *episodes*, a similar pattern was found in *periods*. While

caregivers adjust to infants (often with the aim of redirecting her attention), caregivers also *direct* the child's action. Strikingly, at Briardene, some infants fell silent at the caregiver's bidding. To capture this, a subdivision was made based on whether the caregiver acted to direct or engage with the infant (seeking attention is 'engaging'). This gives the following:

• Moments (interchange where, for a short period, one party matches a visible expression by the other).

• Adjusting periods (lop-sided interchange where the caretaker seeks to influence the infant by adjusting what she does to fit (or alter) the infant's current activity).

• Controlling periods (lop-sided interchange where the caretaker aims to direct the infant (typically by getting it to stop what it is currently doing)).

• Attunement episodes (joint activity where the caregiver and infant together set up a reciprocal pattern. The caregiver responds to the infant's responding and, to the casual observer, this seems mutual. Often this leads to turn-taking or, in other terms, the caregiver giving the infant time to 'conduct the interaction').

• Regulating episodes (joint activity where the caregiver and infant together set up complementary patterning. The caregiver's actions chime with those of the infant creating an impression of behaving in unison. Often this is highly rhythmic and characterized by frequent vocal overlap or chorusing.)

While there are similarities between 'directive' controlling periods and regulating episodes, the categories are not in parallel. Above all, controlling periods (CP) are marked by caregiver success or failure (e.g. the infant may (or may not) fall silent). Regulating episodes (RE), by contrast, are defined as 'joint' action which, thanks to its mutuality, is already 'successful'. Thus while short CPs represent 'success', short REs represent (relative) failure. By contrast, when sustained, both attunement and regulating episodes count as 'successful'.

Analysing Local Culture Styles
While the above framework allows close examination of interactions, what follows is slightly adapted. This is for the following reasons. First, in

examining the complexity of primary intersubjectivity, we saw that, like many biological processes, joint activity shows unidirectional development. We now think some of our categories identify behaviour that, all being well, is marginal at 14 weeks. Specifically, 'moments' are typically now built into longer spells of engagement and, in what follows are therefore ignored[5]. Second, as more data was investigated, we realised that 'adjusting periods' are variable and may also be transitional phenomena. Generally, we find that what occurs at 14 weeks is, in a given set of dyads, associated with a predictable pattern of controlling periods, regulating episodes, and attunement episodes. Before exploring this, however, it is important to establish that all groups both value and achieve unmistakably intersubjective interaction.

For uptake to occur, a caregiver typically attunes her doings to those of the child. To capture this, we bring together periods and episodes. Treating moments as minimal engagement, Table 1 below shows behaviour when a caregiver, at least, *attempts* to engage with the infant:

Table 1: Caregiver Attempts at Attunement (i.e. Periods and Episodes Combined)

	Briardene % of total time	Phoenix % of total time	Durban City % of total time
Attunement attempts (periods and episodes)	65%	59%	91%
Minimal Engagement	35%	41%	9%

Attempts to set up intersubjective engagement dominate all samples. Not surprisingly, perhaps, these are most frequent in the middle class Durban City group. However, in interpreting the 91% of the time when a caregiver focuses on the infant, the reader should bear the following in mind. First, given their socioeconomic status, these caregivers are less likely to be

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[5] One Briardene interaction is entirely without sustained engagement. Since this does involve several moments, it suggests strongly that the reason for the relationship's failure to develop normally may well lie with the caregiver rather than the child.

uncomfortable in front of a video camera. Second, they were recorded in their homes. Third, the style is, perhaps, influenced by educational level. Taken together, it is equally striking that, among the poorer groups too, more than half the time is spent in trying to engage the infant.

Infants are less powerfully affected by location. To show this, it is of value to consider the extent to which they pick up caregiver attempts. In our system, this is captured by the sustained joint activity we classify in terms of 'episodes'. The proportion of time that dyads spend on these is shown on Table 2.

