

**Children's mental representation of referential relations:  
Representational partitioning and "theory of mind"**

**by**

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## **Abstract**

In six experiments I investigated children's handling of intensional contexts. The results were described in terms of a developmental extension of Fauconnier's mental spaces account of meaning representation. Implications for children's mentalistic development were explored.

In chapter 1 I considered the "referential opacity" raised by the representational nature of the mind. I interpreted the findings of Russell (1987) as evidence for a developmental dissociation between handling of intensional contexts - due to the partial nature of representations - and "intentional" referential problems - due to representations being outdated or hypothetical.

In experiments 1-3 I demonstrated this dissociation explicitly, and showed that it extended to non-linguistic intensional contexts. Experiments 4 & 5 showed correlations between children's handling of intensional contexts and linguistic ambiguity, which I explained by their common requirement that representational content be held as partial.

Experiment 6 showed that children's handling of intensional questions (and mentalistic explanations) improved after observing incorrect action on the basis of partial knowledge. This effect of supporting context was short-lived, suggesting that it supported on-line activity not question comprehension.

After earlier success with out-dated and hypothetical representations, children's handling of partial representations at 6-7 years explains their concurrent late success with intensional contexts and linguistic ambiguity, and constitutes a qualitative change in their representational abilities.

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# Contents

Abstract	2
<b>Chapter 1. Some problems with acquiring a folk psychology</b>	<b>7</b>
1. Introduction and overview	7
2. Consensus in theories of the mind?	7
3. Consequences of the representational view of the mind	11
3.1 What are “problems of reference”?	12
3.2 Multiple opacity in “John believes.....”?	16
3.3 Conclusions and questions	19
4. Issues in mentalistic development	20
4.1 Introduction	20
4.2 Referential opacity and pretence	21
4.3 Referential opacity and syntax	24
4.4 Referential opacity and false belief	25
4.5 A direct test of referential opacity?	29
4.6 Referential opacity and intensionality	30
4.7 How existing accounts might accommodate Russell’s data on intensional contexts	32
4.8 Conclusions	38
<b>Chapter 2. Experiments 1-3</b>	<b>39</b>
1. Experiment 1: A simplified version of Russell’s tasks	39
1.1 Introduction	39
1.2 Method	41
1.3 Results and Discussion	44
2. Experiment 2: “Does Heinz know...?” versus “Can we say....?”	49
2.1 Method	49
2.2 Results and Discussion	51
3. Experiment 3: Non-linguistic intensionality?	58
3.1 Introduction	58
3.2 Method	58
3.3 Results and Discussion	63
4. General summary and discussion	69
<b>Chapter 3. Representational partitioning in mentalistic development</b>	<b>73</b>
1. Introduction	73
2. Syntactic partitioning	75

3.	Semantic partitioning	78
3.1	Mental Spaces	80
3.2	Describing the results of Experiments 1-3	88
3.3	Explaining the results of Experiments 1-3	98
4.	Broader implications	105
<b>Chapter 4. Linguistic ambiguity and intensional contexts</b>		<b>109</b>
1.	Introduction	109
2.	Experiment 4: Children's handling of linguistic ambiguity and intensional contexts	115
2.1	Method	115
2.2	Results	117
3.	Experiment 5: Could children's error in intensional contexts be an egocentric or realist response?	120
3.1	Method	120
3.2	Results	123
3.3	Discussion of the evidence against egocentric explanations	127
4.	General discussion of Experiments 4 and 5: Ambiguity, intensionality and the meaning-message distinction	129
<b>Chapter 5: The development of children's handling of intensional contexts: Effects of supporting context</b>		<b>133</b>
1.	Introduction and overview	133
2.	Pre-test battery	135
2.1	Method	135
2.2	Results	136
3.	Studies of on-line effects of context	138
3.1	Method for Study 1	138
3.2	Method for Study 2	142
3.3	Results from Study 1	144
3.4	Results from Study 2	147
4.	Post-test battery	150
4.1	Method	150
4.2	Results	150
5.	General summary and discussion	153
<b>Summary and suggestions for future work</b>		<b>157</b>
1.	Summary	157
2.	Future work	162
	References	166

<b>Appendices</b>	<b>178</b>
1.1 Appendix 1	178
1.2 Appendix 2	179
1.3 Appendix 3	180
1.4 Appendix 4	182

# Chapter 1. Some problems with acquiring a folk psychology

## 1. Introduction and overview

The developmental origins of adult folk psychology have been the subject of intensive research in the last two decades. Central to this endeavour is the question of how and when children come to make adult use of mentalistic notions such as belief and desire in their understanding of human behaviour. Empirical studies have shown striking discontinuities in the development of this ability, centred principally around the age range of 3-4 years. Yet despite the weight of evidence there is little consensus in the literature about how these changes are best described, a problem that may be traced to related controversies in philosophical accounts of folk psychology and the mind. For this reason, I shall use these first few pages to try and establish enough of a common theoretical base to enable a critical exploration of the empirical findings.

I shall begin by suggesting that even quite divergent philosophical accounts agree that our folk psychology treats the mind as if it was a representational system. I will then explore some implications of this assumption for the kinds of problem that children must solve as they develop an adult folk psychology. Finally, these theoretical distinctions will provide some structure for a review of the relevant empirical evidence.

## 2. Consensus in theories of the mind?

Central to our folk psychology is the explanation of human action in terms of interacting attitudes to the world. Paradigmatically, people assume that we act on our desires according to our beliefs. To a first approximation, these attitudes are *about* things; we believe that so and so,

we desire such and such, and importantly, they are *about* things *being a particular way*. So not only can we have different attitudes to the same thing (you may hate tomatoes but I like them), but we may hold them in a different way (I think tomatoes are vegetables, but you think they are fruit). By treating agents as owners of these kinds of attitude we can explain and predict behaviour in a way that is independent of our own current world view.

Formal accounts distil these intuitions into the theory that attitudes are taken via representations, similar in important ways to pictures or sentences. This analogy is appealing since we can readily understand how a picture or sentence is *about* something (it is intentional) and how it captures the situation in *a particular way* which can be inaccurate, partial or even imaginary. Contemporary accounts generally mirror our way of talking about intentional mental states, describing them in a three part relation between an agent, a (propositional) attitude and a representational content in the form of a proposition.

As a straight-forward description of our folk psychological explanations of behaviour this appears uncontroversial<sup>1</sup> and it seems simple enough to ask how children acquire this way of understanding people. However, such a question also forces us to consider the mind that is doing the acquiring, and the nature of the relation between folk psychology and the mind itself is highly contentious. To provide some context for the discussion of developmental issues, I will describe briefly two extreme positions in this debate.

Fodor (e.g., 1975, 1987, 1990) takes the view that our every day folk psychological practice of propositional attitude attribution reflects quite literally the workings of the mind: “To believe that such and such is to have a mental symbol that means such and such tokened in your

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<sup>1</sup> Though I will later describe how even this view belies the difficulties that exist in representing all properties of propositional attitudes in predicate logic.



head in a certain way; it's to have such a token in your "belief box" as I sometimes say" (1987). This entails a very particular view of the mind as a symbol processing machine which operates on a quasi-linguistic machine code: The Language of Thought. Folk psychological notions such as belief and desire thus correspond to real features of our brain that govern equally real propositionally encoded content. Thus, when we say that Fodor believes the world is flat, we are describing a brain state in which Fodor represents symbols corresponding to "the world is flat" in the psychological mode "believes". The unusual logical properties of such natural language statements (more of which later) are explained by the corresponding sentence-like structure of the underlying mental reality.

Fodor's influential position will be discussed further in section 3, when I cover both his own and Alan Leslie's account of how mentalistic development proceeds in a system based upon a language of thought. But before I move on, I want to flag one consequence of this account which will be of relevance to my discussion of developmental theories. In describing attitudes Fodor uses a spatial metaphor, claiming for example that tokens of the language of thought get the causal properties of beliefs by being put "...in your 'belief box' ...". The nature of attitudes is defined by their functional role for the system which derives from their syntax (or metaphorically speaking, their "location"). Thus, although he holds that our folk psychology identifies something real in the mind, Fodor's characterisation of the attitudes themselves is pitched at a deeply counter-intuitive, sub-personal level. This doesn't seem to capture our folk notion of attitudes as essentially personal and something the agent herself takes *actively*. I do not say this as a direct criticism of Fodor's position so much as a forewarning of what is to come, for the difference between sub-personal and personal levels of explanation is a source of major confusion in the developmental literature.

In diametric opposition to Fodor's realism, Dennett (e.g., 1987) claims that it is wrong to think that our folk psychology says anything about the mind at all. Talk of beliefs, desires or mental content is just a theorist's fiction; an explanatory overlay which belies the real nature of the sub-symbolic, *non-representational* mind. According to Dennett, the very properties of "aboutness" or "intentionality" that we perceive as a defining characteristic of mental states are the result of nothing more than our adopting "an intentional stance" to explain behaviour. In his own words "*all there is to being a true believer is being a system whose behaviour is reliably predicted via the intentional strategy*" (1987, p.29, original italics). A proper description of the underlying processes would be made at a purely physical, non-representational level, couched in simple extensional terms<sup>2</sup>.

There are many possible objections to this move (see Lyons, 1995), but one paradoxical advantage is that the problem domain for acquisition is secure and distinct. Unlike Fodor, Dennett pulls the carpet from under our folk intuitions at the outset and once this is done our folk psychological framework is relatively secure. For whatever our scientific enquiries eventually reveal about the mind, they will not be discovering anything about beliefs, desires or representational content.

On this account it seems that mentalistic development would reduce to adopting a conventional, language based, explanatory stance. This appears an impoverished picture only until we consider Dennett's views about language in the brain. Ironically, this will also begin to drag us back towards intentional explanations of the mind; at any rate, the kind of mind assumed by our folk intuitions.

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<sup>2</sup> Dennett's radical approach to folk psychology (like Quine's; Quine, 1960) is largely motivated by a desire for a description of mental activity that only uses (extensional) predicate logic (see Lyons, 1995).

Whilst Fodor treats natural language merely as the product of an input / output device for the true mental medium (the language of thought), Dennett (e.g., 1991, 1995; see also Carruthers, 1996; Clark, 1997) affords it a central role in “reprogramming the brain” allowing organised high level thought (especially conscious thought). In doing so he appears to sneak at least some representation and intentionality in through the back door. Dennett might well reply that we have now shifted the level of explanation upwards, and this is only virtual intentionality installed on a fundamentally non-intentional mind. Nevertheless, this is possibly the higher level medium in which much of the work of acquiring a folk psychology is done and if this is conceded we almost appear to be back where we started. At base, the mind may be non-representational but there still seems to be a higher level intentional currency, which for Dennett is quite literally linguistic.

In sum, differing philosophical accounts of the mind inevitably affect investigations of mentalistic development. However, even between the divergent views of Fodor and Dennett, there is at least a consensus that our folk psychology describes the mind *as if* it was a representational, intentional system. My aim is to use this as a starting point for identifying some problems that children *must* come to handle as they develop an adult-like folk psychology.

### **3. Consequences of the representational view of the mind**

Treating the mind as a representational system seems to capture the partial detachment of the mental world from physical reality. Certainly, representations can be about reality, but they can also be about non-existent or spatio-temporally displaced states of affairs, giving us the freedom to imagine, predict and remember. This freedom also entails the possibility of accidental misrepresentation, and thus the capacity to be wrong. But even a true and accurate representation of reality is much less than an internal copy of the real situation since “.....all representation -

whether it is done by the mind, language, pictures, or anything else - is always under certain aspects and not others....” (Searle, 1983). At best, a representation only ever *partially* captures a situation, and thus can only be true as far as it goes. The focus of this section will be the ways in which these differences between the mental and physical worlds raise problems of reference when we want to think about (or otherwise represent) mental contents.

### 3.1 What are “problems of reference”?

I shall begin with a description in traditional, logical terms; partly because this is the background and dominant terminology of the philosophical and psychological literature, but primarily since the referential phenomena with which I will be concerned are only defined as “problems” because they violate the assumption of extensionality that is central the logical system.

According to Haack, (1978), “a context is extensional if co-referential expressions - singular terms with the same denotation, predicates with the same extension, or sentences with the same truth-value - are substitutable within it without changing the truth-value of the whole, ‘*salva veritate*’, ” (p.246). For example, given that “Jocasta” was the name of “Oedipus’ mother”, if

(1) “Oedipus was married to Jocasta”

is true, then

(2) “Oedipus was married to his mother”

must also be true. This apparently universal extensionality was formalised by Leibniz into the logical rule of “the substitutability of identicals”.

However, there are (now) familiar exceptions to this rule, where some, if not all, extensional substitutions do in fact alter the truth of a sentence. A standard rendition draws a contrast between sentences such as (1) and

(3) Oedipus believed he was married to Jocasta

Whereas sentence (1) remained true when “Jocasta” was substituted for the “identical” “his mother”, the same renders (3) false:

(4) Oedipus believed he was married to his mother\*<sup>3</sup>

since he did not know that Jocasta was his mother.

That the substitutability of identicals may be violated at all is problematic for a logical analysis, some of whose most basic groundings are in this principle (see e.g., Quine, 1953). Thus, there have been projects in the philosophy of language and logic to taxonomise and ultimately find some way of accommodating occurrences of non-substitutability.

In one influential attempt, Quine (1953) begins by identifying quotations as a source of referential problems, where “Failure of substitutivity reveals merely that the occurrence to be supplanted is not *purely referential*, that is, that the statement depends not only on the object but on the form of the name” (p.140, original italics). Thus, in the sentence, “Little John was called ‘Little John’ because he was big”, the first occurrence of the term *Little John* is freely substitutable with any other true description of the man (e.g., John) because this occurrence is “purely referential”, whereas substitution in the second case results in the false sentence “Little John was called ‘John’ because he was big”. Quine suggests that “The principle of substitutivity should not be extended to contexts in which the name to be supplanted occurs without referring simply to the object”. He calls these occurrences “referentially opaque”, because unlike normal

“referentially transparent” contexts, one cannot see through the referring expression to extensional reality.

Quine goes on to show that both the contents of propositional attitude reports (such as (3) above), and modal contexts of necessity and possibility share the same referential properties and thus are referentially opaque. These contexts are assimilated into the logical scheme by treating their problematic contents as quotations governed by the mental and modal predicates, e.g., Jane believes that “x”. “That-” clauses act as a “syntactic barrier” after which the content of the quotation is “...dissociated grammatically and semantically from the outlying text.” (Quine, 1995, p.95). In this way, Quine claims, “Quotation has made propositional attitudes [and modal contexts] safe for extensional logic...”(ibid.).

As we shall see, Quine’s views have influenced theories of mentalistic development, first of all with his terminology, and secondly with his proposed solution to the referential problems involved in handling propositional attitudes. However, the psychological literature frequently ignores two important complications to the picture so far described.

Quine is only too well aware that in normal usage, the content of clauses under verbs of propositional attitude do not always fail tests of extensionality and so are in fact referentially transparent. That is to say, there is a normal usage of verbs such as “believes” in which the content is ascribed according to the speaker’s (and listener’s) knowledge of reality, with no regard for what the subject (the “believer”) actually knows. Consider the sentence “Oedipus believes the Queen of Thebes is a spy”. According to the opaque (*de dicto*) reading assumed above, this means that Oedipus actually believes the proposition “the Queen of Thebes is a spy”: Substitution of the co-referential “his mother” for “Queen of Thebes” would fundamentally alter

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<sup>3</sup> “\*” denotes a false sentence.

the meaning of the proposition and thus the sentence. In this case, Quine's strategy is appropriate: The proposition is isolated from its normal referential and semantic relations by the quotation marks which render it "out of court" for extensional assumptions.

However, there is also a *de re* reading of the same sentence which means something like, "Oedipus believes that woman is a spy". Here, the above substitution does not change the meaning of the sentence since the term "Queen of Thebes" is now being used purely to secure reference for the communicators. This is a problem for Quine's analysis because the information needed to disambiguate the *de re* and *de dicto* readings is frequently pragmatic, so from a decontextualised sentence there is no systematic way of telling when it is appropriate to isolate the object of the attitude in quotation marks. His solution, as for related problems with modal contexts, is to "... omit propositional attitudes *de re* from our overall scientific language couched in the extensional grammar of predicate logic ..." (Quine, 1995, pp.97-99). While this may be an acceptable policy in his project of grounding scientific explanation in logic (and is consistent with his dismissive views about mental states), it effectively cuts off the possibility of describing real referential language in first order predicate logic. In chapter 3 I will mention some logical schemes that attempt to overcome these difficulties, but for now, it is sufficient to note that Quine's system does not accommodate the full range of referential phenomena found in mentalistic natural language.

The second important point is that propositional attitude reports are not unique in creating contexts that fail tests of extensionality. Besides the modal contexts already mentioned, evocation of different times, places, and hypothetical states of affairs also produces referential problems similar to those described above (Carnap, 1947; Dowty, Wall & Peters, 1981; Fauconnier, 1983; see Perner, 1991). Yet whilst this diversity has occasionally been noted (e.g., Perner, 1991) it is

largely ignored in the literature on mentalistic development with the result that “referential opacity” is usually taken to refer exclusively to mentalistic phenomena. Furthermore, this grouping of mentalistic referential problems under a single term has encouraged the view that they are all of a kind. In the next sub-section I shall argue that this is not a valid assumption.

### **3.2 Multiple opacity in “John believes.....”?**

There are in fact a number of reasons why a propositional attitude report of the form “John believes that *p*” might fail tests of extensionality, and each can be related to the view that the mind is a representational system. Importantly, these may not pose equivalent problems for the child. Consider

(5) John believes that the prime minister is John Major.

It is extensionally true (at the time of writing) that the prime minister is Tony Blair, yet substitution yields the false sentence

(6) John believes that Tony Blair is John Major.\*

To judge sentence 6 false we assume that John is not confused about the identity of the two men, but rather represents an old state of affairs in an out of date belief. Since his belief projects back in time it inherits the same referential problems as any description of the past. Consider

(7) Last year the prime minister was John Major

and

(8) Last year Tony Blair was John Major\*



As with sentence 6, sentence 8 is false because the clause “the prime minister was John Major” represents a past situation, and substitution of presently co-extensional terms is inappropriate<sup>4</sup>.

Besides the ability to represent different times, mental states can also be seen to represent hypothetical states of affairs. Consider a situation in which John goes on holiday prior to the general election, and at the time of leaving he has just read an opinion poll that places John Major in the lead. On May 2nd, after the election, it might be the case that

(9) John believes that the prime minister is John Major

which under substitution produces

(10) John believes that Tony Blair is John Major.\*

Sentences 9 and 10 are linguistically identical to 5 and 6, but the failure of substitutivity in 10 is not because John’s belief is out-dated but because an incorrect belief has been produced by his expectation.

Finally, the fact that representations can only ever partially capture their referents also raises referential problems. Consider

(11) John believes that the prime minister is Tony Blair.

Although it is extensionally true that the prime minister is the sometime resident of Chequers, we cannot infer from 11 that

(12) John believes that the sometime resident of Chequers is Tony Blair\*.<sup>5</sup>

Even on the assumption that both sentences are referring within “here-and-now reality” 11 fails to be extensional because the belief it reports is necessarily partial: “... its truth conditions depend

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<sup>4</sup> It is worth noting that this non-substitutivity is a pragmatic constraint in normal usage. We would probably accept “John believes that the resident of No.10 is John Major” and “Last year the resident of No.10 was John Major” as valid substitutions since the co-extensiveness of ‘prime minister’ and ‘resident of No.10’ doesn’t alter over time and we would probably credit John with the knowledge of their equivalence (though see my third example).

upon the features of the representation being represented and not on the things represented in the original representation [the belief itself]" (Searle, 1983, pp25-26). Of course on this treatment, the issue of which (if any) substitutions are possible depends entirely on the nature of the belief, and thus we are back to the controversy over theories of mental representation.

Consider for example, the common view that the content of a belief is best understood as an isolated linguaform proposition: In the case of 11, John believes (in a literal sense) "the prime minister is Tony Blair". If this proposition exhausts the content of John's belief then it is easy enough to understand how any co-extensional substitutions would result in a change of truth value. We would, as it were, be mis-quoting John's belief. However, I believe that this is unsatisfactory since even within opaque (*de dicto*) interpretations it seems that some substitutions are intuitively allowable. Although I claimed above that substitution of "sometime resident of Chequers" for "prime minister" in 11 was invalid, unless we know explicitly of John's ignorance 12\* is at best only possibly false. To illustrate, consider a less obscure co-extension of "prime minister": Surely we would not deny that we could say on the basis of 11 "John believes that the resident of No.10 is Tony Blair", unless we had a particularly dim view of John's general knowledge. Psychological (rather than logical) accounts of folk psychology should take account of such pragmatic issues, which is not to suggest that Quine's logical account is wrong, but once more to emphasise that it is too rigid for our purposes.

However, the main point of these examples remains unaltered. If John's belief is treated as a representation then it is only ever partial (no matter how fuzzy the boundaries appear to be) and thus raises problems of reference in a way that is theoretically distinct from the two foregoing examples about out of date and hypothetical beliefs.

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<sup>5</sup> As with the other examples, this assumes a *de dicto* reading of both sentences.

Having raised these theoretical distinctions I am concerned to establish a consistent terminology. This will be partly idiosyncratic since the systems in the literature tend to be shaped to the author's particular purpose, and I do not wish to inherit unnecessary or inappropriate entailments. Firstly, I shall refer to the complexities arising when reference is not restricted to a single domain as "referential problems" which entails no assumptions about issues of substitutivity etc. Contexts will be called "opaque" whenever co-extensional terms are not freely substitutable (e.g., *de dicto* readings of sentences 5,7 & 11). I shall retain the *de re / de dicto* terminology to refer to the possible transparent and opaque interpretations of sentences describing these contexts. Following Searle (1983), contexts will be called intensional-with-an-s (intensional) when the failure of substitutivity is due to the partial nature of the representational content (e.g., sentence 11, but not 5 or 7). I reserve this as a special case because it will be central to this thesis.

### **3.3 Conclusions and questions**

In sum, talk about mental states is beset with referential problems and ambiguities of interpretation that stem from our treatment of the mind as a representational system. Handling these problems requires the putative representational content to be partitioned and kept free from the normal assumptions of extensional reality: I described briefly Quine's use of quotation marks to this end. However, this analysis raises a number of important issues for development. There are at least two important aspects to handling these referential problems. Firstly, there are the problems of partitioning representational content from one's own knowledge which are formally similar, regardless of why the content differs from reality. This could be achieved by a variety of means (more of which later) and may or may not be a developmental challenge. In principle, this

is dissociable from understanding (in a loose sense) the various ways in which the problems could arise and the particular pragmatic constraints appropriate to each case. From the perspective developed above, there do not seem to be any *a priori* reasons for expecting a belief that refers across time to pose the same difficulties to a child as a belief that is importantly partial, yet (as we shall see) this is a common assumption in the literature. There is also the issue of how children come to understand the complex pragmatics surrounding *de re* and *de dicto* readings of propositional attitude reports. These ambiguities are a part of every day discourse and should not be excluded from our considerations *a la* Quine. Finally, the foregoing analysis frames the referential problems as problems with linguistic descriptions of mental states. Is this their sole status or do they, as Searle (1983) suggests, pervade any representations of representations and thus constitute a problem in more general cognition, as well as mentalistic language? With these distinctions in mind I will now review what the existing theories and findings tell us about children's handling of these mentalistic referential problems.

## **4. Issues in mentalistic development**

### **4.1 Introduction**

The aim of the rest of this chapter is to review the existing literature on children's handling of mentalistic referential problems. Besides adding empirical substance to the phenomena identified in the previous sections, I am concerned to chart the explanatory scope of the various accounts in anticipation of my own investigations. In the front of my mind is the contrast between the well known success of 4 year old children on certain mentalistic tasks (more of which below) and Russell's (1987) finding that children aged 5 and 6 years consistently mis-

handle intensional contexts. Thus, I will focus particularly on how accounts might explain dissociations between children's ability to handle different types of mentalistic referential problem.

#### **4.2 Referential opacity and pretence**

I shall begin with the author who has made the strongest claims about children's handling of mentalistic referential problems. Leslie (e.g., 1987, 1994) begins by identifying pretence at 18 months as children's earliest mentalistic activity and goes on to argue that its logical properties share a "deep isomorphism" with "referential opacity". To make sense of Leslie's claims it is necessary to appreciate his strongly Fodorian view of the mind as symbol processing machine operating on a language of thought. His argument contrasts the way such a system would represent normal experience with the problems posed by representing pretence. It can be summarised roughly as follows.

A normal visual experience, such as when a child sees a banana in a fruit bowl, results in the tokening of a mental sentence "there is a banana in the fruit bowl" in which each symbol e.g., "banana" has certain extensional semantic entailments such as "is a fruit", "is edible" etc. However, suppose she sees her mother pick up the banana, hold it to her ear and speak; then she should token the sentence "mummy pretends that the banana is a telephone" in which "banana" is entered into an novel identity relation with "telephone". The problem is that such sentences threaten to undermine the logical consistency of the whole representational system. As it stands, the extensionality of the system means that the child could now also think "there is a telephone in the fruit bowl" which is undesirable, and worse, there is a slippery slope from here to the symbols losing their meaning entirely. What is needed to avoid catastrophic confusion is a mechanism for

isolating the tokens of a pretend proposition from their usual semantic ties, so there is no chance of co-extensional terms being substituted in or out. Since for Leslie thought is deeply analogous to natural language, he adopts Quine's expedient of quotation marks for opaque contexts as a metaphor for the syntactic decoupling device that allows pretend relations to be computed safely<sup>6</sup>. Mother's pretence can thus be represented in extensional language of thought:

**MOTHER PRETENDS (of) the banana (that ) “it is a telephone”.**

Although Leslie's views have been much discussed (see e.g., Jarrold *et al* 1994; Perner, 1991) most of the criticisms are irrelevant to the current context and I will not review them here. For my purposes, I need only to establish that my questions about children's and adults' handling of referential problems are not adequately answered. I aim to do this in two different ways.

The first is a reiteration of the general points made about Fodor's theory of folk psychology made above. Following Fodor (e.g., Fodor, 1983), Leslie conceives of his decoupling device as an innate module devoted to representing “in quarantine” the propositional content of attitudes such as “pretends”. He compares it with the apparently hard-wired modules of the visual processing system, the implication being that the child-computer sees its mother pretending and cognises the pretence with absolutely no insight into the representational relationships involved. While this sub-personal level of description may be just right for an account of early pretence, it surely doesn't capture the intuitive feel of adult mentalistic insight which is at least partly conscious and accessible to report. Yet Leslie does not dismiss these intuitions as misguided, nor does he add to Fodor's philosophy some account of personal level awareness.

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<sup>6</sup> Leslie (1987) traces the quotation theory from Carnap (1947) through Fodor (1981). I refer back to Quine's related ideas for brevity.

On the face of it, another option might be to view his mechanism only as a means by which adult abilities are grounded. However, Leslie is penned in by his adoption of the Fodorian vision since the workings of a module are *in principle* inaccessible, so cannot be worked up into a higher level of representation which might be available to awareness or report. So when he talks about the module embodying a mentalistic “theory”, it is in the deeply figurative sense in which a car embodies a theory of locomotion. Thus, even if Leslie is right in proposing an innate basis for some aspects of early mentalising, there seems to be a case for quarantining his specific claims about representational partitioning from the questions raised above that encompass higher level communicative and pragmatic elements.

The second concern is with Leslie’s assumptions about the referential problems which his mechanism is supposed to handle. Leslie characterises the decoupler as a domain specific module (the “Theory Of Mind Mechanism”) concerned only with mentalistic calculations. But what about the other contexts that give rise to referential opacity? Does he also need independent syntactic mechanisms to handle reference across time and space, modal contexts and non-mentalistic counterfactuals? If so, this surely detracts from the parsimony of his explanation. And what about the different sources of referential problems *within* the mentalistic realm? It seems that Leslie is committed to *ad hoc* explanations if children find some easier to handle than others. Finally, there is the problem of *de re* versus *de dicto* readings of propositional attitude reports. Since Leslie adopts Quine’s syntactic means of isolating the contents of propositional attitude reports, he also inherits Quine’s difficulty with *de re* and *de dicto* readings. A more sophisticated mechanism is needed just to represent these readings, and this begs the question of how the initial choice between the two is made. Another option for Leslie is to say that propositional attitudes *de re* do not occur in the language of thought but are merely a pragmatic phenomenon in natural

language. However, this defers the problem to another system - some kind of sophisticated natural language interpretation mechanism - that would not only have to pre-empt the partitioning achieved with the language of thought decoupler, but do so in response to the pragmatics of the discourse. In either case this seems to pose a serious challenge to the kind of sub-personal mechanisms postulated by Leslie.

