F 139432
F139432

Theories of theories of mind

edited by

Peter Carruthers
Professor of Philosophy and Director, Hang Seng Centre for Cognitive Studies, University of Sheffield

and

Peter K. Smith
Professor of Psychology, University of Sheffield

Published in association with the Hang Seng Centre for Cognitive Studies, University of Sheffield

CAMBRIDGE
UNIVERSITY PRESS

46599436
UNIVERSITÉ DE POITIERS
BIBLIOTHÈQUE UNIVERSITAIRE DROIT LETTRES POITIERS
541962
D 358 645
30-05-03

Published by the Press Syndicate of the University of Cambridge
The Pitt Building, Trumpington Street, Cambridge CB2 1RP
40 West 20th Street, New York, NY 10011-4211, USA
10 Stamford Road, Oakleigh, Melbourne 3166, Australia

© Cambridge University Press, 1996

First published 1996

Reprinted 1998

Printed in Great Britain at the University Press, Cambridge

A catalogue record for this book is available from the British Library

Library of Congress cataloguing in publication data

Theories of theories of mind / edited by Peter Carruthers
and Peter K. Smith
p. cm.
Chiefly papers presented at a series of workshops, held in 1992 to
July 1994.
Includes bibliographical references and index.
ISBN 0 521 55110 2 (hardback) – ISBN 0 521 55916 2 (paperback)
1. Philosophy of mind–Congresses. 2. Philosophy of mind in
children–Congresses. 3. Cognition in children–Congresses.
I. Carruthers, Peter, 1952– . II. Smith, Peter K.
BD418.3T44 1996
128′.2–dc20 95-14610 CIP

ISBN 0 521 55110 2 hardback
ISBN 0 521 55916 2 paperback

SE

for

SIR Q. W. LEE

Chairman, Hang Seng Bank of Hong Kong

– whose vision and generosity made possible this and a projected nine further volumes

Contents

9 The modularity of theory of mind

Gabriel Segal

1 Introduction

Normal adult human beings are good psychologists. They can explain and, to an extent, predict their own and other people's actions on the basis of a battery of psychological concepts: perception, desire, belief, fear, wonder, doubt, and so on. Let us call the seat of these psychological abilities the 'psychology faculty'. The psychology faculty has been the focus of a great deal of research in experimental, theoretical and developmental cognitive psychology, as well as a fair amount of philosophy.

I believe that this investment of intellectual energy is well worthwhile, since the study of the psychology faculty relates in important ways to a variety of central interdisciplinary concerns. It intersects with questions in the philosophy of mind about eliminativism, knowledge of other minds and our conception of ourselves as human beings. It intersects in interesting and subtle ways with questions in philosophy of language about the semantics of sentences attributing propositional attitudes. And it relates to the most fundamental questions in psychology about concept acquisition and the structure of the mind. In this paper I'll address some aspects of the latter questions.

It is common practice among psychologists, linguists and some philosophers to talk of 'modules' of the mind. But there is a wide variety of quite different conceptions of modularity. In section 2, I will distinguish a few of these which I believe have a good chance of being genuine psychological, natural kinds. I will then go on to ask, in section 3, which ones, if any, apply to the psychology faculty.

2 Modularity

There are two different dimensions within which one can distinguish notions of modularity: synchronic and diachronic. The synchronic notions concern the capacity of a subject at a given time. A normal, adult human can, for example, see, use language, and psychologise. One can ask for an explanation of each of these capacities. And the explanations offered may invoke one or other kind of modularity. The diachronic notions concern the course of development of the capacity from birth (or before) through to maturity. I begin with synchronic notions.

2.1 *Synchronic modularity*

Suppose we are interested in a specific psychological competence, such as vision or language. A precondition of any kind of modular explanation of the competence is that we have a reasonably clear idea of its domain of application. Our visual competence enables us to gather information about the surface markings, shapes, orientations and locations of three-dimensional objects in space, from two-dimensional patterns of light on our retinas. Our linguistic competence concerns phonological, syntactic, and semantic properties of our language, and it underlies our ability to produce and understand the physical forms of sentences. These two domains of application are reasonably well demarcated and distinguishable from each other and from further cognitive domains.

There are probably many areas of cognitive competence that do not apply over a well demarcated domain. By contrast with vision and language, there is presumably no well demarcated domain for the competence to go shopping for Xmas presents or to execute a spying mission behind enemy lines. There are competent shoppers and competent spies. But there is not yet, and probably never could be, a detailed and precise theory of the domains of application of these competences. Or, to put the same point another way, the ability to shop and the ability to spy are not to be explained in terms of isolable competences at all.

Once we have reason to believe that there exists a genuine competence with a definite domain of application, we can ask for an explanation of the competence. And it is here that modularity enters the picture. A module is a component of the mind, or brain, a mechanism, a system or some such that explains the competence. To put it crudely: where there is something definite that we can do, we can ask if there is something definite within us that enables us to do it.

Different conceptions of modularity arise from different explanations of competences. I will distinguish four different notions of synchronic modularity. These almost certainly do not exhaust the field. But they are at least clear and clearly distinguishable, and will be enough to ground the discussion of the psychology faculty.

2.1.1 Intentional modularity

The first notion might well fall under the heading 'component of the mind'. Sometimes we can explain a competence in purely intentional terms by

positing a specific body of psychological states that underlie it. I call the kind of modularity that arises from this, 'intentional modularity'. The idea of an intentional module is present in an early form in the work of Sigmund Freud, and has been further articulated and deployed by Noam Chomsky (see e.g. Chomsky, 1980, 1986). According to Chomsky, our linguistic competence consists in (largely unconscious) knowledge of a body of linguistic rules. The knowledge concerns a self-contained array of interrelated concepts (Phrase, Noun, Verb, Anaphor, Quantifier etc.) that fit together somewhat in the manner of a scientific theory, forming generalisations and so on.[1]

It would be pointless, however, to count any appropriately inter-related body of psychological states as an intentional module. Mere knowledge of a theory isn't likely to be a psychologically interesting category. But some of Freud's and Chomsky's theoretical posits have further interesting features. In particular, there may be a one- or two-way filter to information. In Jerry Fodor's (1983) terminology, intentional modules may be 'informationally encapsulated': some of the information in the subject's mind outside a given module may be unavailable to it. For example, information in the conscious mind is often not available to the Freudian unconscious. And, going the other way, intentional modules may exhibit 'limited accessibility': some of the information within a module may be unavailable to consciousness. For example, we are not conscious of most of the contents of the language faculty. As is often pointed out, that is one reason why linguistics isn't easy. Somewhat stipulatively, I suggest that if a set of appropriately related psychological states exhibits either informational encapsulation or limited accessibility, then they constitute an intentional module.[2]

2.1.2 Computational modularity

The second notion of module is that of a computational system, classically conceived. A computational system is a representation processor.[3] A representation is a physical configuration of some kind, with syntactic and semantic properties. A computer receives representations as inputs, produces representations as outputs and, usually, produces intermediate representations along the way. What makes a representation processor a computer is the role of syntax: which output representation it produces for any given input is entirely determined by the syntactic properties of that input. That is to say, there exists a function from the input representations to the output representations that is specifiable in purely syntactic terms.

A computer, in the relevant sense, is also a physical system. This means that it must be constructed so that the actual causal processes initiated by the input representation and culminating in an output representation do ensure that the syntactically defined function is instantiated. And a computer is also a semantic, or intentional system. The representations have meanings. If the computer is to do anything interesting, then the output representations must be reasonable in the light of the input representations. A genuine inference machine has the special property of being truth-preserving: if the inputs are true, then the outputs are true. But computers need not have that property. It may be that their inputs and outputs don't represent propositions, hence do not have truth values at all, as in a chess-playing computer. Or the computer may implement a heuristic: its outputs will usually be true, given true inputs, but not always.

It is very plausible that the early visual system is a computer. It takes pairs of representations as inputs, each one representing the pattern of light on one retina. And given an input pair it constructs a single output, representing the shapes, orientations etc. of objects in space. A complete theory of the visual system as a computer would specify all the relevant physical, syntactic and semantic properties of the representations, the processes that mediate them and the relations among the three kinds of properties. (See Marr 1982 for a detailed study of the computational theory of vision.)

It is likely that every computational module realises an intentional module. That is because there exists a self-contained and definite description of what it does in purely intentional terms. The only further requirement is that it exhibit either informational encapsulation or limited accessibility. The former is almost inevitable, since any computer will have a characteristic set of inputs. And it is unlikely that any computer in someone's head has a range of inputs that allows it access to all the information in that head.

By contrast, there is no reason to think that every intentional module is realised by a computational one. In understanding Chomsky it is very important to see that his account of linguistic competence is framed only in terms of an intentional module. It is true that he sometimes calls the language faculty a 'computational system'. But by that he doesn't mean 'computational system' in the sense I've just defined it. He just means that the rules we unconsciously know are recursive.

Purely intentional modules can co-exist with computational ones. For example, a number of linguists believe that a variety of computational modules have access to and deploy the information in the language faculty, the latter being conceived of as a purely intentional module, a body of knowledge. A parser, for instance, may be conceived of as a computational module that deploys the information in the language faculty to build up representations of the syntactic and semantic properties of physical sentence-forms.

It is also possible that at least some cognitive competencies are explained by intentional modules without the help of computational modules. There must, of course, be some explanation of how the contents of an intentional module (knowledge or whatever) are deployed in the execution of tasks. But this explanation might not invoke any computations, as I have defined them. Connectionist systems provide one alternative model. And there are surely others.

2.1.3 Fodor modularity

The third kind of module is also computational. But it has an array of further distinguishing properties. This notion is articulated by Jerry Fodor (1983). A 'Fodor module' is a computer which has the following properties: (1) Domain specificity (2) Informational encapsulation (3) Obligatory firing (4) Fast speed (5) Shallow outputs (6) Limited inaccessibility (7) Characteristic ontogeny (8) Dedicated neural architecture (9) Characteristic patterns of breakdown.

While every Fodor module is computational, there is no particular reason to suppose that every computational module is Fodor. As yet we do not have a well worked out theory of any computational module other than the early visual system, and this appears to fit Fodor's criteria rather well. But it is not unlikely that some other psychological competencies are explained by non-Fodor, computational modules. Acquired skills like driving or tennis, for example, may be computational while not having a characteristic ontogeny, though they do exhibit a number of other Fodor features. (Cp. Karmiloff-Smith, 1992.) And perhaps some acquired cognitive competencies, such as symbolic logic or chess are slow and have deep outputs.

2.1.4 Neural modules

The fourth kind of module is neural. A neural module is a functional component of the brain, describable in purely neurological terms.

A neural module need not also be intentional or computational. It may be, for example, that a specific competence, like the ability to construct and use cognitive maps, is fully explained by some neurological system (involving, say, sinusoidal waves in the dendrites of the hippocampus), without the system being a computer or containing (or realising) any body of knowledge. (See O'Keefe and Nadel, 1978.)

Evidently, though, a neural module can also realise any or all of a Fodor, computational and intentional module. Any of the other kinds of module might be realised in a neural module. But they needn't. It's at least *a priori* possible that distributed, global characteristics of the brain, rather than modular ones, realise computational or intentional modules.[4]

I think that, for present purposes, one might as well group distributed connectionist networks together with neural modules. The two could be distinguished. But they share the important properties of being able to realise the other types of module and of being able to stand alone, explaining a competence without realising another type of module.

2.2 *Diachronic modularity*

I move on, now, to the diachronic notion of modularity. This originates with Chomsky. Chomsky compares the development of the language faculty during an individual's maturation to the growth of an organ or limb. The idea is that there is a genetically determined pattern of growth. The language faculty develops – grows within an individual – along a definite and predetermined path. Like an organ, the faculty will only grow, or only grow normally, in an appropriate environment. If one's limbs and organs are to grow, or grow normally, one needs food, air, room to move and so on. The language faculty only grows given appropriate linguistic stimulation in an environment free of excessive trauma.

It is true that the mature state of different language faculties differs across individuals: people speak different languages. However, according to Chomsky, it does not vary very much. Different human languages are alike in deep structural respects and differ only in what might be considered peripheral details. Further, language only varies along specific dimensions (for example lexical items and word order). And the variation is confined within strict and definite limits. For each dimension of variation, there is a limited number of options available. To some extent, this is even true of the choice of lexical items.

Collecting these last two points: variation is parameterised. There is a specific parameter, one for each dimension of variation, and the number of settings a parameter may take is limited. Finally, the way the parameters get set according to experience is determined by species specific genes. Put two individuals in the same environment, however much they differ in other psychological respects, their language faculties will end up much the same.

Acquisition of language is task-specific. Children don't acquire language using general learning processes that can apply in various domains. Rather, the language faculty deploys very specific principles, suited only for learning language. In fact, this follows directly from the parameter approach. Parameters are options specifically for the alteration of Universal Grammar (UG). UG is a sort of language schema: it is what you get when you remove certain specifics from actual languages. Setting the parameters

just specifies what UG leaves unspecified. Obviously, setting parameters of UG is not a process that would work in any other domain.

This is the modular conception of development. One can think of the module, as Chomsky sometimes does, in terms of a box that takes experience as input and produces knowledge of linguistic rules as output. The box is a diachronic intentional module. It has intentional contents (innate knowledge of language), and a set of language specific principles that restrict and determine the possible paths of development. And, importantly, the module has been genetically determined in its specifics. Just as we have specific genetic characteristics that determine that we grow hair and not horns, so we have specific genetic characteristics which ensure that we grow a language faculty.

There are, presumably, diachronic analogues of the computational and neural modules. But matters are complicated enough as it is, so I won't go into those.

3 The psychology faculty

I am going to assume a 'theory-theory' of the psychology faculty. Since the theory has been well articulated and well defended elsewhere (e.g. Josef Perner, 1991a; Henry Wellman, 1990) I will not discuss those issues here. Suffice it to say that psychological competence consists in knowledge of a psychological theory which deploys concepts like perception, desire, and belief within a network of causal-explanatory generalisations.[5]

3.1 *Synchronic modularity*

The psychology faculty certainly appears to be an intentional module. The faculty has a definite and self-contained body of knowledge that is framed in terms of a specific network of interrelated (and indeed, highly sophisticated and logically intriguing) concepts. Further, it appears to exhibit a degree of informational encapsulation. Watching a good actor can generate a sort of theory-of-mind illusion: even though one knows that he is not really in pain, or in love, or trying hard to solve a problem, it still seems to one that he is. It appears, then, that relevant information about the actor's real psychological states fails to influence the workings of the psychology faculty.[6]

Is the psychology faculty a computational module? Many of the theorists in the area offer purely intentional accounts of the faculty, with no explicit commitment to a computational theory: see for example, Perner (1991a), Wellman (1990), Gopnik and Wellman (1992), Meltzoff and Gopnik (1993). On the other hand, the accounts provided by Leslie (see e.g. Leslie and Roth, 1993; Leslie, 1994a) and Baron-Cohen (see e.g. Baron-Cohen and Ring, 1994a; Baron-Cohen, 1994) are at least proto-computational.