Table 2: Episodes (viz. Both Attunement and Regulatory Episodes)

	Briardene % of total time	Phoenix % of total time	Durban City % of total time
Episodes	28%	20%	31%

While the Durban City group manifests slightly more episodic behaviour than the other groups, it is likely that the difference reflects on caregiver efforts and the home setting. In interpreting these figures, I stress that, in poor communities too, infants and caregivers undertake joint activity. In view of universal claims about the intersubjective 'dance' this is unsurprising. Rather, the data confirm that, in a narrow sense, primary intersubjectivity is found across all groups. At this age, it is normal.

More detailed analysis is needed to document intergroup variability. This can be achieved by considering the play/ control patterns that distinguish the two kinds of episode. Relevant figures are shown in Table 3.

Table 3: Attunement and Regulatory Episodes

	Briardene % of total time	Phoenix % of total time	Durban City % of total time
Attunement Episodes	8%	11%	31%
Regulating Episodes	20%	9%	0%

Extending analysis into Durban City showed our method to have some inbuilt Afrocentrism. While Briardene and Phoenix represent opposite trends

in the distribution of episode-types, *no* regulating episodes occur in Durban City at all. This suggests that, in a larger sample, any given community may possess a typical profile of intersubjective behaviour. Given that this is *partly* shaped by encultured caregivers, this is not surprising. Of course, what occurs cannot be explained by culture alone. Even if 14 week infants lack goals, they have a large part in intersubjective events. Infants, it seems, are channelled down paths that, to an extent, reflect what their communities value. At the risk of overstatement, in Durban City, practical value is given to turn-taking and play; in Briardene, emphasis falls on forms of behaviour that represent the forerunners of obedience and music.

    To understand these trends, it may be useful to revise the system to describe what caregivers expect to achieve with infants of this age. Specifically, they get the baby to (i) want something, (ii) act in line with caregiver wishes or (iii) take part in interactive play. The combinations that arise may well have an impact on how a baby plays and responds to a caregiver. Facts like those sketched above suggest that, while using biological parameters, primary intersubjectivity is shaped by caregiver activity[6]. For reasons of space, rather than pursue intergroup variation, I turn to how cultural factors shape infant actions. Later, I use prosodic aspects of vocalizations to show how caregiver actions affect an infant's repertoire. First, however, I show how intersubjective activity enables caregivers to put a cultural stamp on infant activity.

Typical Features of Different Groups

When development is seen as a joint process drawing on infant propensities for social interaction, we cannot be surprised that, by 14 weeks, infants show enculturation. For the same reason, pairs of individuals should be expected to act differently. With this in mind, I have argued that, in the kwaZulu Natal sample, the first 'signs of culture' arise in Briardene (Cowley *et al.* in preparation). Specifically, while all infants use body-based iconic patterns, those from Briardene often understand when they 'should' calm down. While one Durban City caregiver uses her voice to silence her child, this

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[6] For the sake of completeness, the reader will find the overall percentage of time spent on each of the categories listed above in appendix 1.

lacks the ritual properties of the Briardene pattern[7]. In spite of risks of stereotyping, I see greater danger in downplaying or ignoring diversity. Further, the significance of regulating and attunement episodes seems to be, in part, that while the former are more African (they occur in Briardene and Phoenix), the latter characterise interactional patterns found in, at least, African, European and North American settings.

While not yet quantified, Durban City caregivers seem to touch infants more than in Phoenix or, especially, Briardene. Equally, they do so in intimate ways (e.g. by kissing and blowing) and, often, while orienting to areas of the upper-trunk that, publicly, other caregivers leave alone. Strikingly where infants show minor distress, caregivers exploit adjustment periods with a special profile. Attending to an infant's pouts, grimaces and/or wails caregivers are spurred to touch the child, pick her up and *act* to dampen (assumed) discomfort. In Briardene, by contrast, intervention is often 'from a distance'. Rather than comfort infants, we witness full-bodied, highly vocal action that, in 2 dyads, successfully calms the babies down. In Briardene, distress is dealt with by controlling periods that show common cultural features. In Phoenix and Durban City, distress often sets off adjustment periods. Briardene infants, then, are ahead in learning what the layman calls 'obedience'. Already, they respond to what the caregiver does—not just as movement—but as directed action (see Cowley in preparation b). Indexing a want, their behaviour shows group-specific enculturation.