In sum, although the problems may not be insurmountable, these considerations betray the apparent simplicity that Leslie's narrow focus achieves, allowing the case to be made for an alternative.

#### **4.3 Referential opacity and syntax**

Leslie proposes to handle the problem of referential opacity by introducing a syntactic partitioning mechanism in the language of thought. Turning this idea on its head, de Villiers (1999) proposes that developments in children's understanding of natural language syntax provide the representational structure necessary for general handling of folk psychology including referential opacity. Specifically, de Villiers claims that "... the child who becomes capable of the language of complementation, namely embedded propositions, has available a new representational capacity for propositional attitudes. That is, perhaps the complex syntax that is used for describing mental events *makes possible* the representational changes that allow for understanding false beliefs." In support de Villiers reports evidence suggesting that children come to handle the referential opacity of embedded propositions at the same time as they pass standard mentalistic tasks at approximately 4 years of age (see next section for a description of the unexpected transfer task).



That the partitioning achieved in natural language with embedded propositions might serve as a support for the same partitioning in thought is indeed an important possibility and will be discussed in more detail in chapters 3 and 5. However, at this point my purposes seem best served by pointing out just one possible problem with the particular views of de Villiers. As with Leslie's universal decoupling mechanism, the syntax of complementation is the same regardless of the source of the referential problems (recall that the same sentence "John believes that the sometime resident of Chequers is Tony Blair" can be wrong if John's belief is out of date *or* incomplete). Thus, like Leslie, de Villiers is faced with having to make *ad hoc* explanations if - as Russell's data suggest - it turns out that children find some referential problems more difficult to handle than others. The possible form of such explanations will be discussed below.

#### **4.4 Referential opacity and false belief**

If there is a mainstream view of mentalistic development it is that children pass through one or more qualitative shifts on their way to acquiring "a theory of the mind" as a representational system<sup>7</sup>. Although interpretations vary (compare Chandler, e.g. 1988; Gopnik and Wellman, 1992; Perner, 1991) there is a consensus among "theory theorists" that learning to handle false beliefs marks an (if not the) important change. The reason for this is that false beliefs represent a minimal context in which one must go beyond one's own current beliefs to predict behaviour (Dennett, 1978). The result is that a small number of tasks (and their spin-offs) that ask children about false beliefs have come to be seen by many as diagnostic of possessing a theory of mind.

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<sup>7</sup> For these researchers the label "theory of mind", which in the literature at large is used synonymously with "mentalistic development", has a literal meaning: Children's folk psychology is thought to consist in a structured

An example is the unexpected transfer task of Wimmer and Perner (1983). In the original version, the child observes as the location of a chocolate is changed in the absence of the protagonist, Maxi. On Maxi's return the child is asked to predict where Maxi will look for the chocolate. To an adult it is clear that Maxi now has a false belief and will look in the old location. However, children rarely begin to pass this task until their fifth year<sup>8</sup>; younger children reply that Maxi will look in the current location of the chocolate. Consistent results on this and other related tasks (e.g. the deceptive box task of Perner, Leekam and Wimmer, 1987; Gopnik and Astington, 1988) have led to the apparent changes at 3-4 years becoming the primary focus for investigation and theorising. In the next section I shall discuss data that seem inconsistent with this narrow approach and in chapter 3 I shall address some problems with the view that children's development is a theory change. For now I shall only consider the implications of this approach for children's handling of referential problems.

Gopnik (1993) adopts the Quinean terminology of transparent versus opaque contexts to describe what changes when children come to understand false belief. "One way of putting it might be that for the 3-year old, all serious psychological states [perceptions, desires and beliefs as opposed to dreams and pretences] are "transparent" (Quine, 1956). That is, children think of belief ..... as a matter of direct relation between the mind and objects in the world, not as a relation mediated by representations...." (Ibid.). However, once children understand "the possibility of misrepresentation" [as evidenced by passing false belief tasks] they will possess "the intuitions captured by philosophical notions such as 'opacity'". This inference is justified on

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theoretical body of knowledge. To avoid confusion I shall avoid this tendentious label outside of the context of these researchers' views.

the basis that text book examples of opacity “... from the morning star and the evening star (Frege, 1892), ... to Orcutt the spy (Quine, 1956) [and presumably, Jocasta, the mother of Oedipus] all involve cases of misrepresentation.”

In light of the foregoing discussion, there are clearly problems with this final claim. The famous examples from Frege and Quine (and my example from Fauconnier (1983)) concern intensional contexts in which the referential problems arise from the *partial* knowledge of the protagonists. Oedipus does not misrepresent his mother as Jocasta; she really and truly is Jocasta, and he is simply ignorant of another aspect of her identity. Opacity arises in these cases, not because a protagonist is wrong, but as an inevitable (and salient) consequence of the fact that mental representation is partial. So Gopnik’s specific inference from handling misrepresentation to handling opacity (intensionality) is incorrect.

More generally however, Gopnik’s views are similar to those of Perner (e.g., 1991) whose chain of inference from children’s handling of false belief to their handling of opacity (including intensionality) does not contain this conceptual flaw. Perner’s claim is that children who pass the unexpected transfer task understand misrepresentation because they have developed the theoretical insight that the mind is a representational system. This neatly explains the co-emergence of a number of related skills such as handling false belief, strategic deception and discriminating the appearance of an object from the underlying reality. What is more, Perner argues correctly that a theory of this kind would entail understanding, not only misrepresentation and the referential problems arising therefrom, but also the partial nature of representations and thus intensionality. Like the authors above, Perner seems committed to the view that the various

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<sup>8</sup> Wimmer and Perner (1983) actually found a relatively high failure rate amongst four year olds, but a number of subsequent studies have found earlier success resulting in the general consensus that children pass the unexpected

referential problems posed by the representational nature of the mind pose qualitatively similar problems for children. They should all be solved with the advent of a representational theory of the mind, with persisting difficulties having to be explained away. Shortly, I will review the findings of Russell (1987) that pose just such a challenge to Perner's theory.

Finally, there is a certain irony to this debate about referential opacity and false belief tasks, because although misrepresentation by an outdated belief indisputably does create opaque contexts (as in sentence 5 in section 3.2) it is at least arguable that the unexpected transfer and deceptive box tasks actually require the processing of a referentially *transparent* context.

Consider the task described above in which Maxi mistakenly believes that the chocolate (which is now in box B) is in box A. To predict Maxi's search correctly the child must understand that her knowledge conflicts with his belief, and thus think to herself "Maxi thinks the chocolate (in box B) is in box A". Here the referential expression "chocolate (in box B)" is freely substitutable in opposition to what one would expect if the context was opaque. In contrast, the opaque reading "Maxi believes 'the chocolate (in box B) is in box A'" refers to an impossible situation and is nonsensical. The confusion arises, I think, because of the difference between the viewpoints of Maxi and the child: We could perfectly well say from Maxi's point of view that "Maxi believes 'the chocolate (in box A) is in box A'". But from our (and the child's) perspective the crucial point is that Maxi thinks this *but we know better*: This is the essence of the false belief task. Attributing the above sentence to the child is therefore misleading because it relegates this knowledge to the background, giving the misleading appearance that the opaque context "says enough". In sum, it is more accurate to say that representational partitioning (holding Maxi's

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transfer task in their fifth year (see Perner, 1991 for a review).

beliefs separate from one's own) not handling of opacity *per se* is children's real achievement when they handle false beliefs.

#### **4.5 A direct test of referential opacity?**

In the last section I described the unexpected transfer task and argued that it did not in fact require the handling of an opaque context in which extensional substitution had to be resisted. However, a closely related procedure developed by Robinson and Mitchell (1992; see Mitchell, 1996, pp106-109) does indeed seem to require precisely this. Children were given vignettes in which a character with outdated knowledge made a verbal request. For example, Mum and Jane tidy away a bag of red material and a bag of green material into a drawer and a cupboard respectively. In mum's absence Jane removes the two bags to play with the material and replaces them the opposite way around, i.e., the bag of red material is now in the cupboard and *vice versa*. Mum, who is ignorant of the exchange, calls from another room, and says "I need one of the bags of material, it's the bag in the drawer" and the child is required to indicate which bag she wants.

Clearly, in this instance an opaque interpretation of the message is required: It is the red bag that mum *thinks* is in the drawer that mum wants, not the currently co-extensional "bag of green material". Robinson and Mitchell (1992) report that few 3 year olds, several 4 year olds and many aged 5 correctly interpreted mum's request by reaching for the bag in the cupboard. As originally conceived, Robinson and Mitchell's task was looking only at whether children treat utterances as arising from beliefs, however, Mitchell (1996) reinterprets the task as "a direct test of referential opacity". He concludes that children who pass are "...able to demonstrate their understanding of referential opacity in the context of interpreting utterances." (Ibid.). But what

would the nature of such “understanding” be and what can we infer about children’s understanding of the mind?

On a strict reading, to say that one understands opacity implies a reflective insight into the formal, logical problem whereby certain contexts are sensitive to extensional substitution. Such an understanding could be quite independent of any insight into the nature of the mind behind the referential problems. Although this may be an unfair characterisation of Mitchell’s views, he does seem to endorse the independence of opacity and folk psychology when he says that “If we have a working understanding of ... *referential opacity*, then we have a fundamental basis for an understanding of the mind as an organ that interprets and represents reality.” Besides begging the question of what such a working understanding would consist in outside of the context of its use, this view like the others reviewed so far, treats opacity as a single problem with a single solution. On Mitchell’s account it would indeed be surprising if problems of opacity that were formally similar but arose from different consequences of the representational mind varied in difficulty for children. Yet this is exactly what the results of a study by Russell (1987) seem to suggest.

#### **4.6 Referential opacity and intensionality**

Russell’s study is crucially different from those reviewed so far because it looked at children’s handling of intensionality. Recall that intensional contexts arise because representations are necessarily partial, whereas the referential problems in the Wimmer and Perner (1983) and Robinson and Mitchell (1992, 1994) tasks were due to representations being out of date. In Russell’s study children aged 5 to 7 years were told a number of different vignettes in which a character came to have incomplete knowledge about a particular situation, e.g. George has his watch stolen but doesn’t see the thief. Some test questions created intensional contexts by

asking what it was possible to say about the character's thoughts, e.g. "Can we say that George was thinking.....?". As in the case of Oedipus' belief about his wife (sections 3.1 & 3.2), the answer was constrained by the knowledge state of the character so that since he did not know that the thief was a man with curly red hair, it was incorrect to say that George was thinking "I must find the man with curly red hair who stole my watch". Results showed a significant age-related improvement, with errors on the intensional questions decreasing from an average of 87.5% at age 5, to around 50% at age 7. In contrast, virtually all the children were able to answer a control question "Can we say that George knows that the thief is a man with curly red hair?" suggesting that, in line with the expected performance of this age group on the standard false belief tests described above, they were able to divorce what George knew from their own knowledge of reality. Russell also looked at whether children *incorrectly* constrained verbal characterisations of a character's non-mentalistic relations, such as "Can we say that George was standing next to the man with curly red hair who stole his watch?"<sup>9</sup> Such errors were found but were less frequent than those with the intensional context, falling from an average of 35% at age 5 to 15% at age 7.

These data are potentially problematic for all of the above theorists because children's late success with intensional contexts implies a dissociation from their ability to handle false beliefs. It seems these theorists must either demonstrate that Russell's data are flawed, or arrive at an interpretation that denies intensionality any relevance to mentalistic development. These options will be considered in detail below for they form the basis of the first empirical section, but first I shall review another developmental account that seems to have the necessary time course to accommodate these data.

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<sup>9</sup> Russell did not ask this particular question following the vignette about George. To save describing another vignette I have adapted the question to the current example.

#### 4.7 How existing accounts might accommodate Russell's data on intensional contexts

##### *A different developmental theory*

Russell's data do not stand alone in suggesting that the unexpected transfer task may not diagnose the last qualitative step in children's mentalistic development. Besides the well known clustering of changes at around the turn of the third year, there is a second cluster of similar tasks that children rarely pass before 6-7 years. For example, children up to the age of around 5 or 6 years tend to judge that ambiguous verbal input is more informative than it really is (e.g. Carpendale & Chandler, 1996; Flavell, Speer, Green & August, 1981; Robinson, 1994; Robinson & Robinson, 1982; Robinson & Whittaker, 1987). They also appear to have related problems judging the informativeness of pictures (e.g. Chandler and Helm, 1984; Robinson and Robinson, 1982; Taylor, 1988). Could there be a common mentalistic requirement to these tasks that children acquire somewhat later?

Theorists committed to the view that the false belief tasks diagnose an essentially mature theory of mind have tended not to address children's problems with ambiguity directly. Rather, the strategy of Perner and others (Perner and Davies, 1991) has been to try and demonstrate that if task-specific limiting factors are removed, children can indeed succeed on the *mentalistic* component of these apparently harder tasks at only 4 years of age (but see Mitchell, Robinson, Nye & Isaacs, 1997; Robinson, 1994). An alternative tack taken by Chandler (e.g. Carpendale and Chandler, 1996), is to synthesise the results from interpretation and ambiguity tasks into a picture of late conceptual development at 6-7 years. Children's early abilities are not given the singular importance they have in the accounts described above. Instead, Chandler argues that the pattern of success and failure at 4 years can be best explained if children possess a simple "copy



theory” of the mind (Chandler and Boyes, 1982). Later success on the second cluster of tasks corresponds to a qualitative change involving insight into “the interpretive character of the knowing process”.

Although it has the necessary time course, Chandler’s account appears ill equipped to cope with the dissociation between intensional and control questions found by Russell (1987). Children who can acknowledge George’s ignorance of the thief’s hair colour seem already to be beyond a simple copy theory of the mind. A simple copy theory would lead them to assume that if George knows something about the person who stole his watch, he must know everything. But if this is the case, their misunderstanding of the intensional context cannot be due to their possessing a copy theory. Perhaps an elaborated copy theory of some kind would allow them to deny that we can say that George knows the thief is a man with curly red hair, but then they should surely also deny that we can say that George knows that the man with the curly red hair stole his watch. Either way, like Perner and the others, Chandler seems forced to try and explain away children’s problems. So how might Russell’s findings be explained?

*Intensionality as a purely linguistic problem*

Russell himself interprets his findings outside of the context of mentalistic development: “Understanding opaque [intensional] contexts is a form of specifically linguistic knowledge that is probably not present before middle childhood” (1992, p.496)<sup>10</sup>. More precisely, it is the pragmatic knowledge needed to make adult-like *de re* and *de dicto* interpretations of linguistic intensional contexts that children are supposed to lack. Instead they answer according to what is

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<sup>10</sup> Russell’s most recent views incorporate this “linguistic” explanation as part of his account of the 6-7 transition as a problem with executive competence (see below). However, the idea that Russell’s (1987) data can be explained away

“cognitively salient” to them. Children answer “Can we say that George knows that the thief is a man with curly red hair” correctly because the thief’s hair colour is cognitively salient making children attend to George’s lack of knowledge of this fact. In contrast, with “Can we say that George is thinking ‘I must find the man with curly red hair who stole my watch’” the cognitively salient feature is “finding the man” rather than the nature of the verbal description. Consistent with this, children make a *de re* reading in contrast to the adult *de dicto* reading. This idea also receives support from Russell’s (1987) finding that the same children who treat intensional contexts as extensional also tend mistakenly to treat extensional contexts intensionally (e.g., by denying that we could say that George is standing next to the man with curly red hair who stole his watch). However, a problem with this interpretation is that in the absence of a systematic theory of cognitive salience, explanations can only be made *post hoc*. This point will be returned to in chapters 3 and 5. For the moment what matters is that this explanation has been persuasive.

Although viewing intensionality as a problem posed in language interpretation, not in mental representation, contrasts with the “theory theorists” general approach, Perner uses just such an explanation to reconcile these data with his theory. By claiming that the problem Russell poses is a pragmatic one, he places it outside of the “theory of representation” domain of his own account (Perner, 1991 n7.4). Despite his different perspective Mitchell (1996) accommodates Russell’s data in a similar way and this option is also open to Chandler and others.

However, the strategy of treating intensionality as a purely linguistic phenomenon is at odds with the account developed in section 3.2. If we accept the suggestion that mental states

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as problem with language alone has been adopted by other researchers and so is considered here as an independent possibility.

such as belief are best treated as if they were representations (regardless of the underlying reality) then mental states that take other mental states as their object will possess the same intensionality as belief reports. My belief that John believes that “*p*” (where “*p*” is a proposition) will be true if John believes that “*p*” regardless of the truth of “*p*”, and if my characterisation of “*p*” is in terms that John knows or could reasonably be thought to know<sup>11</sup> (see Searle, 1983, pp. 25-26). In itself, this account does not undermine Russell’s explanation of children’s problems but it does suggest that there is no conceptual error in asking whether children’s problems persist in non-linguistic intensional contexts. This possibility will be examined in Experiment 3.

Even if intensionality is accepted in principle as a mentalistic phenomenon there are still a number of avenues open to those wishing to explain away Russell’s findings.

#### *Task-specific problems*

There would seem to be a case for incidental task-specific factors masking children’s true competence. Russell (1987) asked children questions about fictional characters in a series of vignettes which may be more artificial and place a higher memory load than the unexpected transfer task which usually employs puppets or human stooges to act out the scenario. It is also possible that the younger children in Russell’s study did not have the linguistic competence to comprehend the key test questions which contained up to four embedded clauses. Although children’s success at reporting that George doesn’t know that the thief is a man with curly red hair weakens this argument somewhat, the differences between Russell’s tasks and standard

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<sup>11</sup> This all assumes that my interest in attributing the thought to John is to say something about John’s thought (the corollary of a *de dicto* reading of a belief report). It is surely also possible to have a thought about John’s thought with no such entailments: My belief that John is searching in the fridge because he believes it to contain beer would surely not normally be false just because John’s own account was that he thought he would find Budweiser. And this fact is independent of the thorny philosophical debate about whether there are such things as *de re* 1st order beliefs.

theory of mind tasks are too great for the possibility of task-specific problems to be ignored.

Experiment 1 addresses these issues.

### *Performance errors*

It is also possible that children's errors are due to deficiencies in general cognitive mechanisms or abilities rather than with language or folk psychology *per se*. Fodor (1992) characterises 3- year olds' difficulty with false beliefs as an over-conservative tendency to select the simplest folk psychological hypotheses, driven by their limited resources for cognitive processing. In principle (and in some real circumstances Fodor argues) 3- year olds can handle false beliefs but the usefulness of this ability is offset against its relative cost in their limited cognitive economy. For three year olds the equation is such that a belief-based hypothesis will not normally be employed. Thus, eventual success on the unexpected transfer task is due to the general increase in processing resources rather than any qualitative change in understanding. An argument of this kind could be adapted to address Russell's results and this will be examined in Experiment 3.

Problems with executive control are another possible reason for children's failure. According to Russell (1996) executive problems result in two broad types of mistake; performance errors, where children's underlying competence is obscured by their inability to overcome a task-specific pre-potent response, and competence errors, where the child has a general inability to think "explicitly and at will" about the problem domain (Ibid., p215). Mitchell's "reality masking hypothesis" (e.g., Mitchell, 1996; see also Russell, Mauthner, Sharpe & Tidswell, 1991) is an explanation of the first kind, which suggests that an innate cognitive bias towards "reality" is often responsible for seducing otherwise competent children into making

errors. Such an explanation of Russell's data would say that children fail to constrain "what we can say" about George because they cannot overcome their own, greater knowledge of the object. This is more taxing than the tasks passed at 4 years because the required distinction between knowledge of true descriptions is more difficult for children than the distinction between knowledge and false belief. It is difficult to imagine an experiment to eliminate this possibility, for if we remove the disparity of knowledge between the speaker / listener and the protagonist (and hence the possibility of being overdetermined by one's own knowledge) we lose the essence of an intensional context. This question can only be addressed indirectly. In Experiments 1 and 3, children's success of control questions makes such an error on the test question unlikely. Experiment 5 tests children's handling of ambiguity - which I shall argue poses similar problems to intensional contexts - in a situation where realist or egocentric errors are impossible.

Russell (1996) conceives of children's mis-handling of intensionality as a problem of executive competence. The form of Russell's questions ("Can we say..... that a person thinks x") allows him to argue that they require reasoning about the abstract notions of sentence truth value versus objective truth. Thus, intensionality can be allied with Piaget's conservation tasks (e.g., Piaget, 1950) that ask about the abstract entities of mass, volume, number etc. Russell conceives of "the 6-7 transition" in which children start to pass all of these tasks as a change in their ability to think "explicitly and at will" about such abstract properties without being side-tracked by salient features of the situation such as the change in height of liquid poured into a vessel of different width. This sets the views I attributed to Russell, about the purely linguistic nature of intensionality and the "cognitive salience" account of the form of children's errors, in their broader context. However, as I have already suggested, there are good reasons for thinking that there is nothing exclusively linguistic about intensionality nor anything reflective about knowing

the appropriateness of co-extensional substitution. These matters are addressed empirically in Experiment 1 by removing the reflective aspect of Russell's question, so that it is less plausible to argue that children are reasoning about the "truth" of a verbal characterisation of a mental state. In Experiment 3 the linguistic intensional context is removed completely.

#### **4.8 Conclusions**

Viewed in the context of my analysis of the sources of referential problems in mentalistic contexts, Russell's (1987) data on children's handling of intensionality present a problem for common accounts of mentalistic development. They provide grounds for suspicion that there may be systematic, qualitative differences between the types of referential problem that can be handled by 4-year olds and older children: Specifically, that problems due to the partial nature of representations may be more difficult than those arising from outdated or hypothetical representations. I have discussed a number of ways in which existing developmental accounts might avoid this conclusion and it will be among the purposes of Experiments 1,2,3 and 5 to investigate these potential explanations. These experiments will also provide positive data pertaining to an account in terms of qualitatively different referential problems which will be developed in chapter 3.

## **Chapter 2. Experiments 1-3**

Experiments 1 and 3 form the basis of a paper by Apperly and Robinson (1998) published in the journal *Cognition*.

In the previous chapter I described Russell's (1987) finding that children aged 6-7 had difficulties with linguistic intensional contexts and suggested the potential importance of this finding for theories of mentalistic development. This chapter has three complementary aims. The first is to check that Russell's findings are replicable and generalise to similar tasks. The second is to investigate possible ways of handling them within contemporary developmental accounts. The last is to chart the extent of children's difficulties with referential problems of this kind. I begin by examining the possibility that incidental task-specific factors are responsible for children's errors.

### **1. Experiment 1: A simplified version of Russell's tasks**

#### **1.1 Introduction**

As summarised above, Russell's (1987) tasks required children to reflect on whether a particular linguistic description was true or false: Can we say George was thinking.....? I aimed to create a simplified version of Russell's task that retained the essential features of intensional contexts arising out of the partial knowledge of one story character, while eliminating some task-specific complexity. I reduced the number of embedded clauses in the test question from four to one. Importantly, the reflective clause of the test question was

also removed: Children were not asked to judge whether we can say such and such about George's thoughts, but were simply asked whether the protagonist knew such and such. Hence the form of my test questions was very similar to those which have been widely used in theory of mind research (e.g. Pillow, 1989, 1993; Pratt & Bryant, 1990) and have been answered correctly even by 3-4 year olds. I used objects referred to by two descriptions (X and Y). The child and experimenter knew both descriptions whilst the puppet protagonist was only able to find out one (X) when he looked at the object. Thus, description X was the only correct content of the puppet's propositional attitudes towards the object. Children's understanding of this was assessed with three questions. Following Russell I considered whether children were willing to use description "Y" in an extensional context: "Can Heinz see the 'Y' in the box?". I also checked that the children could differentiate intentional and extensional contexts by asking, "Does Heinz know the 'X' is 'Y'?". Unlike Russell (1987) where a similar "critical knowledge question" was used as an entry criterion for the study, I compared performance on the intentional and intensional questions directly. An intensional context was created by asking: "Does Heinz know there's a 'Y' in the box?". Recall that the children in Russell's experiments found intensional contexts (which had the most embedded clauses of all) particularly hard. By reducing task-specific demands I expected both the overall difficulty and this disparity to decrease. It is consistent with the simple idea of qualitatively different referential problems that any questions that appear to concern the partial nature of Heinz's knowledge should remain harder than the standard false belief tasks<sup>12</sup>.

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<sup>12</sup> I should forewarn that this idea will turn out to be too simple to accommodate my findings and will be refined in later discussion and in chapter 3 in particular.



## 1.2 Method

Each child was tested individually on four tasks. Two were like the task described above in which it was not appropriate to judge that the protagonist knew the second description on the basis of his limited information access. The third, a control task, was similar in form but this time it was appropriate to judge that the protagonist knew the second description even though he had the same limited information access. The fourth task was a standard deceptive box task.

### *Participants*

28 children from a nursery class (13 boys and 15 girls) aged between 3;7 and 4;9 (mean age 4;3), and 48 children from a reception class (27 boys and 21 girls) aged between 4;10 and 5;11 (mean age 5;4) were tested. They will be referred to as the 4- and 5-year-olds respectively. All the children attended the same junior/infant school with a lower middle class / upper working class catchment area in Birmingham, UK, and spoke English as their first language.

### *Materials*

A bouncy ball, a rubber dice<sup>13</sup> and a toy duck were all contained in similar tin boxes. During the experiment, each item was referred to by two possible descriptions: “ball”/“present”, “dice”/“rubber” and “duck”/“toy” respectively. In the case of the first two items, only one description was obvious from visual inspection (“ball” and “dice”). For the third, both “duck” and “toy” were discernible from visual access and this was used in the

control task. The fourth item, used for the deceptive box task, was a plastic horse, which was contained in a packaging box with a picture of a teddy on the outside. The protagonist for every trial was a puppet called Heinz.

### *Procedure*

Trials with the ball and dice followed the same general form. Children were first allowed to look inside the box and the visually obvious label was agreed (children had no difficulty in naming the ball and the dice). Next, the second label had to be agreed. In the case of the ball, the children were conspiratorially informed that “..this is going to be a present for Heinz, except we haven’t told him and we don’t want him to find out right now, so we’ll have to whisper very quietly when he looks...”. For the dice, they were allowed to feel the item, and if they did not spontaneously identify it as a rubber, it was demonstrated until this second label was agreed. The two descriptions were then reiterated: “...so it *looks* like a dice and it *feels* like a rubber...”. Children had therefore heard referential use of both labels for each item and the different modes of perceptual access had been made clear. Next the children observed as Heinz looked inside the box. The lack of other perceptual access was emphasised in the case of the ball by whispering the questions, and in the case of the dice by saying “Now Heinz is going to look inside the box but he’s not going to *feel*”.

With the box still open, half of the children were asked:

Q1. (Extensional) Can Heinz see the [present/rubber] inside the box? (correct = yes)

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<sup>13</sup> Although it would strictly be correct to use the singular form “die”, this was not an appropriate term of reference for the age range of children to be tested and “dice” was used in the test questions. For simplicity, I shall also use the term “dice” to refer to the singular object throughout the thesis.

The other half had no question, guarding against the possibility of this initial “extensional” question promoting later errors. After the box was closed the children were asked either:

Q2. (Intentional) Does Heinz know the [ball/dice] is a [present/rubber]? (correct = no)

or

Q3.(Intensional) Does Heinz know there’s a [present/rubber] in the box? (correct = no)

The trial with the duck/toy was similar. However, in this case only one label, “duck”, was agreed in advance to control against children allowing substitution merely because the labels had been agreed with the experimenter. Thus, the “toy” label was novel to the children when they were asked Q1: “Can Heinz see the toy inside the box?”(correct = yes). Next they were asked Q1a: “Can you see the toy with your eyes right now?” (correct = no, as the box was tipped away from the child). All children were asked Q3: “Does Heinz know there’s a toy inside the box?” (correct = yes) followed by Q3a: “Do you know there’s a toy inside the box?”(correct = yes). Thus, this trial served as a double control, ensuring firstly that the child was willing to allow substitution of descriptions when the context was transparent, and secondly that the child was able correctly to attribute the basic seeing-knowing relationship both to themselves and the puppet.