There is little direct evidence that bears on the question. Since we do not yet have any worked out computational theory of the psychology faculty, there are no specific tests that can be carried out to confirm or refute such a theory. However, there is a rather general argument that can be applied to this particular case. Fodor has argued that any systematic competence is almost certainly computational. I believe that when the argument is articulated with care and in depth, it is very powerful. It would take considerable space to spell it out properly. For that reason, and because it has been expressed in other places, (e.g. Fodor, 1975, 1987) and is reasonably well known, I will just provide a very quick sketch.

One paradigmatic group of systematic competences are those involving propositional attitudes themselves: competencies to form beliefs on the basis of evidence, to reason through practical syllogisms and so on. Such competencies have an open-ended character. There are infinitely many beliefs we might form, given only enough time, patience, memory and so on. The most attractive explanation of the open-ended character of the competences is that they are explained by possession of a finite stock of concepts that can be put together in a finite number of structures. Thus the concepts of lions, crocodiles and chasing can form the thought that lions chase crocodiles, by combining the two nominal concepts with the binary predicative one. Combining the same concepts in the same general structure but a different order gives one the thought that crocodiles chase lions. This thought can then be entertained, believed, doubted, desired-true, etc.

Given this general hypothesis, we can provide a powerful and elegant explanation of the open-ended nature of the competence. Any failures to form thoughts that are potentially determined by the competence are then explained by performance limitations: limited memory space and so on. Further, the hypothesis explains the systematic patterns we find among our thoughts: anyone who can think that lions chase crocodiles can also think that crocodiles chase lions. Why is this? Because once you have the concepts and can combine nominals with binary predicates, you can have both thoughts. Thus, what explains your capacity to have one thought, automatically explains your capacity to have the other.

Suppose, then, that each thought is made of isolable concepts that can recombine in different configurations. This already makes thought look rather like language: concepts are like words, thoughts are like sentences, modes of combining concepts into thoughts are like linguistic semantic structures. But now note that the actual production of thoughts is itself highly systematic: if you believe that p and you believe that if p then q, you will very likely be caused to believe q. If you desire q, and you believe that doing A is the best way to bring about q, and you believe you have no reason not to do A, then you will probably decide to do A. It looks, to put it simply, that the transitions among occurrent thoughts are rule-governed.

Computers come into the story when we ask how a physical system, such as a brain, could realise a systematic competence. To cut a long story short: if the concepts were syntactic objects, physically realised in the brain, then the brain could realise the competence. Moreover, as it seems, this is the only currently available precise and detailed theory that bears the explanatory burden. We know exactly what it means to say that a competence is realised by a computational system, and we can see exactly how the hypothesis explains the competence. No other theory or model has yet achieved this status. Obviously that doesn't mean the hypothesis is true. But it does mean that it is a good idea to pursue it in optimistic spirits until it is shown to be wrong, or until an alternative supplants it.

It is now obvious why one might think that the psychology faculty is a computational module. For our psychological competence is systematic in just the required sense. For each thought one can have, one can think that someone else believes, or doubts or entertains it. Hence it is open-ended. And the faculty's capacity to represent attitudes exhibits patterns, also mimicking those exhibited by the attitudes themselves. Finally, thoughts about desires, beliefs and so on, follow one another in systematic and apparently rule-governed ways: if you believe that Dee-Dee believes p, and that she believes that if p then q, then you will probably believe that Dee-Dee probably believes that q. All of this follows more or less directly from the theory-theory.

Is the psychology module also a Fodor module? At present it seems to fit the criteria reasonably well, but not entirely. It does appear to be domain specific, informationally encapsulated, to fire obligatorily, to be reasonably fast and to have a characteristic ontogeny (of which more below). It is not yet clear whether it has dedicated neural architecture (but see below). It's also not clear whether any of its contents are inaccessible to consciousness. On the whole, they seem to be accessible; but maybe there's more there than we know about. Further, the faculty's outputs are definitely deep, rather than shallow. But it may be that this last is not really an essential feature of Fodor modularity. Finally, it's also not clear whether it exhibits a characteristic pattern of breakdown. Autistic people are certainly impaired in their capacity to psychologise. But they seem to lack the faculty altogether, and so wouldn't provide evidence of characteristic breakdowns within it. See Baron-Cohen (1994) for further discussion.

Is the psychology faculty a neural module? At this stage the evidence is inconclusive. Baron-Cohen and Ring (1994a) cite some evidence, both from deficits and from SPECT scans, that the Orbito-Frontal Cortex is implicated in theory-of-mind tasks. This doesn't yet show neural modularity. However, the evidence is at least suggestive, and begins to point in that direction. Lacking any general arguments either for or against an expectation of neural modularity, we must await further developments before drawing a conclusion.

3.2 *Diachronic modularity*

Gopnik and Wellman (1994) present a carefully formulated version of the theory-theory, and argue that it is incompatible with the modularity of the psychology faculty.[7] They argue further that their version of the theory-theory provides the empirically more accurate account of the two.

Gopnik and Wellman operate with a single and very general notion of modularity. They mention Fodor, Chomsky and Leslie in one sentence. This runs together Fodor modules with diachronic and synchronic intentional modules (Chomsky) and computational modules (Leslie). However, they focus mainly on development, and their arguments bear directly on the issue of diachronic modularity. The arguments are subtle and stimulating, and deserve discussion.

The developmental aspect of their view holds that theory of mind is developed by a general theory-forming capacity, much like that deployed by adult scientists. They provide the following account of a fairly typical series of stages in theory change in science, and argue that it is mirrored in the child's developing theory of mind: (a) The theorist holds an initial theory which is confronted by counterevidence. When first presented with the counterevidence, the theorist may ignore it, treat it as noise. (b) Often the next stage is to bring in new theoretical apparatus, but use it only in auxiliary hypotheses, allowing the retention of the guts of the original theory. (c) The third stage is to use the new theoretical apparatus in other parts of the theory, but only apply it in limited contexts, still keeping the original theory on centre stage. (d) Finally the new apparatus becomes central, and a new theory is organised around it.

According to Gopnik and Wellman, the process of developing a theory of mind between the ages of two and five years follows that pattern. Very briefly: two-year-olds appear to use two basic mentalistic concepts, which are proto-concepts of perception and desire. These differ from the adult analogues in that they are not really representational. Desires are drives towards objects. Perceptions are rather simple causal relations between objects and persons. Crucially, two-year-olds don't have the idea of misperception: one cannot see an object yet be mistaken about some of its visual properties. At around three, an early concept of belief appears. But

this also is non-representational: it is as if what one believes is just a copy of a real state of the world. The 'false-belief' tests pioneered by Wimmer and Perner show that three-year-olds typically cannot grasp the idea that one has a mistaken belief about an object. If one believes anything about it, then what one believes is true. By four or five, children have the adult conception of beliefs and other representational states and attitudes.

The development of a theory of mind exhibits the typical pattern of theoretical change. (a) Denial: three-year-olds do sometimes deny counterevidence: if a cup is blue and an adult says 'I think it is white', three-year-olds tend to insist that the adult thinks it is blue. (b) New theoretical concepts appear first in auxiliary hypotheses: three-year-olds do begin to show understanding of genuinely representational states. But this understanding first shows up only in relation to desires and perception, and doesn't extend to other core concepts of their theory. (c) New concepts used only in limited contexts: it appears that three-year-olds can come up with explanations in terms of false beliefs – hence a representational concept of belief – when there is enough pressure. If confronted with someone who has clearly acted in a way that fails to satisfy their desires, the children do sometimes explain this by false beliefs. However, they still tend to fail the standard false-belief tests, and don't seem to use the representational concept of belief in normal circumstances.

In fact it is not easy to see why there should be any conflict between the developmental theory-theory and diachronic modularity. The diachronic modularity thesis construes maturation of the psychology faculty as a process of setting parameters. Given certain stimulations from the environment, there automatically results an intentionally characterisable change in the faculty. Consider, for example, the much discussed change that typically occurs between the ages of three and four. At three children typically fail false belief tests, at four they pass them. Let us suppose, as Gopnik and Wellman do, that this change involves a genuine case of conceptual development.[8] They acquire a new concept, one that they lacked before. For convenience I'll adopt Perner's terminology. Thus the three-year-old begins with a concept of 'prelief' and ends up with a concept of belief.

According to the diachronic modularity theory, what has occurred is that there is, as it were, a switch in the diachronic module. The switch is labelled 'prelief-belief', and it moves from one setting to the other. This move may be caused by mostly exogenous factors. Or it may be caused more endogenously, by an internal clock or some such. One point of the switch metaphor (or the term 'parameter') is just to register the idea that there are a very limited number of conceptual changes that can occur at any moment in the developmental process.

The reason why it looks hard to find any incompatibility between these two accounts is that the latter could easily be seen as a model of the former

UNIVERSITÉ DE POITIERS Bibliothèque de l'Institut de Psychologie

The idea would be that the maturation of the psychology faculty is a cognitive process, rather like developing a theory on the basis of evidence. And, further, developing this theory is a matter of the setting of parameters in a diachronic module. Indeed one might even have much the same views about the development of scientific theories. Thus the process of conceptual change described by the developmental theory-theory, the move from a prelief theory to a belief theory, just is the setting of a parameter in the diachronic module.

But there is a genuine conflict. It concerns the specificity of the acquisition process. On the developmental theory-theory the processes involved in acquiring a theory of mind are general, the same ones that apply in other domains. On the diachronic modularity theory, the processes are specific to theory of mind and owed to a genetic programme that severely constrains the pattern and endpoint of development.

I think that the diachronic modularity view has a strong lead over the developmental theory-theory. There are at least four reasons for this.

First: as Leslie and Roth (1993) point out, the developmental theory-theory sees the child not just as a theorist, but as a quite brilliant theorist. The concepts of propositional attitudes are highly sophisticated and logically complex (as philosophers of psychology and language are painfully aware). And the theory is brilliant in its simplicity, explanatory power and breadth of application. In fact it is so good that its essential explanatory framework of states with causal powers mirrored by representational properties is retained in cognitive psychology. Children are good at developing theories in some other particular areas: e.g. some aspects of folk physics and folk biology. But they don't appear to be brilliant theorists across the board. For example, it takes them longer to come to grips with the intuitively rather simple concepts of preservation of magnitude and density than with the representational concept of belief. This suggests that specific areas of children's theory development, including psychology, involve special processes rather than general ones.

The point is not conclusive since there may be further factors that determine the rate of development. In particular there may be more pressure on children to learn about psychology than about preservation or density, in part because it's more important to them, in part because of the influence of adults. Nevertheless, it does seem to me that representational concepts of propositional attitudes are so sophisticated that unless children were pre-programmed to come up with them, it is hard to believe that they would do so within roughly their first four years.

Second: the pattern and end point of development do seem to be remarkably similar across individuals. As Gopnik and Wellman concede, the few cross-cultural studies that have been done suggest that the pattern is identical across the species. They respond to this by suggesting that if adults converge on the same theory in different cultures, then we would not expect much cross-cultural variation in children. But this is not a good response. First, we might ask how the adults happened to converge. The obvious answer is that they converged as children. And that brings us back to modularity. Secondly, it is not clear how large a role adults can play on Gopnik and Wellman's own theory. Their emphasis is precisely on the idea that children alter their earlier theories in the face of their inadequacies and failures. Adults would seem to be rather incidental to such a process.

If Gopnik and Wellman are to accord a greater role to adults as teachers, then they need to show how this role is to fit with their emphasis on the resemblance of the ontogeny of the psychology faculty to theory change in science. When people are taught theories, the pattern of change does not typically match that of development in science: there is no rejection of counterevidence, appearance of the new concept in auxiliary hypotheses and so on. Indeed, acquisition by teaching appears to be a possibility alternative to both modularity and Gopnik and Wellman's developmental theory-theory (see Astington, this volume).

Further, there does seem to be enough evidence from the many studies that have been done in the West, to show that development of a theory of mind has special characteristics that differentiate it from normal theorising. What is so striking is the similarity of development, after the starting point, across children. Most of them do come up with the same theory at roughly the same time. Moreover, at least as far as one can tell from anecdotal evidence, history, and literature, it appears that every normal human being from every culture, apart from very small children and genetically defective individuals, deploys some sort of belief-desire psychology.

By contrast, it is surely not the case that if one collected a few million scientists who started out with the same initial theory, then gave them the same counterevidence, that nearly all of them would arrive at the same revised theory – within roughly the same time span. And this is particularly so if they differ in general intelligence, in learning ability, in psychological well being and so on, the way children do. Indeed, we already know that psychologists disagree over the truth of the core aspects of belief-desire psychology. These points strongly suggests that acquiring a theory of mind involves a special acquisition process rather than a general one.[9]

Third: there is an important disanalogy between theory change in science and development of theory of mind in children. One of the processes driving theory change in science is explicit meta-theoretical reflection. Presumably, when a scientist is confronted by counterevidence, she begins to worry that her theory is false, and this causes her to look for alternatives. But very young infants do not appear to have the conceptual sophistication to formulate this worry: it is unlikely that they are aware that they hold a theory, that it is confronted by counterevidence and that it is therefore probably false. So it seems that at least one of the processes responsible for theory change in science does not play a role in acquisition of a theory of mind.[10]

The fourth, and most compelling reason to favour modularity is Williams Syndrome. This is a rare genetic disorder resulting in certain characteristic facial features and physical problems as well as a unique and particularly striking cognitive profile. Subjects are retarded, with an average IQ of around 50. They are also particularly impaired with respect to arithmetical and visual-spatial abilities. However they exhibit an unusually high level of linguistic ability, with a particular penchant for sophisticated and unusual vocabulary items. And, crucial to the present issue, they have often been noted for their relatively high degree of social skills.

A recent study conducted by Helen Tager-Flusberg, Kate Sullivan and Deborah Zaitchik presented a group of Williams Syndrome children (aged 4;4 to 11;2) with standard false-belief tests, as well as a series of simplified versions of the tests and a task that 'tapped children's ability to use mental states to *explain* action.'[11] They found that with the exception of the two youngest children, who lacked the linguistic ability or attention span to handle the tests, all the subjects passed the tests. These results indicate that children with Williams Syndrome have an intact psychology faculty.

By contrast, children with Williams Syndrome seem to suffer general impairments when it comes to the acquisition of theoretical, explanatory knowledge. Although this has not been researched in detail, as far as I know, at least one series of tests confirms the picture. Susan Carey, Susan Johnson and Karen Levine offer the hypothesis that there are at least two kinds of learning processes: 'enrichment processes' which are capable of 'accumulating and correlating information in something possibly like an associative network of knowledge', and 'conceptual change processes ... which actively reorganise knowledge and produce genuinely new conceptual structures'. They assembled tasks designed to diagnose the presence of each of the two kinds of process in the field of naive biology. They found that children with Williams Syndrome matched children of equivalent mental age on the tasks requiring only enrichment processes, but performed significantly worse on those requiring conceptual change processes.