In Phoenix, caregiver talk shows more concern with assumed 'internal' causes of distress. Several times, caregivers project negative states on to infants who, to our eyes, are content (e.g. 'you want to go home?'). Such projection may evoke distress and, when the infant is picked up, a happy outcome. In our terms, this projecting behaviour is also an 'adjusting period'. These observations bring out both differences between groups and how relevant behaviour may affect infants. If intersubjective activity has

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[7] In two of the six Briardene infants, similar behaviour occurs on several occasions. Further, what the mother does involves both more spontaneous and more ritualised commanding (see, Cowley et al., in prep.). In the Durban City example, there is no comparable display and the infant seems to depend heavily on the mother's 'tone of voice'.

developmental effects, these may provoke long term consequences. Indeed, a distinction between *attunement* and *regulating episodes* might be reinterpreted as arising from such a process. In turn, this raises basic questions about the literature. Specifically, theorists often follow Stern (1977) in emphasizing the playfulness of primary intersubjectivity, its reciprocity, and its likeness to waltzing or being in love. While fitting attunement episodes, these metaphors misdescribe the (slightly) less common regulating episodes. Globally, then, our findings are *not* compatible with seeing joint behaviour as predominantly reciprocal. Judged both by the time spent on shaping what infants do and general impressions of the events, caregivers and infants seem to be more concerned—not with reciprocity—but with interpersonal control.

As Povall (2001) argues, issues of control always influence intersubjective behaviour. Even playful and reciprocal interactions exploit the interactional space a caregiver provides. Especially in Briardene and Phoenix, intersubjective activity features much behaviour overtly concerned with what infants do and feel. This arises both when infants show obedience and in the playful regulating episodes. At such times, caregivers encourage infants to act jointly in ways that—to European or American eyes—seem overpowering or intrusive. Yet, given infant enjoyment, any such view must be rejected. During fast paced interaction, moreover, children move in harmony and speak in chorus. In contrast to the turn-taking of attunement episodes, this can be seen as 'protosong'. Finally, even in Durban City, much the same time is dedicated to controlling periods as attunement episodes (29,5% vs 31%). While a cognitive internalist sees these as contingent aspects of 'style', rejecting the approach suggests that the intergroup contrasts may have major developmental consequences.

Before considering these effects, we return to theory. On a distributed view, intersubjective behaviour contributes to developmental change by transforming the infant's cognitive powers. While Trevarthen would see this in terms of how relationships are orchestrated, here it is stressed that the caregiver's actions become predictable and thus simplify the cognitive environment. At the same time, there is a contrary pattern. Given the caregiver's culture, infant activity becomes more informative and evokes new kinds of adult action. Thus, by dovetailing with caregiver doings, a Briardene child can make, say, a demand for 'silence' into a dual resource.

Once shutting up becomes a useful way of 'going on', *not* falling silent also takes on new informational importance. Building on Thibault's (2000) model of semiogenesis, Cowley *et al.* (in preparation a) argue that, far from being reducible to conditioned response, learning when to be quiet exemplifies indexical activity. At least three pieces of evidence support this claim. First, similar behaviour often *fails* to silence the child. Second, while showing consistency, the caregiver's eliciting behaviour lacks specifiable structure. Third, not only does the child index a caregiver want but how this is done changes in tandem with caregiver response. Strange as it may sound, given its jointness and dyadic specificity, child activity drives behavioural change. Enacting *de facto* interpretation, the baby develops motorcentric behaviour showing what a caregiver calls 'understanding'. Infants thus develop capacities to represent comprehensible social activity. Over time, they change the adult's behaviour in ways that allow them to create, meet, transform or undermine caregiver goals.