On the deceptive box trial children were shown the box and asked what they thought was inside. After agreeing upon “teddy”, the children were allowed to look inside the box and find the horse. After closing the box, children were asked “Heinz hasn’t seen inside this box before. When he first sees it, before he opens it, what will he think is inside?”

The four trials were partially counter-balanced: The deceptive box test always came first or last and the duck/toy control test always came before the dice and ball tasks. The

order of the latter two tasks was counter-balanced and the question type (intentional or intensional) varied between participants. In sum, aside from simple differences in order, there were four distinct trial types for the ball and dice items. Trial type was consistent within child: intentional only, extensional and intentional, intensional only, and extensional and intensional.

### **1.3 Results and Discussion**

Children's answers in the duck/toy control task were checked first. Two children were excluded from the 4-year-old sample after they insisted that they could see the toy when the box was tipped away from them (control question Q1a). Two children were excluded from the 5-year-old sample for the same reason and a further three for evidencing suspicions about the puppet's ability to see or know anything. All other children got the four questions of the duck/toy control task correct.

Performance on the deceptive box task was in line with the published literature: 10 of the 26 4-year-olds (38%) answered correctly, compared with 33 of the 43 5-year-olds (76%). As would be expected, performance on the deceptive box improved significantly with age  $\chi^2 (1, N = 69) = 10.11, p < .002$ .

For the other two tasks, the dice/rubber and ball/present, there were no significant order effects (chi-squared test, all  $ps > 0.43$ ). Contrary to the findings of Russell (1987) children performed at ceiling in answer to the extensional question: They all judged correctly that Heinz could see the present or rubber. This could be interpreted as a sign that children did not over-extend the consequences of the puppet's ignorance of those descriptions of the items to extensional contexts created by the verb "see". However this

same result would be predicted if children were generally relaxed about referential substitution in any context, and as we shall see below their answers to the intentional and intensional questions suggest that this was the case.

Table 1 gives a break-down of children’s performance in the four basic experimental groups. To test whether the presence or absence of the extensional question Q1 (“Can Heinz see...?”) had any effect upon responses to intentional or intensional questions children were classified according to whether they got none, one or both of these (Q2 or Q3) questions correct. No effect was found (chi-squared test, all  $ps > .389$ ).

*Table 1. Numbers of 4 and 5 year olds who got none, one or both intentional (or intensional) questions correct in the four principle conditions of Experiment 1.*

Condition	Number of correct responses in Nursery class (4 years) $N = 26$			Number of correct responses in Reception class (5 years) $N = 43$		
	0	1	2	0	1	2
Intentional only	2	2	2	1	3	7
Intentional + extensional	5	1	1	3	2	5
Intensional only	4	1	1	7	2	2
Intensional + extensional	7	0	0	10	1	0

On the basis of this result, data from children who were asked Q1 (extensional) were combined with those from children who were not.

*Table 2. Numbers (percentage) of 4- and 5-year-olds who answered intentional and intensional questions correctly in the dice/ rubber and ball/present tasks in Experiment 1.*

Age group	Question	Dice/rubber	Ball/present	Deceptive box
Nursery (4 years)	Q2 Intentional “Knows X is Y?” <i>N</i> = 13	6 (46%)	3 (23%)	10 (38%)
	Q3 Intensional “Knows Y is in box?” <i>N</i> = 13	2 (16%)	1 (8%)	
Reception (5 years)	Q2 Intentional “Knows X is Y?” <i>N</i> = 21	14 (67%)	15 (71%)	33 (76%)
	Q3 Intensional “Knows Y is in box?” <i>N</i> = 22	3 (14%)	4 (18%)	

Table 2 shows the incidence of correct responses to the two questions in the dice/ rubber and ball/present tasks together with the deceptive box task. My main interest was in the answers to intentional Q2 (e.g. “Does Heinz know the dice is a rubber?”) and intensional Q3 (e.g. “Does Heinz know there’s a rubber in the box?”). As shown in Table 2, the younger children performed poorly in answer to both questions, with no significant differences between questions. In contrast, the older children showed highly significant differences between answers to intentional and intensional question types, with the intensional question (“Does Heinz know there’s a rubber/present in the box?”) the more difficult. For the dice/rubber,  $\chi^2(1, N = 43) = 12.6, p < .0001$  and for the ball/present,  $\chi^2(1,$

$N = 43$ ) = 12.35,  $p < .0001$ . Many children judged correctly that Heinz did not know that the dice was a rubber (or the ball a present) while few judged correctly that Heinz did not know there was a rubber (or a present) in the box.

These differences for the 5-year-olds were reflected in comparisons with the deceptive box test. There was no difference in difficulty between intentional Q2 and the deceptive box task, while intentional Q3 was harder than the deceptive box task:

McNemar's  $\chi^2(1, N = 22) = 13.1, p < .001$  for the dice/ rubber, and  $\chi^2(1, N = 22) = 12.1, p < .001$  for the ball/present. These results are consistent with the assumption that intentional Q2, like the deceptive box test, tapped children's ability to distinguish between intentional contexts (as represented by the mind) and extensional contexts (the real state of affairs).

Comparing the age groups, although performance on the intentional Q2 ("Knows X is Y?") showed signs of improvement from an average of 34% to 69%, this did not reach significance when the frequencies of responses (neither Q2 correct, one Q2 correct or both Q2s correct) were compared:  $\chi^2(2, N = 34) = 5.12, p = .077$ . Performance on the intentional Q3 ("Knows Y is in the box?") did not improve significantly: Average scores across the two Q3s were 3/26 (11%) to 7/43 (15%).

In line with the findings of O'Neill, Astington and Flavell (1992) and Robinson, Thomas, Parton and Nye (1997), the 5-year-olds in the current study were able to distinguish between the knowledge acquired from seeing versus feeling. Although this appeared to be a little harder than the deceptive box task this difference was non-significant. Additionally, in the present study, they used this modality specific access to infer the puppet's knowledge of alternative descriptions for the objects, as assessed by

intentional Q2. However, the dramatic disparity with performance on intensional Q3 suggests that even though children could correctly identify what the puppet did or did not “know”, they often failed to apply this in intensional contexts where substitution of co-referential terms affected the truth value of the sentence.

To summarise, Experiment 1 shows that while children may predict successfully another’s false belief, and correctly report another’s ignorance of a label for an object, they are significantly worse at treating *descriptions* of what a person knows as constrained by that person’s actual knowledge about an object. While performance on the false belief task and the intentional Q2 showed improvement across the age groups, performance on the intensional task remained consistently bad. This poor performance in response to intensional Q3 replicates the finding of Russell (1987) and demonstrates an explicit dissociation from handling of false belief. While the reduced complexity of my tasks makes it far harder to explain this result away as incidental, the fact that this also failed to reduce the difference between Q2 and Q3 is evidence against the simple proposal that partial knowledge is particularly difficult for children.

However, in contrast to Russell (1987) children in the current study never made the inverse mistake of treating extensional contexts intensionally, suggesting that their problem is not a pragmatic misunderstanding of the conditions under which “...the protagonist’s ignorance is relevant to the verbal characterisation of her situation or behaviour...” (ibid. p.303). Their problems seem exclusive to intensional contexts. That errors persisted with a non-reflective test question (“Does Heinz know...” rather than “Can we say that George was thinking.....”) also makes it harder to argue that children are struggling with the



abstract notion of sentence truth value, weakening the “executive competence” explanation.

One response to this might be to argue that dropping the reflective clause loses the essence of Russell’s experiment; that my questions pose a quite different problem that children fail for a different reason. The next experiment addresses this point by comparing children’s performance on the two types of task directly.

## **2. Experiment 2: “Does Heinz know...?” versus “Can we say....?”**

### **2.1 Method**

Each child received a warm-up task followed by four experimental tasks consisting of Russell’s (1987) two intensional tasks and our two modified tasks.

#### *Participants*

47 children (26 boys and 21 girls) aged between 5;8 and 6;10 (mean age 6;2) were tested. All children attended the same junior / infant school with a middle class catchment area in Birmingham U.K., and spoke English as their first language.

#### *Materials*

I used Russell’s (1987) “watch” story, summarised in the introduction, and also his “butterfly” story about a man buying a hat for his wife without knowing that it had a butterfly trapped beneath it. The man could be described as thinking “I like the blue hat with the lace trimming” but not as thinking “I like the hat with the butterfly trapped inside it”.

The modified tasks were identical to those in Experiment 1 except the rubber dice was replaced by a rubber ruler. The warm-up task used a plastic duck contained in a tin box, as in the control condition of Experiment 1.

### *Procedure*

Russell's stories were read aloud to children who were then asked his same three questions:

Q1) Intentional knowledge question, e.g. for the watch story, "Can we say that George knew that the thief was a man with curly red hair?" (correct: No)

Q2) Intensional question, "Can we say that George was thinking: 'I must find the man with the curly red hair who stole my watch'?" (correct: No)

Q3) Control question, "Can we say that George was thinking: 'I must find the thief who stole my watch'?" (correct: Yes)

In order to match Russell's tasks and my modified versions as closely as possible, I deviated from his method so that half the children received Q1 first and Q2 second, and half the other way round. All children received Q3 last since in my modified task there was no such question (see below).

The method for the modified tasks was the same as for Experiment 1 except the extensional question was omitted. Given the complete success of 4-5 year olds in the previous study, I did not want to arouse the suspicions of the 5-6 year olds in this study by asking them an inappropriately easy extensional question.

The initial warm up task with the duck/toy was similar to the control task in Experiment 1, only children were asked:

Q1: “Can Heinz see the toy inside the box?” (correct: Yes).

Q2: “Can we say that Heinz knows there’s a toy inside the box?” (correct: Yes).

Thus, besides getting children accustomed to the test situation, this task also introduced them to the linguistic form used in Russell’s tasks.

Following the warm-up, children received the original and modified tasks alternately in an otherwise counterbalanced set of orders.

## **2.2 Results and Discussion**

Performance on the warm-up task was checked first. Three children were excluded from the modified tasks after they refused to accept that the puppet could see or hear anything. Their data were included in the analysis of Russell’s tasks since these did not rely on the puppet. All other children answered both questions of the warm-up task correctly, suggesting that the language used was within their grasp.

For the tasks combined, there were no significant effects of age, gender, order of presentation of the intentional and intensional questions nor of whether a modified or original task was presented first. All orders were combined for the rest of the analyses. Table 3 shows the numbers of children who answered correctly on the intentional and intensional questions in each of the four tasks.

Table 3. Numbers (percentage) of children giving correct answers on the four experimental conditions in Experiment 2.

Question type	Ball/Present	Ruler/Rubber	Watch story	Butterfly story
Intentional question	37/44 (84%)	42/44 (95%)	35/47 (74%)	37/47 (79%)
Intensional question	20/44 (45%)	25/44 (57%)	14/47 (30%)	17/47 (36%)

For general comparisons of performance on the two Russell tasks with that on our two modified tasks, each child was given two scores between 0 and 2 according to the number of tasks from each set answered correctly.

As Table 3 shows, children performed near ceiling on the *intentional questions* in my modified tasks, and less well on those questions in Russell's tasks. Comparing scores on the two task types, 10 children make mistakes only on Russell's tasks and 2 show the opposite pattern ( $p = .039$  by sign test).

For the *intensional questions*, around one third of children answered correctly on the Russell tasks. This is roughly in line with the performance of the 6-year-olds in Russell's study (25% correct on the watch story and 40% correct on the butterfly story). Comparing overall scores, children's performance was better in my modified tasks with 19 children succeeding on my tasks and not Russell's, and 5 showing the opposite pattern ( $p = .006$  by sign test). However, consideration of the individual tasks showed that this difference was significant only between the ruler/rubber task and Russell's tasks (McNemar's  $\chi^2(1, N=44) = 6.78$  and  $3.90$  for comparisons with the Watch and Butterfly stories respectively,  $p = .009$  and  $.049$ ).

In line with Russell's results, children's performance on the intentional questions was dramatically better than on the intensional ones both for the original and modified tasks. For each of the four tasks this difference was highly significant: McNemar's  $\chi^2$  all  $>17$ , all  $ps < .0001$ . No child was successful on an intensional question while failing the corresponding intentional question for the same task. The important result from Russell's study has therefore been replicated: Although most of the children could divorce an intentional mental state from an extensional one, many of them had difficulty divorcing the verbal characterisation of the intentional state from that of the extensional one. Children frequently judged that we could substitute a co-referential term, such as "rubber" for "dice", or "man with curly red hair" for "thief" when describing the puppet's knowledge.

Using the same combined scores, there was a significant correlation between children's performance on the intensional questions of two types of task, Spearman's correlation coefficient ( $N = 44$ ) = .432,  $p = .003$ .

The order of *control question* presentation on the vignette tasks was not counter-balanced with the other questions. Children made some errors (in contrast to perfect performance in Russell's study): 10/47 on the watch story, 3/47 on the butterfly story, which might be due to the fact that this question was always the last of the battery of three.

In summary, my modified tasks do seem to have decreased significantly some difficulties specific to Russell's procedure, but the intensional questions remain significantly harder than intentional questions. Furthermore, children's consistent, correlated performance across the original and modified tasks suggest that they *are* tapping the same fundamental ability. This established, I can now return to questioning the basis of

the enormous discrepancy between children's ability to contrast explicitly a person's knowledge and ignorance of two descriptions of an object (X and Y respectively), and their ability to acknowledge that it is wrong to make "Y" the content of the person's propositional attitudes. The discussion at the end of chapter 1 can now be used to make some concrete, empirical predictions.

*Why do children have problems with intensional contexts?*

Maybe there was simply a performance difficulty with the intensional question, in that children for some reason failed to make use of the fact that Heinz did not know the dice was a rubber. That is, whereas the intentional Q2 asked children directly about Heinz's knowledge of the item's properties, perhaps the intensional Q3 asked them only indirectly to take Heinz's ignorance into account. Such an explanation for the difference in difficulty would predict an effect of presentation order on answers to the two questions, i.e. if children were asked the intentional question first they should perform better on the intensional question than if they were asked the intensional question first. In Experiment 1 I was concerned not to confound any such effect with overall differences between the two types of question. Having found such differences, Experiment 3 was designed to allow the above prediction to be tested.

Mitchell (1996), Perner (1991) and Russell (1991) have all suggested a language based explanation for why children might answer "Yes" to an intensional question while answering "No" to an intentional one. Whilst the latter unambiguously concerns Heinz's knowledge *vis à vis* descriptions of the object (e.g. that the dice is a rubber), the former could be heard as "Does Heinz know there's an [object that you and I know is, and

therefore can refer to as, “a present”] in the box?” which has the correct answer “yes”. As Russell noted in his 1987 article, the distinction between transparent (*de re*) and opaque (*de dicto*) interpretations is a purely pragmatic one, so in certain circumstances a transparent interpretation *could* be the more appropriate. Perhaps children have problems deciding which interpretation to make.

For such an explanation to hold water we need to ensure that adults do indeed observe the anticipated convention in our scenarios. Only then could children’s responses be considered non-conventional. I therefore presented 33 sixth-form students (17-18 years) with the dice/rubber and ball/present tasks from Experiment 1. I was only interested in responses to the intensional question but as in Experiment 1, for half of the sample this was preceded by an extensional question. I anticipated that the relative familiarity of dice/rubbers would allow some adults to say that one could tell just by looking that it was a rubber, and this was borne out in the results: For the dice/rubber only 25/33 (76%) said that Heinz did not know there was a rubber inside the box. For the ball/present there were no familiarity problems and this time 30/33 (91%) said that he did not know there was a present inside the box. Thus, overall I was happy that the adult interpretation of our scenarios was as anticipated, which allows the explanation in terms of linguistic pragmatic difficulties to remain a plausible possibility.

Yet another possible reason for children’s errors arises from my analysis of the sources of referential problems in various mentalistic tasks: The representational demands of intensional contexts may be qualitatively different from those of the theory of mind tasks passed at around 4 years because they require representation of the fact that mental representations are partial. As I indicated above, this suggestion appears inadequate in light of my results since the intentional

question above (e.g., “Does Heinz know that the ball is a present?”) surely asks about partial representation but was no harder than the deceptive box test. However, while this is certainly the adult interpretation of both intentional and intensional questions, this may not necessarily be the case for children. It may be possible to succeed on intentional Q2 but not intensional Q3 simply by appreciating that Heinz only has partial access to information. He sees the ball in the box and does not hear that it is a present but the relation between these two facts (i.e., that they both share the same object of reference) is not represented. If this is the case - and Heinz’s knowledge and ignorance of different aspects of the same object are represented only as separate facts - then this is an important respect in which the child fails to represent Heinz’s knowledge as partial.

Without the support of such a representation, children cannot make an opaque interpretation of the intensional context which, as we saw above, arises precisely because the way we describe the object of Heinz’s knowledge is constrained by what Heinz knows. To labour the point, if the facts that Heinz knows about the ball but not about the present are not held as relating to the same item, the child’s own knowledge that they co-refer will force transparent interpretations of intensional contexts: Either term can describe Heinz referring to the object since for the child they do co-refer<sup>14</sup>. This point is not pedantic but crucial, because transparent readings have very different effects upon the meanings of questions 2 and 3.

Intensional Q3 has an opaque reading corresponding to something like: “Does Heinz know that ‘there’s a present in the box?’”, which has the correct answer “No”. In contrast, a transparent reading would be: “Does Heinz know there’s something in the box?” which has the correct answer “Yes”, since Heinz has *seen* inside the box. This is clearly



different from intentional Q2 which has the opaque reading: “Does Heinz know that ‘the ball is a present?’” (correct answer “No”), and the transparent reading: “Does Heinz know that thing is a present?” which still has the correct answer “No”. Thus, whilst for an adult, the natural reading of intentional Q2 contrasts explicitly what we know with what Heinz knows, the answer to the question remains the same under the other possible reading.

This analysis shows the crucial difference between the intentional and intensional questions very clearly, and allows a basic failure to represent the partial nature of mental representations to remain in the running as a reason for children’s difficulties. Another reason why this account is worthy of consideration is that, unlike many of the others reviewed in chapter 1, an explanation that splits children’s achievements in this way might be extended to explain their problems with other tasks. For example, ambiguous utterances can occur because, as representations of the world, messages only capture certain aspects of their referents. Hence in an ambiguous sentence, it is impossible to distinguish the intended referent from another similar object which meets the same limited specifications of the description. The current account thus suggests that ambiguity tasks are harder than false belief tasks because they require the child to model the contents of the ambiguous utterance as partial and therefore limited in their referential scope. This idea will receive more attention in chapter 4. I mention it now to justify the inclusion of an ambiguity task in Experiment 3.

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<sup>14</sup> This account is elaborated in the next chapter.

### **3. Experiment 3: Non-linguistic intensionality?**

#### **3.1 Introduction**

If children's problems in Experiments 1 and 2 were due to a lack of knowledge about the pragmatic substitution rules in talk about mental states, the obvious prediction is that where there is no linguistic intensional context, reasoning about partial knowledge will be no more difficult than any other theory of mind task. In contrast, if children have a basic problem representing this consequence of the representational mind, predicting actions arising from partial knowledge will be as difficult as describing it. In Experiment 3 children were asked to predict Heinz's search behaviour on the basis of partial knowledge. This method had two additional advantages over Experiment 1. First, it was possible to make a very exact false belief style control so that there was no uncertainty about task-specific difficulties. Second, whilst in the language based situations so far discussed, children's answers to the intensional questions could only be conventionally wrong (in comparison with the interpretations of adults), in Experiment 3 children's mistakes would be clear errors - not a matter of interpretation but simply wrong.

#### **3.2 Method**

The principal test conditions used objects that could be referred to by two descriptions (X and Y), only one of which was visually obvious (X). These were paired with objects whose appearance demanded the non-obvious description Y. So for example, the dice/rubber from Experiment 1 was paired with a rubber of normal appearance. After the child had examined the objects and the descriptions had been agreed, s/he watched as

the puppet was allowed visual access only. As in Experiment 1, I checked that children had followed the scenario with intentional Q2: “Does Heinz know that the X is a Y?” Presentation of this question was counter-balanced with pseudo-intensional Q1 “Where will Heinz go to look for a Y?” This question was labelled pseudo-intensional in recognition of the fact that, whilst it was not intensional in itself, a correct answer required the child to represent Heinz’s knowledge. On Searle’s (1983) account (see chapter 1) his metarepresentation would necessarily entail an intensional context. Importantly, each child received both questions within trials. Recall that in the discussion of Experiment 1 I mentioned the possibility that children’s extensional errors (in answer to the intensional question) were merely performance problems and that these might be eliminated if children were prompted to consider the partial representational content. The above design means that half of the children receive just such a prompt, in the form of intentional Q2, before they are asked to predict what Heinz will do.

Earlier, I noted that the handling of ambiguity and intensional contexts both seem to require that the partial nature of representations be represented. I was therefore interested in whether performance on a test that required the child to recognise ambiguity in an utterance would be related to that on the pseudo-intensional tasks.

### *Participants*

39 children (19 boys and 20 girls) aged between 4;3 and 5;2 (mean age 4;9) who were in reception classes, 54 children (27 boys and 27 girls) aged between 5;3 and 6;2 (mean age 5;9) from year 1 classes, and 37 children (18 boys and 19 girls) aged between 6;3 and 7;2 (mean age 6;9) from year 2 classes were tested. I shall refer to these as the 4, 5

and 6-year olds respectively. All the children attended the same infant/junior school with a lower middle class / upper working class catchment area in Birmingham UK, and spoke English as their first language.

### *Materials*

There were three different pairs of items used for the two pseudo-intensional conditions and the intentional control condition respectively. In the pseudo-intensional conditions, one item in each pair had a dual function, only one of which was visually apparent. The dice/rubber from Experiment 1 was used again and was paired with a rubber of normal appearance. The rubbers were contained in separate boxes. The second item was a baby's toy that looked like a ball and contained a bell which was not apparent unless the ball was shaken. This was paired with a typical bell. Rather than boxes, covers that could be removed noiselessly were used to hide these items (see Procedure). The intentional control condition used a pair of identical pencil sharpeners that could be hidden under two up-turned tins. For the ambiguity task I used a Lego chassis with missing rear wheels that could be fitted with identically coloured (both red and black) wheels of different sizes. The deceptive box control task was as described in Experiment 1. The puppet, Heinz, was used once more as the co-protagonist in each trial.

### *Procedure*

Children were tested individually with all five items. In the two *pseudo-intensional tasks*, children always received the item with the dual identity first. With the dice, they were allowed to see the item in its box and the visually obvious label was agreed before

they felt it. If children did not identify it as a rubber spontaneously upon feeling, it was demonstrated. Once agreed, the two descriptions were then reiterated: "...so it *looks* like a dice and it *feels* like a rubber...". Next they looked in the second box and were asked to identify the other rubber. Children had no difficulty with these naming tests. Next, children observed as Heinz *looked* inside the boxes, now placed apart on the table in front of the child (both the relative spatial position of the two boxes and the order in which the puppet looked was random). As before, Heinz's lack of other perceptual access was emphasised by saying "Now Heinz is *looking* inside the boxes, but he's not *feeling*". With the lids back on the boxes, children were shown a cartoon drawn in pencil and told that Heinz wants to change the mouth on the figure from a frown to a smile, so he needs to find a rubber.

Children were asked either the pseudo-intensional question first:

Q1) "Where will Heinz go to find a rubber?"

and regardless of their answer, this was followed by the intentional question

Q2) "Does Heinz know that the dice is a rubber?"

Or they received these questions in the opposite order. This ordering was counter-balanced between child but was consistent within child. Children's responses invariably took the form of a pointing gesture.

Trials with the ball/bell followed the same general form. This time children heard and identified the bell before they saw and identified it as a ball. Again, these labels were reiterated with emphasis upon what information was available from seeing versus hearing: "It *looks* like a ball and it *sounds* like a bell". Both items were placed on the table in front of the child and individually covered. After Heinz had viewed the items under the covers

the child was told that he wanted to make some noise to wake up his friend who was asleep under the table. The pseudo-intensional question then became:

Q1) "Where will Heinz go to make some noise?"

whilst the intentional question remained

Q2) "Does Heinz know that the ball is a bell?"

The *intentional control task* had a similar surface form but was crucially different because this time, Heinz did not know about one of the objects. On the hypothesis that children's problems are with *partial knowledge* in particular, one would expect this task - like the deceptive box - to be easier than the "pseudo-intensional" tasks. Children were introduced to one pencil sharpener in the presence of Heinz. They were then told that he wants to hide it under one of the (two up-turned) boxes on the table. Once he had seen the sharpener hidden under one box, Heinz was removed from the table and put out of the way in a bag. Children were then shown a second identical sharpener and it was suggested that they hide it under the other box on the table. It was emphasised that Heinz could not see what we were doing. Heinz then returned to the table, needing a pencil sharpener. Children were either asked the action question:

Q1) "Where will Heinz go and look for a pencil sharpener?"

followed by intentional knowledge question:

Q2) "Does Heinz know that there's a pencil sharpener in here?" (pointing to the second box)

or they received the Q2 first and Q1 second.

In the *ambiguity task*, children were asked to judge the listener's knowledge (following Robinson and Whittaker, 1987; Sodian, 1988). Children were shown a Lego

chassis and told that Heinz had been making this toy, but that "...he can't decide which wheels to put on it". Children were shown that both sets of wheels fitted, producing a car-like or tractor-like model, then the wheels were hidden under two boxes on the table. Children were told "Now we're going to get Heinz to make up his mind, we're going to ask him to tell us exactly which ones he wants". Heinz then "whispered" to the experimenter, who relayed the ambiguous message to the child: "He says he wants the red and black wheels". The test question followed:

"Do we know which ones he wants?"

The procedure for the *deceptive box task* was as described in Experiment 1.

The five trials and their variants were partially counter-balanced. The three pseudo-intentional and intentional trials were always blocked together, but were ordered in the six possible ways. Half of the time, these tasks were preceded by the deceptive box and ambiguity tasks, in that order. On the other occasions, the ambiguity and deceptive box tasks came after the three other tasks, in that order.

### **3.3 Results and Discussion**

There were no effects of task order so all of the orders were combined for further analysis. Tables 4 and 6 summarise the data from the four different tasks.

Performance on the *intentional control task* Q1 was not significantly above the chance baseline<sup>15</sup> in the 4-year-olds: 24/39, 61%. Performance on Q2 ("Does Heinz know there's a sharpener in here?") appeared better with children achieving 26/39 (67%) correct from an anticipated zero baseline. As expected, the 5-year-olds performed better on Q1:

47/54, 87%, significantly above chance ( $p < .0001$  by sign test). This was significantly better than the 4-year-olds ( $\chi^2(1, N = 93) = 16.13, p < .001$ ). The 5-year-olds also improved on Q2: 52/54 (96%) ( $\chi^2(1, N = 93) = 14.69, p < .001$ ). In line with expectation, there was no significant further improvement on this near ceiling performance between the 5- and 6-year-olds, with children in year 2 scoring 31/37 (84%) on Q1 and 37/37 on Q2. In the five and six year old groups, five and six children respectively were correct on Q2 and incorrect on Q1, while no children showed the opposite pattern. This difference was statistically significant only for the oldest group,  $p = .032$  by sign test. However, answering Q2 first had no effect upon children's answers to Q1, nor *vice versa*: All  $ps > .47$  by chi-square test.

On the *deceptive box task* (see Table 6) 19/39 (49%) of the 4-year-olds were successful (from a 0% baseline), suggesting that the intentional control task was, if anything, a conservative measure of children's ability to distinguish intentional and extensional contexts. As would be expected, 5- and 6-year olds performed near ceiling (47/54 and 34/37 respectively).

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<sup>15</sup> Both Intentional control Q1 and "pseudo-intensional" Q1 conditions have theoretical 50% baselines while empirical evidence tells us that the ambiguity and deceptive box tasks have zero baselines.