If children with Williams Syndrome are able to acquire theories of mind but are severely impaired with respect to acquiring theories in all or most other areas (barring language), then it certainly appears that the acquisition processes involved in theory of mind are specialised in the way required by the modular conception of development. It is difficult to see how the developmental theory-theory could account for such a phenomenon.

There is a fifth consideration to prefer the modularity theory to Gopnik and Wellman's. This is not a consideration that favours the truth of the former, but rather its explanatory power. (Unfortunately, explanatory power doesn't argue for truth: they are just different virtues.) Gopnik and Wellman say this: 'the developmental data chart a succession of conceptions of mind each logically related to earlier conceptions'. This makes it look as though the revision of the theory, say, the move from prelief to belief, has the nature of an inductive or deductive rational process. If that were so, then it would indeed be easy to see the theoretical change as an instance of a general cognitive process that occurs in many other domains. But conceptual development is not like that: no deduction or induction can give one new concepts for old. The process of coming up with new concepts, whether in science or in maturation, is not a logical process. That is why it so hard to understand.

When a three-year-old is confronted by counterevidence to their current theory, and for the first time deploys a concept of a genuinely representational attitude (perception or desire), something very special has happened. They don't just use some kind of logic to reason through the problem. Rather, a new concept makes its first appearance. How does this happen? Why is it that concept that appears, rather than another, or no new concept at all? The developmental theory-theory does not really help answer these questions.

The modular approach does not fully answer them either. But it does give us a way of looking at them. The concept just grows under those circumstances. And the reason it does is that it is built into our genes. Specifically, just as we are specifically determined to grow hair but not horns. The modularity theory thus reduces conceptual development in childhood to a kind of process that is reasonably well understood in general terms, and applies across a very wide range of phenomena. The developmental theory-theory doesn't achieve anything parallel. One might say that there's no great mystery left on the modularity theory, while there is on the theory-theory.

Gopnik and Wellman point to two aspects of development of a theory of mind that seem hard to account for in terms of modularity. First, they point out that the early theory tends to produce false representations. I take it that they mean that the early non-representational concepts of attitudes are inaccurate, and feature in false claims about psychology. They argue: '[E]rroneous (as opposed to incomplete) representations, which are later modified and restructured, are ... difficult to explain on a purely modular account. Evolution might of course select for erroneous representation, the representation just has to be good enough to survive. But if the representational system is good enough, why, on a modularity account, would it be replaced in later development?'

The second aspect is the resemblance of the development of a theory of mind to typical cases of theory change:

It is, of course, logically possible that a maturational sequence of successive modules might just by accident parallel a theory-formation process, and that the triggering inputs just happen to bear the same relation to the privileged representations that evidence bears to theory. Such a view, however, seems unmotivated. It is easy to see how evolution might have selected for an (approximately) correct innately determined representation of the world. It is much more difficult to see how evolution would have selected for a series of representational systems, each maturing separately only to be replaced by another.

The modularist can meet these points. It is not implausible to suppose that the early theories of mind – the two-year-old's, three-year-old's and so on – are hangovers from phylogenetically prior stages. If this is right, then each new stage can be viewed as a case of what in systematics is called 'terminal addition'. A terminal addition occurs when the ontogenetic sequence of a descendant adds a final stage to the ontogenetic sequence of the ancestor (see Stephen Jay Gould, 1977, see also Povinelli, this volume, for related discussion). The false representations of, say, the three-year-old are a product of a relatively primitive system that was present in the species some while ago. The system was, indeed, good enough for survival. However, the new system, the one that humans now have, and that comes on-line at about four years of age, is a better one, and it was added on as a terminal stage of growth in the ontogenetic sequence.

Further, it is not implausible that the neural hardware underlying the earlier theories is a necessary developmental precursor of that underlying the later ones. Dendrites and axons are conditioned to grow in certain ways, given certain behavioural successes and failures. These behavioural successes and failures can only come about given the existence of an early theory that leads to them. There is no special reason not to suppose that the particular pattern of growth in these particular conditions is determined by specific genes. Ontogeny often doesn't recapitulate phylogeny. But we shouldn't be amazed if sometimes it does.

Of course the suggestion that the psychology faculty evolved by terminal addition is pure speculation. But at this stage that is all that anyone can provide. And that is all that is required to meet Gopnik and Wellman's challenge.

In conclusion, then, it does seem that as matters stand the diachronic modular theory has a significant lead over the developmental theory-theory.

ACKNOWLEDGEMENTS

Many thanks for comments and discussion to Simon Baron-Cohen, Ned Block, Sue Carey, Peter Carruthers, Noam Chomsky, Jerry Fodor, Alison Gopnik, Alan Leslie, David Papineau, Terry Parsons, Barry C. Smith, Peter K. Smith, Denis Walsh,

members of the London Family, and of the Theories of Theories of Mind workshop, and audiences at the philosophy departments of Amherst College, The University of Massachusetts at Amherst, The University of Madison-Wisconsin and Rutgers University.

NOTES

1 The notion of intentional modules is akin to James Higginbotham's (1987) notion of 'modules of understanding'.
2 The above should be considered only a very quick first sketch of intentional modularity. If one or more genuine psychological natural kinds fall under the concept then a lot of work remains to be done articulating it.
3 Unlike intentional modularity, computational modularity has already been well articulated by philosophers and cognitive scientists. See e.g. Haugeland, 1978 and 1982. Note that he commits himself to an account of intentionality that goes beyond anything I say here.
4 Technically, I should at this point revise my initial characterisation of modularity. I said that a module is a component of the mind, or brain . . . that explains a competence. Since explanation isn't transitive, a functional component of the brain that realises say, a computational module that explains a competence, might not itself explain a competence. I leave it to the reader to adjust the characterisation so that it covers such components of the brain. Thanks to Scott Sturgeon for the point.
5 In fact much of what I shall say is equally applicable to at least some versions of the simulation theory.
6 Baron-Cohen (1994) suggests that the psychology faculty is not informationally encapsulated. But I think his reason isn't adequate. See my comments in the same journal.
7 See also Gopnik and Wellman (1992) and Meltzoff and Gopnik (1993) for more on the same theme.
8 This is not a small concession. Leslie (1994a), argues that three-year-olds have the adult conception of belief, but they can't deploy it properly. If this is right, then the analogy with conceptual change in science is undermined.
9 Autism appears to be a genetic defect that results in a fairly specific theory of mind deficit. It might seem as though it therefore provides good evidence for modularity. But it doesn't really. Gopnik and Wellman allow that the child is born with an innate theory which is the starting point for subsequent development. Autism may be explained by lack of this initial theory, rather than lack of a module. See Meltzoff and Gopnik (1993) for a suggestion along roughly these lines.
10 I am indebted to Peter Carruthers for this point.
11 The work cited here and in the following paragraph was presented at the sixth international conference of the Williams Syndrome Association, at the University of California, San Diego, July 1994. The quotations are from *Building Bridges Across Disciplines: Cognition to Gene*, program and abstracts from that conference.

Language seems the obvious candidate here. I have argued that it would help an individual ontogenetically by helping them label intervening variables/mental states of themselves and others; and it would help it phylogenetically, by the process of developing within a community of adults linguistically communicating about such states. It is not so clear that this phylogenetic scaffolding could be created by a community of creatures busy being self-aware or busy carrying out pretend simulations. Self-awareness and pretence of this kind are intrinsically solitary, whereas we need a social context for the evolution of mind-reading. Language seems to be the right candidate.

The likely importance of enculturation for mind-reading development in chimpanzees fits in well with the postulated role for language. Adult humans, and adult chimpanzees, behave very differently to young chimpanzees. In some ways the latter can benefit from human care-givers; they attend to and manipulate objects more (Bard and Vauclair, 1984), engage in longer bouts of mutual gaze (Bard, 1994), and show richer pretence and can be trained in simple forms of sign language. This demonstrates the powerful nature of the social environment in supporting the ontogeny of mind-reading skils. However they had to evolve too. Even chimpanzees with a lot of exposure to human care-givers (such as Sarah, who featured in the early Premack experiments) don't show unambiguous mind-reading skills. Enculturation in a ToM community is not sufficient for mind-reading. But it is very likely to be necessary; as Tomasello, Savage-Rumbaugh, and Kruger (1993) also suggest, if we could imagine a child being reared by chimpanzees, it might not develop an explicit theory of mind because of deficient enculturation.

In summary, only language seems likely to convince us – or sceptics among us – of mind-reading ability beyond the level of 'very clever behaviourist'; level I, with arguments about level E1, in Karmiloff-Smith's (1992) RR model. Only language would enable an individual to develop this through to explicit mind-reading; consolidating E1 and reaching E2/3. And only a linguistic community would have provided the phylogenetic scaffolding for this to happen. Only if chimpanzees could talk to each other about mental states would they have evolved mind-reading, and only if they could talk to us about mental states would we believe them.

ACKNOWLEDGEMENTS

I am grateful to Peter Carruthers for comments on an earlier version of this chapter.

References

American Psychiatric Association (1987). *Diagnostic and Statistical Manual of Mental Disorders* (3rd revised edition). Washington DC.

Amsterdam, B. (1972). Mirror self-image reactions before age two. *Developmental Psychobiology*, *5*, 297–305.

Anselmi, D., Tomasello, M., and Acunzo, M. (1986). Young children's responses to neutral and specific contingent queries. *Journal of Child Language, 13,* 135–44.

Asendorpf, J. B., and Baudonniere, P. M. (1993). Self-awareness and other-awareness: mirror self-recognition and synchronic imitation among unfamiliar peers. *Developmental Psychology*, *29*, 88–95.

Asperger, H. (1944). Die 'autistischen Psychopathen' im kindesalter. *Archiv fur Psychiatrie und Nervenkrankheiten*, *117*, 76–136.

Astington, J. W. (1990). Narrative and the child's theory of mind. In B. Britton and A. Pellegrini (eds.), *Narrative Thought and Narrative Language*. Hillsdale, NJ: Erlbaum.

Astington, J. W., Harris, P. L., and Olson, D. R. (1988, eds.). *Developing Theories of Mind*. Cambridge, Cambridge University Press.

Astington, J. W., and Jenkins, J. M. (1995, March). Language and theory of mind: a theoretical review and a longitudinal study. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Indianapolis, IN.

Avis, J., and Harris, P. L. (1991). Belief-desire reasoning among Baka children: evidence for a universal conception of mind. *Child Development, 62,* 460–7.

Baillargeon, R. (1987). Object permanence in 3.5 and 4.5 month old infants. *Developmental Psychology*, *23*, 655–64.

Bakeman, R., and Adamson, L. (1984). Coordinating attention to people and objects in mother-infant and peer-infant interaction. *Child Development*, *55*, 1278–89.

Baldwin, D.A. (1995). Understanding the link between joint attention and language aquisition. In C. Moore, and P. Dunham (eds.), *Joint Attention: Its Origins and Role in Development*. Hillsdale, NJ: Lawrence Erlbaum.

Baldwin, D. A., and Moses, L. J. (1994). Early understanding of referential intent and attentional focus: evidence from language and emotion. In C. Lewis and P. Mitchell (eds.), *Children's Early Understanding of Mind: Origins and Development*. pp 133–56. Hillsdale, NJ: Erlbaum.

Bard, K. A. (1994). Evolutionary roots of intuitive parenting: maternal competence in chmpanzees. *Early Development and Parenting*, *3*, 19–28.

Bard, K. A., Platzman, Lester, B. M. and Suomi, S. J. (1992). Orientation to social and non-social stimuli in neonatal chimpanzees and humans. *Infant Behavior and Development*, *15*, 43–6.

Bard, K. A., and Vauclair, J. (1984). The communicative context of object manipulation in ape and human adult-infant pairs. *Journal of Human Evolution*, *13*, 181–90.

Barkow, J., Cosmides, L., and Tooby, J. (eds.), (1992). *The Adapted Mind: Evolutionary Psychology and the Generation of Culture*, Oxford: Oxford University Press.

Baron-Cohen, S. (1987). Autism and symbolic play. *British Journal of Developmental Psychology*, *5*, 139–48.

(1988). Social and pragmatic deficits in autism. Cognitive or affective? *Journal of Autism and Developmental Disorders*, *18*, 379–402.

(1989a). The autistic child's theory of mind: A case of specific developmental delay. *Journal of Child Psychology and Psychiatry*, *30*, 285–98.

(1989b). Perceptual role-taking and protodeclarative pointing in autism. *British Journal of Developmental Psychology*, *7*, 113–27.

(1989c). Are autistic children behaviourists? An examination of their mental-physical and appearance-reality distinctions. *Journal of Autism and Developmental Disorders*, *19*, 579–600.

(1990). Autism: A specific cognitive disorder of 'mind-blindness'. *International Review of Psychiatry*, *2*, 81–90.

(1991a). The development of a theory of mind in autism: Deviance and delay? *Psychiatric Clinics of North America*, *14*, 33–51.

(1991b). Do people with autism understand what causes emotion? *Child Development*, *62*, 385–95.

(1991c). Precursors to a theory of mind: Understanding attention in others. In A. Whiten (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading*, pp. 233–51. Oxford: Basil Blackwell.

(1992). Out of sight or out of mind: another look at deception in autism. *Journal of Child Psychology and Psychiatry*, *33*, 1141–55.

(1993). From attention-goal psychology to belief-desire psychology: the development of a theory of mind and its dysfunction. In S. Baron-Cohen, H. Tager-Flusberg, and D. J. Cohen (eds.), *Understanding Other Minds: Perspectives from Autism*. Oxford: Oxford University Press.

(1994). How to build a baby that can read minds: cognitive mechanisms in mindreading. *Cahiers de Psychologie Cognitive/ Current Psychology of Cognition*, *13*, 513–52.

(1995a). *Mindblindness*. MIT Press/Bradford Books.

(1995b). The Eye-Direction Detector (EDD) and the Shared Attention Mechanism (SAM): two cases for evolutionary psychology. In C. Moore, and P. Dunham (eds.), *The Role of Joint Attention in Development*. Hillsdale, NJ: Erlbaum.

Baron-Cohen, S., Allen, J., and Gillberg, C. (1992). Can autism be detected at 18 months? The needle, the haystack, and the CHAT. *British Journal of Psychiatry*, *161*, 839–43.

Baron-Cohen, S., Campbell, R., Karmiloff-Smith, A., Grant, J., and Walker, J. (1995). Are children with autism blind to the mentalistic significance of the eyes? *British Journal of Developmental Psychology*. In press.

Baron-Cohen, S., Cox, A., Baird, G., Swettenham, J., Drew, A., and Charman, T. (1994). Psychological markers in the detection of autism in infancy, in a large population. Unpublished manuscript, University of Cambridge.

Baron-Cohen, S., and Cross, P. (1992). Reading the eyes: evidence for the role of perception in the development of a theory of mind. *Mind and Language*, *6*, 173–86.

Baron-Cohen, S., and Goodhart, F. (1994). The 'seeing leads to knowing' deficit in autism: the Pratt and Bryant probe. *British Journal of Developmental Psychology*, *12*, 397–402.