Adults exploit social norms and, as a result, require infants to develop progressively more complex and culturally relevant ways of contextualizing. The infant's repertoire can thus develop without its having any need of knowing norms or internalizing cultural patterns. This happens because, as for Tetris players, the infant's action is pragmatic, epistemic *and* perceptual. This is found in, for example, different ways in which infants and communities evaluate (and respond to) distress. Similar reasoning applies to abstract cultural categories. We can imagine, for example, that Phoenix projections nurture sensitivity to socially defined emotional schemata. From a distributed view, we see—in principle—how norm-based constructs influence behaviour. However, to show how intersubjective activity shapes (what we see as) abstract categories, we turn to vocalizations. Remarkably, their acoustic properties show 14 week infants pick up on physical patterns that index *cultural* aspects of speech.

Distributing Cognition by Voice

In the literature, no-one reports cultural differences in infant 'speech' at 3 months. Thus in a recent, comprehensive review of early vocalization, Oller (2000) suggests that, at this stage, infants are merely learning to produce syllables. Even in work on primary intersubjectivity, the most daring proposal is that, at this age, inter-utterance matching occurs on several vocal

parameters (Papousek & Papousek 1989). Certainly, on the basis of this literature, we find no reason to expect significant differences in infant vocalizations across groups or dyads. Nor, of course, is there any suggestion that this may have a part in development.

Microtemporal aspects of adult talk can be investigated acoustically to clarify how the real-time flow of utterance-activity contributes to their sense (Cowley 1993; 1998; 2001). Rather than 'interpret' what we hear, we often respond to a speaking voice or, perhaps, ascribe sense to *how* vocalizations sound (against a background of 'the said'). Elsewhere I have argued this is best seen as the 'first-order contextualizing' that underpins 'interactional ascriptions' (see Cowley 2001b). In the terms of distributed cognition, much sense-making depends on how utterance-activity plays out between people. It thus exploits both close co-ordination and real-time vocal intermeshing. With this in mind, we examined how caregivers attune to infants. Thus, moments of utterance-activity from Briardene and Durban City were selected for auditory and acoustic analysis. These were chosen as involving 'affective duetting' that was defined as closely co-ordinated vocalizations with musical properties. Care was taken to feature vocalizations arising during both turn-taking and choral interaction. All examples are from attunement and regulating episodes.

The initial question was whether co-ordination between voices showed caregivers to exploit interpersonal musical relations. Accordingly, WinSal V software was used to carry out analysis of fundamental frequency (F0) and durational aspects of the duets. Following Cowley (1993), initial and peak measures of (F0) were taken at vowel onset and pitch maxima. Applied to baby vocalizations, many problems faced in dealing with adult talk disappear. This is because, at 14 weeks, babies use vowel-like vocalizations which, often, end in a quasi-consonant (see Oller 2000). Measures are thus easily made. While finding that mothers indeed exploit musical parameters in responding to infant voices (see Povall 2001), infant vocalizations also show striking patterns. Remarkably, during affective duetting, infants from the two communities vocalize (and, presumably, perceive) differently. Below, affect attunement is shown by representative utterances from duets by four infants. These are coded iconically to bring out both pitch movement (line shape) and overall duration (shown by line length).

IsiZulu niche		English -niche	
Tembo		Ezra	
Tembilile		Amy	

Durban City infants both talk in turns (some of the time) and produce short utterances dominated by falling tones. In Briardene, infants chorus and set up melodic patterns. Perhaps for this reason, their utterances are often longer (see Povall 2001). While the findings remain tentative, 14 week infants pick up on vocal patterns characteristic of caregivers, communities and what becomes the infant's first language. While those in the English environment orient to stress-based and intonational aspects of speech, those with isiZulu speaking caregivers are more taken by melodic patterns and long-lasting gestalts. Of course, for a cognitive internalist, this is merely an anthropological curiosity.