Table 4. Number of correct judgements on two questions from the “pseudo-intensional” task and the intentional control task.

Age group	Intentional control: Q1 50% Baseline (Where will Heinz go...?)	Intentional control: Q2 (“Does Heinz know...?”)	“Pseudo-intensional” conditions: Q1: 50% baseline (“Where will Heinz go....?”)		Intentional Q2 from “pseudo-intensional” conditions (“Does Heinz know...?”)	
			Dice / Rubber	Ball / Bell	Dice / Rubber	Ball / Bell
4-year olds N=39	24 (61%)	26 (67%)	15 (38%)	15 (38%)	16 (41%)	18 (46%)
5-year olds N=54	47 (87%)	52 (96%)	27 (50%)	22 (41%)	44 (81%)	51 (94%)
6-year olds N=37	31 (84%)	37 (100%)	24 (66%)	20 (54%)	37 (100%)	35 (96%)

Responses to the (intentional) knowledge question (Q2) of the *pseudo-intensional task* (“Does Heinz know that the dice is a rubber?”) showed the same pattern of change as the intentional control. The 4-, 5- and 6-year olds scored an average of 17/39 (44%), 47/54 (87%) and 36/37 (97%) respectively across the two tests. Children were classified as having got none, one or both of the knowledge questions correct, and on this basis, children showed significant improvement with age,  $\chi^2(4, N = 130) = 47.5, p < .0001$ .

In marked contrast, scores on the action questions (Q1: “Where will Heinz go to...”) of each of the two *pseudo-intensional tasks* were not significantly different from chance in any of the three age groups. For the dice/rubber and ball/bell, scores were: 4-year olds,

15/39 (38%) and 15/39 (38%); 5-year olds, 27/54 (50%) and 22/54 (41%); six-year olds, 24/37 (65%) and 20/37 (54%) respectively. The fact that the rubber was referred to directly and the bell was only “to make some noise” made no significant difference to children’s performance on the two tests. The two tasks were therefore considered together, with children classified according to whether they got none, one or both of the pseudo-intensional questions correct. The combined performance on the two pseudo-intensional tasks was compared with its expected distribution on the basis of chance performance. On this more sensitive measure, the 6-year-olds, but neither of the younger age groups, performed significantly above chance (goodness of fit  $\chi^2(2, N=37) = 10.4, p < .01$ , other  $ps > .05$ ). Similarly, when combined performance was considered, there was a significant change in children’s performance across the three years ( $\chi^2(4, N=130) = 12.99, p = .011$ ).

For both 5- and 6-year olds, the action question (Q1) was significantly harder than both the knowledge question (Q2) and the matched intentional control task (all  $ps < .001$  by sign test). This replicates the disparity of performance between intentional and intensional questions observed in Experiment 1.

Table 5 details children’s combined performance on the pseudo-intensional task according to whether they had the pseudo-intensional or the intentional knowledge question first. The tendency was towards better performance when the intentional question came first, but no order effects approached significance (all  $\chi^2 < 1.41$ , all  $ps > .494$ ): Asking children first whether Heinz knew the dual identity of the test item did not assist them in predicting where he would search. This suggests that children’s difficulty with the action question was not simply due to their failure to recall Heinz’s knowledge state. This is

indeed arresting, because even if one does not normally subscribe to the performance error accounts outlined above, one might reasonably expect such a relevant prompt to assist children.

*Table 5. Number (percentage of sub-group) of children in the three age groups who got zero, one or both pseudo-intensional questions correct, divided according to whether they received the questions before or after the intentional knowledge question.*

Order of questions in the pseudo-intensional condition	Number of pseudo-intensional questions correct	4-year-olds <i>N</i> = 39	5-year-olds <i>N</i> = 54	6-year-olds <i>N</i> = 37
Intentional question first	0	4 (29%)	7 (29%)	3 (19%)
	1	8 (57%)	11 (46%)	4 (25%)
	2	2 (14%)	6 (25%)	9 (56%)
	Mean	6 (43%)	11.5 (48%)	11 (69%)
Pseudo-intensional question first	0	10 (40%)	9 (30%)	7 (30%)
	1	12 (48%)	16 (53%)	6 (29%)
	2	3 (12%)	5 (17%)	8 (38%)
	Mean	9 (36%)	13 (43%)	11 (52%)

In line with other results in the literature (see Robinson, 1994), on the *ambiguity task* there was a significant difference between the performance of 4-year-olds (6/39, 15%), 5-year-olds (24/54, 44%) and 6-year-olds (23/37, 62%),  $\chi^2(2, N=130) = 17.72, p < .0001$ . It is clear from observation of the data that this is due to an improvement in performance with increasing age. As expected, the ambiguity task was consistently harder than the deceptive box task (see Table 6; all *ps* < .001 by sign test).

Table 6. Number of correct judgements on the ambiguity and deceptive box tasks.

Age group	Ambiguity condition	Deceptive box condition
Reception (4 years) $N=39$	6 (15%)	19 (49%)
Year 1 (5 years) $N=54$	24 (44%)	47 (87%)
Year 2 (6 years) $N=37$	23 (62%)	34 (92%)

To compare performance on the ambiguity task with that on the pseudo-intensional tasks, scores for the two pseudo-intensional tasks were combined. There was no significant contingency between the ambiguity and pseudo-intensional questions for the 4-year-olds. For the 5-year-olds there was just significant contingency ( $\chi^2(2, N = 54) = 6.01, p < .05$ ). For the 6-year-olds the contingency was non-significant ( $\chi^2(2, N = 37) = 5.66, p = .059$ ) largely as a result of noise from the pseudo-intensional task's 50% base line. Following the method in Everitt (1977, pp.41-44) it was possible to reduce this problem by partitioning the  $\chi^2$  statistic. First, a contingency test was performed comparing success on the ambiguity task for children who got either 0 or 1 of the pseudo-intensional action questions (Q1) correct ( $\chi^2(1, N = 20) = .213$ ). These two categories (that theoretically accounted for 75% of chance responses) were then combined, and compared with the ambiguity results of children who had got both pseudo-intensional action questions correct. Contingency between the ambiguity and pseudo-intensional tasks was then significant ( $\chi^2(1, N = 37) =$

5.45,  $p < .02$ ), suggesting, together with the results from the 5-year-olds, that the ambiguity and pseudo-intensional tasks may place common demands on children.

To summarise, the results replicate the well known finding that by five years of age, children have little difficulty making the intentional/extensional distinction (as required for success on deceptive box and unexpected transfer tests of false belief, and the intentional control condition in the current study). Performance on the ambiguity task is also consistent with the literature. Set against these bench-marks, the children's performance on the pseudo-intensional task is quite striking. In line with their performance on the deceptive box test and intentional control, 5- and 6-year-olds found the intentional knowledge question (Q2) easy: "Of course Heinz doesn't know that the dice is a rubber; he hasn't felt it!". In contrast, these children were at chance when they had to apply this knowledge and predict where Heinz would look. Furthermore, answering intentional (Q2) first did not assist children's answering of intensional Q3. However, there were significantly more 6-year-olds passing *both* tasks than expected by chance, which suggests that at least some of these oldest children were fully competent. Additionally, for both the 5- and 6-year-olds there was significant contingency between performance on the pseudo-intensional tasks and the ambiguity task. In chapter 4 I shall argue that this is no coincidence but in fact results from a basic similarity in the representational demands of the two conditions.

#### **4. General summary and discussion**

The first aim of Experiments 1 and 2 was to establish the replicability of Russell's (1987) finding that children aged 5-6 have great difficulty handling intensional contexts. In Experiment 1, my modified tasks contained much less task-specific complexity than Russell's, yet children's

problems persisted. Correlation of Russell's tasks and my modified versions in Experiment 2 supported the conclusion that the shared feature of an intensional context was the source of this problem.

Reduction of the task-specific complexity and the use of appropriate controls in Experiments 1 and 3 makes it difficult to explain away children's problems with intensional contexts as incidental to the test procedure. This poses a challenge to the view that the theory of mind tests passed at around four years diagnose the development of a theory of metarepresentation (e.g. Gopnik & Wellman, 1992; Perner, 1991). Such a theory should be able to cope with intensional contexts as easily as false beliefs, yet my data suggest that this is not the case.

A number of authors have characterised children's failure on Russell's tasks as a specifically linguistic or pragmatic problem, with no implications for mentalistic development. The current experiments provide three lines of evidence against this view. Firstly, linguistic knowledge of the kind discussed was irrelevant in Experiment 3 since there simply was no linguistically grounded intensional context and thus no opportunity to make a non-conventional, transparent interpretation. In spite of this, referential problems persist because, as Searle (1983) stresses, intensionality results from representations only partially capturing their referents; it is independent of the mode in which metarepresentation occurs and thus is not a linguistic phenomenon *per se*. In the next chapter I will argue that this result calls for a rethinking of the psychological nature of referential problems.

The second line of evidence against explanation in terms of linguistic knowledge concerns the correlation in Experiment 3 between the pseudo-intensional / intensional

conditions and the ambiguity task (much more of which in chapter 4). Ambiguity has nothing to do with the pragmatics of when an opaque or transparent interpretation is appropriate. Finally, my failure in Experiment 1 to replicate Russell's finding of intensional errors in extensional contexts, weakens the case for an explanation solely in terms of pragmatic difficulties. Russell's finding of both intensional errors in extensional contexts and extensional errors in intensional contexts allowed him to argue that children's problem is with pragmatic substitution rules, which are over-applied in the former case and under-applied in the latter. This explanation is less persuasive if (as the current findings suggest) children only mis-apply the rules in one direction.

What about performance problems: Could children's economy of effort in selecting explanatory hypotheses (e.g., Fodor, 1992), reality bias (e.g., Mitchell, 1996), or executive limitations (e.g., Russell, 1996) explain my results? The counter-intuitive finding that answering a question about what Heinz does not know had no significant effect upon children's ability to predict how he will act points away from such explanations. More specifically, for a Fodor-style explanation, the very close similarity between the intentional control condition and the pseudo-intensional condition, surely makes the suggestion that children fail to select a "belief-based" hypothesis in the latter difficult to sustain. The only substantial difference between the two main conditions in Experiment 3 is that in the pseudo-intensional task, Heinz's knowledge is *partial* whilst in the control - as in all of the standard theory of mind test formulations - ignorance is *total*. The necessary refinement, that children who can select a "belief-based" hypothesis fail to select a "partial belief-based" one when necessary seems somewhat *ad hoc*. The possibility that children are

failing to disengage from their own privileged knowledge to report another's partial knowledge will be addressed further in chapter 4.

Finally, the developmental account of Chandler (e.g. Carpendale and Chandler, 1996) which withholds a mature understanding of the mind until 6-7, initially seems better equipped to explain the observed pattern of late change. However, I have already suggested that it may fall down on the details. In the introduction I argued that the difference between a copy theory and an interpretive theory of the mind could not easily explain the dissociation between intentional and intensional questions in Russell's experiment (Russell, 1987). This argument applies equally to the results of my experiments. Furthermore, in Experiment 3 the close similarity between the intentional control and the pseudo-intensional tasks makes a change in a child's gross theory about how the mind works seem an unnecessarily complex means of explaining the difference in task difficulty. Chandler's framework has the necessary form but appears to lack the explanatory substance.

In sum, having established the replicability and generality of the problems identified by Russell (1987) in Experiments 1 and 2, I examined a series of ways in which they might be dealt with by contemporary theories of mentalistic development, and argued that each account is found wanting. In the next chapter I shall elaborate upon the explanation advanced in the discussion of Experiments 1 and 2, in terms of children's inability to represent the partial nature of representations, in the hope of developing a framework within which the phenomena can be described and examined.



# Chapter 3. Representational partitioning in mentalistic development

## 1. Introduction

The investigations in the last chapter show a dissociation in children's handling of mentalistic referential problems that contemporary developmental theories find difficult to accommodate. Specifically, children find it hard to treat mental states as only *partially* capturing their referent situations. In the discussion of Experiments 1 and 2 I suggested a working explanation of the surprising difference between questions such as "Does Heinz know that the ball is a present?" (easy for 5-year-olds) and "Does Heinz know that there is a present in the box?" (difficult for 5-year olds). However, this was couched in terms of concepts of "opacity" and "transparency", grounded in traditional logical theories which I had already questioned in chapter 1. To improve and expand this account we need to look again at the nature of these referential problems.

In chapter 1 I suggested three ways in which Quine's solution to the problem of opaque contexts (Quine, 1953) might fall short of being an adequate account of the normal language of folk psychology. Firstly, Quine addresses the problem of *de re / de dicto* ambiguities in propositional attitude reports by excluding the former interpretation from "our overall scientific language couched in the extensional grammar of predicate logic". In doing so, he effectively denies his account the possibility of dealing with this natural language phenomenon. Secondly, and relatedly, by taking the decontextualised sentence as his unit of analysis, Quine excludes the

possibility that the restrictions on co-extensional substitution in opaque contexts could be flexible or context dependent: Quotation marks are an impermeable barrier to extensionality. Finally, the single syntactic expedient of quotation marks leaves no scope for a distinction between the different sources of referential problem. Yet in the last two chapters, I argued that the common view in the developmental literature of referential problems as a single phenomenon struggles to accommodate the findings of Russell (1987) and Experiments 1-3. Quine's framework would seem an inadequate basis for the development of a better developmental account.

However, there is a vast literature in philosophy of logic and language, linguistics and artificial intelligence devoted to finding solutions to some or all of these problems. These accounts vary enormously in the ease with which they can be applied to the problems of mentalistic development. It is beyond the scope of this thesis to review them here, less still to argue comprehensively for the superiority of one solution over another. My approach will be to indicate some of the broad options that are available in order to place the choice I eventually favour - Fauconnier's (1985) psychologically oriented "Mental Spaces" account - in context.

To start, I need to re-introduce the idea of representational partitioning from chapter 1. Recall that referential problems arise when we (the representing system) entertain the relation between "here-and-now reality" which is assumed to be extensional and another situation or context in which objects do not fall under an identical range of description. Examples might be the same situation at a different time, a hypothetical variant or a (necessarily partial) mental or non-mental representation of the situation. The meanings due to these differences can only be represented if the various contexts (including "reality") are in some way recognised and "partitioned" from each other. This is the function of Quine's quotation marks which serve to

isolate the contents of propositional attitudes, quotations and modal contexts from the extensional assumptions of his predicate logic.

## 2. Syntactic partitioning

Quine insisted on preserving the integrity of his logical scheme at the expense of a full account of propositional attitude reports, but formal accounts employing syntactic partitioning are possible. *De re* interpretations of linguistic belief reports can be represented by introducing a three-place (as opposed to the usual two-place) predicate for the “representation relation” between an idea, an object and a person (Kaplan, 1969, cited Edelberg, 1992). So for the *de re* interpretation of “Oedipus believes the queen of Thebes is a spy” (read as “Oedipus believes that person to be a spy”), Oedipus’ belief is isolated by quotation marks (or some other syntactic device), as in the *de dicto* interpretation, but the object of his belief is an “idea”,  $\alpha$ , whose relation to “queen of Thebes” is defined separately and *extensionally*:

$$\alpha(R(\alpha, \text{queen of Thebes}, \text{Oedipus}) \ \& \ B(\text{Oedipus}, \text{“}\alpha \text{ is a spy”}))$$

where predicate “R” expresses the representation relationship and “B” the belief relationship.

Such accounts have been posited to solve a variety of referential problems associated with belief reports (see e.g., Edelberg, 1992; Zalta, 1988; Rappaport, 1986 proposes a semantic/associative network model that appears to instantiate a similar system). However, a possible objection to these approaches is their use of purely mental “ideas” to mediate between belief reports and the world. This apparent ontological commitment to a category of things with no concrete basis is the reason this approach was eschewed by Quine, who sought to restrict his logical account of the

world (and the mind) to the concrete and the real. Other thinkers sensitive to these issues also tend to reject this approach (see e.g., Dennett, 1987).

Crimmins (1992) offers an account of belief reports which seeks to avoid these particular problems. It relies on the view that a believer has a whole range of *concrete* “notions” and “ideas” which together amount to him/her believing an extensional proposition, and that these constitute *the particular way* it is believed. In a belief report the speaker explicitly identifies the proposition that is believed, and this is entirely sufficient for communication provided the believer can be assumed to have a “normal idea” of the object of the belief. This corresponds to the traditional conception of a *de re* belief report which entails no restrictions on the characterisation of the object. However, where this is not the case (and this not being the case is relevant), the speaker uses pragmatic means to refer tacitly to the believer’s way of believing (the ideas and notions) and thus narrows the implications of the report. This corresponds to a *de dicto* belief report. Importantly, the ideas and notions are concrete; they are assumed to have a physically circumscribed existence, in contrast with the abstract and purely mental “ideas” discussed in the previous paragraph. In this way, Crimmins claims to have avoided the special ontological assumptions entailed in the above type of accounts.

Crimmins takes an important step away from many traditional logical approaches by locating important aspects of meaning outside of the decontextualised sentence. However, whilst the account relies upon pragmatic cues to direct belief report interpretations, it is implemented in a semantic/associative network where the level of description is symbolic<sup>16</sup>. Crimmins thus seems to face the difficulty (previously mentioned in connection with Fodor and Leslie) of having to

explain the apparent discrepancy between the “high-level, conscious” nature of our folk psychological intuitions and “low-level symbolic” level of description in his system.

*Problems with syntactic partitioning*

Crimmins’ difficulty is general to symbolic / syntactic accounts, but as noted in chapter 1, may not be insurmountable. It is open to such theorists to dismiss the discrepancy between our intuitions and their accounts as illusory and maintain that a sub-personal, symbolic level of description can explain all the facts of cognition. As in chapter 1, it is not my purpose here to present a general argument against this position, but to justify my opting against it as a framework for considering my results.

Firstly, such theories tend to presuppose a representational format which is innately specified, limiting much of development to the switching on of cognitive modules (see e.g., Leslie, 1987, 1994; Baron-Cohen and Ring, 1994) or a gradual increase in global processing resources (e.g., Fodor, 1992). I have already indicated the problems that such accounts might have with the data presented in Experiments 1-3.

Secondly, the accounts reviewed above deal exclusively with the referential problems associated with propositional attitude reports (and often only a sub-set of these in each case) yet in chapter 1 I noted that there are many related referential problems in non-mentalistic contexts. Certainly, there is nothing to stop similar, syntactic accounts being made of non-mentalistic referential phenomena but this must add to the complexity of the representational system. As I argued of Leslie’s views in chapter 1, consideration of one set of referential problems in isolation

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<sup>16</sup> Although distinct from logic-based systems where a symbol is characterised by a unique name, semantic/associative network are still symbolic: information is represented by inter-connected nodes whose meaning consists in their position in the network.

gives the misleading impression of a parsimonious explanation. Once syntactic mechanisms are multiplied up to cope with the full variety of referential problems, the resulting complexity looks less attractive as a developmental account.

### **3. Semantic partitioning**

According to Fauconnier (1985; 1997), aspects of meaning are constructed in the mind by the partitioning of content into “mental spaces” whose properties lend it different meanings. This account (and that of Dinsmore, 1992<sup>17</sup>) is intended primarily to explain a wide variety of natural language phenomena, including the referential problems discussed in chapter 1. However, it is developed in Fauconnier (1997) and Dinsmore (1992) to range over aspects of thinking and reasoning. It is pitched at the highest cognitive level of on-line processing and is intended to be psychologically plausible and empirically testable. Mental spaces are thus vastly different from “possible worlds” (Montague, 1974, cited Fauconnier, 1985) which are posited to define sentence meaning objectively. Mental space constructions are “in the head” of an individual “...they are not something that is being referred to, but rather something that can itself be used to refer to real, and perhaps imaginary, worlds.” (Fauconnier, 1985, p.xxxvi). The spaces themselves are set up in response to the demands of the discourse or the reasoning task and are internally structured by the knowledge base of the individual. Unlike syntactic partitioning mechanisms which are by their nature static and mechanistic, mental spaces are dynamic and flexible, and are individuated by their meaning rather than their form. It therefore seems useful to think of them as *semantically* partitioned processing spaces.

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<sup>17</sup> The “partitioned representations” of Dinsmore (1992) are in many respects similar to Fauconnier’s mental spaces. For clarity I shall usually talk only about Fauconnier, and use his terminology; referring to Dinsmore only when his account adds something relevant.

Importantly, Dinsmore (1992) writes that “The theory of partitioned representations imposes a *higher-level* organisation on representations. It makes no specific commitment to how the content is structured within spaces, nor to the nature of the reasoning processes that might occur locally within a space” (p.51, original italics). He thus separates his arguments for partitioned representations (which centre on their being a highly efficient means of representing complex information) from the debate surrounding more detailed choices about the representational substrate; between propositional, analogical or procedural representations for example. However, both Dinsmore and Fauconnier also argue that the advantages of partitioned representations (and mental spaces) are enhanced by some choices over others: Among other things, Dinsmore discusses Johnson-Laird’s analogical “mental models” to this end; Fauconnier suggests that “frames” (Filmore, 1982, 1985) and Idealised Cognitive Models (Lakoff, 1987) might contribute importantly to the internal structure of spaces.

With this additional baggage, the theories of both Dinsmore and Fauconnier involve a radical departure from many conventional assumptions in linguistics and philosophy of language and logic, including the rejection of a purely objective semantics for natural language and concepts (see Dinsmore, 1992; Fauconnier, 1985, 1997; Lakoff, 1980, 1987). Important aspects of these views appear in other contemporary work in the cognitive sciences, particularly that concerning embodied cognition (see e.g., Clark, 1997 for a review) and the approach that characterises beliefs as a reflection of the subject’s internal “notional world” (e.g., Dennett, 1987). For these authors the inadequacy of the traditional view justifies a different approach. It is beyond the scope of my thesis to join this debate, so while noting its controversial nature, I shall examine my findings through Fauconnier’s scheme without questioning its assumptions any

further. I hope a sceptical reader will, at least, appreciate the principal advantages of partitioned spaces as a way of describing the referential problems.

### 3.1 Mental Spaces

At the heart of Fauconnier's approach is the conception of language as a much richer source of meaning than traditional logical analysis suggests. He quotes Turner, (1991): "Expressions do not mean; they are prompts for us to construct meanings by working with processes we already know. In no sense is the meaning of [an]... utterance "right there in the words". When we understand an utterance, we are in no sense understanding "just what the words say"; the words themselves say nothing independent of the detailed knowledge and powerful cognitive processes we bring to bear"(p.206). Fauconnier's scheme describes the generation of meaning in natural language in this broader context.

To do so, we are told, requires an overturning of our common sense views of language, "In our folk theory, it is the words that carry the meaning: We 'say what we mean,' we 'put meaning into words,' and so on."(Fauconnier, 1985, p.xviii). Yet he claims that there is no such direct relation, rather that "...languages are designed ..... to prompt us into making the constructions appropriate for a given context with a minimum of grammatical structure." "Language does not itself do the cognitive building - it 'just' gives us the minimal, but sufficient, clues for finding the domains and principles appropriate for building [meaning] in a given situation."(ibid.) This is clearly a radical departure from the logical analyses discussed above which Fauconnier criticises: [of Quine] "By assuming like everyone else that natural language sentences, although endowed with fairly bizarre logical properties, were still in principle objects of the same *nature* as the formal sentences of logical systems, he transposed to the former,



queries appropriate for the latter”(p.xx). In place of this approach, Fauconnier suggests a scheme in which the “bizarre logical properties” arise as a natural consequence on the general ways in which language cues meaning representation in constructed *mental spaces*.

Partitioned mental space structures are set up “on line” in response to the demands of discourse or reasoning: In the case of understanding an utterance, syntactic, semantic and pragmatic cues could all act as “space builders”. The spaces have internal structure, with general information from the individual’s knowledge base plus specific information appropriate to the particular situation. As words<sup>18</sup> fit into these structures they derive their richer, situation specific and partially subjective meaning. I will illustrate these ideas with some examples relevant to a discussion of Experiments 1-3.

Beginning with the simple sentence, “The cat sat on the mat”, the contents of the sentence (cat sitting on mat) are all contained within a single domain - call it “reality”<sup>19</sup>. Complexity arises when reference extends beyond the real “here and now” setting; when different domains are evoked. In the case of propositional attitude reports, some words in a sentence can refer to “reality” and others to mental contents.

Recall that the sentence “Oedipus believes the Queen of Thebes is a spy” has a *de re* interpretation, corresponding to something like

1) “Oedipus believes the person referred to as “the Queen of Thebes” is a spy.” in which any other true description may replace “Queen of Thebes”,  
and the *de dicto*

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<sup>18</sup> For clarity, I shall usually talk about external “words” or “linguistic content”, but assume (like Fauconnier and Dinsmore) that most of the same things can be said of “inner speech” or reasoning.

2) “Oedipus believes that the person he takes to be the Queen of Thebes is a spy”

in which substitution of co-referential terms is constrained by what Oedipus himself knows about the Queen of Thebes. To make an interpretation, the listener must assign the phrase “Queen of Thebes” a referring relation, either as an extensional label (1) or an intensional label (informally, part of Oedipus belief) as in (2).

Figures 1 and 2 show how this is achieved with mental spaces. The verb phrase “Oedipus believes...” implies the domain of “Oedipus’ belief” in addition to the domain of “reality” and thus cues the listener to set up two corresponding mental spaces between which the sentence contents can be partitioned. In Fauconnier’s parlance, it acts as a “space builder”. Figure 1 depicts schematically the distribution of phrase contents to make a *de re* interpretation. The noun phrase “the Queen of Thebes” is held as relating to an external state of affairs by its placement in the “reality” mental space, and its reference to Oedipus’ belief (that she is a spy) is marked by the arrow linking it to the “belief” mental space, which contains the phrase “is a spy”. **This Error! Reference source not found.** represents an interpretation structure “in the listener’s head” corresponding to the transparent reading above. Note that at this point, the semantic nature of the partitioning is relatively unimportant: The spaces can be regarded simply as a useful descriptive tool for the referential phenomena. It is only when I come to address the developmental data that I make use of the more controversial elements of the scheme.

Figure 2 shows how a *de dicto* interpretation results from a different distribution of the sentence contents between the same spaces. This time both “the Queen...” and “is a spy” are held

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<sup>19</sup> This is not *objective* reality and therefore is not fully extensional: It is still “in the listener’s head” and therefore a representation. However, from the first person viewpoint and for the purposes of the examples here it can be assumed to be both real and extensional.

as relating to Oedipus' belief, by their placement in the belief space in which co-extensional terms preserve their individual (intensional) meanings.

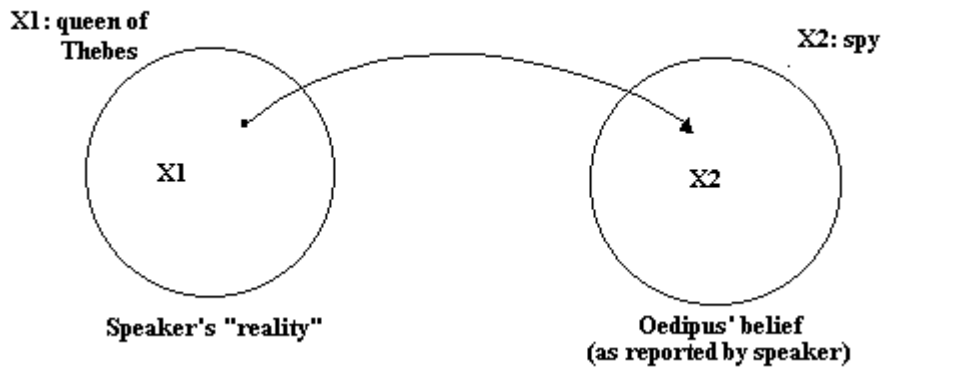


Figure 1. “Oedipus believes the Queen of Thebes is a spy”: ‘Oedipus believes the person referred to as “the Queen of Thebes” is a spy.’