Baron-Cohen, S., Leslie, A., and Frith, U. (1985). Does the autistic child have a 'theory of mind'? *Cognition*, *21*, 37–46.

(1986). Mechanical, behavioural and intentional understanding of picture stories in autistic children. *British Journal of Developmental Psychology*, *4*, 113–25.

Baron-Cohen, S., and Ring, H. (1994a). A model of the mindreading system: neuropsychological and neurobiological perspectives. In C. Lewis and P. Mitchell (eds.), *Children in Early Understanding of Mind: Origins and Development*. Hillsdale, NJ: Erlbaum.

(1994b). The relationship between EDD and ToMM: neuro-psychological and neurobiological perspectives. In C. Lewis, and P. Mitchell (eds.), *Children in Early Understanding of Mind: Origins and Development*. Hillsdale, NJ: Erlbaum.

Baron-Cohen, S., Tager-Flusberg, H., and Cohen, D. J. (eds.), (1993). *Understanding Other Minds. Perspectives from Autism*. Oxford: Oxford University Press.

Barresi, J., and Moore, C. (in press). Intentional relations and social understanding. *Behavioural and Brain Sciences*.

Bartsch, K., and Wellman, H. M. (1989). Young children's attribution of action to beliefs and desires. *Child Development*, *60*, 946–64.

(1995). *Children Talk About the Mind*. New York: Oxford University Press.

Bates, E., Benigni, L., Bretherton, I., Camaioni, L., and Volterra, V. (1979). Cognition and communication from 9–13 months: correlational findings. In E. Bates (ed.), *The emergence of symbols: cognition and communication in infancy*. New York: Academic Press.

Bates, E., Camaioni, L., and Volterra, V. (1975). The acquisition of performatives prior to speech. *Merrill-Palmer Quarterly*, *21*, 205–26.

Baumrind, D. (1971). Current patterns of parental authority. *Developmental Psychology Monographs*, *4* (1, Part 2).

Bennett, J. (1976). *Linguistic Behaviour*. Cambridge: Cambridge University Press.

(1978). Some remarks about concepts. *Behavioral and Brain Sciences*, *1*, 557–60.

(1991). How to read minds in behaviour: a suggestion from a philosopher. In A. Whiten (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading*. Oxford: Basil Blackwell.

Bennett, K., and Harvey, P. (1985). Brain size, development and metabolism in birds and mammals. *Journal of Zoology*, *207*, 491–509.

Bischof-Köhler, D (1988). Uber der Zusammenhang von Empathie und der Fahigkeit, sich im Spiegel zu erkennen [On the association between empathy and ability to recognize oneself in the mirror]. *Schhweizerische Zeitschrift für Psychologie*, *47*, 147–59.

Bishop, D. (1989). Autism, Asperger's syndrome and senatic-pragmatic disorder:

where are the boundaries? *British Journal of Disorders of Communication, 24,* 107–21.
(1993). Autism, executive function and theory of mind. *Journal of Child Psychology and Psychiatry, 34,* 279–93.
Bishop, D., North, and Donlan, C. (in press). Genetic basis of specific language disorder: evidence from a twin study. *Developmental Medicine and Child Neurology.*
Bishop, D., and Rosenbloom, L. (1987). Classification of childhood language disorders. In W. Yule, and M. Rutter (eds.), *Language Development and Disorders. Clinics in Developmental Medicine.* London: Mac Keith Press.
Blackburn, S. (1992). Theory, observation and drama. *Mind and Language, 7,* 187–203.
Boakes, R. (1984). *From Darwin to Behaviourism: Psychology and the Minds of Animals.* Cambridge: Cambridge University Press.
Boden, M. (1990). *The Philosophy of Artificial Intelligence.* Oxford: Oxford University Press.
Bolton, P., and Rutter, M. (1990). Genetic influences in autism. *International Review of Psychiatry, 2,* 67–80.
Boucher, J. (1976). Is autism primarily a language disorder? *British Journal of Disorders of Communication, 11,* 135–43.
Bowler, D. M. (1992). 'Theory of mind' in Asperger's Syndrome. *Journal of Child Psychology and Psychiatry, 33,* 877–93.
Bowler, D. M., and Norris, M. (1993). Predictors of success on false belief tasks in pre-school children. Paper presented at the 6th European Conference on Developmental Psychology, Bonn.
Braverman, M. *et al.* (1989). Affect comprehension in children with pervasive developmental disorders. *Journal of Autism and Developmental Disorders,* 19, 301–16.
Brown, R. (1980). The maintenance of conversation. In D. R. Olson (ed.), *The Social Foundation of Thought and Language,* pp. 187–210. London: Norton.
Brown, J. R., and Dunn, J. (1991). 'You can cry, mum': The social and developmental implications of talk about internal states. *British Journal of Developmental Psychology, 9,* 237–56.
Brownell, C. A., and Carriger, M. S. (1990). Changes in cooperation and self-other distinction during the second year. *Child Development, 61,* 1164–74.
Bruner, J. (1983). *Child's talk: learning to use language.* Oxford: Oxford University Press.
(1990). *Acts of Meaning.* Cambridge, MA: Harvard University Press.
Bruner, J., and Feldman, C. (1993). Theories of mind and the problem of autism. In S. Baron-Cohen, H. Tager-Flusberg and D. Cohen (eds.), *Understanding Other Minds. Perspectives from Autism.* Oxford: Oxford University Press.
Burma, B. H. (1949). Reality, existence, and classification: A discussion of the species problem. *Madroño, 127,* 193–209.
Butterworth, G. (1991). The ontogeny and phylogeny of joint visual attention. In A. Whiten (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading.* Oxford: Basil Blackwell.
Butterworth, G., and Cochran, E. (1980). Towards a mechanism of joint visual attention in human infancy. *Int. J. Behav. Develop. 3.*

Butterworth, G. and Jarrett, N. (1991). What minds have in common is space: spatial mechanisms serving joint visual attention in infancy. *British Journal of Developmental Psychology. 9.*
Byrne, R. W., and Whiten, A. (eds.), (1988). *Machiavellian Intelligence: Social Expertise and the Evolution of Intellect in Monkeys, Apes, and Humans.* Oxford: Blackwell.
(1990). Tactical deception in primates: the 1990 database. *Primate Report, 27,* 1–101.
(1991). Computation and mindreading in primate tactical deception. In A. Whiten (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading.* Oxford: Basil Blackwell.
(1992). Cognitive evolution in primates: Evidence from tactical deception? *Man (N.S.), 27,* 609–27.
Carey, S. (1985). *Conceptual Change in Childhood.* Cambridge, MA: Bradford Books: MIT Press.
(1988). Conceptual differences between children and adults, *Mind and Language, 3(3),* 167–83.
Carruthers, P. (1992). *Human Knowledge and Human Nature.* Oxford: Oxford University Press.
(1996). *Language, Thought, and Consciousness: An Essay in Philosophical Psychology.* Cambridge: Cambridge University Press.
Case, R. (1985). *Intellectual Development.* Orlando, FL: Academic Press.
(1989, April). A neo-Piagetian analysis of the child's understanding of other people, and the internal conditions which motivate their behavior. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Kansas City, MO.
Chance, M. R. A. (1967). Attention structure as the basis of primate rank orders. *Man, 2,* 503–18.
Chamberlin, T. C. (1897). The method of multiple working hypotheses. *Journal of Geology, 5,* 837–48.
Charman, T., and Baron-Cohen, S. (1992). Understanding drawings and beliefs: A further test of the metarepresentation theory of autism. *Journal of Child Psychology and Psychiatry, 33,* 1105–12.
Cheney, D. L., and Seyfarth, R. M. (1990a). Attending to behaviour versus attending to knowledge: Examining monkeys' attribution of mental states. *Animal Behaviour, 40,* 742–53.
(1990b). *How Monkeys See the World.* Chicago: University of Chicago Press.
(1991). Reading minds or reading behaviour? Tests for a theory of mind in monkeys. In A. Whiten (Ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading,* pp. 175–94. Oxford: Basil Blackwell.
(1992). Characterizing the mind of another species. *Behavioral and Brain Sciences, 15,* 172-9.
Chevalier-Skolnikoff, S. (1983). Sensorimotor development in orang-utans and other primates. *Journal of Human Evolution, 12,* 545–61.
Chomsky, N. (1965). *Aspects of the theory of syntax.* Cambridge, MA: MIT Press.
(1980). *Rules and Representations.* New York: Columbia University Press.
(1986). *Knowledge of Language: Its Nature, Origin and Use.* New York: Preager.

Churchland, P. M. (1981). Eliminative materialism and the propositional attitudes. *Journal of Philosophy*, *78*, 67–90.

(1988). *Matter and Consciousness* (revised edition). Cambridge, MA.: MIT Press.

(1989). *A Neurocomputational Perspective*. Cambridge, MA: Bradford Books/MIT Press.

Clements, W. A., and Perner, J. (1994). Implicit understanding of belief. *Cognitive Development*, *9*, 377–95.

Cole, M., and Scribner, S. (1978). Introduction. In L. S. Vygotsky, *Mind in Society*. Cambridge, MA: Harvard University Press.

Collin, F. (1985). *Theory and Understanding*. Oxford: Basil Blackwell.

Collingwood, R. G. (1946). *The Idea of History*. Oxford: Oxford University Press.

Corkum, V., and Moore, C. (in press). In C. Moore and P. Dunham (eds.), *Joint Attention: Its Origin and Role in Development*, Hillsdale, NJ: Erlbaum.

Courschesne, E. (1992). A neurophysiological view of autism. In E. Schopler and G. Mesibov (eds.), *Neurobiological Issues in Autism*. New York: Plenum Press.

Cunningham, M. A. (1968). A comparison of the language of psychotic and non-psychotic children who are mentally retarded, *Journal of Child Psychology and Psychiatry*, 9, 229–44.

Currie, G. (1990). *The Nature of Fiction*. New York: Cambridge University Press.

(1995). Imagination and simulation: Aesthetics meets cognitive science. In A. Stone and M. Davies (eds.), *Mental Simulation: Evaluations and applications*. Oxford: Basil Blackwell.

(forthcoming). Mental Imagery as the Simulation of Vision.

(In preparation). Mental Simulation: Theory and Evidence.

Davidson, D. (1980). Psychology as philosophy. In D. Davidson (ed.), *Essays on actions and events*. Oxford: Oxford University Press.

Davies, M. (1994). The mental simulation debate. *Proceedings of the British Academy*, *83*, 99–127.

Davies, M. and Stone, T. (eds.), (1995). *Folk Psychology and the Theory of Mind Debate: Core Readings*. Oxford: Basil Blackwell.

Dawson, G., and Lewy, A. (1989). Reciprocal subcortical influences in autism: the role of attentional mechanisms. In G. Dawson (ed.), *Autism: Nature, Diagnosis and Treatment*. New York: Guilford Press.

Dennett, D. C. (1978). Artificial intelligence as philosophy and psychology. In D. C. Dennett, *Brainstorms*. Cambridge, MA: Bradford Books/MIT Press.

(1981). Making sense of ourselves. *Philosophical Topics*, *12*, Number 1; reprinted as J.I. Biro and R.W. Shahan (eds.), *Mind, Brain, and Function: Essays in the Philosophy of Mind*, Brighton: Harvester Press, 1982, 63–81. Reprinted in *The Intentional Stance*. Cambridge, MA.: MIT Press, 83–101.

(1983). Intentional systems in cognitive ethology: The 'Panglossian paradigm' defended. *Behavioral and Brain Sciences*, *6*, 343–90.

(1987). *The Intentional Stance*. Cambridge, MA: MIT Press.

(1984). Cognitive wheels: the frame problem of AI. In C. Hookway (ed.), *Minds Machines and Evolution*. Cambridge: Cambridge University Press. Reprinted in Boden (1990).

(1988). The intentional stance in theory and practice. In R. W. Byrne, and A. Whiten (eds.), *Machiavellian Intelligence: Social Expertise and the Evolution of Intellect*. Oxford: Oxford University Press.

De Villiers, J. G. (March, 1995). Steps in the mastery of sentence complements. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Indianapolis, IN.

De Waal, F. B. M. (1982). *Chimpanzee Politics*. London: Jonathan Cape.

Doherty, M. (1994). Metalinguistic awareness and theory of mind: Two words for the same thing. Paper presented at the Hang Seng Theories of Theories of Mind Conference, Sheffield, 13–16th July, 1994.

Donaldson, M. (1978). *Children's Minds*. London: Fontana.

Doré, F., and Mercier, P. (1992). *Les Fondements de l'Apprentissage et de la Cognition*. Lille: Presses Universitaires de Lille.

Dreyfus, H. L., and Dreyfus, S. (1986). *Mind over Machine*. New York: Free Press, Macmillan.

Dunn, J. (1988). *The Beginnings of Social Understanding*. Cambridge, MA: Harvard University Press.

(1991). Understanding others: Evidence from naturalistic studies of children. In A. Whiten (ed.), *Naturalistic Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading*, pp 233–51, Oxford: Basil Blackwell.

(1994). Changing minds and changing relationships. In C. Lewis and P. Mitchell (eds.), *Children's Early Understanding of Mind: Origins and Development*, pp. 297–310. Hove, U.K.: Erlbaum.

Dunn, J., Brown, J., and Beardsall, L. (1991). Family talk about feeling states and children's later understanding of others' emotions. *Developmental Psychology, 27*, 448–55.

Dunn, J., Brown, J., Slomkowski, C., Tesla, C., and Youngblade, L. (1991). Young children's understanding of other people's feelings and beliefs: individual differences and their antecedents. *Child Development, 62*, 1352–66.

Eddy, T. J., Gallup, G. G. Jr, and Povinelli, D. J. (1993). Attribution of cognitive states to animals: Anthropomorphism in comparative perspective. *Journal of Social Issues*, *49*, 87–101.

Eisenmajer, R., and Prior, M. (1991). Cognitive linguistic correlates of 'theory of mind' ability in autistic children. *British Journal of Developmental Psychology, 9*, 351–64.

Eisenberg, N., and Strayer, J. (1987a). *Empathy and its Development*. New York: Cambridge University Press.

(1987b). Critical issues in the study of empathy. In Eisenberg and Strayer, *Empathy and its Development*. New York: Cambridge University Press.

Evans, G. (1982). *The Varieties of Reference*. Oxford: Oxford University Press.

Farah, M. (1984). The neurological basis of mental imagery: a componential analysis. *Cognition 18*, 245–72.

Fein, D., Pennington, B., Markowitz, P., Braverman, M., and Waterhouse, L. (1986). Toward a neuropsychological model of infantile autism: are the social deficits primary? *Journal of the American Academy of Child Psychiatry, 25*, 198–212.

Feldman, C. F. (1992). The new theory of theory of mind. *Human Development, 35*, 107–17.