On a distributed view, the vocalizations are evidence that, at 14 weeks, infants are actively orienting to *cultural* patterns. Importantly, these features of Briardene and Durban City speech are both managed in real-time and realised as vocal events. They emerge in the affective duetting that arises as in caregiver managed joint activity. On the distributed view, as stressed by Preston and de Waal (2002), it seems that like many vertebrates, infants use 'perception-action mechanisms'. Given the underdeveloped state of the baby's brain, little else can explain the variability. Drawing on Laland *et al.*'s (2000) work, natural selection may have exploited a feedback mechanism that favours biases that respond to specific aspects of vocalization. Informally, it pays to be vocally cute or, to mesh vocalizing with a caregiver's sound-patterns. Of course, adults may also benefit from sensitivity to affective duetting. Apart from anything else, this is an economical way to control curious language-less offspring. Perhaps this explains why, across communities, caregivers show close orientation to infant vocal and visible activity (in adjustment periods). As noted, they later exploit in-built features of what children do to channel activity to their expectations. The resulting episodes and periods, I claim, simplify the

infant's cognitive environment. Caregivers gain short-term emotional benefits (whatever that means) as well as rewards that come from infant obedience. While reducing effort, there must be occasions when selective advantages accrue to infants who know when to be silent. Co-evolutionary processes, then, allow brain-body systems to couple human voices to serve each individual's ends.

Observations confirm that, at 14 weeks, much sociocognitive development is a dynamic process between persons. Caregivers act as representatives of an encultured world. The niche, including caregivers and voices, is an external memory used to extend and transform infant powers. Rather as biology and cultural constraints drive Kanzi's communication, vocal patterns drive changes in infant skills. Just as Kanzi relies on *his* interests, infant vocalizations serve agent-based goals. Real-time vocal activity, then, simplifies the familiar. Later, the process comes to allow affective regulation and, of course, subsequent developments in neural organization[8]. Further, rather than exploit off-line understanding, this uses the same real-time 'coherency' that Cowley (e.g. 1998, 2001b) documents in adult talk. Indeed real-time responding may even be necessary for the emergence of episodic interaction. Of course, an infant also needs caregivers whose doings index social norms and local ways of acting. Vocalizations, then, serve events allowing infants and caretakers to meet, create, transform and undermine expectations. By design, the systems couple as they exploit affective, epistemic and perceptual resources.

Our evidence bears on how relationships are orchestrated. While employing co-operation and play, conflicts of interest also exploit patterns of control. This, it seems, is how intersubjectivity drives developmental change. As soon as an infant can 'go on', what it does is open to interpretation whose consequences can, in turn, spur it to ever more complex ways of acting. Vocalizations must thus be seen as part of 'what develops' beyond the skull. They are intentional, culture-based patterns that arise as an infant's biased behaviour is fitted to caregiver activity. What develops, then, is a cultural process that relies on simplifying effects that change a caregiver's speech. Over time, the interplay feeds back on how the infant acts and, of course, re-

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[8] This is because, to vocalize jointly, the brain must specialise in listening to and producing a particular typology of vocal patterns.

organizes the brain. Co-development comes, eventually, to fit social categories: just as observers grasp intersubjective events, the relevant behavior represents the social world. For the infant, of course, representing acts have little to do with the putative mechanisms of folk psychology. Rather, they use in-built tendencies, co-contructed patterns, and, above all, motives and emotions. While knowing little about these, in other vertebrates, they allow assessment and management strategies (see Owings & Morton 1998). We find no reason to think infants differ. In short, while much occurs within the skull, at 3 months, cognitive development also happens beyond the skin: utterance-activity is the basis for complex interpersonal sense-making.