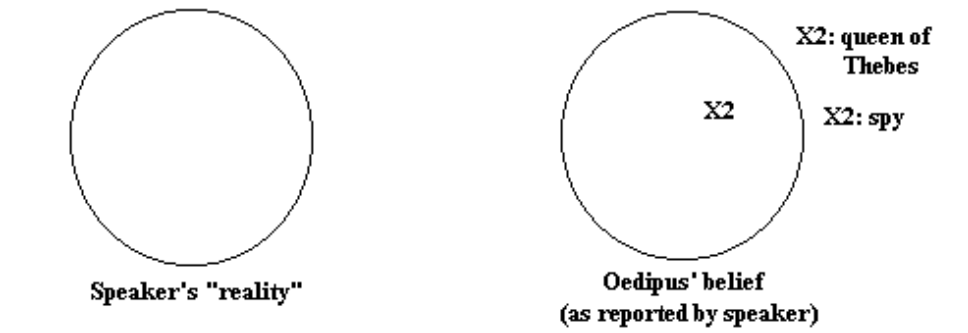


Figure 2. “Oedipus believes the Queen of Thebes is a spy”: ‘Oedipus believes that the person he takes to be the Queen of Thebes is a spy.’

*De dicto* and *de re* interpretations of propositional attitude reports, far from being respectively a case in need of special treatment and an anomalous “outrider” to the logical system, are on this account just two sides of the same coin, each arising as a natural alternative to the other in the way meaning is constructed in the mind. Where a system in the Quinean spirit uses quotation marks to seal off propositional attitude contents from their normal referential ties, Fauconnier’s scheme achieves the same partitioning without recourse to syntactic means, by having the context set up different mental spaces into which the words can be assigned and linked to produce an interpretation.

Other opaque contexts identified by Quine are dealt with in exactly the same way, with the building of “necessary”, “possible”, “counterfactual” and “quotation” spaces for example. Fauconnier goes on to show that such philosophical puzzles are just particular instances of referential problems that arise in any discourse that ranges beyond a single context. Crudely put, the traditional view is that logical forms such as counterfactual or modal contexts are the “pure” problems for the cognitive system which must be abstracted from messy everyday discourse about fictions or plans: The “logical” problem is separated from the “contextual” or “communicative” problem and may even be processed in a separate sub-system. In contrast, for Fauconnier, this division of processing is artificial and misleading: On his account, the only difference between abstract and everyday problems is the amount of context-dependent structuring of the partitioned spaces.

As an illustration of this approach, consider the “fuzzy” limits on co-extensional substitution described in chapter 1. Recall my claim that whilst “sometime resident of Chequers” might not be substitutable for the co-extensional “prime minister” in an intensional context, it would be peculiar (without good reason) to deny that we could say that “John does not know that

the resident of No.10 is Tony Blair”. As with Crimmins’ use of “normal ideas”, the mental space corresponding to “John’s knowledge” is structured by the listener’s own knowledge of the extension of “prime minister” with appropriate augmentation if the listener has reason to doubt John’s knowledge of these. Unlike many traditional accounts, Fauconnier gives a central role to such pragmatic knowledge. And unlike Crimmins’ account, the knowledge is high-level in the sense that it belongs to the “person” as usually understood in folk psychology, rather than consisting in an arbitrary property such as position in a semantic network.

Reference across temporal contexts - where some features of objects may change and some do not - is readily accommodated in the same way. Figures 3 and 4 depict two interpretations for a sentence describing a future marriage<sup>20</sup>. “In forty years time” acts as a space builder, implying present and future contexts into which the terms “middle aged daughter” and “marry” can fit.

Figure 3 corresponds to a *de re* interpretation, with the current “middle aged daughter” referring to the future [person who will] “marry”. This example is analogous to my discussion of the Wimmer and Perner’s (1983) unexpected transfer task where the child has to entertain the idea that “Maxi thinks the chocolate [in B] is in A”. In that case, reference between the two times is not explicitly represented in the sentence, but is inferred from knowledge that Maxi’s mind represents an out-dated situation. Figure 4 corresponds to a *de dicto* reading in which both references to the daughter are placed in the future time frame.

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<sup>20</sup> This example is from Fauconnier, (1985).

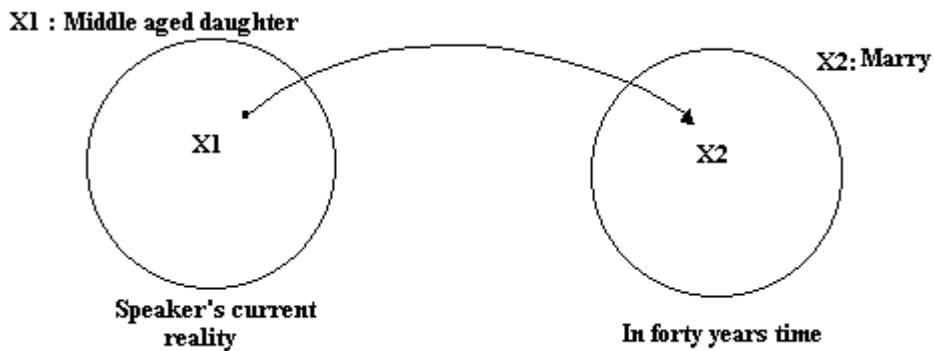


Figure 3 De re interpretation of “In forty years time my middle aged daughter will marry”: ‘In forty years my middle aged daughter will marry; by then she will be an old woman’.

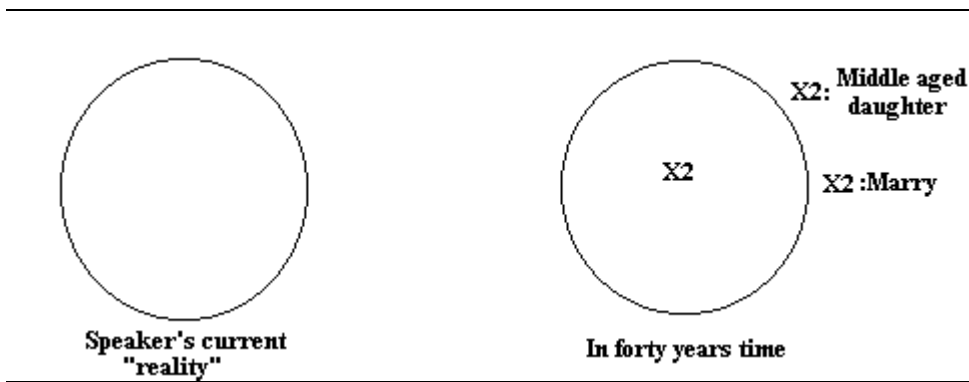


Figure 4. De dicto interpretation of “In forty years time my middle aged daughter will marry”: ‘In forty years time my daughter will marry; by then she will be middle aged’.

On this account, the on-line processing behind a *de re* (and thus referentially transparent) interpretation entails setting up a second mental space from “reality” and relating a term in the base “reality” space to its counter-part in the other space. A *de dicto* interpretation of an opaque

context entails setting up a second mental space and relating terms *within* it<sup>21</sup> (without foregoing one's own knowledge of the real state of affairs). But if the analysis in chapter 1 is correct, and the standard false belief tasks do not involve an opaque context, are we not still left with the possibility that children's mis-handling of intensional contexts could be due to a general failure with the processing needed for a *de dicto* interpretation? The results of Robinson and Mitchell (1992,1994) suggest not, since many five year old children can treat a request as referentially opaque (though, I argued, not in the broad sense supposed by Mitchell, 1996; see chapter 1). However, to check this particular aspect of their findings I ran a small investigation which avoided the complications of having to resolve a character's beliefs and desires.

*Children's handling of a non-mentalistic opaque context.*

15 children in a reception class (mean age 4;8) were presented with a story supported by pictures. Children were told that the first picture was of "yesterday" and showed a character, "Johnny", eating an orange for breakfast. The second picture showed Johnny asleep in bed that night. The third picture was "today" and showed Johnny eating a banana for breakfast: "Look, Johnny's eating a banana for breakfast today!" Children were then asked, "Do you remember yesterday? Yesterday, was Johnny's breakfast yellow?" Although this question is formally ambiguous (it is possible to make a *de re* interpretation, allowing "Johnny's breakfast" to refer to today's breakfast yesterday, and say "yes, Johnny's banana was yellow yesterday!") this was not the intuition of a number of adults who read the story; all made the anticipated opaque interpretation and said "No, it was orange". 14/15 four year olds also gave this answer. Although this informal investigation has many deficiencies - it lacks control or comparison tasks for

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<sup>21</sup> Within the parameters that define the space, co-extensive terms are freely substitutable.

example - its results corroborate the findings of Robinson and Mitchell (1992, 1994), suggesting that children aged 4-5 can indeed handle some sorts of opaque context. Children's mis-handling of intensional contexts cannot be a problem with the form of *de dicto* processing *per se*.

*Children's problems are with content not form*

In Fauconnier's account, the formal aspects of partitioning and within-space reasoning are the same, regardless of the source of the referential problems: Reference to different times, spaces, hypothetical state of affairs or a mental contents are all handled in the same way. Therefore, to explain the dissociations reported in Experiments 1-3 we must consider the semantic basis for partitioning. I shall argue that children's problems are not with partitioning *per se* but with partitioning content in the necessary way. I begin by describing the results in these terms before exploring explanations in later sections.

### **3.2 Describing the results of Experiments 1-3**

*Depicting adult interpretations in mental spaces*

Representing *de re* and *de dicto* interpretations of the key questions in Experiment 1 with mental space diagrams makes the contrast between their possible interpretations clear. Figure 5 and Figure 6 show *de re* and *de dicto* interpretations of the intensional question "Does Heinz know that there's a rubber in the box?" In the *de re* interpretation which might be paraphrased as "Does Heinz know that there's something in the box?"<sup>22</sup> the term "rubber" is put in the mental

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<sup>22</sup> Admittedly, such an interpretation is difficult to envisage in the circumstances of experiment 1 where Heinz's ignorance was highly relevant (which makes children's errors all the more surprising). But imagine a scenario where Heinz's knowing *that the dice was a rubber* was completely irrelevant: All that mattered was that he knew that there was *something* in one box and not another. In such circumstances, provided the speaker and listener shared



space for the speaker's reality (where it is extensional within the limits of the speaker's knowledge) and refers to Heinz's knowledge which is a separate space. In the *de dicto* interpretation, paraphrased "Does Heinz know that the box contains a rubber?", "rubber" is treated as a direct description of Heinz's knowledge by its placement in the "knowledge space".

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knowledge of the rubber, it would seem inappropriate for the listener to say "No: Heinz doesn't know that is the full box because he doesn't know the thing inside is a rubber!"



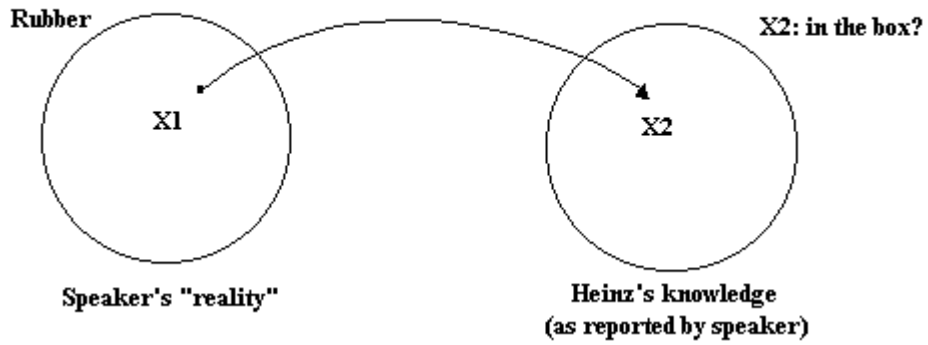


Figure 5. De re interpretation of “Does Heinz know that there’s a rubber in the box?”: ‘Does Heinz know that there’s something in the box?’

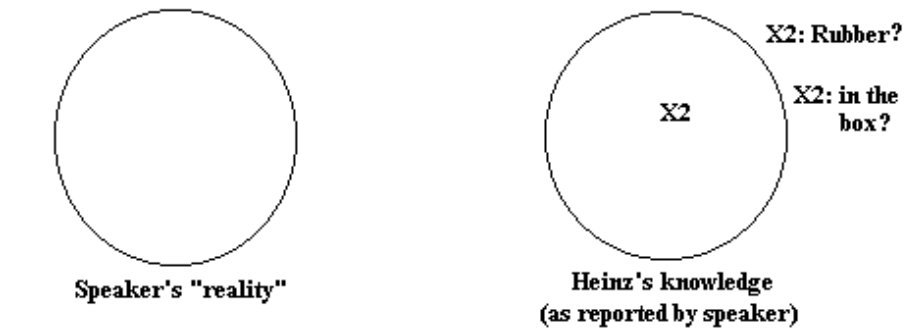


Figure 6. De dicto interpretation of “Does Heinz know that there’s a rubber in the box?”: ‘Does Heinz know that the box contains a rubber?’

Figure 7 and Figure 8 show *de re* and *de dicto* interpretations of the intentional question “Does Heinz know that the dice is a rubber?” In the *de re* interpretation, “dice” is put in the space for speaker’s reality and refers to Heinz’s knowledge of the term “rubber” represented in the second space. This might be paraphrased as “Does Heinz know that *that* is a rubber?” (where *that* refers to the item in the box). In the *de dicto* interpretation, both “dice” and “rubber” are treated as descriptions of Heinz’s knowledge by their placement in the “knowledge space”. This might be paraphrased as “Does Heinz know the item is both a dice and a rubber?”, which I suggest is not the way an adult would interpret the question. This is inconsequential however, since Heinz knows that the item is a dice, so correct answers to both questions turn only on his ignorance of the fact that it is also a rubber.

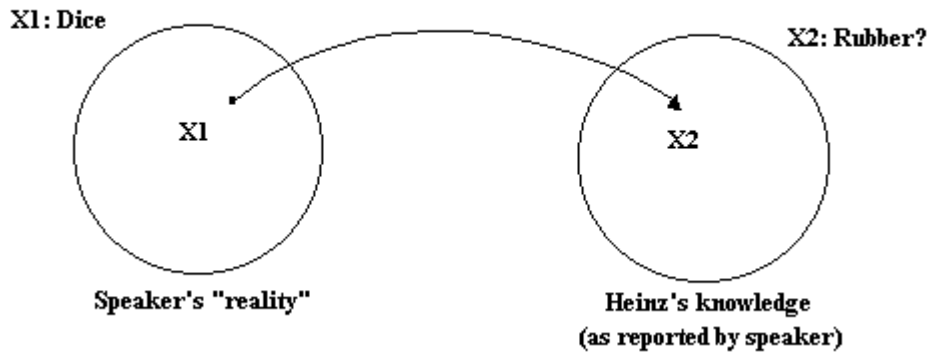


Figure 7. De re interpretation of “Does Heinz know that the dice is a rubber?”: ‘Does Heinz know that that is a rubber?’

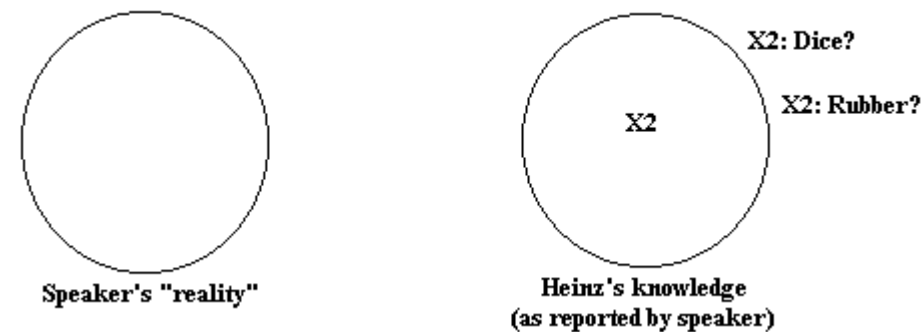


Figure 8. De dicto interpretation of “Does Heinz know that the dice is a rubber?”: ‘Does Heinz know the item is both a dice and a rubber?’

In my discussion of the results of Experiments 1 and 2 I used this difference in the meaning of possible interpretations of the intentional and intensional questions to suggest an explanation of children's surprising success on the former, given their failure on the latter. I argued that children fail to make *de dicto* interpretations of intensional contexts because they do not treat representational content as partial, but that a correct answer on the intentional question was possible because in this case, a *de re* interpretation prompts the same answer as the correct *de dicto* alternative. But couching this explanation in terms of adult-like *de re* and *de dicto* interpretations leads to a difficulty that I did not address at the time. For surely, the knowledge required for a *de re* interpretation of the intentional question (i.e., that Heinz doesn't know about the rubber) would be perfectly adequate for an adult to predict that he will not seek the object when he needs a rubber (which children could not do in Experiment 3). From this perspective, the account appears inconsistent, for it suggests that children simultaneously do and do not handle partial knowledge. I will use the account of meaning construction in semantically partitioned mental spaces to try and resolve this problem.

#### *Qualitatively different semantic spaces*

My purpose in this section is to develop the idea that children's representation of knowledge in mental spaces is importantly different from that of adults'. This is the part of my account that sets it apart from the others discussed before, and underlies its ability to accommodate my data. But before I start I need to avoid the trap of being penned in by the language used to describe the referential problems. *De re* and *de dicto* interpretations in the above examples corresponded in a straight forward way with the varying distribution of content and mappings between spaces. However, once one contemplates non-adult mental spaces, the same

formal distributions and mappings represent different meanings and the correspondence with adult interpretations is lost. For this reason I shall use a new terminology to refer to the way in which content is distributed between spaces and assume that this removes the adult meaning entailments. I shall describe as *cross space interpretation* the situation in which an item of content in “reality” space refers to a co-extensive item (under a different name) in another space corresponding to “knowledge” (as in Figure 7); *within space interpretation* will correspond to the case in which items of content are related *within* the knowledge space (as in Figure 8).

I suggest that 5-6 year olds’ handling of mentalistic problems is qualitatively different from adults’ because they fail to treat mental states as *partial*. In the mental spaces scheme this means that the space set up to represent Heinz’s knowledge captures it in a way that is undifferentiated with respect to its particular aspects: One might say that it represents *that* he knows about it rather than *the way in which* he knows about it. Thus, for the intensional question, children make a *within space* (not a *cross space*) interpretation, but none the less make the error of allowing co-extensional substitution because the “knowledge” space is effectively extensional (see Figure 9). Likewise, on the pseudo-intensional question, children model Heinz’s relation to the dice/rubber via a similar “knowledge” space and thus predict that he will search as if he knows everything about the object.

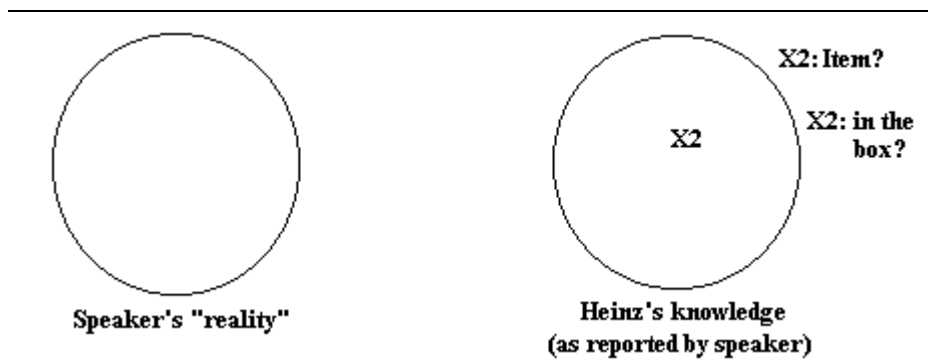


Figure 9. Children's incorrect within space interpretation of "Does Heinz know that there's a rubber in the box?": 'Does Heinz know there's an item in the box?'

On the face of it, this analysis makes it difficult to explain children's success on the intentional question. Firstly, I have to assume that children are not making a *within space* interpretation (effectively asking whether Heinz knows that the item is both a dice and a rubber) which, on the above reasoning, they would answer incorrectly. This assumption is supported by the argument that a *within space* interpretation is not the most likely one for adults (see above). Secondly, the *cross space* interpretation (effectively asking whether Heinz knows that the item is a rubber) also appears vulnerable if "dice" and "rubber" are treated as equivalent terms. This problem can be resolved with a more detailed analysis of mental space construction that develops the idea that the structure of spaces may vary according to the situation.

Mental spaces function in on-line meaning construction. Their internal structure (and thus the meaning of their content) is cued and set up according to the ongoing activity. Thus, a space such as that for Heinz's knowledge is not a fixed or definitive representation of the subject's knowledge of what Heinz knows; it will be limited to the requirements of the situation. With the *within space* interpretation of the intentional question, the term "rubber" first of all serves a "referential" function, ensuring that the space for Heinz's knowledge represents the item in the



box. For an adult, it also serves a “descriptive” function, narrowing referential scope so that the question effectively asks “Does Heinz know that the item is a rubber?” rather than “Does Heinz know that there’s an item in the box?”. However, for the child there can be no such extra descriptive function since the terms co-extend: The rubber is the dice is the item in the box.

In contrast, with the *cross space* interpretation of the intentional question, referential and descriptive function are divided across the terms “dice” and “rubber” respectively. “Dice” secures reference to the item in the box by its placement in the “reality” space and picks out its counterpart “rubber” *in the partitioned knowledge space*. I suggest that in this case, there is no reason for the knowledge space to represent “the item in the box” - this purpose is served by the reality space. Thus, children can weigh up Heinz’s knowledge or ignorance of the “rubber” as an isolated entity: Not because they treat it as partial ignorance in the proper sense (which would involve representing its relation to other things that Heinz *did* know), but because they are able to keep its relation to other descriptions in a separate processing space. The understanding corresponding to this analysis is difficult to paraphrase, but might be described as a recollection that Heinz didn’t feel the rubber that he saw, while thinking that he “knows” it is in the box.

On this account, the intentional question asks children about simple knowledge or ignorance of an item. Their success is due to processing that is qualitatively different from that required for the intensional (or pseudo-intensional) question, where knowledge or ignorance of different of ways knowing the same object must be compared. In light of this analysis, it is less surprising that there was no beneficial effect of first answering an intentional question, on children’s performance on the pseudo-intensional question in Experiment 3. This point will be returned to in chapter 5. Crucially, children’s processing is also qualitatively different from the way an adult processes the intentional question: In principle, adults could make an intensional

*within space* interpretation of the intentional question; children could not, because as soon as they represent Heinz's knowledge of the rubber in its relation to other ways of knowing the item, the distinction between these descriptions is lost.

However, whilst the mental spaces account may have provided a way of describing children's performance it has certainly not explained why it arises in the developmental process. Why should children who can hold mental content under a limited range of descriptions when it is out of date or hypothetical have such difficulty with intensional contexts where the content is partial<sup>23</sup>?

### **3.3 Explaining the results of Experiments 1-3**

#### *Knowledge and mental spaces*

There are three senses in which processing in mental spaces relies on the subject's "knowledge". Firstly, there is the knowledge by which verbs of propositional attitude, along with temporal, spatial, modal and many other words, act as "space builders" to cue the construction of additional mental spaces. That is to say, one must realise that a situation other than "here-and-now reality" is implied and the appropriate processing structures must be constructed. Secondly, there is the background knowledge that combines to give these respective spaces their *internal* structure and content: For example, appreciation that seeing leads to knowing and that knowing something of an object does not entail knowing everything. Thirdly, there is the pragmatic knowledge which determines a particular (*de re* or *de dicto*) interpretation. In the account of extensional errors developed above, children's problems are with the second kind of knowledge.

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<sup>23</sup> As discussed in chapter 1, mental representations are necessarily partial. In intensional contexts they are incomplete in a way that affects meaning in that situation.

They already treat mentalistic contexts as a cue to set up an extra processing space when they answer the intentional question correctly, but they fail to hold its content under its particular descriptions. The question of which interpretation to make can be viewed as a separate, pragmatic problem that can only be tackled once the representational capacity is in place.

*Do children lack a theoretical insight?*

In chapter 1 I described the “theory-theory” as the closest to a mainstream view of mentalistic development, and whilst I argued that the particular theories of Gopnik, Perner and Chandler could not easily account for my data, in itself this does not rule out the possibility that the knowledge required to set up and structure mental spaces could be theoretical in nature. I shall tackle this question by examining more closely what is meant by a mentalistic theory and what the accounts in the literature have to offer.

The term “theory-theory” derives from the philosophical view that our folk psychology consists in a structured body of knowledge in which notions such as beliefs and desires are theoretical entities related by inference rules (“practical syllogisms” such as “an agent will act on his/her desires according to his/her beliefs”) (see e.g., Carruthers, 1996). In psychology, this account is adapted to make use of (and at times confound) two meanings of the word “theory”: The first corresponding to a active mode of understanding, possessed and understood by the individual; the second corresponding only to an abstract description of a scheme by which the individual can be said to be operating.

As described in chapter 1, Fodor (1992) appears to adopt the “theory-theory” view quite literally when he suggests that a “Very Simple Theory of Mind” might consist in a realist account of propositional attitudes in a language of thought, and the following “covering laws”:

1) *ceteris paribus*, people act in a way that will satisfy their desires if their beliefs are true;

2) *ceteris paribus*, people's beliefs are true.

However, in another sense this is not a “theory” at all. Its causal powers do not derive from its position in the rational, explanatory framework of its possessor. The laws define *for the reader* the way in which “beliefs” and “desires” interact, whilst for the system (person) this information is syntactic and sub-personal. This is a theory only in the second sense: The system may be said to instantiate a theory-driven process but in a normal sense of the word, the “theory” is only in the reader’s head. Clearly, this is not the kind of theory that could be arrived at by a reasoning (“theoretical”) process which is exactly Fodor’s point: VSTM is innate. Some objections to this sub-personal, syntactic view have already been discussed in chapter 1, so I will avoid repeating them here. My current point is that Fodor’s (and similarly Leslie’s) use of the term “theory” is a very restricted one.

Gopnik (e.g., 1993; Gopnik and Meltzoff, 1996; Gopnik and Wellman, 1992) appears to intend both senses of “theory” when she proposes that children acquire the “theory” of folk psychology by a process of hypothesis testing and theory building: “...children construct a coherent, abstract account of the mind which enables them to explain and predict psychological phenomena. ....this kind of cognitive structure appears to share many features with a scientific theory” (1993, p.10). However, Gopnik also claims (in the same paragraph) that the theories are *implicit* rather than explicit. This caveat appears to be motivated by the difficulties that children have with articulating or justifying their putative theories. Although unsurprising in 3- and 4-year olds, this might itself be a cause for worry about the quality of the thought processes in which the theorising is supposed to occur. But more importantly, a solution which relegates the theorising process to an implicit level risks forfeiting the analogy with scientific thinking

altogether. Gopnik's (and similarly for Wellman, 1988, 1991) scientific analogy is with an active, deliberate, explicit process of formulating hypotheses to compare with the data from experience (or experiment). If the child's "theorising" is only implicit the *explanatory* value derived from the analogy is surely lost. Gopnik's account becomes a *descriptive* metaphor possessed by the psychologist, but not (in the sense intended) by the child: Children may be "scientists" but they do no experiments of their own. Viewed in this way, Gopnik's use of the "theory" concept resembles that of Fodor and Leslie, only Gopnik posits a number of "theories" to describe the child's behaviour where Fodor only uses one (see Russell, 1992 for some other arguments against the analogy between the child and the scientist).

Perner (1991) takes a different line on what it is for the child to possess and develop a theory. On his account, children are not credited with possessing a theory until 4 years, but the theory is explicit (though not fully reportable). The developmental process behind this achievement is not clearly defined, but it is an active and constructive one and the product at age 4 has the form of a "theory of representation", entailing a conceptual insight into the relation between an object and a representation of the object. Unlike Gopnik's account, there is no theory change (only a single acquisition) and therefore no strong claims about hypothesis testing or conceptual revolutions.

In chapter 2 I argued that children's consistent mis-handling of intensional contexts was evidence against an account such as Perner's which entails understanding that representations are partial. Could my results be accommodated by a simple amendment to the theory which grants 4-year olds the understanding that representations may be of a different time or place, or even hypothetical, but withholds insight into their partial nature until 6-7 years? *Prima facie* they could not, for such an account still fails to explain the dissociation between the intentional and

intensional questions. Unless one considers the different referential problems that these questions pose they surely both ask about partial knowledge. However, it seems possible to accept this point and still maintain that the processing apparatus (such as mental spaces) is set up and structured by knowledge that is theory-based. Whatever the on-line processes, the burden of work, and developmental work in particular, is borne by theories which the child improves over time.