Fivush, R., Gray, J. T., and Fromhoff, F. A. (1987). Two-year-olds talk about the past. *Cognitive Development, 2*, 393–409.
Flavell, J. H. (1988). From cognitive connections to mental representations. In J.W. Astington, P. L. Harris and D. R. Olson (eds.), *Developing Theories of Mind*, pp. 244–67. Cambridge, Cambridge University Press.
Flavell, J. H., Everett, B. A., Croft, K., and Flavell, E. R. (1981). Young children's knowledge about visual perception: further evidence for the level 1-level 2 distinction. *Developmental Psychology*, *17*, 99–103.
Flavell, J. H., Flavell, E. R., and Green, F. L. (1987). Young children's knowledge about the apparent-real and pretend-real distinctions. *Developmental Psychology, 23,* 816–22.
Flavell, J. H., Flavell, E. R., Green, F. L., and Wilcox, S. A. (1980). Young children's knowledge about visual perception: effect of observer's distance from target on perceptual clarity of target. *Developmental Psychology*, *16*, 10–12.
Fodor, J. (1968a). The appeal to tacit knowledge in psychological explanations, *Journal of Philosophy*, *65*, 627–40.
(1968b). *Psychological Explanation*. New York: Random House.
(1975). *The Language of Thought*. New York: Thomas Y. Crowell.
(1983). *The Modularity of Mind: An Essay on Faculty Psychology*. Cambridge, MA: MIT Press.
(1987). *Psychosemantics: The Problem of Meaning in the Philosophy of Mind.* Cambridge, MA: MIT Press.
(1992). A theory of the child's theory of mind. *Cognition, 44,* 283–96.
Folstein, S., and Rutter, M. (1988). Autism: familial aggregation and genetic implications. *Journal of Autism and Developmental Disorders*, *18*, 3–30.
Fox, M. W. (1982). Are most animals 'mindless automotons'? A reply to Gordon G. Gallup Jr. *American Journal of Primatology, 3*, 341–3.
Frankfurt, H. (1971). Freedom of the will and the concept of a person. *Philosophical Review*, *68*, 5–20.
Frege, G. (1892). On sense and reference. *Zeitschrift fur Philosophie und philosophische Kritik*, *100*, 25–50. Reprinted in P. Geach, and M. Black (eds., 1970). *Translations from the philosophical writings of Gottlob Frege*. Oxford: Basil Blackwell.
Frith, C. (1992). *The Cognitive Neuropsychology of Schizophrenia*. Hove, UK: Lawrence Erlbaum Associates.
Frith, U. (1989). *Autism: Explaining the Enigma.* Oxford: Basil Blackwell.
(Ed.), (1991). *Autism and Asperger's Syndrome*. Cambridge. Cambridge University Press.
Frith, U., and Happé, F. (1994). Autism: beyond 'theory of mind'. *Cognition, 50,* 115–32.
Frith, U., Happé, F., and Siddons, F. (1994). Autism and theory of mind in everyday life. *Social Development, 3,* 108–23.
Frith, U., and Hermelin, B. (1969). The role of visual and motor cues for normal, subnormal and autistic children. *Journal of Child Psychology and Psychiatry*, *10*, 153–63.
Frith, U., Morton, J., and Leslie, A. M. (1991). The cognitive basis of a biological disorder: autism. *Trends in Neurosciences*, *14,* 433–8.
Frye, D., Zelazo, P. D., and Palfai, T. (Unpublished manuscript). *The cognitive basis of theory of mind.* New York University.

Furrow, D., Moore, C., Davidge and Chiasson, L. (1992). Mental terms in mothers' and children's speech: similarities and relationships. *Journal of Child Language*, *19*, 617–31.
Gallup, G. G., Jr (1970). Chimpanzees: self-recognition. *Science*, *167*, 86–7.
(1982). Self-awareness and the emergence of mind in primates. *American Journal of Primatology*, 2, 237–48.
Gallup, G. G., Jr, Nash, R. F., and Ellison, A. L., Jr (1971). Tonic immobility as a reaction to predation: artificial eyes as a fear stimulus for chickens. *Psychonomic Science*, *23*, 79–80.
Gallup, G. G., Jr, Povinelli, D. J., Suarez, S. D., Anderson, J. R., Lethmate, J., and Menzel, E. W. (in press). Further reflections on self-recognition in primates. *Animal Behaviour*.
Gallup, GG., Jr and Suarez, SD. (1986). Self-awareness and the emergence of mind in humans and other primates. In J. Suls and A.G. Greenwald (eds.). *Psychological Perspectives on the Self. Volume 3*, (pp 3–26). Hillsdale, NJ: Erlbaum.
Geertz, C. (1973). *The Interpretation of Cultures*. New York: Basic Books.
Ghiselin, M. T. (1975). A radical solution to the species problem. *Systematic Zoology*, *23*, 536–44.
Gillberg, C. (1992). Autism and autistic-like conditions. Subclasses among disorders of empathy. *Journal of Child Psychology and Psychiatry*, *33*, 813–42.
Goldman, A. (1989). Interpretation psychologized. *Mind and Language*, *4*, 161–85.
(1992a). Empathy, mind, and morals. *Proceedings and Addresses of the American Philosophical Association*, *66* (3).
(1992b). In defense of the simulation theory. *Mind and Language*, *7*, 104–19.
(1993a). The psychology of folk psychology. *Behavioural and Brain Sciences*, *16*, 15–28.
(1993b). *Philosophical Applications of Cognitive Science*. Boulder, CO: Westview Press.
Gómez, J. C. (1990). The emergence of intentional communication as a problem-solving strategy in the gorilla. In S. T. Parker and K. R. Gibson (eds.), *'Language' and Intelligence in Monkeys and Apes: Comparative Developmental Perspectives* (pp. 333–55). Cambridge, MA.: Cambridge University Press.
(1991). Visual behaviour as a window for reading the mind of others in primates. In A. Whiten (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading*. Oxford: Basil Blackwell.
(1992). *El desarrollo de la comunicación intencional en el gorila*. Ph.D. Dissertation, Universidad Autónoma de Madrid.
(1993). Intentions, agents and enculturated apes. Behavioural and Brain sciences, *16* (3), 520–1.
(1994). Shared attention in ontogeny and phylogeny: SAM, TOM, Grice, and the great apes. *Cahiers de Psychologie Cognitive/Current Psychology of Cognition*, *13(5)*, 590–8.
(in press). Ostensive behavior in the great apes: the role of eye contact. In A. Russon, S. Parker, and K. Bard (eds.), *Reaching into Thought*, Cambridge, MA.: Cambridge University Press.
Gómez, J. C., and Teixidor, P. (1992). Theory of mind in an orangutan: a nonverbal test of false-belief appreciation? Paper presented at the *XIV Congress of the International Primatological Society. Strasbourg, August.*

Gómez, J. C., Sarriá, E., and Tamarit, J. (1993). The comparative study of early communication and theories of mind: ontogeny, phylogeny and pathology. In S. Baron-Cohen, H. Tager-Flusberg, and D. Cohen (eds.), *Understanding Other Minds: Perspectives from Autism*, pp. 397–426. Oxford: Oxford University Press.

Goodman, N. (1947). The problem of counterfactual conditionals. *Journal of Philosophy 44*, 113–28.

Goodman, R. (1989). Infantile autism: A syndrome of multiple primary deficits? *Journal of Autism and Developmental Disorders, 19*, 409–24.

Gopnik, A. (1988). Conceptual and semantic development as theory change. *Mind and Language, 3(3)*, 197–217.

(1990). Developing the idea of intentionality: Children's theories of mind. *Canadian Journal of Philosophy, 20*, 89–114.

(1993). How we know our minds: The illusion of first-person knowledge of intentionality. *Behavioral and Brain Sciences, 16*, 1–14.

Gopnik, A., and Astington, J. W. (1988). Children's understanding of representational change and its relation to the understanding of false belief and the appearance-reality distinction. *Child Development, 59*, 26–37.

Gopnik, A., and Graf, P. (1988). Knowing how you know: Young children's ability to identify and remember the sources of their beliefs. *Child Development*, 59, 1366–71.

Gopnik, A., and Melzoff, A. N. (1993). The role of imitation in understanding persons and in developing a theory of mind. In S. Baron-Cohen H. Tager-Flusberg and D. J Cohen (eds.), *Understanding Other Minds: Perspectives from Autism.* Oxford: Oxford University Press.

Gopnik, A., Melzoff, A. N., and Slaughter V. (1994) Changing your views: How understanding visual perception can lead to a new theory of mind. In C. Lewis and P. Mitchell (eds.), *Children's Early Undertaking of Mind*, Hilsdale, NJ: Erlbaum.

Gopnik, A., and Wellman, H. M. (1992). Why the child's theory of mind really *is* a theory. *Mind and Language, 7*:1–2, 145–71.

(1994). The 'theory theory'. In L. Hirshfield and S. Gelman, (eds.), *Domain-Specificity in Cultural Cognition.* New York: Cambridge University Press.

Gordon, R. M. (1986). Folk psychology as simulation. *Mind and Language*, *1*, 158–71.

(1992a). The simulation theory: Objections and misconceptions. *Mind and Language*, *7*, 11–34.

(1992b). Reply to Stich and Nichols. *Mind and Language*, *7*, 85–97.

(1992c). Reply to Perner and Howes. *Mind and Language*, *7*, 98–103.

(1995a). Simulation without introspection or inference from me to you. In T. Stone and M. Davies (eds.). *Mental simulation: Evaluations and Applications.* Oxford: Blackwell.

(1995b). Sympathy, simulation and the impartial spectator, *Ethics*, forthcoming. Reprinted in L. May, M. Friedman and A. Clark (eds.), *Mind and Morals*, Cambridge, Mass: MIT Press.

Gordon, R. M., and Barker, J. (1994). Autism and the theory of mind debate. In G. Graham and G. Stephens (eds.), *Philosophical Psychopathology.* Cambridge, MA: MIT Press.

Gould, S. J. (1977). *Ontogeny and Phylogeny*. Cambridge, MA: Harvard University Press.

Gould, S. J., and Vrba, E. (1982). Exaptation – a missing term in the science of form. *Paleobiology 8*, 4–15.

Greenfield, P. M., and Savage-Rumbaugh, S. (1990). Grammatical combination in *Pan paniscus*: processes of learning and invention in the evolution and development of language. In S. T. Parker and K. R. Gibson (eds.), *'Language' and Intelligence in Monkeys and Apes: Comparative Developmental Perspectives*, pp. 540–78. Cambridge: Cambridge University Press.

(1993). Comparing communicative competence in child and chimp: the pragmatics of repetition. *Journal of Child Language*, *20*, 1–26.

Griffin, D. (1976). *The Question of Animal Awareness: Evolutionary Continuity and Mental Experience.* New York : Rockefeller University Press.

Hadwin, J., and Perner, J. (1991). Pleased and surprised: children's cognitive theory of emotion. *British Journal of Developmental Psychology, 9*, 215–34.

Hallock, M. B., Worobey, J. and Self, P. A (1989). Behavioural development in chimpanzees (*Pan troglodytes*) and human neonates across the first month of life. *International Journal of Behavioural Development*, *12*, 527–40.

Halle, M., and Stevens, K. (1962). Speech recognition: a model and a program for research. In Fodor and Katz (eds.), *The Structure of Language: Readings in the Philosophy of Language*. Englewood Cliffs, NJ: Prentice-Hall.

Happé, F. G. E. (1993). Communicative competence and the theory of mind in autism. A test of relevance theory. *Cognition*, *48*, 101–19.

(1994a). Current psychological theories of autism: the 'theory of mind' account and rival theories. *Journal of Child Psychology and Psychiatry. 35*, 215–30.

(1994b). Pretending and planning. In S. Baron-Cohen H. Tager-Flusberg and D. J Cohen (eds.), *Understanding Other Minds: Perspectives from Autism.* Oxford: Oxford University Press.

Harris, P. L. (1989). *Children and Emotion: The Development of Psychological Understanding.* Oxford: Basil Blackwell.

(1991). The work of the imagination. In A. Whiten (ed.), *Natural Theories of Mind: The Evolution, Development and Simulation of Everyday Mindreading.* Oxford: Basil Blackwell.

(1992). From simulation to folk psychology: The case for development. *Mind and Language*, *7*, 120–44.

(1993). Pretending and planning. In S. Baron-Cohen H. Tager-Flusberg and D. J Cohen (eds.), *Understanding Other Minds: Perspectives from Autism.* Oxford: Oxford University Press.

Harris, P. L., Brown, E., Marriott, C., Whittall, S., and Harmer, S. (1991). Monsters, ghosts and witches: testing the limits of the fantasy-reality distinction in young children. *British Journal of Developmental Psychology*, *9*, 105–23.

Harris, P. L., Johnson, C. N., Hutton, D., Andrews, G. and Cooke, T. (1989). Young children's theory of mind and emotion. *Cognition and Emotion, 3*, 379–400.

Harris, P. L., and Kavanaugh, R. D. (1993). Young children's understanding of pretence. *Society for Research in Child Development Monographs* (Serial No. 237).

Harris, P. L., Kavanaugh, R. D., and Meredith, M. (1994). Young children's comprehension of pretend episodes: the integration of successive actions. *Child Development, 65*, 16–30.

Haugeland, J. (1978). The nature and plausibility of cognitivism. *The Behavioral and Brain Sciences,* 1.

Heal, J. (1986). Replication and functionalism. In J. Butterfield (ed.), *Language, Mind, and Logic* (pp. 135–50). Cambridge, Cambridge University Press.

(1994). Simulation vs. theory-theory: what is at issue? *Proceedings of the British Academy*, *83*, 129–44.

(1995). How to think about thinking. In T. Stone and M. Davies (eds.), *Mental Simulation: Evaluations and Applications.* Oxford: Basil Blackwell.

Heath, S.B. (1983). *Ways with Words*. Cambridge: Cambridge University Press.

Heelas, P., and Lock, A. (eds.), (1981). *Indigenous Psychologies.* London: Academic Press.

Heider, F. (1958). *The Psychology of Interpersonal Relations*. New York: Wiley.

Hermelin, B., and O'Connor, N.(1970). *Psychological Experiments with Autistic Children*. Oxford: Pergamon.

Hess, J., Novak, M. A., and Povinelli, D. J. (1993). 'Natural pointing' in a rhesus monkey, but no evidence of empathy. *Animal Behaviour*, *46*, 1023–5.

Heyes, C. M. (1993). Anecdotes, training, trapping, and triangulating: do animals attribute mental states? *Animal Behaviour*, *47*, 177–88.

(1994a). Reflections on self-recognition in primates. *Animal Behaviour*, *47*, 909–19.

(1994b). Cues, convergence and a curmudgeon: a reply to Povinelli. *Animal Behaviour*, *48*, 242–4.

Higginbotham, J. (1987). The autonomy of syntax and semantics. In J. Garfield (ed.), *Modularity in Knowledge Representation and Natural Language Understanding*. Cambridge MA: MIT Press.

Hobson, R. P. (1986). The autistic child's appraisal of expressions of emotion. A further study. *Journal of Child Psychology and Psychiatry*, *27*, 671–80.