Theoretical and Applied Consequences

The variability of primary intersubjectivity is incompatible with I-O models because it shows much learning to be under dual infant-caregiver control. While reliant on brains, it also uses affect and biased perception/action mechanisms. As mammals, human infants depend, not just on competency, but also emotional/motivational systems. *Contra* Piaget, by 14 weeks, many social outcomes exploit encultured co-ordination. We find Zulu children learning obedience, Pheonix parents ascribing mental states, and Whites rewarding distress with intimate touching. Variability emerges from perception-action routines and affects future events. Since development uses utterance-activity, studying what babies and caregivers do contributes to the distributed view. In infants, cognition is activity that exploits biological, physical, cultural, social and person-level parameters. Development is driven, in part, by joint action. What changes is a culturally located ability to contextualize events by using, on the one hand, the brain and, on the other, previous experience of what are taken as similar events.

Human social intelligence draws on the real-time dynamics of utterance-activity. In kwaZulu Natal, interaction at 14 weeks has affective and cultural content based on caregiver experience. While Briardene infants often act obediently and use protosong, their Pheonix counterparts engage in proto-conversation and receive more empathetic attention. Durban City infants, by contrast, grow up in surroundings where, in public, local values emphasise gentle words and soothing. This content, I argue, affects their predispositions and socio-cognitive development. Far from being irrelevant

to language (e.g. Pinker 1994), early utterance-activity shapes how we respond to others, why we act as we do and, of course, who we are. Even at 14 weeks, socio-cognitive development is permeated by culture.

The importance of culture may be greatest where there is poverty, disease and malnutrition. In comparing development or establishing how parents 'should' behave, therefore, there is reason to treat universal models with scepticism. The need to account for variability is illustrated by observations about distress. While found everywhere, its values vary between individuals and communities. In Briardene, as noted, distress is typically dealt with in controlling periods but, elsewhere, adjusting periods are preferred. While Pheonix and Durban City parents often distract or comfort infants, those from Briardene generally prefer to control the baby's doings. Since interaction between judgements, values and activity all affect development, joint behaviour can reflect local *optima*. Where resources are scarce, for example, there may be reason to make less use of touch or soothing. Further, as behaviour, values and beliefs affect infants *before* they are learned, we urge caution in promoting Western-style child rearing. This, I think, is relevant to those who believe that there is much of value in indigenous knowledge as well as African values and languages.

Without theories of *how* development occurs, African children are ignored, or seen in deficit terms. Yet, to build human potential while fighting poverty and disease, cross-group investigations are needed. Indeed, without culture-sensitive measures how can resources be spread between, say, de-worming, anemia prevention, zinc supplements and schools? While in need of expansion, the data show that dynamic social patterns affect how we feel, think and act. Finally, as persons, brains and communities are shaped by local cognitive processes, the proposed view has political implications[9]. When practices are scrutinised, many social problems will be found to be more 'delicate' than those due to racism, sexism, homophobia etc. While often based in prejudice and poverty, problems also derive from, for

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[9] Of course, *any* theory has political implications. If the distributed view differs from those of the neo-liberal establishment, it does so by appealing neither to a legalistic 'human rights' view nor pseudo-scientific discourse analysis. Finally, unlike critical theory, a distributed approach brings science into contact with local people's day to day concerns.

example, ignorance, disease, modernization, malnutrition and/or practices compatible with neo-liberal ideology. Given distributed cognition, initiatives to improve community life must rely on careful use of material resources, research and, above all, local views of how the world ought to be.

Appendix 1
Table 4: All categories (intergroup comparison)

	Briardene % of total time	Phoenix % of total time	Durban City % of total time
Attunement Episode	8%	11%	31%
Regulating Episode	20%	9%	0%
Controlling Period	25%	3%	29,5%
Adjusting Period	12%	36%	30,5%
Minimal Engagement	35%	41%	9%

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