However, such an account is in danger of pitching the sophistication of the developmental mechanism too high. Once one concedes that the representational demands of complex, theoretical reasoning about the mind might entail partitioning, it is less clear how theoretical knowledge can also be the basis for these representations without allowing that some fairly sophisticated knowledge is given innately. However, even strong nativists such as Fodor and Leslie fall short of positing innate knowledge at such a high level, and such a move would in any case be strongly at odds with the constructivist spirit of Perner's account. In short, a process as complicated as explicit theorising seems to require a representational substrate whose existence it cannot also explain. This conclusion paves the way for a return to mental spaces, and consideration of the scope for a developmental account based on Fauconnier's ideas about space construction.

*A lower-level basis for semantic partitioning*

Above I outlined my reasons for avoiding a theory based explanations of children's extensional errors. I argued that as descriptive accounts they lacked explanatory clout, whilst as explanatory accounts they were pitched at too high a cognitive level. I also mentioned both Fauconnier's and Dinsmore's contention that the processing advantages of partitioned spaces are

optimised if the semantic structure of spaces is based upon frames (Filmore, 1982, 1985) or idealised cognitive models (Lakoff, 1987). The structure of such knowledge may be defined much less formally than a theory so the problems associated with the high level of the “theory-theory” account are avoidable. Fauconnier (1997) develops the idea that original and sophisticated space structure can be created on-line by a process of analogical mapping and blending from these knowledge representations. On the basis of these ideas, I shall sketch a speculative, explanatory account of children’s exceptional problems with partial representations.

An important point in Fauconnier’s scheme is the possibility for the same knowledge (frames; idealised cognitive models) to structure different spaces with analogous problems. This casts the developing ability to handle mentalistic referential problems in an interesting light, for I shall argue that for the easier kinds there are sound analogies with non-mentalistic problems, while for intensional contexts there are not.

Consider for example the standard unexpected transfer task (Wimmer & Perner, 1983). To answer correctly that Maxi will look in the old location, the child has to treat the mind as representing an outdated state of affairs and juggle referential relationships between two temporal contexts. Perner has argued (1991, pp.54-55) that search after invisible displacement requires a similar ability to separate past from present yet this is achieved around the age of 18 months. Although one can argue that this particular ability is not formally the same as the false belief task - perhaps requiring only that the child recall the past without relating it to the present - it does raise the possibility that some such early ability to represent different times could subsequently provide a basis for representing mental reference across time, so simplifying the task of learning.

The other standard test of false belief is the deceptive box task (see e.g. Gopnik and Astington, 1988). There are two versions and each can be analysed in a similar way. In one, the child discovers that a sweet box contains, not sweets, but pencils, and then has to predict what an ignorant person will think is inside. To answer correctly, it is necessary to take into account the protagonist's incorrect expectation, in the face of one's own knowledge of reality. Now, the child has to model referential relations between a real and a "possible" state of affairs, and again there may be a precedent, this time in early pretence. In the more common version of the task, the child is asked to recall their own ignorant past belief, rather than predict the belief of another person. This is best viewed as a combination of the two tasks since the child has to model the relations between a real and a previously expected state of affairs.

In all these cases, the ability of 4-year-olds to treat people's minds as representing out-of-date or hypothetical states of affairs may be a development of their earlier abilities to represent times, possibilities and places other than the here and now.

Although both false belief tasks involve analysing a mental representation, neither requires the child to represent the fact that mental representations are only partial. I suggest that the above analysis could provide an answer to the puzzle posed earlier, in which I asked why children who can hold mental content under a limited range of descriptions when it is out of date or hypothetical have such difficulty with intensional contexts where the content is partial. On the current account, children's successful handling of outdated or hypothetical mental states is based upon analogies with non-mentalistic problems, not an abstract understanding about the non-preservation of aspects of representational mental content in different contexts. It is therefore less surprising that such knowledge does not generalise to a view of mental states as partial.



Furthermore, since there is no obvious non-mentalistic precedent in children's earlier abilities for the contents of a space being partial, it is perhaps not surprising that intensional contexts are more difficult to handle than other mentalistic referential problems.

#### **4. Broader implications**

The above account was developed in response to the results of Experiments 1-3 and its focus is correspondingly narrow. In this final section I want to take a step back and view the more general implications of my approach. As discussed in section 3, both Fauconnier (1985, 1997) and Dinsmore (1992) argue against some common assumptions about the characterisation of language and the mind. In particular, their rejection of a traditional, objective semantics will be seen by some researchers (e.g., Fodor, 1991) as a major problem with the stronger claims of their theories. I shall continue to leave this problem unaddressed and instead focus on some possible advantages this approach might have for thinking about psychological development.

The radical nativism and radical individual constructivism in the developmental theories discussed above can be seen in part to follow from the assumption of an objective semantics. If our conceptual system is a simple reflection of the objective structure of the world, then it is possible in principle for conceptual development to proceed on an individual basis, outside of social influence. Indeed it might be preferable to construct (or possess *a priori*) one's own concepts, since secondary sources (e.g., parents, teachers, peers) are (notoriously) prone to error. Nativists and constructivists diverge in their accounts of who does the work of bringing the conceptual system into line with reality. For the constructivist it is each individual child, for the nativist it is (for the most part) the blind forces of natural selection: Adaptation over evolutionary

time takes the place of ontogenetic construction. These assumptions have often defined the boundaries of theoretical discussion about mentalistic development.

This general outlook contributes to a view of conceptual development that gives little significance to learning from other people. Yet children are raised in a linguistic and conceptual community where ideas may be freely available without the effort of individual acquisition. Furthermore, there are certain concepts (folk psychological ideas being prominent examples) which may not have any existence independent of the conceptual community. Whilst it is surely possible to address these issues without rejecting objective semantics, my point is to note that the accounts of Fauconnier and Dinsmore have the potential to deal with them quite naturally (without additional theoretical apparatus) while also raising novel issues for investigation.

In broad terms, the fact that mental spaces model on-line personal level meaning construction immediately makes it impossible to ignore the social and contextual contributions to meaning. Fauconnier demonstrates at length that a great many logical / referential problems and linguistic anomalies arise because of the tradition of treating decontextualised words and sentences as the unambiguous bearers of meaning. In contrast, such “problems” require no special treatment in the mental spaces scheme which has the flexibility to allow context an important role.

Within the boundaries of the debate outlined above, the fact that mentalistic language is shot-through with referential complexity and ambiguity appears to make it a poor basis for constructivist approaches to development and fuels the claims of nativists. However, the nativist solution of characterising mentalistic abilities within an unambiguous, extensional language of thought is at least partly illusory since it simplifies the issues only by deferring the question of how normal (and thus frequently ambiguous and intensional) mentalistic discourse is possible to

a separate domain of enquiry. The results of Experiment 3 suggest that this separation cannot be achieved perfectly because the phenomenon of intensionality appears to infiltrate non-linguistic, mentalistic reasoning.

In contrast, for Fauconnier, the “problems” with mentalistic language are really no such thing, and thus language - or rather, discourse in context - is a perfectly good way for children to find out about folk psychology. But to realise the developmental implications of this it is important to remember how Fauconnier views language in the cognitive scheme: “Language does not itself do the cognitive building - it ‘just’ gives us the minimal, but sufficient, clues for finding the domains and principles appropriate for building [meaning] in a given situation.” Thus, besides language we should be considering the structure available in non-linguistic context as a means by which children might be assisted in setting up partitioned spaces. These ideas clearly require further development that is beyond the scope of this thesis, however in chapter 5 I investigate two ways of assisting children’s understanding based on this perspective. I hope I have done enough here to suggest how the mental spaces view might form the basis of a new way of thinking about the role of language, social interaction and non-linguistic context in conceptual development.

The view developed here has some more specific implications for how we regard mentalistic development and its relation to other problem domains. Firstly, on the current account, children are not acquiring a monolithic theory (or insight) of the mind or of representations: They achieve competence with particular consequences of the representational view of the mind at different times and perhaps for different reasons. One reaction to my explanation of children’s particular difficulty with partial knowledge might be to look upon intensionality as a “purer” test of mentalistic insight since, unlike the easier mentalistic tasks, it turns on a property unique to representations. However, the theoretical advantage of such a move

is unclear, whilst the disadvantage of a domain specific conception would be its inability to inform solutions to other problems, and an important developmental aspect of the account would be lost. The data on children's handling of linguistic ambiguity in Experiments 3, 4 and 5 suggest that their problems might indeed be more broadly based and this is explored in more detail in the next chapter.

In sum, I think that the approach described above is broadly complementary with a number of recent attempts in the literature to re-evaluate the role of innate and learned components in conceptual development (e.g., Karmiloff-Smith, 1992; Elman *et al*, 1997) and to emphasise the role of social and linguistic experience (e.g., Nelson, 1996). In the domain of mentalistic development I have added to these accounts some representational detail and predictive power.

## **Chapter 4. Linguistic ambiguity and intensional contexts**

### **1. Introduction**

The principal aim of this chapter is to explore some implications of the account developed in the last chapter for the more widely researched topic of children's difficulties with handling ambiguous utterances. There are a number of reasons for this interest. Firstly, there is a coincidence of timing: As with intensional contexts, children come to recognise ambiguity in utterances at around 6-7 years. Furthermore, there are authors who explicitly link this achievement with a late developing mentalistic insight (e.g., Carpendale and Chandler, 1996; Chandler, 1988). Could my analysis shed light on the nature of such a link? Secondly, in chapter 2 I suggest that there are theoretical reasons (elaborated below) for thinking that the two problems might be related, since both intensionality and linguistic ambiguity arise because representations are partial. Thirdly, Experiment 3 gave evidence of a contingency between children's handling of these problems, adding weight to the claim that they share a common limiting factor. Experiments 4 and 5 allow stricter tests of this relationship. In Experiment 4 I develop and test a unique prediction about children's handling of linguistic ambiguity arising from my characterisation of their problems with partial representations. I discuss the implications of these findings for accounts of the relation between ambiguity and mentalistic development. The design of Experiment 5 also allows me to address the possibility that children's mis-handling of intensional contexts could be the result of an egocentric or "realist" error.

### *Children's problems with ambiguity*

At several points above I have described linguistic statements - particularly when taken as decontextualised sentences - as “ambiguous”, implying that they could have more than one meaning. For the purposes of this chapter however, a narrower sense will be employed. Following the literature (see e.g., Robinson and Whittaker, 1987; Robinson, 1994) an utterance will be termed “ambiguous” when it is intended to refer to a single object or event in the world, but actually refers to more than one. Numerous empirical investigations over the last twenty years provide consistent evidence about the developmental course for children’s handling of such problems. At first, children readily make a single interpretation of ambiguous utterances, possibly for the simple reason that they fail to notice the multiple reference. Later, they show signs of being unsure and may even acknowledge uncertainty about what the speaker meant, but having made an interpretation they seem to lose track of the problem and are confident that their interpretation is the correct one. Later still, typically at around the age of 7 years, children are able to identify the message itself as the source of the problem and realise that further information is necessary to guarantee that the listener will make the correct interpretation (e.g. Beal & Flavell, 1982; Flavell, Speer, Green & August, 1981; Robinson, 1994; Robinson & Robinson, 1977; 1983; Robinson & Whittaker, 1985,1987).

Children’s difficulty with understanding about utterance ambiguity has been characterised as a failure to treat the utterance as a clue to the intended meaning, and more particularly as a failure to hold in mind the distinction between the speaker’s intended meaning or intended referent and the literal meaning of the words themselves (Beal, 1988; Bonitatibus, 1988a, 1988b; Robinson, Goelman and Olson, 1983; Robinson & Robinson, 1977; Robinson & Whittaker,

1986). Evidence consistent with this characterisation comes from Robinson, Goelman & Olson (1983). Children played two variations of a communication game with the experimenter. In both variations, child and experimenter sat on either side of an opaque screen with identical sets of pictures, each took turns to tell the other about one of the set, and then listener and speaker compared their choices to see whether the listener had selected the correct picture. On some trials the experimenter gave an utterance which referred to two of the pictures, and the child saw that s/he had chosen wrongly. In the first version of the game, following these trials the child was asked “Did I tell you enough about my card?” and if s/he judged “No”, “What should I have said?” In the second version of the game the experimenter offered the child the suggestion that she had given a disambiguated version of the message, e.g. “A man with a blue flower, is that what I said?” when the message had actually not specified the flower’s colour. For both games there were parallel trials in which the child was speaker and the experimenter was listener, and children’s answers to the test questions were unaffected by the role played. The results showed a highly significant relationship between performance in the two variations of the game: 5 and 6 year olds who failed to identify ambiguous utterances as inadequate, were inclined also to accept the suggestion that a disambiguated version of the utterance had actually been said, despite correctly rejecting suggested messages which did not match the intended referent. Once these children knew the intended referent, they seemed not to be able to hold separately in mind the ambiguous verbal description of it. Bonitatibus (1988a) reports similar results.

However, Robinson and Whittaker (1987) are more cautious in drawing this strong conclusion. They argue that in general, there is no firm basis for locating children’s problems in the imperfect match between the speaker’s internal representation of intended meaning and the literal meaning of the utterance: It is equally plausible that the problem lies in holding separate

the verbal representation and the (known) object of reference which it inadequately describes. In Experiment 4 I will investigate this distinction.

Children's problems with ambiguity have also been viewed as a symptom of broader mentalistic difficulties. Sodian (1988) advances an account in terms of a developing "epistemological theory": 4-year-olds conceive of information access as an all-or-nothing relation; some form of perceptual access is enough to secure "knowledge" of the object; it is not until 6-years that they take account of the informativeness of the experience. Chandler's (e.g., Carpendale and Chandler, 1996; Chandler, 1988) argument for a late developing mentalistic insight into "the interpretive character of the knowing process" can be seen as adding some detail to Sodian's descriptive account. Without an interpretive theory of mind the child cannot understand that a particular input - an ambiguous utterance or drawing - might be interpreted in different ways by different people.

This account is broadly consistent with that of Robinson and Whittaker (1987) in that the very concepts of mis-match between intended and literal meaning or between a verbal description and a referent depend upon the possibility of different interpretations of "literal meanings" and "verbal descriptions". However, whilst these accounts may converge on a description of children's behaviour with ambiguous utterances they are less clear on what a concept of interpretation or ability to distinguish intended versus literal meaning might consist in. By providing a more fine-grained analysis of the problems such "understanding" poses I hope to make a move in this direction.



*Utterance ambiguity and the partial nature of representations*

In chapter 1 I argued that Searle's (1983) discussion of the partial nature of representations drives a theoretical wedge between intensionality and other types of referential problem. In chapters two and three I developed this analysis into an account of children's persisting difficulties with mentalistic intensional contexts. But according to Searle, intentional mental states are only a particular kind of representation: Words and pictures also represent, and are partial. Thus, the problems I have so far described only in mentalistic contexts might be expected to generalise to other situations where a representation's partial nature is important. Identification of utterance ambiguity may be just such a situation.

An utterance is ambiguous when the referring expression - that is necessarily only a partial representation - is insufficiently narrow in its scope to identify the single intended referent. In more mundane terms, there is always potential for a one-to-many mapping between under-specified referring expressions and a field of similar referents; communication is successful when the referring expression contains enough detail to secure reference uniquely in the given situation. For example, in the Robinson *et al* (1983) study, "the man with the flower" referred to more than one picture in an array of drawings of men wearing differently coloured flowers and hats, when in fact the speaker wanted to identify the man with the blue flower. In such a case, appreciation of ambiguity in the message requires that the message contents be held under their particular terms of description; held not just as referring but as doing so *in a particular way*. As with intensional contexts, this requires children to represent the *partial* relation between the message and the referent. Thus, from the current perspective, children's tendency to accept other descriptions that successfully refer to the intended object ("the man with the blue flower") as

“what was said” can be seen to stem from a similar problem to their tendency in intensional contexts to treat the referring expression “rubber” extensionally. In each case, the terms in question co-refer with the relevant expression (either the original message or the notional knowledge state) but do so in a different way with a correspondingly different meaning.

Importantly, this account makes a novel prediction about the kind of questions regarding ambiguous utterances that children will be able to answer. The use of an intensional referring expression in Robinson *et al*'s question “A *man with a blue flower*, is that what I said?” is analogous to the intensional questions of Experiments 1-3 and Russell (1987) e.g., “Does Heinz know that there’s a *rubber* in the box?”. If this similarity is genuine one would expect a re-phrasing of the question that allowed reference to be secured independent of the terms of description, to reduce children’s problems in the same way as the “intentional” question of Experiments 1-3. For example, in “Did I say that the man’s flower was blue?”, reference is secured with *the man’s flower* independent of the description *blue*; *c.f.* “Does Heinz know that *the dice* is a rubber?”. This prediction is interesting because if supported, it would provide evidence against the view that children’s problems with ambiguity arise from a simple confusion of the content of ambiguous messages with the speaker’s communicative intention.

Experiment 4 also tested the prediction that children’s handling of ambiguity would correlate with their handling of intensionality in the type of tasks used in the first three experiments.

## 2. Experiment 4: Children's handling of linguistic ambiguity and intensional contexts

### 2.1 Method

#### *Participants*

48 children (28 boys and 20 girls) aged between 4;2 and 5;2 (mean age 4;8) who were in reception classes, and 49 (25 boys and 24 girls) between 5;3 and 6;2 (mean age 5;9) from year 1 classes were tested. I shall refer to these as 4- and 5-year-olds respectively. Although at the low end of the age range commonly used for ambiguity experiments, these children attended a particularly good infant / junior school with a middle class catchment area in Birmingham, UK, and were of an unusually high general educational standard.

#### *Procedure*

Children played a communication game similar to that used by Robinson *et al* (1983) and received two intensional tasks taken from Experiment 1. In the communication game the child and puppet protagonist (Heinz) each received identical sets of picture cards. On four short warm up trials the messages from the puppet were always unambiguous. Four experimental trials followed, in which puppet and child had matching sets of cards which had two variable dimensions. There was a set of balloons that varied in their colour and shape, and a set of men who varied in the size and colour of their hats. Within each trial, the pictures varied on one dimension only: e.g., two red balloons, one round and one long. On each trial the puppet gave an ambiguous message (via the experimenter): e.g., "Heinz says he chose the red balloon". Children

were usually quick to select one of their cards as “the one Heinz chose”, and each time, the puppet held up a different card to show that their choice was incorrect. On two trials they were then asked about message ambiguity in the same way as in Robinson *et al* (1983), “Did Heinz tell us enough?” and if they said “no”, “What should he have told us?”. To pass, children had to answer both questions correctly. The other two trials asked about what Heinz had said. There was an intentional question modelled upon “Does Heinz know that the dice is a rubber?” e.g., “Did Heinz say that the red balloon was round?” (as appropriate) and an intensional question “Did Heinz say it was the round balloon that he chose?” (analogous to Robinson *et al*’s “The man with the blue flower, is that what I said?” and “Does Heinz know that there’s a rubber in the box?”). Importantly, the word “say” was stressed in these questions, and the puppet’s chosen picture was obscured. Thus, it was pragmatically clear that the question referred to the puppet’s first referential utterance rather than his subsequent act of showing the card that he had chosen. The four trials were presented in semi-counter-balanced order, avoiding two consecutive ambiguity trials.

On the intensional tasks, the stimuli were a ruler which was a rubber, and the ball/present described above. For both stimuli, the experimenter agreed the two labels with the child, who then observed as Heinz the puppet looked, but did not hear about the present or feel that the ruler was a rubber. On each trial children were asked two questions in counter-balanced order: An intentional question “Does Heinz know that the ball is a present?” and an intensional question, “Does Heinz know there’s a present in the box?”, both of which have the correct answer “no”. The pair of trials came together either before or after the ambiguity trials and order of the two trials was counterbalanced between child.

## 2.2 Results

In the 4-year-old sample, 10/48 children failed to complete all the test conditions because they were reluctant to attribute “knowledge” to the puppet, thus for comparison between conditions 38 children were included. None of these missed an ambiguity question, so for comparisons within ambiguity tasks,  $N= 48$ . In the 5-year-old sample, 2/49 children failed to complete all of the test conditions for the same reason, but neither were ambiguity conditions so the numbers for between and within condition comparisons were 47 and 49 respectively. There were no effects of test order (all  $ps > .12$  by 1-way ANOVA) so all orders were combined for further analysis.

*Table 7. 4 and 5 year olds’ correct responses to the intentional and intensional questions in the referential opacity tasks.*

Number of Intensional questions correct	Number of Intentional questions correct							
	4-5-year-olds ( $N = 38$ )				5-6-year-olds ( $N = 47$ )			
	0	1	2	Total	0	1	2	Total
0	5	5	4	14	2	3	2	7
1	0	4	7	11	0	4	9	13
2	0	0	13	13	1	1	25	27
Total	5	9	24	38	3	8	36	47

Table 7 shows children’s performance on the intentional and intensional questions of the two opacity tasks. In both the 4- and 5-year-olds, the intentional questions (“...knows the ball is a present.”) were significantly easier than the intensional ones (“...knows there’s a present in the box.”) (sign test,  $p < .0001$ , and  $p < .0042$  respectively). There was a significant difference in

performance on the intensional questions between age groups  $\chi^2 (2, N=85) = 6.52, p = .04$ , whilst within age-group, there were no effects of age on children's performance (both  $ps > .07$  by 1-way ANOVA).

*Table 8. 4 and 5 year old's correct responses to questions in the ambiguity task.*

Age group	Number of successful evaluations of message quality: "Did Heinz tell us enough?; What should he have said?"			Number correct on Intentional question	Number correct on Intensional question
	0	1	2		
4-year-olds ( $N = 48$ )	22 (46%)	6 (12%)	20 (42%)	31 (65%)	25 (52%)
5-year-olds ( $N = 49$ )	17 (35%)	6 (12%)	26 (53%)	44 (90%)	29 (59%)

Table 8 shows the performance of the two age groups on the ambiguity tasks. Importantly, the intentional question ("...say the red balloon was round?") was easier than the intensional question ("...say it was the round balloon he chose?"). In the 4-year-old group this effect was non-significant with 7 children succeeding on the intentional and not the intensional question, and only 1 showing the opposite pattern ( $p = .07$  by sign test), whilst 15 5-year-olds succeeded on the intentional and not the intensional question and none showed the opposite pattern ( $p < .0001$  by sign test). On the ambiguity tasks there were no significant effects of age within (both  $ps > .06$  by 1-way ANOVA) or between ( $\chi^2 (2, N=97) = 1.41, p = .49$ ) groups.

Performance on ambiguity and intensional questions was significantly correlated in both the 4- and 5-year-old groups, even when age was partialled out (partial correlation coefficients, .395 ( $N = 38$ ) and .429 ( $N = 47$ ),  $ps = .016$  and  $.003$  respectively).

In sum, both predictions were supported: (1) Intensional contexts concerning both linguistic representations (“what was said”) and mental representations (what Heinz knows) were significantly harder for children to handle than intentional contexts in which referential scope was not narrowed by the terms of description; (2) children’s handling of ambiguity was correlated with their handling of intensional contexts. These findings will be discussed in more detail below, but first I want to use the relation between the intensional and ambiguity tasks to address the possibility, raised at the end of chapter 2, that children’s problems with intensional contexts are the result of egocentric or realist errors.

Such an explanation would say that children fail to handle the partial nature of representational content because they cannot overcome their own, greater knowledge of the represented object. Children’s handling of linguistic ambiguity allows this possibility to be explored because, unlike intensional contexts which arise for the very reason that the speaker / listener knows more than the holder of the propositional attitude, children can be asked to assess the quality of ambiguous messages even when they don’t know the intended referent. In such a case, their response cannot be determined by their own knowledge of the “correct” or complete answer. Thus, if children’s errors correlated with their errors in intensional contexts, this could count as evidence that the latter were not due to egocentric or realist responses either. Certainly, such evidence is only indirect, but the nature of intensional contexts means that this is the best that can be achieved.

### **3. Experiment 5: Could children's error in intensional contexts be an egocentric or realist response?**

#### **3.1 Method**

Each child was tested individually on six tasks. Two tasks were the modified “intensional” tasks of Experiments 1 and 2 and it was not appropriate to judge that the protagonist knew the second description on the basis of his limited information access. There were two ambiguity tasks similar to those used by Sodian (1988) in which a protagonist gives an ambiguous message referring to an array of items. Before they find out the “real” answer, children are asked whether they know “which one he chose”. To see whether they understood the protagonist's meaning as being distinct from the message children were then asked about what they were “told”<sup>24</sup>. On the basis of the previous experiment I expected children to find this easier than the judgement about their own knowledge. There were also two referential communication control tasks in which the context was transparent and the message unambiguous. These controls served two important purposes. First, they ensured that children were assessing the communicative meaning in their answers to the “tell” questions and not just the linguistic content of the utterance. Second, they checked that children did not take the second question in the ambiguity tasks to signal that their answer to the first was incorrect. Provided children were

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<sup>24</sup> At the time, “tell” was used in preference to “say” because the similarity between the wording of the question and Heinz's message made it possible for children to give the correct answer on the basis of verbatim recall. This was not a problem in experiment 4 because the two “say” questions used different wordings which we expected to differ in difficulty.



prepared to give two “yes” answers in the control tasks, it would be safe to conclude that the anticipated “yes”, “no” pattern in the ambiguity task was not due to such an artefact.

### *Participants*

49 children from two reception classes (25 boys and 24 girls) aged between 4;10 and 5;10 (mean age 5;4), and 48 children from two year 1 classes (19 boys and 29 girls) aged between 5;7 and 6;8 (mean age 6;2) were tested. I shall refer to these as the 5- and 6-year-olds respectively. All the children attended the same junior/infant school with a middle class catchment area in Birmingham UK, and spoke English as their first language.

### *Materials*

For the ambiguity conditions, I used a Lego chassis with missing rear wheels that could be fitted with identically coloured wheels (both red and black) of different sizes, and two Lego drivers, both with black trousers but with different coloured tops. The “intensional” conditions were the same as in Experiments 1 and 2. The control conditions used paired items whose definite descriptions in the task were all visually apparent. A paintbrush was paired with a sweet / mint, and a pen was paired with a toy / train. The protagonist for every trial was the puppet called Heinz.

### *Procedure*

In both ambiguity trials children were required to judge the listener’s knowledge following an ambiguous message and in addition to evaluate the content of the message. This knowledge judgement was made in ignorance of the intended referent so avoiding the possibility of egocentric errors. However, it is important to acknowledge that the literature

suggests that such judgements are often easier than “message evaluation tasks” of the kind used in Experiment 4 (see e.g., Robinson and Whittaker, 1985; Sodian, 1988). In one trial children were shown a Lego chassis and told that Heinz had been making a toy, but that “...he can’t decide which wheels to put on it”. Children were then shown that both wheels fitted, producing a car-like or a tractor-like model. They were told that “we’re going to play a game with Heinz to help him make up his mind...” and they watched as the two wheels were hidden under boxes on the table. Addressing the puppet, the experimenter said, “so Heinz, tell us which one you want”. Heinz then “whispered” to the experimenter who relayed the ambiguous message to the child: “He says he wants the red and black wheels”. Two test questions followed in this order:

Knowledge question: “Do we know which one he wants?”

Children who answered “yes” usually pointed to one of the items. If they did not, they were asked “So which one is it?” This gave an object for the next question:

Tell question: “Did Heinz tell us that he wanted the ‘C’?”

where “C” was the distinguishing characteristic of the item selected if the child had made an interpretation in the Knowledge question. When the child had said (correctly) that we did not know which one Heinz chose (and thus had not volunteered an interpretation) C was arbitrarily “the big wheels”. This was not entirely satisfactory since we had no way of knowing whether children still had a preference for one interpretation over another. If C was inconsistent with their preference it might be possible for “correct” answers to be given by denying that C referred to the chosen object at all. This problem is addressed in the results section. The other trial followed exactly the same form, with appropriate changes to the introduction of the task. This time the ambiguous message was “Heinz says he wants

the man with the black trousers” and the default option in the tell question (if the child did not make an interpretation) was “Did Heinz tell us he wanted the man with the red top?”