(1991). Against the theory of 'theory of mind'. *British Journal of Developmental Psychology, 9,* 33–51.

(1993a). *Autism and the Development of Mind.* Hove, UK: Erlbaum.

(1993b). Understanding persons: the role of affect. In S. Baron-Cohen, H. Tager-Flusberg and D. Cohen (eds.), *Understanding Other Minds: Perspectives from Autism.* Oxford University Press.

Hoffman, M. (1984). Interaction of affect and cognition in empathy. In C. Izard, J. Kagan, and R. Zajonc (eds.), *Emotions, Cognitions, and Behavior,* pp. 103–31. New York: Cambridge University Press.

(1987). The contribution of empathy to justice and moral judgement. In N. Eisenberg, and J. Strayer, (1987). *Empathy and its Development*. New York: Cambridge University Press.

Hoffman, W. L., and Prior, M. R. (1982). Neuropsychological dimensions of autism in children: a test of the hemispheric dysfunction hypothesis. *Journal of Clinical Neurology*, *4,* 27–41.

Hogrefe, G., Wimmer, H., and Perner, J. (1986). Ignorance versus false belief: a developmental lag in attribution of epistemic states. *Child Development, 57,* 567–82.

Holland, D., and Quinn, N. (eds.), (1987). *Cultural Models in Language and Thought.* Cambridge: Cambridge University Press.

Holmes, H. A., Roldan, C., and Miller, S. A. (1994). *A cross-task comparison of false belief understanding in a Head Start population.* Unpublished manuscript, University of Florida.

Hood, L., and Bloom, L. (1979). What, when and how about why: a longitudinal study of early expressions of causality. *Monographs of the Society for Research in Child Development*, *44*, Serial no 181.

Howes, C., and Matheson, C. C. (1992). Sequences in the development of competent play with peers. social and pretend play. *Developmental Psychology*, *28*, 961–74.

Hresko, W. P., Reid, D. K., and Hammill, D. D. (1981). *The Test of Early Language Development (TELD)*. Austin, TX: Pro-Ed.

Hudson, J. A. (1990). The emergence of autobiographical memory in mother-child conversation. In R. Fivush and J. A. Hudson (eds.), *Knowing and Remembering in Young Children.* Cambridge: Cambridge University Press.

Hume, D. (1739/1978). *A Treatise of Human Nature*, 2nd edn., L.A. Selby-Bigge (ed.), with text rev. and variant readings by P. H. Nidditch, Oxford: Oxford University Press.

Hummer, P., Wimmer, H., and Antes, G. (1993). On the origins of denial negation. *Journal of Child Language, 20*, 607–18.

Hurlburt, R., Happé, F., and Frith, U. (1994). Sampling the form of inner experience of three adults with Asperger syndrome. *Psychological Medicine, 24*.

Jarrold, C., Boucher, J., and Smith, P. K. (in preparation). Generativity deficits in pretend play in autism.

(1994). Executive function deficits and the pretend play of children with autism. A research note, *Journal of Child Psychology and Psychiatry*, 1473–82.

Jarrold, C., Carruthers, P., Smith, P., and Boucher, J. (1994). Pretend play: is it metarepresentational? *Mind and Language, 9*, 445–68.

Jarrold, C., Smith, P. K., Boucher, J., and Harris, P. (1994). Children with autism's comprehension of pretence, *Journal of Autism and Developmental Disorders*, *24*, No 4.

Jenkins, J. M., and Astington, J. W. (in press). Cognitive factors and family structure associated with theory of mind development in young children. *Development Psychology*.

Johnson, C. N. (1988). Theory of mind and the structure of conscious experience. In J. W. Astington, P. L. Harris, and D. R. Olson (eds.), *Developing Theories of Mind.* New York: Cambridge University Press.

(1991, April). From anticipation to reflection: biological, cognitive and social underpinnings of children's understanding of intentionality. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Seattle, WA.

Johnson, D. B. (1982). Altruistic behavior and the development of the self in infants. *Merrill-Palmer Quarterly*, *28*, 379–88.

Johnson, M. H., and Morton, J. (1991). *Biology and Cognitive Development: The Case of Face Recognition*. Cambridge, MA: Blackwell.

Johnson–Laird, P. (1983). *Mental Models: Towards a Cognitive Science of Language, Inference and Consciousness*. Cambridge, MA: Harvard University Press.

Kagan, J. (1981). *The Second Year: The Emergence of Self-Awareness*. Cambridge, MA: Harvard University Press.

Kahneman, D., and Tversky, A. (1982). The simulation heuristic. In D. Kahneman, P. Slovic, and A. Tversky (eds.), *Judgement Under Uncertainty*. Cambridge: Cambridge University Press.

Kanner, L. (1943). Autistic disturbances of affective contact. *Nervous Child, 2*, 217–50.

Karmiloff-Smith, A. (1988). The child is a theoretician, not an inductivist. *Mind and Language 3*, 183–95.

(1992). *Beyond Modularity*. Cambridge, MA: MIT Press.

Karmiloff-Smith, A., and Inhelder, B. (1974/5). If you want to get ahead, get a theory. *Cognition 3:3*, 195–212.

Keil, F. C. (1989). *Concepts, Kinds, and Cognitive Development.* Cambridge, MA Bradford Books: MIT Press.

Klin, A., and Volkmar, F. (1993). The development of individuals with autism: implications for the theory of mind hypothesis. In S. Baron-Cohen, H. Tager-Flusberg and D. Cohen (eds.), *Understanding Other Minds: Perspectives from Autism.* Oxford: Oxford University Press.

Köhler, W. (1927). *The mentality of apes*. N. York: Vintage. [Original: *Intelligenzprüfungen an Menschenaffen*. Berlín: Springer, 1921.]

Kosslyn, S. (1981). The medium and the message in mental imagery: A theory. *Psychological Review, 88*, 46–66.

(1983). *Ghosts in the Mind's Machine*. New York: Norton.

(1994). *Image and Brain*. Cambridge, MA: Bradford Books/MIT Press.

Krauss, R. M., and Glucksberg, S. (1969). The development of communication: competence as a function of age. *Child Development, 42*, 255–66.

Krebs, J. R., and Dawkins, R. (1984). Animal signals: mindreading and manipulation. In J. R. Krebs and N. B. Davies (eds.), *Behavioural Ecology: An Evolutionary Approach*. Oxford: Basil Blackwell.

La Fontaine, J. S. (1984). Person and individual: some anthropological reflections. In M. Carrithers, S. Collins, and S. Lukes (eds.), *The Category of the Person: Anthropology, Philosophy, History*, pp. 123–40, Cambridge: Cambridge University Press.

Lakatos, I. (1970). Falsification and the methodology of scientific research programmes. In I. Lakatos and A. Musgrave (eds.), *Criticism and the Growth of Knowledge*. Cambridge: Cambridge University Press.

(1978). *Philosophical Papers, volume 1. The Methodology of Scientific Research Programmes*. Edited by G. Currie and J. Worrall. Cambridge: Cambridge University Press.

Lamb, S. (1991). First moral sense: Aspects and contributors to a beginning morality in the second year of life. In W. Kurtines and J. Gewirtz (eds.), *Handbook of Moral Behavior and Development, 2: Research*. Hillsdale, NJ: Erlbaum.

Langer, E. (1975). The illusion of control. *Journal of Personality and Social Psychology 32*, 311–28.

Langer, S. K. (1942). *Philosophy in a New Key*. Cambridge, MA: Harvard University Press.

Leekam, S., Baron-Cohen, S., Brown, S., Perrett, D., and Milders, M., (1994). Eye-Direction Detection: a dissociation between geometric and joint-attention skills in autism. Unpublished ms, Institute of Social and Applied Psychology, University of Kent, Canterbury.

Lempers, J. D., Flavell, E. R., and Flavell, J. H. (1977). The development in very young children of tacit knowledge concerning visual perception. *Genetic Psychology Monographs, 95*, 3–53.

Leslie, A. M. (1987). Pretence and representation: the origins of 'theory of mind'. *Psychological Review*, *94*, 412–26.

(1988). Some implications of pretence for mechanisms underlying the child's theory of mind. In J. Astington, Harris, P. L., and Olsen, D. R. (eds.), *Developing Theories of Mind.* Cambridge: Cambridge University Press.

(1991) The theory of mind impairment in autism: evidence for a modular mechanism of development? In Whiten, A (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading*. Oxford: Basil Blackwell.

(1992). Autism and the 'theory of mind' module. *Current Directions in Psychological Science*, *1*, 18–21.

(1994a). Pretending and believing: issues in the theory of ToMM. *Cognition*, *50*, 211–38.

(1994b). ToMM, ToBy, and agency: core architecture and domain specificity. In L. Hirschfeld and S. Gelman (eds.), *Mapping the Mind: Domain Specificity in Cognition and Culture*, pp. 119–48. New York: Cambridge University Press.

Leslie, A. M., and Frith, U. (1988). Autistic children's understanding of seeing, knowing, and believing. *British Journal of Developmental Psychology, 6*, 315–24.

(1990). Prospects for a cognitive neuropsychology of autism. Hobson's choice, *Psychological Review*, *97*, 122–31.

Leslie, A. M., and German, T. P. (1995). Knowledge and ability in 'theory of mind': one-eyed overview of a debate. In T. Stone, and M. Davies (eds.), *Mental Simulation: Evaluations and applications*. Oxford: Blackwell.

Leslie, A. M., and Roth, D. (1993). What autism teaches us about metarepresentation. In S. Baron Cohen, H. Tager-Flusberg, and D. Cohen (eds.), *Understanding Other Minds: Perspectives from Autism*. Oxford: Oxford University Press.

Leslie, A., and Thaiss, L. (1992). Domain specificity in conceptual development. neuropsychological evidence from autism. *Cognition*, *43*, 225–51.

Lewis, D. (1966). An argument for the identity theory. *Journal of Philosophy*, *63*, 17–25.

(1972). Psychophysical and theoretical identifications. *Australasian Journal of Philosophy*, *50*, 249–58. Reprinted in N. Block (ed.), *Readings in Philosophy of Psychology, Volume 1*. London: Methuen, 1980.

(1973). *Counterfactuals*. Cambridge, MA: Harvard University Press.

Lewis, M. M. (1938). The beginning and early functions of questions in a child's speech. *British Journal of Educational Psychology, 8*, 150–71.

Lewis, M., and Brooks-Gunn, J. (1979). *Social Cognition and the Acquisition of the Self.* New York: Plenum Press.

Lewis, M., Sullivan, M. W., Stanger, C., and Weiss, M. (1989). Self-development and self-conscious emotions. *Child Development*, *60*, 146–56.

Lewis, V., and Boucher, J. (1988). Spontaneous, instructed, and elicited play in relatively able autistic children. *British Journal of Developmental Psychology*, *6*, 315–24.

Lillard, A. S. (1993). Pretend play skills and the child's theory of mind. *Child Development*, *64*, 348–71.

Lin, A. C., Bard, K. A., and Anderson, J. R. (1992). Development of self-recognition in chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology*, *106*, 120–7.

Lutz, C. (1985). Ethnopsychology compared to what? Explaining behavior and consciousness among the Ifaluk. In G. M. White and J. Kirkpatrick (eds.), *Person, Self, and Experience*. pp 35–59. Berkeley: University of California Press.

(1987). Goals, events, and understanding in Ifaluk emotion theory. In D. Holland and N. Quinn (eds.), *Cultural Models in Language and Thought*. Cambridge: Cambridge University Press.

Malcolm, N. (1958). Knowledge of other minds. *Journal of Philosophy*, 55.

Markman, K., Gavanski, I., Sherman, S., and McMullen, M. (1993). The mental simulation of better and worse possible worlds. *Journal of Experimental Social Psychology 29*, 87–109.

Marks, J. (1994). Blood will tell (won't it?): a century of molecular discourse on anthropological systematics. *American Journal of Physical Anthropology*, *94*: 59–79.

Marr, D. C. (1977). Artificial Intelligence: A personal view. *Artificial Intelligence*, *9*, 37–48. Reprinted in Boden (1990).

(1982). *Vision*, New York: W. H. Freeman.

Mathieu, M., and Bergeron, G. (1981). Piagetian assessment on cognitive development in chimpanzees (*Pan troglodytes*). In A. B. Chiarelli and R. S. Corruccini (eds.), *Primate Behavior and Sociobiology*, pp. 142–7. New York, Springer-Verlag.

Mauss, M. (1984). A category of the human mind: the notion of person; the notion of self. In M. Carrithers, S. Collins, and S. Lukes (eds.), *The Category of the Person: Anthropology, Philosophy, History*. pp 1–25. Cambridge, Cambridge University Press.

Mayr, E. (1957). Difficulties and importance of the biological species concept. In E. Mayr, (ed.), *The Species Problem*, pp 371–88. Washington DC: American Association for the Advancement of Science.

McCormick, P. (1994). Children's understanding of mind: a case for cultural diversity. Unpublished doctoral dissertation, University of Toronto (OISE), Toronto, Ont.

McDowell, J. (1985). Functionalism and anomalous monism. In E. LePore and B. P. McLaughlin (eds.), *Actions and Events: Perspectives on the Philosophy of Donald Davidson*. Oxford: Basil Blackwell, 387–98.

Meltzoff, A. (1993). Molyneux's babies: Cross–modal perception, imitation and the mind of the preverbal infant. In N. Eilan, R. McCarthy, and B. Brewer (eds.), *Spatial Representation*. Cambridge, MA: Blackwell.

Meltzoff, A., and Gopnik, A. (1993). The role of imitation in understanding persons and developing a theory of mind. In S. Baron-Cohen, H. Tager-Flusberg and D. J. Cohen (eds.), *Understanding Other Minds: Perspectives from Autism*. Oxford: Oxford University Press.

Meltzoff, A., and Moore, M. (1983). Newborn infants imitate adult facial gestures, *Child Development 54*, 702–9.

Menzel, E. W. (1988). A group of young chimpanzees in a one-acre field: leadership and communication. In R. W. Byrne and A. Whiten (eds.), *Machiavellian Intelligence: Social Expertise and the Evolution of Intellect*. pp. 155–9. Oxford: Clarendon Press.

Menzel, E. W., Jr and Johnson, M. K. (1976). Communication and cognitive organization in humans and other animals. *Annals New York Academy of Sciences*, *280*, 131–46.

Menzel, E. W., Savage-Rumbaugh, E. S., and Lawson, J. (1985). Chimpanzee (*Pan troglodytes*) spatial problem solving with the use of mirrors and televised equivalents of mirrors. *Journal of Comparative Psychology*, *99*, 211–17.

Mignault, C. (1985). Transition between sensorimotor and symbolic activities in nursery-reared chimpanzees (*Pan troglodytes*). *Journal of Human Evolution*, *14*, 747–58.

Miller, N. E. (1959). Liberalization of basic S-R concepts. In S. Koch (ed.), *Psychology: A Study of a Science*. New York: McGraw Hill.

Miller, P. H. (1993). *Theories of Developmental Psychology* (3rd edition). New York: Freeman.