The control conditions were matched to the ambiguity tasks, with the children being told that “Heinz has to choose one of these things to keep for himself, and so we’re going to play a game to help him make up his mind”. The two items were hidden under boxes and again, Heinz’s message was relayed via the experimenter “Heinz says he wants the sweet (or toy)”. This was followed by two questions:

Knowledge question: “Do we know which one he chose?”

Tell question: “Did Heinz tell us he wanted the mint (train)?”

Trials with the ball and ruler were as in Experiment 1 and 2, with the same two questions:

Q1. (Intensional) Does Heinz know there’s a [present/rubber] in the box? (correct = no)

followed by

Q2. (Intentional) Does Heinz know the [ball/dice] is a [present/rubber]? (correct = no)

Trials were always presented in their pairs whose ordering was reversed for half the children. The three pairs were presented in counter-balanced order, creating 12 orderings in total.

### **3.2 Results**

I was principally interested in comparing children’s performance on the ambiguity “knowledge” questions with that on the ambiguity “tell” question, and the “intensional” questions of the intensional tasks.

Within each age group no significant effects of age or test order were found and results were collapsed for further analysis. Three children in the 5-year-old group were excluded from the “intensional” tasks when they would not accept that the puppet could see or know anything.

In both age groups, there was near ceiling performance on both *control task* questions. One child made one mistake in identifying which item Heinz had chosen. On the tell question, both 5- and 6-year-olds were generally successful in confirming that Heinz had *told* us something that he hadn't literally said (45/49, 45/49; 43/48, 45/48 respectively). This confirmed that children were not merely using superficial recollection of the words spoken to answer “tell” questions. Also, it confirmed that children were not misinterpreting Q2 as a cue to correct (and thus change) their answer to Q1.

Table 9 summarises children's performance on the *ambiguity tasks*. On the *knowledge question* (Do we know which one he chose?) 5-year-olds scored 15/49 (31%) with the wheels and 17/49 (35%) with the men. On the *tell questions* they scored 23/49 (47%) with the wheels and 30/49 (61%) with the men. Recall that we could only be sure of the basis for children's answers when they had failed the knowledge question: A total of 25/53 of the children who correctly denied that “Heinz told us .....” had failed to deny that they “knew which one he chose”. Overall, tell questions were easier than knowledge questions: McNemar's  $\chi^2(1, N = 49) = 5.53; 9.41, p=.021; .0016$  for the wheels and men respectively.

On the knowledge question, the 6-year-olds scored 27/48 (56%) with the wheels trial and 31/48 (65%) with the men, and on the tell question 44/48 (92%) and 43/48 (90%) respectively. A total of 31 correct responses to the tell question were made by children who had failed the

knowledge question. Overall the tell question was easier: McNemar's  $\chi^2(1, N = 48) = 17; 16.3$ ,  $p < .0001$  for the wheels and men, respectively.

Performance on each type of question was combined to give scores of 0,1 or 2 for comparisons between the two age groups. One-way analyses of variance comparing the two age groups' performance on the knowledge and tell questions showed a significant improvement with age on both: Tell question,  $F(1, 97) = 25.12, p < .00001$ ; know question,  $F(1, 97) = 10.29, p = .0018$ .

Table 9. Scores on the two questions of the ambiguity condition.

Did he tell us .....	Do we know which one he chose?											
	5-year-olds ( $N = 49$ )						6-year-olds ( $N = 48$ )					
	Lego wheels			Lego men			Lego wheels			Lego men		
	0	1	Total	0	1	Total	0	1	Total	0	1	Total
0	24	2	26	17	2	19	4	0	4	4	1	5
1	10	13	23	15	15	30	18	26	44	13	30	43
Total	34	15	49	32	17	49	22	26	48	17	31	48

Table 10 summarises children's performance on the "intentional" tasks. The 5-year-olds' scores on the *intentional questions* were 19/46 (41%) for the ball/present and 21/46 (46%) for the ruler/rubber. The *intentional questions* were significantly easier, with scores 35/46 (76%) and 36/46 (78%) respectively: McNemar's  $\chi^2(1, N = 46) = 16; 15, p < .0001$  for each. 6-year-olds' scores on the *intentional questions* were 33/48 (69%) for the ball/present and 42/48 (88%) for the ruler/rubber. For the ball/present, the *intentional question* was significantly easier, children

scoring 46/48 (96%), McNemar's  $\chi^2(1, N = 48) p = .002$ . However, children's high performance on the intensional question with the ruler/rubber was not exceeded on the intentional question where they scored 42/48 (88%). Performance on each type of question was combined to give scores of 0, 1 or 2 for comparisons between the two age groups. One-way analyses of variance comparing the two age group's performance on intentional and intensional questions showed a significant improvement with age on both: intensional question  $F(1, 94) = 24.27, p < .00001$ ; intentional question,  $F(1, 94) = 9.28, p = .003$ .

Table 10. Scores on intentional and intensional questions of the "intensional" tasks.

Intentional question	Intensional question											
	5-year-olds ( $N = 46$ )						6-year-olds ( $N = 48$ )					
	Dice/rubber			Ruler/rubber			Dice/rubber			Ruler/rubber		
	0	1	Total	0	1	Total	0	1	Total	0	1	Total
0	12	0	12	10	0	10	6	0	6	2	0	2
1	16	18	34	15	21	36	9	33	42	4	42	46
Total	28	18	46	25	21	46	15	33	48	6	42	48

Combined scores of 0, 1 or 2 correct answers were also used for *tests of correlation* of intensional and ambiguity "knowledge" questions. In the 5-year-old group the predicted correlation was found even when age was partialled out: partial correlation coefficient  $= .438, p = .003$ . Performance on the *intentional* and *tell* questions was also correlated in this group, partial correlation coefficient (controlling for age)  $= .576, p < .0001$ . However, for the

6-year-olds, there was no correlation between the summed scores on intensional and knowledge questions, partial correlation coefficient (controlling for age) = .21,  $p = .167$ . This might have been due to the generally high performance of this group on all questions and the unusually good performance on the intensional question about the ruler/rubber in particular. Such a suggestion receives support from the lack of contingency between the two intensional tasks with children in the older group finding the more concrete rubber/ruler stimulus substantially easier. In contrast, such contingency *was* found in the younger age group ( $\chi^2(1, N = 46) = 9.33, p = .0023$ ).

### **3.3 Discussion of the evidence against egocentric explanations**

First I wish to focus only upon how the data from Experiment 5 relate to egocentric explanations of children's problems with intensional contexts. Recall that children had to judge their knowledge from the utterance before they knew what the speaker actually intended, therefore their errors could not be due to an inability to disengage from their own knowledge of this "reality". If these errors correlated with children's errors in intensional contexts we would have indirect evidence against egocentric or "realist" explanations of the latter. Such a correlation was found in the 5-year-old group but not in the older children, whose performance on all tasks was much better. As described above, this finding may be a ceiling effect due to the high performance of the older group (particularly on one intensional task) which allowed incidental task-specific factors to have a significant influence.

However, there are potential problems with the general interpretation of children's errors on the ambiguity tasks used in this experiment. Sodian (1988; see also Robinson and Whittaker, 1985) argues that in a task where they do not themselves know the correct answer, "children may

assess their own knowledge by attending to feelings of uncertainty ..... about the interpretation of a message without any understanding of the reasons for this certainty or uncertainty, that is, without an assessment of message quality.” In support of this, Sodian found in one experiment that children were significantly better at assessing their own or another’s knowledge when they could experience first person uncertainty, than another’s knowledge when they knew the intended referent themselves. In a second experiment she showed that even this judgement was easier than a “message evaluation” task where they were asked whether the speaker told the protagonist “exactly where” an item was. How far do these findings pose problems for my interpretation of the results from Experiment 5 which relies upon my message posing a problem of message evaluation?

Firstly, from observation of the data there does not seem to be any tendency for the knowledge judgements in this experiment to be dramatically different in difficulty from the message evaluation questions in the last experiment. This may have a basis in important differences between the questions used in Sodian’s study and my own. Sodian’s knowledge question following a message that failed to distinguish between two possible locations, was “Do you know where the chocolate is?”. This seems to direct the child to answer whether *they* could find the chocolate, and Sodian may be right in thinking that a feeling of uncertainty would be of considerable help in such a decision. In contrast, my knowledge question seems more reflective. In its presented context, “Do we know which one he chose?” seems more oriented towards an evaluation of the quality of the message than the goal of locating the chosen item. Whilst ignorance of the intended meaning could plausibly assist such an assessment of message quality, it might not replace it as a route to the correct answer.



Uncertainty about the basis for children's judgements regarding ambiguous messages when they are themselves ignorant of the intended meaning is unavoidable, and the results of this experiment are correspondingly less easy to interpret than those of Experiment 4. In conclusion, I would argue that the results from Experiment 5 provide reasonable, if not compelling evidence against the view that children's problems with intensional contexts reflect egocentric or "realist" errors.

#### **4. General discussion of Experiments 4 and 5: Ambiguity, intensionality and the meaning-message distinction**

As mentioned above, the design of Experiment 4 avoided the difficulty with interpreting children's errors on the ambiguity task of Experiment 5. In combination, the two experiments provide a substantial and complementary body of novel evidence about children's handling of ambiguous utterances. I shall therefore consider both experiments together in this part of the discussion.

Overall, children's handling of ambiguity was found to correlate with their handling of intensional contexts. The exception to this pattern in the oldest group of Experiment 5 (who at 6;2 were the oldest group studied) appeared due to children's disproportionately good performance on one of the intensional questions. Experiment 4 employed the more rigorous and explicit measure of children's ability to identify ambiguity in the message itself, and these data provide the stronger evidence of a common difficulty between the two types of task. Yet the fact that difficulty with ambiguity and (in the 5-year-olds at least) the correlation with intensional contexts was also found in Experiment 5 suggests that the same limiting factor as for Experiment 4 was responsible for children's errors. Importantly, this experiment also showed that children's errors

were not principally due to their being over-determined by their own knowledge of the intended referent.

Above I suggested that an account of children's errors in terms of problems with partial referential relations made a prediction that was divergent from the simple "meaning-message" account. If children are attending to the speaker's intention rather than her message, then once they have made an interpretation or been told the intended referent, they should tend to affirm that the speaker "told" them or "said" any true description of the referent object, ignoring the content of the message. If instead, the error arises because their answers are over-determined by the referential, rather than the descriptive function of intentional contents (such as message contents), their erroneous belief that they do know what the speaker means should not interfere with their knowledge of what they were "told" or what was "said".

Consistent with this prediction, following an ambiguous utterance both 5- and 6-year-olds in Experiment 5 found it significantly easier to say that Heinz did not "tell us that he wanted the [object under an *unambiguous* description]" than to say that we didn't know which one he chose. A control condition showed that children rarely interpreted the "tell" question as referring to Heinz's verbatim utterance, suggesting that their success was not artefactual. Similarly, children found the intentional question easier than the ambiguity question in Experiment 4. However, this experiment also showed that their ability to consider "what was said" was sensitive to the phrasing of the question: Children's success seemed limited to cases in which the referring expression did not also serve to ask how the content was described in the ambiguous utterance. So are children *really* able to distinguish the meaning of the utterance from the intended meaning of the speaker?

Consideration of the representational demands of the two cases gives the precision needed to answer this question. As with the intentional / intensional dissociation discussed in the last chapter, the puzzle of children's behaviour arises from our adult perspective on what the questions actually ask. On an adult understanding of the verb "say" it is completely inconsistent to affirm that "Heinz said that it was the round balloon he chose" while denying that "Heinz said that the red balloon was round". However, this is not the case if we suppose that the child is failing to represent the message contents under their particular (partial) descriptions. In exactly the same way as for the mentalistic dissociation (see chapter 3; section 5), such a child will be able to give the expected, adult, answer to the intentional but not the intensional question about "what Heinz said". And as for that case, this does not imply an adult *understanding* of the first question, but stems instead from a coincidence of the child's and the adult response. In so far as it is useful to talk of children's "understanding", it might be awkwardly paraphrased as "Heinz did not describe the red balloon as round but he did indicate that it was the round balloon that he chose".

From this perspective, children's problems with tracing ambiguity to the utterance cannot be due to a simple inability to consider the meaning of the utterance apart from the intended meaning of the speaker (whether or not "intended meaning" is taken to be the speaker's mental representation or as Robinson and Whittaker (1987) suggest, the actual referent). Success on the intentional question is surely evidence of such an ability, even if it is qualitatively different from an adult's treatment of the problem<sup>25</sup>. However, the crucial insight behind these suggestions is retained in the current account. For if the child does not represent a referring expression under its

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<sup>25</sup> On the same basis, Sodian's suggestion that children conceive of information access as a simple all-or-nothing relation until 6-years, seems inaccurate.

particular terms they lack the capacity to reflect on the aspects of linguistic meaning that arise therefrom. From the child's point of view, an utterance will appear adequate if it is consistent with the object of reference. So whilst they may be aware that the communicative act has been unsuccessful in identifying a *unique* referent, they will not identify the problem with the utterance itself which seems to have done its job quite adequately. Thus, there does indeed remain an important sense in which children are unable to consider the meaning of an utterance apart from its intended meaning.

As with handling of intensional contexts, there are a number of ways in which this developing ability could be viewed. However, I feel that the critical comments about theory-theory accounts made in the last chapter are equally applicable here. To propose that children possess and are able to articulate the kind of theories of linguistic meaning consonant with their changing behaviour on ambiguity tasks, once more, pitches the level of explanation very high. Tentatively, I suggest that the changes might instead be viewed as the process of coming to represent the meaning of co-referential terms as individuated by their descriptive as well as their referential role. As a working account, this captures the subtlety of children's pattern of ability, and its relation with their handling of intensional contexts.

# **Chapter 5: The development of children's handling of intensional contexts: Effects of supporting context**

## **1. Introduction and overview**

In this study I attempt to address the developmental question of how children might come to handle intensional contexts successfully. Based upon the suggestions made at the end of chapter 3, I was principally interested in whether children's performance was sensitive to various aspects of supporting context. This was investigated in two sessions. The design of the study also made it possible to see whether (anticipated) context-related effects in on-line performance generalised in the longer term to affect children's handling of the kind of intensional contexts used in previous experiments.

Two main types of supporting context were considered: Observation of incorrect action on the basis of partial knowledge and explicit discussion of the information access and mental states of the protagonists. There is evidence from the literature that younger (3-4-year-old) children find it easier to explain action on the basis of a false belief mentalistically than to predict such action before it has occurred (e.g., Bartsch and Wellman, 1989; Robinson and Mitchell, 1995; but see e.g., Moses and Flavell, 1990; Wimmer and Mayringer, 1998, with accompanying commentary from Bartsch). It seemed plausible that a similar experience could assist older children. I decided to test the effect of a structured mentalistic discussion since it also seemed possible that children's problems with partial knowledge could stem from a difficulty with following the causal links between different levels of information access and the resulting

variations in protagonists' knowledge. If this was the case, one would expect to see improvements in children's ability to answer intensional questions following such a discussion.

Children aged between 5;7 and 6;6 were chosen. Evidence from Experiments 1-5 suggested that children of this age were beginning successfully to handle intensional contexts so should be most receptive to help. In a pre-test phase, children were administered a battery of four "intensional" tasks taken from earlier experiments. They were scored on the intensional questions (0-4 correct answers) and each score category was divided equally between two groups.

In the first study of the on-line effects of context, children in both groups were read two vignettes with accompanying pictures, and were required to explain a character's action. In the "partial" group, the action was performed on the basis of partial ignorance. In the control "total" group, this action was performed on the basis of total ignorance or a false belief. So whilst the controls were not specifically helped with cases of partial knowledge, their general experience with vignettes and the experimenter were the same as for the partial group. In both groups this was followed by a discussion of the discrepancy between the characters' various knowledge states using pictures of their thought bubbles<sup>26</sup> followed by a re-posing of the explanation question.

In the second study of on-line effects, two weeks later, children were read two vignettes with accompanying pictures. Towards the end of each, one character asked a question about the knowledge of another (e.g., Doesn't he know that his present is in the bag?). In the partial group this question was based on partial ignorance and was intensional whilst in the total group it was based on total ignorance. This question was then posed to the child. After the child's answer, a

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<sup>26</sup> Wellman, Hollander and Schult (1996) report that children younger than those in my sample readily understand thought bubbles as a means of expressing someone's thoughts.

story character made the correct reply to the question (e.g., No, because he doesn't know that the dinosaur is his present"). There was a series of questions about protagonists' information access and knowledge, ending with a repetition of the intensional question.

Two weeks after the second study, children were given a post-test battery of four intensional tasks. This allowed me to look for persisting effects of the on-line studies by comparing pre- and post-test scores. A further benefit from this, and the pre-test study, was that the use of a total of eight intensional tasks allowed a large scale check of some of the important findings from previous experiments.

Given the large size of the overall study I shall report details of the pre-test, on-line studies and post-test separately. I hope that the superior clarity brought with this approach will compensate for the unconventional style.

## **2. Pre-test battery**

### **2.1 Method**

#### *Participants*

47 year 1 children were tested. Five failed to complete all four intensional tasks because they refused to accept that the puppet could see or know anything. 42 children (20 male, 22 female) entered the study, aged between 5;7 - 6;6 (Mean 6;0). All children attended the same junior / infant school with a lower middle class / upper working class catchment area in Birmingham UK, and spoke English as their first language.

### *Procedure*

Children were all given the “breakfast” task described (together with the results from these children) in chapter 3: 3.1, as a warm-up to get them used to the experimenter and the use of vignettes. Children were then given four intensional tasks in fully counter-balanced order. There were two concrete tasks which were acted out with Heinz the puppet: The ball/present task described in Experiment 1; the action prediction task using the dice/rubber as described in Experiment 3. All children were asked both intensional and intentional questions, with the order counter-balanced between child. There were two “story” tasks in which children were asked questions about a vignette. One involved George and the thief (from Russell, 1987), the second was a novel story about Julie and the Magician (see appendix 1). On these tasks, children were once more asked intensional and intentional questions in the same order as for the concrete tasks, and finally they were asked a control question (in which they must allow substitution) as in Russell, 1987.

## **2.2 Results**

Children’s performance on the battery was summarised in scores for both the intentional and the intensional questions, ranging from 0 (all incorrect) to 4 (all correct), see Table 11. These data were first analysed using ANOVA with intentional vs. intensional as a repeated measure. As anticipated, intentional questions were significantly easier than intensional questions;  $F(1, 42) = 86.0, p < .0001$ . Subsequent analyses were performed separately on the intentional and intensional scores.



Table 11. Scores on the intentional and intensional question types in the pre-test battery of tasks.

Question type	Total battery score				
	0	1	2	3	4
Intensional	7	16	11	5	3
Intentional	0	3	4	10	25

Children were categorised by age according to whether they fell in the first or second six-month half of the sample. An analysis of variance was computed on the *intensional question* scores with task type (concrete vs. story) as repeated measures, age category and question order (intentional first or intensional first) as between subject variables. There were significant main effects associated with task type ( $F(1, 42) = 17.4, p < .0001$ ) with concrete tasks being easier than story tasks (see Table 12). This is consistent with the findings of Experiment 2. There was also a main effect of age ( $F(1, 42) = 6.53, p = .015$ ). As in Experiment 3, question order (i.e., intentional first or intensional first) had no significant effect ( $F(1, 42) = 1.04, p = .313$ ). There were no significant interactions between question order and age ( $F(1, 42) = 1.04$ ), or between task type and either age or question order ( $F(1, 42) = .20; .00$ ) respectively.

A similar analysis of variance was also computed on the *intentional question* scores. There was a significant main effect of task type ( $F(1, 42) = 6.41, p = .016$ ) which once more appears to be due to concrete tasks being easier than story tasks. There were no significant effects of age or question order ( $ps > .12$ ) and all interactions were non-significant ( $ps > .19$ ).

Concrete and story sub-batteries could not be compared fairly since the concrete task, where action was predicted, had a base-line of 50% (unlike Experiment 2 where both concrete tasks employed similar intensional questions to the story tasks and thus all had a 0% baseline).

For the same reason, only the sub-battery of story tasks will be used in the next sections for comparison with children’s performance on the story-based studies of on-line effects.

*Table 12. Scores on the intentional and intensional questions on the two task types.*

Question type	Sub-battery score					
	Concrete tasks			Story tasks		
	0	1	2	0	1	2
Intensional	9	22	11	26	11	5
Intentional	1	6	35	4	11	27
Control	*	*	*	3	9	30

In sum, the test battery data add further support to the conclusions drawn from Experiments 1-4: That intensional questions are significantly harder than intentional questions in a variety of settings; and that this effect is robust and unaffected by the order of presentation of the two questions.

### **3. Studies of on-line effects of context**

#### **3.1 Method for Study 1**

##### *Procedure*

Children were divided into two groups (“partial” and “total”) each with - as far as possible - equal numbers from each intensional question score category. A one-way ANOVA revealed there to be no significant difference between groups ( $F(1,42) = .0002, p = .9898$ ). Each child was

read two vignettes with accompanying questions and discussion (see appendix 2 for vignettes not given in the text).

In the *partial group* (N = 22) the stories involved a protagonist acting on the basis of partial knowledge. Each story was accompanied by a series of pictures.

#### Sample vignette

“It is Todd’s birthday and his Mummy and Daddy have arranged a party for him. Lots of his friends and people from the street where he lives have come to his house. Todd doesn’t know, but his Mummy has asked Mr Jones from next door to dress as a clown and do a show for the children. Look, there he is, getting ready to do the show for the children, and all the parents are in the other room talking. Just then Todd’s auntie gives him a plate with some food and asks him to take it to Mr Jones. Todd walks all around, looking for Mr. Jones. He goes into all the different rooms and sees the clown getting ready for the show. But after a couple of minutes, he comes back saying that he can’t find Mr Jones.”

At the end of the story children were asked three questions in the following order:

- (1) (action explanation) Why can’t Todd find Mr Jones?
- (2) (intensional) Does Todd know that Mr Jones is right over there in the corner?
- (3) (intentional) Does Todd know that Mr Jones is the clown?

Children were then asked “shall we have a think about what Todd knows?” and were shown a picture of Todd with a thought bubble picturing Mr Jones dressed normally. They were told “look, he’s thinking of what Mr Jones looks like normally!” and were encouraged to describe his appearance. They were then asked “shall we look at what his Auntie is thinking?” and were

shown a picture of Auntie with a thought bubble showing Mr Jones half way into his clown costume. They were told “look, she knows that Mr Jones is dressed as a clown” and were encouraged to describe his appearance. Finally they were again asked

(4) Why can't Todd find Mr Jones?

The questions were always asked in the same order to ensure that each child was lead through the explanation of the protagonist's behaviour in the same way. The two vignettes were presented in counterbalanced order between child.

#### Scoring the action questions in the partial group

Whilst a model answer to the action question might have been “He can't find Mr Jones because he doesn't know that Mr Jones is a clown” I felt that a strict criterion of this kind was unsatisfactory since it was in danger of missing cases where the mental state of the protagonist was pragmatically implied rather than explicitly mentioned. Instead, answers were deemed correct if they made appropriate mention of the protagonist's partial ignorance. In the above story, children asked “Why can't Todd find Mr Jones?” passed if they said “Cos he's dressed up like a clown” (participant number 33; the majority of passers gave very similar responses) and failed if they said e.g., “Cos he's hiding” (participant number 46), “Cos he's lost” (participant number 45), or “I don't know”. For the second vignette, the passers mentioned the protagonist's lack of perceptual access *to the relevant feature*: “Cos she didn't see his black beard” (participant number 33). Allusion to non-specific ignorance “She didn't know that he stole the bag” (participant number 40) counted as a fail, along with children who did not supply an answer.

To guard against the possibility of biased interpretation, 11 randomly selected sets of responses were blind coded from the tape recordings by a second person (E.J. Robinson). For one

child, the responses to one vignette were not taped, so a total of 21 cases of Q1 and Q4 were scored. There was only one discrepant decision and this was easily settled by discussion.

In the *total group* ( $N = 20$ ), the stories read to the children involved a protagonist acting on the basis of total ignorance of a change in a state of affairs (and hence a false belief). In all other respects, the stories, questions and discussion of the protagonist's knowledge were similar to the "partial" group.

#### Sample vignette

Arthur has just moved into his new house and he is showing his friend Lisa around. When she sees the walls of his sitting room painted orange, she says, "oh, wouldn't they look a lot nicer if they were blue?" Arthur thinks she is probably right, so after she has left he rushes out to buy some blue paint and starts work painting the walls. He works very hard all afternoon, and finishes painting all the walls blue.

When Lisa got home after visiting Arthur, she was talking to a friend about Arthur's new house. "It's mostly very nice, but I don't like his sitting room. The walls are orange!"

Children were asked:

Q1) (action explanation) Why did Lisa say that Arthur's sitting room walls were orange?

Q2) (knowledge) Does Lisa know that Arthur's walls are blue now?

Children were then asked, "shall we think about what Lisa knows?" and were shown a picture of Lisa with a thought bubble showing Arthur's walls painted orange. This was contrasted with a picture of the walls "as they are really". Children were then asked:

Q3) Why did Lisa say that Arthur's walls were orange?

The questions were always asked in the same order. The two vignettes were presented in counterbalanced order between child. One child was absent during testing so  $N = 19$ .

Similar criteria to those described above were used in judging the correctness of children's explanations of the protagonist's action.

### **3.2 Method for Study 2**

In both partial and total groups, children were read two vignettes supported by pictures and presented in counter-balanced order between child (see appendix 3 for vignettes not included in the text). These were followed by a series of questions, presented in the same order.

#### *Procedure*

In the *partial group* there were three means by which children might be assisted in answering the intensional questions. Firstly, as with intervention 1, the stories involved a protagonist *acting* on the basis of partial knowledge. Secondly, the intensional question is first posed rhetorically by one of the story protagonists before being addressed to the child. Following the child's answer another story protagonist also responds to the question by contrasting the subject's knowledge and ignorance of the object, the aim being to clarify the meaning of the intensional question without confronting a child's (possibly incorrect) answer directly. Thirdly, subsequent questions led the child through the protagonist's information access, including an intensional question about their knowledge, before re-posing the intensional question.

### Sample vignette

Mary and her mum are going to visit her gran at her house. Her gran has just bought a new china ornament in the shape of a rabbit. But you can also take the top off and use it as a pot and her gran is keeping sweets in it.

When she arrives, her gran sends Mary to get some sweets, “They’re in the pot in the lounge” she says.

Mary goes into the lounge, looking for a pot. She looks on the shelf and sees a clock and the china rabbit, and she looks on the table and sees the fruit bowl. Then she calls back to her mum and her gran saying “I can’t find the sweets anywhere”.

Her mum says to her gran “Doesn’t she know that the pot is on the shelf?”

Q1) (intensional) Does Mary know that the pot is on the shelf?

Her gran says to her mum, “Well maybe she doesn’t know that the rabbit is a pot”.

Q2) Did Mary see the rabbit?

Q3) Can she tell just by looking that it’s a pot?

Q4) (intentional) Does Mary know that the rabbit is a pot?

Q5) (repeated intensional) Does Mary know that the pot is on the shelf?

Vignettes for the *total group* involved a protagonist acting on the basis of a false belief (total ignorance). In all other respects they were similar to the partial group’s although there were necessarily fewer questions about information access.

### Sample vignette

One day Claire was in MacDonaldis. There she is at her table eating her burger, and look, that’s her bag on the chair next to her. When she finished her food, she needed to go to the toilet, so she

left her bag on the chair because she would only be a minute. But while she was away, the waiter noticed the bag left on the seat and took it away to keep it safe. When Claire came back from the toilet, she saw that her bag had disappeared and shouted “quick, help me, a thief has just stolen my bag!” Behind the counter, the cook said to waiter, “doesn’t she know that we have it here?”

Q1) Does Claire know that they have her bag behind the counter?

The waiter said “Maybe she doesn’t know we just took it away to keep it safe”

Q2) Did Claire see the waiter take her bag?

Q3) Can she tell who took her bag?

Q4) Who does Claire think took her bag?