Millikan, R. G. (1993). The myth of the essential indexical. In her *White Queen Psychology and other Essays for Alice*. Cambridge, Mass.: MIT Press.

Minshew, N. (1992). Neurological localisation in autism. In E. Schopler and G. Mesibov (eds.), *High-Functioning Individuals with Autism*. New York: Plenum Press.

Mitchell, P., and Lacohée, H. (1991). Children's early understanding of false belief. *Cognition, 39,* 107–27.

Mitchell, R. W. (1986). A framework for discussing deception. In R. W. Mitchell and N. S. Thompson (eds.), *Deception: Perspectives on Human and Non-Human Deceit*. pp.3–40. Albany, N.Y.: SUNY Press.

(1993). Mental models of mirror-self-recognition: two theories. *New Ideas in Psychology*, *11*, 295–325.

Mitchell, R. W., Parker, S. T., and Boccia, M. L. (1994). Mirror self-recognition and mental state attribution. *American Psychologist*, *49*, 761–2.

Moore, C., Furrow, D., Chiasson, L., and Patriquin, M. (1994). Developmental relationships between production and comprehension of mental terms. *First Language, 14,* 1–17.

Moore, C., Pure, K., and Furrow, D. (1990). Children's understanding of the modal expressions of speaker certainty and uncertainty and its relation to the development of a representational theory of mind. *Child Development, 61,* 722–30.

Morton, A. (1991). The inevitability of folk psychology. In R. J. Bogdan (ed.), *Mind and Common Sense*. Cambridge: Cambridge University Press.

Morton, J. (1989). The origins of autism. *New Scientist*, *1694*, 44–7.

Mundy, P., Sigman, M., Ungerer, J. A., and Sherman, T. (1986). Defining the social deficits in autism: the contribution of non-verbal communication measures. *Journal of Child Psychology and Psychiatry*, *27*, 657–69.

Nagell, K., Olguin, R. S., and Tomasello, M. (1993). Processes of social learning in the tool use of chimpanzees (*Pan troglodytes*) and human children (*Homo sapiens*). *Journal of Comparative Psychology*, *107*, 174–86.

Naito, M., Komatsu, S., and Fuke, T. (1995). Normal and autistic children's understanding of their own and others' false belief: a study from Japan. *British Journal of Developmental Psychology 13*.

Nisbett, R., and Ross, L. (1980). *Human Inference: Strategies and Shortcomings of Social Judgement.* Englewood Cliffs, NJ: Prentice-Hall.
O'Keefe, J., and Nadel, L. (1978). *The Hippocampus as a Cognitive Map.* Oxford: Clarendon Press.
O'Neill, D. K. (1993). *The ability of 2-year-olds to make informative requests.* Unpublished doctoral dissertation, Stanford University.
O'Neill, D. K., and Gopnik, A. (1991). Young children's ability to identify the sources of their beliefs. *Developmental Psychology*, *27*, 390–7.
Olson, D. R. (1988). On the origins of belief and other internal states in children. In J. W. Astington, P. L. Harris and D. R. Olson (eds.), *Developing Theories of Mind*, pp. 414–26. New York: Cambridge.
(1993). The development of representations: The origins of mental life. *Canadian Psychology, 34,* 1–14.
(1994). *The World on Paper*. Cambridge: Cambridge University Press.
Ornitz, E. M., and Ritvo, E. R. (1968). Perceptual inconstancy in early infantile autism. *Archives of General Psychiatry*, *18*, 76–98.
Oswald, D. P., and Ollendick, T. (1989). Role taking and social competence in autism and mental retardation. *Journal of Autism and Developmental Disorders*, *19*, 119–28.
Ozonoff, S., Pennington, B., and Rogers, S. (1990). Are there specific emotion perception deficits in young autistic children? *Journal of Child Psychology and Psychiatry*, *31*, 343–61.
(1991a). Executive function deficits in high-functioning autistic children. Relationship to theory of mind. *Journal of Child Psychology and Psychiatry*, *32*, 1081–1106.
(1991b). Asperger's Syndrome. Evidence for an empirical distinction from high functioning autism. *Journal of Child Psychology and Psychiatry*, *23*, 704–7.
Paley, V. G. (1984). *Boys and Girls: Superheroes in the Doll Corner*. Chicago, IL: Chicago University Press.
Parker, S. T., and Gibson, K. R. (1977). Object manipulation, tool use and sensorimotor intelligence as feeding adaptations in cebus monkeys and great apes. *Journal of Human Evolution*, *6*, 623–41.
Parkin, L., and Perner, J. (1994). False directions in children's theory of mind: what it means to understand belief as representation. *Cognition, 46*.
Pea, R. (1982). Origins of verbal logic: spontaneous denials by two- and three-year-olds. *Journal of Child Language, 9,* 597–626.
Peacocke, C. (1983). *Sense and Content*. Oxford: Oxford University Press.
(1986). *Thoughts.* Oxford: Basil Blackwell.
(1991). *A Study of Concepts.* Cambridge, MA: MIT Press.
Peacocke, P. (1994). Introduction: The issues and their further development. In C. Peacocke (ed.), *Objectivity, Simulation and the Unity of Consciousness. Proceedings of the British Academy*, *83*, xi–xxvi.
Perner, J. (1991a). *Understanding the representational mind.* Cambridge, MA: Bradford books: MIT Press.
(1991b). Letter of 24 September 1991 to Martin Davies with comments on papers by Goldman, Gordon, and Stich and Nichols for the Special Issue on Simulation in *Mind and Language*.
(1993). The theory of mind deficit in autism: rethinking the metarepresentation

theory. In S. Baron-Cohen, H. Tager-Flusberg, and D. J. Cohen (eds.), *Understanding Other Minds: Perspectives from Autism.* Oxford: Oxford University Press.
(1994). The necessity and impossibility of simulation. *Proceedings of the British Academy*, *83*, 129–44.
(submitted). The many faces of belief: reflections on Fodor's and the child's theory of mind. *Cognition.*
Perner, J., Baker, S., and Hutton, D. (1994). Prelief: the conceptual origins of belief and pretence. In C. Lewis and P. Mitchell (eds.), *Children's Early Understanding of Mind: Origins and Development.* Hove, UK. Erlbaum.
Perner, J., Frith, U., Leslie, A. M., and Leekam, S. R. (1989). Exploration of the autistic child's theory of mind: knowledge, belief and communication. *Child Development*, *60*, 689–700.
Perner, J., and Howes, D. (1992). 'He thinks he knows'; and more developmental evidence against the simulation (role-taking) theory. *Mind and Language*, *7*, 72–86.
Perner, J., Leekam, S. R., and Wimmer, H. (1987). Three-year olds' difficulty with false belief: The case for a conceptual deficit. *British Journal of Developmental Psychology*, *5*, 125–37.
Perner, J., Ruffman, T., and Leekam, S. R. (1994). Theory of mind is contagious: you catch it from your sibs. *Child Development, 65*, 1228–38.
Peskin, J. (1993). *Pretence and deception: preschoolers' predictions of counterfactual actions.* Unpublished manuscript, University of Toronto.
Peterson, C. (1990). The who, when and where of early narratives. *Journal of Child Language, 17,* 433–55.
Pettit, P. (1986). Broad-minded explanation and psychology. In P. Pettit and J. McDowell (eds.), *Subject, Thought, and Context*. Oxford: Oxford University Press, 17–58.
Phillips, W. (1993). *Understanding intention and desire by children with autism.* Unpublished PhD thesis, Institute of Psychiatry, University of London.
Phillips, W., Baron-Cohen, S., and Rutter, M. (1994). To what extent can children with autism understand desire? Paper submitted for publication.
Piaget, J. (1936). *La Naissance de l'Intelligence Chez l'Enfant*. Neuchatel: Delachaux et Niestlé.
(1937). *La Construction du Réel Chez l'Enfant*. Neuchâtel: Delachaux et Niestlé.
Pillow, B. H. (1989). Early understanding of perception as a source of knowledge. *Journal of Experimental Child Psychology, 47,* 116–29.
Pinder, S. (1984). *Language Learnability and Language Development*, Cambridge, MA: Harvard University Press.
Pinker, S. (1994). *The Language Instinct*. Harmondsworth: Penguin.
Potì, P., and Spinozzi, G. (1994). Early sensorimotor development in chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology*, *108*, 93–103.
Povinelli, D. J. (1991). *Social intelligence in monkeys and apes.* Doctoral dissertation, Yale University, New Haven, Connecticut.
(1993). Reconstructing the evolution of mind. *American Psychologist, 48*, 493–509.
(1994a). Comparative studies of animal mental state attribution: a reply to Heyes. *Animal Behaviour, 48*, 239–41.

(1994b). How to create self-recognizing gorillas (but don't try it on macaques). In S. Parker, R. Mitchell, and M. Boccia (eds.), *Self-Awareness in Animals and Humans*, pp 291–4. Cambridge: Cambridge University Press.

Povinelli, D.J., and deBlois, S. (1992a). Young children's (*Homo sapiens*) understanding of knowledge formation in themselves and others. *Journal of Comparative Psychology*, *106*, 228–38.

(1992b). On (not) attributing mental states to monkeys: first, know thyself. *Behavioral and Brain Sciences*, *15*, 164–6.

Povinelli, D. J., and Eddy, T. J. (1994). The eyes as a window: what young chimpanzees see on the other side. *Cahiers de Psychologie Cognitive/Current Psychology of Cognition*, *13*, 695–705.

(In press a). Chimpanzees: Joint visual attention. *Psychological Science*.

(In press b). What young chimpanzees know about seeing. *Monographs of the Society for Research in Child Development*.

Povinelli, D. J., and Godfrey, L. R. (1993). The chimpanzee's mind: How noble in reason? How absent of ethics? In M. Nitecki and D. Nitecki (eds.), *Evolutionary Ethics*. pp 277–324. Albany, SUNY Press.

Povinelli, D. J., Nelson, K. E., and Boysen, S. T. (1990). Inferences about guessing and knowing by chimpanzees (Pan troglodytes). *Journal of Comparative Psychology*, *104*, 203–10.

(1992). Comprehension of role reversal in chimpanzees: evidence of empathy? *Animal Behaviour*, *43*, 633–40.

Povinelli, D. J., Parks, K. A., and Novak, M. A. (1991). Do rhesus monkeys (Macaca mulatta) attribute knowledge and ignorance to others? *Journal of Comparative Psychology*, *105*, 318–25.

(1992). Role reversal by rhesus monkeys, but no evidence of empathy. *Animal Behaviour*, *43*, 269–81.

Povinelli, D. J., Rulf, A. B., and Bierschwale, D. T. (1994). Absence of knowledge attribution and self-recognition in young chimpanzees (Pan troglodytes). *Journal of Comparative Psychology*, *108*, 74–80.

Povinelli, D. J., Rulf, A. R., Landau, K. R., and Bierschwale, D. T. (1993). Self-recognition in chimpanzees (*Pan troglodytes*): distribution, ontogeny, and patterns of emergence. *Journal of Comparative Psychology*, *107*, 347–72.

Pratt, C., and Bryant, P. E. (1990). Young children understand that looking leads to knowing (so long as they are looking into a single barrel). *Child Development*, *61*, 973–82.

Premack, D. (1984). Pedagogy and aesthetics as sources of culture. In M. S. Gazzaniga (ed.), *Handbook of Cognitive Neuroscience*. pp.15–35. New York, Plenum Press.

(1988). 'Does the chimpanzee have a theory of mind?' revisited. In R.W. Byrne and A. Whiten (eds.), *Machiavellian Intelligence: Social Expertise and the Evolution of Intellect*, pp.160–79. Oxford: Oxford University Press.

Premack, D., and Dasser, V. (1991). Perceptual origins and conceptual evidence for theory of mind in apes and children. In A. Whiten (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading*, pp. 253–66. Oxford: Basil Blackwell.

Premack, D., and Premack, A. J. (1983). *The Mind of an Ape*. N. York: Norton.

Premack, D., and Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *The Behavioral and Brain Sciences*, *1*, 515–26.

Preston, B. (1993). Behaviorism and mentalism: is there a third alternative? *Synthese*, *79*.

Prior, M. R., Dahlstrom, B., and Squires, T. (1990). Autistic children's knowledge of thinking and feeling states in other people. *Journal of Child Psychology and Psychiatry*, *31*, 587–601.

Przetacznik-Gierowska, M., and Likeza, M. (1990). Cognitive and interpersonal functions of children's questions. In G. Conti-Ramsden and C. E. Snow (eds.), *Children's Language, vol 7*, pp. 69–101. Hillsdale, N.J.: Erlbaum.

Pylyshyn, Z. (1973). What the mind's eye tells the mind's brain: a critique of mental imagery. *Psychological Bulletin*, *80*, 1–24.

(1978). When is attribution of beliefs justified? *Behavioural and Brain Sciences*, *1*, 592–3.

(1980). Computation and cognition: issues in the foundations of cognitive science. *Behavioral and Brain Sciences 3*, 111–32.

(1981). The imagery debate: Analog media versus tacit knowledge. In N. Block (ed.), *Imagery*. Cambridge, MA: MIT Press.

Raver, C. C., and Leadbeater, B. J. (1993). The problem of the other in research on theory of mind and social development. *Human Development*, *36*, 350–62.

Reddy, V. (1991). Playing with others' expectations: teasing and mucking about in the first year. In Whiten, A. (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading*. Oxford: Basil Blackwell.

Reed, T., and Peterson, C. (1990). A comparative study of autistic subjects' performance at two levels of visual and cognitive perspective taking. *Journal of Autism and Developmental Disorders*, *20*, 555–68.

Ricks, D., and Wing, L. (1976). Language, communication and the use of symbols. In L.Wing (ed.), *Early Childhood Autism: Clinical, Educational and Social Aspects* (2nd edn). New York: Pergamon Press.

Rimland, B. (1971). The differentiation of childhood psychosis. *Journal of Autism and Childhood Schizophrenia*, *1*, 161–74.

Robinson, W. P. (1986). Children's understanding of the distinction between messages and meanings: Emergence and implications. In M. Richards and P. Light (eds.), *Children of Social Worlds*. Cambridge, England: Polity Press.

Roese, N., and Olson, J. (1993). The structure of counterfactual thought, *Personality and Social Psychology Bulletin*, *19*, 312–19.

Rogers, S. J., and Pennington, B. F. (1991). A theoretical approach to the deficits in infantile autism. *Development and Psychopathology*, *3*, 137–62.

Rogoff, B., Chavajay, P., and Matusov, E. (1993). Questioning assumptions about culture and individuals. *Behavioral and Brain Sciences*, *16*, 533–4.

Rollin, B. E. (1989). *The Unheeded Cry: Animal Consciousness, Animal Pain and Science*. Oxford: Oxford University Press.

Roth, D., and Leslie, A. M. (1991). The recognition of attitude conveyed by utterance: a study of preschool and autistic children. *British Journal of Developmental Psychology*, 9, 315–30.

Ruffman, T. K. (1994). Do children understand the mind by means of simulation or a theory?: Evidence from their understanding of inference. Unpublished manuscript, Laboratory of Experimental Psychology, University of Sussex.

Ruffman, T. K., and Olson, D. R. (1989). Children's ascriptions of knowledge to others. *Developmental Psychology*, *25*, 601–6.

Rumsey, J. M. (1985). Conceptual problem solving in highly verbal, nonretarded men. *Journal of Autism and Developmental Disorders*, *15*, 23–6.
Rumsey, J. M., and Hamburger, S. D. (1988). Neurological findings in high-functioning men with infantile autism, residual state. *Journal of Clinical and Experimental Neuropsychology*, *10*, 201–21.
Russell, J., Mauthner, N., Sharpe S., and Tidswell, T. (1991). The 'Windows Task' as a measure of strategic deception in preschoolers and autistic subjects. *British Journal of Developmental Psychology*, *9*, 331–50.
Rutter, M. (1968). Concepts of autism: a review of research. *Journal of Child Psychology and Psychiatry* , *9*, 1–25.
(1978). Diagnosis and definition. In M. Rutter and E. Schopler (eds.), *Autism: a Reappraisal of Concepts and Treatment.* New York: Plenum Press.
Samet, J. (1993). Autism and theory of mind: Some philosophical perspectives. In S. Baron-Cohen, H. Tager-Flusberg, and D. Cohen (eds.), *Understanding Other Minds: Perspectives from Autism*. Oxford: Oxford University Press.
Savage-Rumbaugh, E. S. (1986). *Ape Language: From Conditioned Response to Symbol*. New York: Columbia University Press.
Savage-Rumbaugh, E. S., Murphy, J., Sevcik, R. A., Brakke, K., Williams, S. L., and Rumbaugh, D. M. (1993). Language comprehension in ape and child. *Monographs of the Society for Research in Child Development, 58,* Serial No. 233.
Savic, S. (1975). Aspects of adult-child communication: the problem of question acquisition. *Journal of Child Language, 2,* 25–260.
Scaife, M., and Bruner, J. (1975). The capacity for joint visual attention in the infant. *Nature*, *253*, 265–6.
Schaffer, R. H. (1984). *The Child's Entry into a Social World* (Trad. cast.: *Interacción y Socialización*. Madrid: Visor, 1989, Trans.). London: Academic Press.
Scheiffelin, B. B., and Ochs, E. (1986). *Language Socialization Across Cultures*. Cambridge: Cambridge University Press.
Schiffer, S. (1981). Truth and the theory of content. In H. Parret and J. Bouverese (eds.), *Meaning and Understanding*. Berlin: Walter de Gruyter.
Scott, F., Baron-Cohen, S., and Leslie, A. M. (1994). Can pigs fly? A study of counterfactual reasoning in normal, autistic and Down's syndrome children. Manuscript.
Seyfarth, R. M., and Cheney, D. (1992). Meaning and mind in monkeys. *Scientific American*, *267* (Dec), 78–84.
Shah, A. (1988). Visuo-spatial islets of abilities and intellectual functioning in autism. Ph.D. Dissertation, University of London.
Shatz, M., and O'Reilly, A. W. (1990). Conversational or communicative skill? A reassessment of two-year-olds' behaviour in miscommunication episodes. *Journal of Child Language*, *17*, 131–46.
Shatz, M., Wellman, H. M., and Silber, S. (1983). The acquisition of mental terms: A systematic investigation of the first reference to mental state. *Cognition, 14,* 301–21.
Sigman, M., Ungerer, J. M., Mundy, P., and Sherman, T. (1986). Social interactions of autistic, mentally retarded, and normal children and their caregivers. *Journal of Child Psychology and Psychiatry*, *27*, 647–56.
(1987). Cognition in autistic children. In D. Cohen, A. Donnellan, and R. Paul (eds.), *Handbook of Autism and Atypical Developmental Disorders.* Silver Springs, MD: V.H. Winston.

Silverman, P. S. (1986). Can a pigtail macaque learn to manipulate a thief? In R. W. Mitchell and N. S. Thompson (eds.), *Deception: Perspectives on Human and Nonhuman Deceit*. pp.151–67. Cambridge: Cambridge University Press.
Simner, M. (1971). Newborn's response to the cry of another infant, *Developmental Psychology 5*, 136–50.
Slaughter V. (1994). Conceptual coherence in the child's theory of mind, University of California at Berkeley doctoral dissertation.
Smith, P. K. (1982). Does play matter? Functional and evolutionary aspects of animal and human play. *Behavioural and Brain Sciences*, 5, 139–84.
Sodian, B., and Wimmer, H. (1987). Children's understanding of inference as a source of knowledge. *Child Development, 58*, 424–33.
Sodian, B., and Frith, U. (1992). Deception and sabotage in autistic, retarded and normal children. *Journal of Child Psychology and Pychiatry*, *33*, 591–605.
Spelke, E., Breinlinger K., Macomber J., and Jacobson, K. (1992). Origins of knowledge, *Psychological Review*, *4*.
Spinozzi, G. (1993). Development of spontaneous classificatory behavior in chimpanzees (*Pan troglodytes*). *Journal of Comparative Psychology*, *107*, 193–200.
Spitz, R. A. (1965). *The First Year of Life*. New York, International Universities Press.
Spitz, R. A., and Wolf, K. M. (1946). The smiling response: a contribution to the ongenesis of social relationships. *Genetic Psychology Monographs*, *34*, 57–125.
Stalnaker, R. (1968). A theory of conditionals. In N. Rescher, *Studies of Logical Theory*. Oxford: Blackwell.
Steel, J. G., Gorman, R., and Flexman, J. E. (1984). Neuropsychiatric testing in an autistic idiot-savant. Evidence for nonverbal abstract capacity. *Journal of the American Academy of Child Psychiatry*, *23*, 704–7.
Stich, S. P. (1978). Beliefs and subdoxastic states. *Philosophy of Science, 45*, 499–518.
(1981). Dennett on intentional systems. *Philosophical Topics*, *12*, Number 1; reprinted as J. I. Biro and R. W. Shahan (eds.), *Mind, Brain, and Function: Essays in the Philosophy of Mind*, Brighton: Harvester Press, 1982, 39–62.
(1983). *From Folk-Psychology to Cognitive Science.* Cambridge, MA: MIT Press.
Stich, S. P., and Nichols, S. (1992). Folk psychology: simulation or tacit theory? *Mind and Language*, *7*, 35–71.
(1995). Second thoughts on simulation. In T. Stone and M. Davies, (eds.), *Mental Simulation: Evaluations and applications*. Oxford: Basil Blackwell.
Stone, T., and Davies, M. (eds.), (1995). *Mental Simulation: Evaluations and Applications*. Oxford: Basil Blackwell.
Stotland, E. (1969). Exploratory investigations of empathy. In L. Berkowitz (ed.), *Advances in Experimental Social Psychology, 4*. New York: Academic Press.
Sullivan, K., and Winner, E. (1993). Three-year-olds' understanding of mental states: The influence of trickery. *Journal of Experimental Child Psychology, 56,* 135–48.
Swartz, K. B., and Evans, S. (1991). Not all chimpanzees show self-recognition. *Primates*, *32*, 483–96.
Tager-Flusberg, H. (1992). Autistic children's talk about psychological states:

deficits in the early acquisition of a theory of mind. *Child Development, 63,* 161–72.
(1993). What language reveals about the understanding of minds in children with autism. In Baron-Cohen S., Tager-Flusberg H., and Cohen D. J. (eds.), *Understanding Other Minds: Perspectives from Autism.* Oxford: Oxford University Press.
(1995, March), Language and the acquisition of a theory of mind: evidence from autism and Williams syndrome. Paper presented at the Biennial Meeting of the Society for Research in Child Development, Indianapolis, IN.
(1994). Social-cognitive abilities in Williams syndrome. Paper presented at the Conference of the Williams Syndrome Association, San Diego, CA, 27 July.
Tan, J., and Harris, P. L. (1991). Autistic children understand seeing and wanting. *Development and Psychopathology, 3,* 163–74.
Thompson, R. (1987). Empathy and emotional understanding: the early development of empathy. In N. Eisenberg and J. Strayer (eds.), *Empathy and its Development.* New York: Cambridge University Press.
Tomasello, M. (1988). The role of joint attentional processes in early language development. *Language Sciences, 10,* 69–88.
(In press). The power of culture: evidence from apes. *Human Development.*
Tomasello, M., and Call, J. (1994). Social cognition of monkeys and apes. *Yearbook of Physical Anthropology, 37,* in press.
Tomasello, M., Savage-Rumbaugh, S., and Kruger, A. C. (1993). Imitative learning of actions on objects by children, chimpanzees, and enculturated chimpanzees. *Child Development, 64,* 1688–705.
Tomasello, M., Kruger, A., and Ratner, H. H. (1993). Cultural learning. *Behavioral and Brain Sciences, 16,* 495–552.
Trevarthen, C. B. (1977). Descriptive analyses of infant communicative behaviour. In H. R. Schaffer (ed.), *Studies in Mother-Infant Interaction.* London: Academic Press.
(1993). Predispositions on cultural learning in young infants. *Behavioral and Brain Sciences, 16,* 534.
Tyack, D., and Ingram, D. (1977). Children's production and comprehension of questions. *Journal of Child Language, 4,* 211–24.
Vaidyanathan, R. (1991). Development of forms and functions of negation in the early stages of language acquisition: a study in Tamil. *Journal of Child Language, 18,* 51–66.
van Lawick-Goodall, J. (1968). The behaviour of free-living chimpanzees in the Gombe Stream reserve. *Animal Behaviour Monographs, 1,* 161–311.
Vauclair, J., and Bard, K. A. (1983). Development of manipulations with objects in ape and human infants. *Journal of Human Evolution, 12,* 631–45.
Vrba, E. (1989). Levels of selection and sorting with special reference to the species level. In R. Dawkins and M. Ridley (eds.), *Oxford Surveys in Evolutionary Biology.* New York: Oxford University Press.
Vygotsky, L. S. (1962). *Thought and Language.* Cambridge, MA: MIT Press.
(1967). Play and its role in the mental development of the child. *Soviet Psychology, 5,* 6–18. Reprinted in J. K. Gardner (ed.), *Readings in Developmental Psychology.* Boston, MA: Little, Brown, 1978.
(1978). *Mind in Society.* Cambridge, MA: Harvard University Press.

(1981). The genesis of higher mental functions. In J. V. Wertsch (ed.), *The Concept of Activity in Soviet Psychology,* pp.144–88. Armonk, NY: Sharpe.
Wellman, H. M. (1990) *The Child's Theory of Mind.* Cambridge MA: MIT Press.
(1991). From desires to beliefs: acquisition of a theory of mind. In A. Whiten. (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading.* Oxford: Basil Blackwell.
Wellman, H. M., and Estes, D, (1986). Early understanding of mental entities: a reexamination of childhood realism. *Child Development, 57,* 910–23.
Wertsch, J. V. (1985). *Vygotsky and the Social Formation of Mind.* Cambridge, MA: Harvard University Press.
Wertsch, J. V., and Tulviste, P. (1992). L. S. Vygotsky and contemporary developmental psychology. *Developmental Psychology, 28,* 548–57.
Whiten, A. (1993). Evolving theories of mind: the nature of non-verbal mentalism in other primates. In S. Baron-Cohen, H. Tager-Flusberg, and D. Cohen (eds.), *Understanding Other Minds: Perspectives from Austism,* pp.367–96. Oxford: Oxford University Press.
(1994). Grades of mindreading. In C. Lewis and P. Mitchell (eds.), *Children's Early Understanding of Mind: Origins and Development.* Hove UK: Erlbaum.
(in press). The evolution and development of emotional states, emotional expressions and emotion-reading in human and non-human primates. In B. Shore and C. Worthman (eds.), *Emotions: a Bio-Cultural Perspective.* Cambridge: Cambridge University Press.
(1991: ed.) *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading.* Oxford: Basil Blackwell.
Whiten, A., and Byrne, R. W. (1988). Tactical deception in primates. *Behavioral and Brain Sciences, 11,* 233–44.
(1991). The emergence of metarepresentation in human ontogeny and primate phylogeny. In A. Whiten (ed.), *Natural Theories of Mind: Evolution, Development and Simulation of Everyday Mindreading,* pp. 267–81. Oxford: Blackwell.
Widman, L., and Loparo, K. (1989). Artificial intelligence, simulation, and modeling: a critical survey. In L. Widman, K. Loparo, and N. Nielsen (eds.), *Artificial Intelligences, Simulation, and Modeling.* New York: John Wiley.
Wimmer, H., Hogrefe, G.-J., and Perner, J. (1988). Children's understanding of informational access as source of knowledge. *Child Development, 59,* 386–96.
Wimmer, H., Hogrefe, G.-J., and Sodian, B. (1988). A second stage in children's conception of mental life: understanding sources of information. In J. W. Astington, P. L. Harris, and D. R. Olson (eds.), *Developing Theories of Mind,* 173–92. New York: Cambridge University Press.
Wimmer, H. and Perner, J. (1983). Beliefs about beliefs: representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition, 13,* 103–28.
Wimmer, H., and Weichbold, V. (1994). Children's theory of mind: Fodor's heuristics examined. *Cognition, 53,* 45–57.
Wing, L. (1981). Asperger Syndrome: a clinical account. *Journal of Psychological Medicine, 11,* 115–29.
(1988). The continuum of autistic characteristics. In E. Schopler and G. Mesibov (eds.), *Diagnosis and Assessment in Autism.* New York: Plenum Press.

Wing, L., and Gould, J. (1979). Severe impairments of social interaction and associated abnormalities in children: epidemiology and classification. *Journal of Autism and Developmental Disorders*, *9*, 11–29.
Wittgenstein, L. (1953). *Philosophical Investigations*. Oxford: Basil Blackwell.
Wolpert, L. (1992). *The Unnatural Nature of Science*. London: Faber.
Wood, D. J., Bruner, J. S., and Ross, G. (1976). The role of tutoring in problem solving. *Journal of Child Psychology and Psychiatry, 17,* 89–100.
Woodfield, A. (1994, July). Which concepts of mind do pre-school children use? Paper presented at the conference on Theories of Theories of Mind, Sheffield University, England.
Woodruff, G., and Premack, D. (1979). Intentional communication in the chimpanzee: the development of deception. *Cognition*, *7*: 333–62.
World Health Organisation (1987). *International Classification of Diseases* (9th edition). Geneva.14
Yirmiya, N., Sigman, M., Kasari, C., and Mundy, P. (1992). Empathy and cognition in high-functioning children with autism. *Child Development, 63*, 150–60.
Zahn-Waxler, C., and Radke-Yarrow, M. (1982). The development of altruism: alternative research strategies. In N. Eisenberg (ed.), *The Development of Prosocial Behavior*. New York: Academic Press.
Zaitchik, D. (1990). When representations conflict with reality: The preschooler's problem with false beliefs and 'false' photographs. *Cognition*, *35*, 41–68.

Author index