### **3.3 Results from Study 1**

#### *Partial group*

Children’s ability to explain action (Q1) and answer related intensional questions (Q2) was compared with their performance on the sub-battery of story tasks from the pre-test. Two analyses of variance were computed, with Q1(or Q2) and story task scores as repeated measures and age as a between subject variable. There were significant main effects of the within subject variables ( $F(1, 22) = 20.3, p < .0001$ ;  $F(1, 22) = 49.6, p < .0001$  respectively). From the summary in Table 13, it is clear that this is due to Q1 and Q2 being easier than the intensional questions of the story pre-test tasks. The main difference between the sets of tasks is that in study 1, children had observed the protagonists’ action on the basis of partial knowledge, whilst in the pre-test stories they were only told of their partial information access. All main and interaction



effects of age were non-significant (all  $ps > .174$ ). There were no effects of the order of task presentation on children's performance on Q1 for either task (both  $\chi^2(1,22) < .26$ ).

Importantly, it is also clear from Table 13 that both Q1 and Q2 remained more difficult than intentional Q3 (e.g., "Does Todd know that Mr. Jones is a clown?"). There were 12 children who made errors on Q1 and not Q3, and 8 children who made errors on Q2 and not Q3, with none showing the opposite pattern, both  $ps < .008$  by sign test.

On Q4 children found it easier to explain action after the other questions and the discussion of the knowledge states of the story protagonists. In an analysis of variance with Q1 and Q4 as repeated measures and age as a between subject variable, there was a main effect of question ( $F(1, 22) = 10.2, p = .005$ ). Inspection of the data revealed this change to be due to 7 children improving from a score of 1 on Q1 to a score of 2 on Q4. However, this could have been an artefact of the scoring criteria, by which children who had been encouraged simply to mention Mr Jones' appearance (regardless of who knew about it) might have seemed to improve. All age effects were non-significant.

*Table 13. Scores on the four questions of the partial tasks of study 1.*

Total score	Q1 Explaining action.	Q2 Intensional	Q3 Intentional	Q4 Explaining action	Pre-test story task
0	2	0	0	2	14
1	10	8	0	3	5
2	10	14	22	17	3

*Total group*

Table 14 summarises children’s combined scores for the two tasks. An analysis of variance was computed with Q1 and scores on the intensional question of the pre-test story tasks as repeated measures and age as a between subject variable. The main effect of task type was significant ( $F(1, 19) = 20.6, p < .0001$ ). Neither the main effect nor interaction effect of age category were significant (both  $ps > .20$ ). Explaining action (Q1) appeared harder than successfully denying the protagonist’s knowledge (Q2). However, inspection of the data revealed all but one of these errors to be on the “decorating” story, with children tending to say that Lisa told her friend that Arthur’s walls were orange “because she didn’t like them”. Such responses were scored as “errors” since they did not refer to her ignorance of the new colour. But these answers may not have been completely inappropriate since there may be an adult reading of the situation that sees Lisa’s dislike of the colour rather than her ignorance of the change as the relevant reason for her telling her friend that the walls are orange. Discussing Lisa’s knowledge with the experimenter did little to change children’s explanations when they were asked again with Q3.

*Table 14. Scores on the three questions in the total tasks of study 1.*

Total score	Q1 Explaining action	Q2 Knowledge	Q3 explaining action
0	1	0	0
1	7	0	7
2	11	19	12

In sum, as expected, children had little difficulty answering intentional knowledge questions in both partial and total groups. The novel findings were firstly that, after observing action on the basis of partial knowledge, children were significantly better at answering an intentional question about that knowledge. Secondly children barely seemed to find it harder (if at all) to explain action on the basis of partial knowledge than action on the basis of a false belief (total ignorance); though see the caveat in the last paragraph. Finally, whilst in the total group discussing the protagonist's knowledge with the experimenter appeared to have no effect, there was limited evidence that it helped children explain action in the partial group. The effects of age observed in the pre-test were not found.

### **3.4 Results from Study 2**

#### *Partial group*

An analysis of variance was computed with intentional Q1 and scores on the intentional question of the pre-test story tasks as repeated measures and age as a between subject variable. There was a significant difference in performance on the two types of question ( $F(1, 22) = 10.7$   $p = .004$ ) and from Table 15 it is clear that this is because Q1 was easier. There were no significant effects of age (both  $ps > .31$ ). Consistent with the findings of the first study, children found it easier to answer an intentional question after observing behaviour on the basis of partial knowledge. As before, there were no effects of the order of task presentation on children's ability to answer Q1 (both  $\chi^2(1, 22) < 2.7$ ).

An analysis of variance was computed with intensional Q1 (or Q5) and intentional Q4 as repeated measures and age category as a between subject variable. Although easier than the corresponding pre-test tasks, intensional Q1(Q5) remained harder than intentional Q4 ( $F(1, 22) = 5.55, p = .029$ ;  $F(1, 22) = 11.58, p = .003$ ). Age was not significant in either comparison (all  $ps > .60$ ). In a similar analysis of variance comparing Q1 and Q5 there were no significant differences (all  $ps > .47$ ). However, it is clear in Table 15 that the trend was for children to perform less well when the intensional question was repeated, contrary to what one would expect if the prior discussion of the protagonists' information access had assisted children.

*Table 15. Scores on three key questions in the partial tasks of study 2, compared with scores on the pre-test story task.*

Total score	Q1 Intensional	Q4 Intentional	Q5 Intensional	Pre-test story task
0	5	1	4	14
1	4	3	10	5
2	13	18	8	3

#### *Total group*

Two children had left the school by the time of testing so the sample size was reduced to 18.

It is clear from Table 16 that, as expected for this age group, children had little difficulty on either the knowledge question or the question about what the protagonist thinks.

*Table 16. Scores on the two key questions of the total tasks of study 2.*

Total score	Q1 Does X know...	Q4 What does X think...
0	0	1
1	0	3
2	18	14

In sum, the provision of richer contextual cues from the protagonists' surprising behaviour once again assisted children's understanding of intensional contexts to the point where they were close in difficulty to intentional contexts. This time, the explicit, structured discussion of the protagonists' information access and knowledge did not improve children's performance on the repeated question. This result is possibly more reliable than the earlier, opposite finding, since in this case an intensional question (rather than a request for explanation of action) was repeated. Although the meaning of this question is also subject to the *de re / de dicto* ambiguity of interpretation, there is consistent evidence from the foregoing experiments about the nature of children's errors. Their answers could therefore be scored with more certainty than those in the first study. Despite the improvements, these data also show children's problems with intensional contexts to be remarkably robust; insensitive to a similar foregoing task, and persisting even when they have just heard a very similar question answered by one of the story protagonists.

## 4. Post-test battery

### 4.1 Method

#### *Procedure*

As for the pre-test, children were given four intensional tasks in fully counter-balanced order. There were two concrete tasks which were acted out with Heinz the puppet: The ruler / rubber task described in Experiment 1; the action prediction task using the ball/bell as described in Experiment 3. Both intensional and intentional questions were asked, in counter-balanced order between child. There were two “story” tasks in which children were asked questions about vignettes (see appendix 4). On these tasks, children were once more asked intensional and intentional questions in the same order as for the concrete tasks, and finally they were asked a control question (in which they must allow substitution) following Russell, 1987.

### 4.2 Results

One child left the school before post-testing so for the partial group  $N = 21$ , and for the total group,  $N = 18$ . As before, children’s performance on the battery was summarised in scores for both the intentional and the intensional questions, ranging from 0 (all incorrect) to 4 (all correct). Table 17 summarises these data for the partial and total groups. Clearly, intensional questions have reverted to being far harder than intentional questions.

Table 17. Scores on the intentional and intensional questions in the post-test.

Total score	Partial		Total	
	Intentional	Intensional	Intentional	Intensional
0	0	1	0	1
1	0	5	0	6
2	1	8	1	7
3	4	3	4	2
4	16	4	13	2

*Within post-test analyses*

An analysis of variance was computed with task type (concrete vs. story) as a repeated measure and age category, group (partial or total) and question order (intentional first or intensional first) as between subject variables. There were no significant between subject main effects (all  $ps > .14$ ). Within subject, there was a significant effect of task type ( $F(1, 39) = 27.4, p < .0001$ ) and a significant interaction between task type and question order ( $F(1, 39) = 6.36, p = .017$ ). Observation of the data reveals this interaction to be primarily due to an effect in the story task performance with children who received the intensional question first making more errors than those receiving the intentional question first. This result will be explored in the discussion along with the reasons why receiving an intentional question first usually *fails* to have a priming effect upon answers to the intensional question. All other effects were non-significant (all  $ps > .13$ ).

In addition to the factors mentioned in the pre-test, the fact that the ruler / rubber condition seemed particularly easy for children on this occasion, with 32/39 (82%) correct

answers, will have contributed to the difference between task types. There is no obvious reason for this, other than children's prior exposure to the dice/rubber which may have led them to think that Heinz would not fall for the same trick again. However, even with this unusual performance, children's 100% performance on the intentional question was significantly better ( $p = .016$  by sign test). There was no evidence of a difference between intervention groups: Four of these errors were in the total group, three in the partial group.

Performance on the *control* questions of the story tasks was similar to that in the pre-test with 27 children getting both correct, 10 making one error and 2 making two.

#### *Analyses comparing pre- and post- test performance*

An analysis of variance was computed with pre- and post- test scores as a repeated measure, group (total vs. partial) and age category as between subject variables. Neither between subject main effect was significant, but there was a significant interaction between group and age category ( $F(1, 39) = 4.36, p = .044$ ). Inspection of the means for the four sub-groups suggested that this was principally due to the younger children in the partial group performing better than the younger children in the total group. Importantly however, this effect was found, irrespective of whether children had received the interventions: The three way interaction between group, age category and pre- vs. post- intervention was non-significant ( $p = .428$ ). All other interactions were non-significant (all  $ps > .06$ ).

On the story tasks, children's performance pre- and post- intervention was significantly correlated, even when age was controlled for (Pearson's partial correlation coefficient (36, 2-tailed) = .459,  $p = .004$ ).



In sum, no clear evidence was found for any persisting effect of the two intervention sessions on children's ability to handle intensional contexts. Indeed, the correlation described above suggests that individual performance was also relatively stable.

## **5. General summary and discussion**

39 children completed a total of eight intensional tasks in the pre- and post- test batteries and this substantial body of data was broadly consistent with the findings of Experiments 1-4: Intensional questions were in every case more difficult for children than intentional questions. I want to draw attention to two results in particular. Firstly, the finding in Experiment 3, that children also experience difficulty with the non-verbal task of predicting action on the basis of partial knowledge, was repeated in both test batteries. This is reassuring since the extension of children's problems to non-verbal contexts is important to the account of their handling of referential problems developed in chapter 3. Secondly, as in Experiments 2 and 3 it was generally the case that receiving an intentional question first had no effect on children's success with intensional questions. No effect was found in the pre-test battery or on the concrete tasks of the post-test; only in the post-test story tasks was there any effect. The case against a priming role for the intentional question, and thus a performance error account, is therefore strengthened further (see discussion below).

Within both studies children were significantly better at answering intensional questions than they were on the pre-test versions yet as before, they were usually better still on intentional questions. In the first study, observing a protagonist's (partially) ignorant behaviour also led to more correct explanations of action than correct answers to intensional questions in the pre-test. Even more explanations were judged satisfactory when children were asked the question again

following a structured discussion of the story characters' respective states of knowledge (but see above discussion of this result). In the second study, children's success with intensional questions followed observation of a protagonist's (partially) ignorant behaviour *and* the answering of a similarly phrased intensional question by one of the story characters. In this case it is perhaps surprising that they made any mistakes at all, yet they did persist and in fact the number of mistakes increased slightly following the structured discussion of the protagonists' information access and knowledge states.

Comparing pre- and post- test performance, there seemed to be little or no effect of the intervening studies. This suggests that whatever enabled children to perform better within the sessions was not persistent or generalisable.

To lead into my discussion of the effects of context upon children's abilities, I want to return briefly to the issue of performance errors. It is surely plausible, as Moses and Flavell (1990) argue regarding false belief experiments (see also Fodor, 1992), that explaining action is easier than predicting action because the former case provides more evidence of the mental state which in effect can be read off the behaviour. However, as a sole explanation for children's errors I believe that such an account is inadequate. It fails to explain why deriving an answer to intensional questions from behaviour is easy, while deriving the same answer from recollection of the character's knowledge (answer to intentional question: "No, he doesn't know that Mr Jones is a clown") is difficult<sup>27</sup>. We need an account which distinguishes the information available to the child in these two situations. I suggest that this is just what the account of representational

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<sup>27</sup> It is possible that my exceptional finding in the post-test of a limited priming effect for intentional questions was genuinely due to children on the brink of competence (recall that they were by then 6;4) receiving some benefit from this question ordering. However, I do not feel that this affects the general argument against performance error accounts.

competence advanced in chapter 3 provides, and that without something of this sort, performance factors can only be called upon as explanations on an *ad hoc* basis.

The finding that children's performance can be improved only in the extreme short term, is consistent with the idea that supporting contexts can affect on-line processing of meaning. However, the limited evidence available here only justifies some brief speculation about what might actually be happening. In chapter 3 I argued that children's processing of the intentional question and its (apparently adequate) answer was qualitatively different from an adult's. On this basis it is unsurprising that it has no priming effect on answers to the intensional question (perhaps excepting children on the brink of success). In contrast, it is possible that, when observing action on the basis of partial knowledge, some of the work of dividing the protagonist's limited knowledge of the object from children's own, more complete knowledge, is done for them. The necessary structure (as well as the meaning) is inherent in the context, and in contrast with the intentional question, there is no sensible alternative "reading" of the situation. Assisted in this way by the context, children are able to process the meanings of intensional questions. But there was no generalisation of this ability to the post-test intensional question because children could not yet set up the processing structures themselves.

Such an account might initially seem to apply equally to younger children's explanation of action on the basis of a false belief. If this is so one might treat it with caution since the evidence for a beneficial effect in this domain is both equivocal and controversial (see introduction). However, while I think there may be some similarity, the argument is different for younger children who (on the account advanced in chapter 3) may already be capable in non-mentalistic contexts, of the kind of partitioning of content involved in false belief tasks. If this is the case, observation of behaviour may only act as a prompt to take notice of the belief, rather

than reduce significantly the work of setting up the appropriate representational structure. This could increase *or* decrease the chances of observation of behaviour having a helpful effect for these young children. The point is that it would be doing so for a different reason than for older children. Thus, arguments relevant to the former do not necessarily affect the latter.

# Summary and suggestions for future work

## 1. Summary

I began by introducing the topic of children's mentalistic development in its relation to long-standing problems and debates in philosophy of mind. I suggested that psychological investigations are often dogged by a conflation of questions regarding the problem domain for acquisition - "What is the nature of folk psychology?" - and those regarding the nature of the mind itself. Although clearly related, maintaining a distinction between these questions allowed me to adopt a line of consensus on the first - that folk psychology considers the mind to be representational - while considering freely the options for developmental accounts in relation to the second.

If we have broad agreement that folk psychology describes the mind as a representational system, then we can assume that children must learn to handle (or otherwise possess innate solutions to) the problems that this entails. In chapter 1 I addressed such a problem. The phenomenon of referential opacity is an exception to the assumption, common in systems of logic, that words sharing the same extension may be freely substituted for one another in a sentence without altering its overall meaning. I argued against common assumptions in the developmental literature that this is a phenomenon exclusive to contexts involving representations, or that when representations *are* involved it always arises for the same reason. Specifically, I claimed that it was useful to distinguish opacity due to the fact that representations may refer across time or to hypothetical entities, from that due to representations only partially

capturing their referents, and further, that there were no *a priori* reasons for thinking that these types of opacity should pose equivalent developmental challenges.

Later in the same chapter I considered how the literature on mentalistic development informs us about children's handling of these referential problems. I presented the findings of Russell (1987) which appear to suggest an age dissociation between some types of referential opacity that are due to out-dated or hypothetical mental states and the specific case of intensionality which is due to their being partial. I argued that these data were problematic for any developmental theory that treats handling of the representational mind as a unified process and went on to discuss the ways in which they might be explained by existing accounts. This formed the starting point for my empirical investigations.

Experiments 1-3 served two general purposes: They investigated some of the ways in which existing accounts might explain Russell's data, and allowed more firm conclusions to be drawn about the precise nature of the dissociations within children's handling of referential problems. Experiment 1 was an attempt to remove some of the incidental demands specific to Russell's procedure while maintaining the essence of the intensional contexts. These simplified procedures provided for more realistic comparison with conventional theory of mind tasks usually passed at around 4 years. Despite these changes, children's problems persisted. While many 4-year olds and most five year olds were able to pass a deceptive box task and answer "intentional" questions (e.g., "Does Heinz know that the dice is a rubber?") very few were able to answer "intensional" questions (e.g., "Does Heinz know that there's a rubber in the box?").

Experiment 2 compared the two concrete intensional tasks from Experiment 1 with the two intensional story tasks from Russell (1987). As anticipated, the reduced complexity of the concrete tasks meant that there were fewer errors on all questions, however the clear difference

between intentional and intensional questions remained. Furthermore, responses to the intensional questions were consistent across the two task types suggesting that they were indeed tapping the same ability.

In chapter 1 I had discussed the possibility that children's problems on tasks like Russell's were purely linguistic and thus independent from their general mentalistic abilities. Against this move, I drew attention to Searle's (1983) contention that the phenomenon of intensionality should pervade any situation where representational contents are re-represented. If this is the case, children's problems with handling partial knowledge should persist in the absence of a linguistic intensional context. Experiment 3 looked at children's ability to predict action on the basis of partial knowledge and found that errors did indeed persist at a much greater rate than on intentional questions about the same knowledge. Importantly, in this experiment, half of the children received the intentional question (e.g., "Does Heinz know that the dice is a rubber?") *before* they predicted Heinz's actions yet no priming effect was observed. This suggested that children were not simply failing to recall the relevant information when they predicted that he would search for a rubber that he did not know about.

The consistent finding in Experiments 1-3 of a dissociation between children's handling of intentional and intensional contexts, and the difficulties that this poses for existing accounts, motivated the development of a novel approach in chapter 3. I briefly surveyed the literature on the representation of mentalistic contexts, drawing a contrast between syntactic and semantic systems of partitioning, eventually favouring Fauconnier's (1985, 1997) "mental spaces" approach. In this scheme, intentional and intensional questions pose qualitatively different representational problems which may have different developmental paths. Further, the apparent inconsistency between children's ability to answer intentional but not intensional questions was

resolved. Younger children's "correct" answers on the intentional question stem from a non-adult understanding of the question which arises from a non-adult semantic basis for partitioning. Effectively, young children and adults are answering different questions in response to "Does Heinz know that the dice is a rubber?". I considered how this pattern of development might proceed with sub-personal mechanisms or with the development of a succession of explicit "theories" and explored a novel approach consistent with the mental spaces scheme. In the resulting thumb-nail sketch of development, I argued that children might first come to handle mental states representing temporally displaced or hypothetical states of affairs. For these abilities, there are ready analogies with earlier developing abilities such as understanding change across time and pretence. In contrast, handling the partial nature of representations may present children with a unique problem that is not solved until later.

In Chapter 4 I looked beyond the limited domain of children's handling of mentalistic intensional contexts to consider the possibility that problems with handling partial representations could be an important factor in children's well documented difficulties with linguistic ambiguity. Experiment 4 compared children's performance on two message evaluation and two intensional tasks and found a correlated pattern of errors for both ages. This experiment also investigated children's handling of intentional and intensional characterisations of message contents and found the same dissociation as with mental contents: Children were largely successful at denying that "Heinz said the red balloon was round" while tending to accept that "Heinz said it was the round balloon that he chose". Together, these findings led to a re-thinking of the "meaning-message" account of children's problems with ambiguity, that conceded some ability to treat message meaning as separable from the speaker's intentions, but maintained that for as long as



they fail to represent the referring expression under its particular terms they will not recognise ambiguity in messages.

Experiment 5 in the same chapter showed that children's handling of intensional contexts was also related to their ability to judge knowledge arising from ambiguous utterances. This added to the findings of the previous experiment because such judgements can be made independent of knowledge of the speaker's intended referent. Not only was this evidence against egocentric errors as a mediating factor for the correlations in Experiments 4 and 5, it is also indirect evidence against egocentric explanations of children's general problems with intensional contexts.

In chapter 5 I returned to the core issue of children's handling of partial knowledge and intensional contexts, and considered how this might develop. I looked at both the on-line and longer term effects of observing incorrect action on the basis of partial knowledge and at explicit discussion of story protagonists' information access and knowledge state upon children's ability to answer intensional questions. There was a significant increase in the number of correct responses to intensional questions immediately after observing incorrect action and children were similarly successful at explaining the protagonist's action in mentalistic terms. However, there was no further improvement on intensional questions following the discussion about knowledge states, nor were there generalised or long-term improvement as assessed by batteries of intensional tasks administered before and after the studies of on-line effects. I discussed why observation of incorrect action, but not the discussion (or preceding intentional question), might help children set up a mental space that held the protagonists' knowledge as *partial*.

## 2. Future work

I hope that there are a number of ways in which the results and ideas presented above might be developed in further work, and in this final section I shall discuss one that I think is of immediate relevance and another that is more novel and open-ended.

### *Developing the ability to handle partial representations*

The general question that I would like to explore in more detail concerns the nature of children's changing understanding of partial representations as they handle firstly intentional contexts and later, intensional contexts. One approach is to investigate situations in which children can be assisted to perform better than their normal baseline level.

In chapter 5 I began to address this question, and found that observing incorrect action on the basis of partial knowledge assisted children's answering of intensional questions in the short term. My interpretation of these results in terms of the mental spaces scheme was highly speculative and it would be useful to explore such context effects in more detail. For example, does observing incorrect action have a similar beneficial effect upon children's ability to predict later action on the basis of the same knowledge? Would intensional descriptions of a protagonist's partial knowledge work just as well (recall that in chapter 5 study 2, children heard such a description *after* observing incorrect action so the effects could not be assessed independently)? Can we find any generalising effects in the short term, if not in the long term? These studies would also add to our understanding of the relation between "mental" and "linguistic" representations of the same problem.

An alternative approach to these questions is available through the link between children's handling of intensional contexts and of linguistic ambiguity. Besides extending the

above questions into a different context (recall that we can also ask intensional questions about linguistic content) there is the possibility of looking for transfer of training between the two types of problem. Robinson & Robinson (1982, 1985) examined the consequence of responding to children's ambiguous utterances with "I don't know which one you mean", and allowing the children to provide further information. Following this intervention there was significant improvement in children's understanding about the role of message ambiguity in communication failure, compared with a control group. Could this also help children answer intensional questions about ambiguous messages (such as those in Experiment 4), or even questions about partial knowledge? If so, we would have more powerful evidence than that provided by the correlation studies, for problems with partial representations being the common factor in both handling message ambiguity and intensional contexts.

*De re versus de dicto interpretations*

Although I argued in chapter 3 that the pattern of children's problems with intentional and intensional contexts could not be described simply as a difficulty with selecting the correct *de re* or *de dicto* interpretations of propositional attitude reports, there remains an important place for the pragmatic factors that influence this choice. Furthermore, mental spaces seem to provide a highly appropriate framework for investigation their role empirically. Possible factors to investigate might be:

i) Varying the intentions of the speaker in the discourse context in order to manipulate the relevance of the particular description used. For example: A party host introduces two guests to each other by name, John and Helen, in the presence of a third guest, Peter. Unbeknownst to John, Helen is the host's sister. Later, John is looking for someone to talk to and the host asks

Peter “Does John know my sister is in the kitchen?” Here it seems obvious that the speaker intends the listener to make a *de re* interpretation, but in a different context the speaker’s intention could easily be otherwise, i.e., to ask whether John knows that Helen is his sister.

ii) Varying the sentence position of the referring expression. “Did he say it was the red balloon he chose?” versus, “The red balloon, was that the one he chose?”<sup>28</sup>

iii) Varying the spoken emphasis. “Did he *say* it was the red balloon he chose?” versus, “Did he say it was the *red* balloon he chose?”

iv) Varying the position of information within discourse. This could link with recent work on “adult realism”. Mitchell, Robinson, Isaacs & Nye (1996) report that, when asked to judge the belief of a person who has been told one thing (e.g., that there is orange juice in a jug) but seen something contradictory (e.g., milk in the jug), adults were influenced by their privileged knowledge of what is *really* the case. That is, adults were more inclined to judge that an utterance will be believed when they themselves knew it to be true than when they knew it to be false, despite the fact that the listener was in exactly the same position in both cases. This was described as a realist error in the published study (the participants’ knowledge of reality “contaminated” their judgements), but it can equally well be seen as a failure to take account of the listener’s partial knowledge. This removes the hitherto untested assumption that it is one’s view of the “truth” that, in a non-specific way, contaminates one’s thinking. This may be of interest since subsequent unpublished investigations by Mitchell & Robinson show that contamination is often greater when the adult is told about reality early in the narrative rather than near the end. It is difficult to see how a reality bias could, on its own, explain this effect. From an extension of the account developed in this thesis, this effect could be viewed as the

result of constructing different discourse representations in which referential links between mental spaces have differing availabilities.

This final suggestion clearly moves us beyond consideration of the *de re / de dicto* distinction as traditionally conceived. It is consistent with the mental spaces approach that this distinction be viewed as a particular example of more general issues concerning the effects of narrative and discourse structure on how people tend to interpret language. There would seem to be potential for the analysis of semantic partitioning, motivated in chapter 3 by developmental effects, to be brought to bear also on adult meaning construction and comprehension.

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<sup>28</sup> Russell and Hawarth (Unpublished manuscript) show an effect of such a manipulation.

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## Appendices

### 1.1 Appendix 1

#### Two vignettes and questions from the pre-test battery

1) George has been saving up for a long time to buy a wrist-watch. At last when he had enough money he went into town and bought a beautiful silver wrist-watch. That night, before he went to sleep, he took off the watch and placed it on his bed-side table, and then fell into a deep, deep sleep. At midnight when George was fast asleep and snoring a robber broke into George's house and stole the watch. This robber was a man with curly red hair. The next morning George woke up to find that the watch had gone so he set out to find the thief.

1) Can we say that George knew that the thief was a man with curly red hair?

2) Can we say that George was thinking: "I must find the man with curly red hair who stole my watch?"

3) Can we say that George was thinking: "I must find the thief who stole my watch?"

2) This is a story about a little girl called Julie. She's having a birthday party and all her friends have arrived for the afternoon. Julie doesn't know, but her mum has a surprise for her. She has asked a magician to come to the party at four o'clock to do a magic show for all of the children.

The party is going really well and Julie is having a lovely time. Just at four o'clock she notices a car arriving outside her house. A man in a green coat gets out of the car and comes

up the drive towards the house. Julie runs to fetch her mum and tell her there's someone coming to the door.

- 1) Can we say that Julie knows that the man in the green coat is a magician?
- 2) Can we say that Julie is thinking: "I must tell my mum that a magician is coming to the front door?"
- 3) Can we say that Julie is thinking: "I must tell my mum that a man in a green coat is coming to the front door?"

## **1.2 Appendix 2**

### Second vignette from the "partial" group of study 1

One day Claire was in MacDonalds. There she is at her table eating her burger, and look, that's her bag on the chair next to her. When she finished her food, she needed to go to the toilet, so she left her bag on the chair because she would only be a minute. But while she was away, a thief came and stole her bag. Look, the thief was a man with a big black beard! When Claire came back from the toilet, she saw a man disappearing out of the door with her bag. Stop! she shouted, but the man had already gone around the corner. Luckily, there was a policeman nearby and she ran over and said, "Quick, help me, a man has just stolen my bag!"

- Q1) Why didn't Claire tell the policeman that a man with a black beard had stolen her bag?
- Q2) Does Claire know that a man with a black beard stole her bag?
- Q3) Does Claire know that the thief was a man with a black beard?
- Q4) Why didn't Claire tell the policeman that a man with a black beard had stolen her bag?

Second vignette from the “total” group of intervention 1

Martin and Nina are having some cake to eat in their kitchen. Martin puts the cake away in the blue cupboard and then goes out to play. While he is outside, Nina is doing some cleaning and she takes the cake out of the blue cupboard. When she has finished cleaning she puts the cake away again, this time in the red cupboard. Here comes Martin, and he’s hungry again after playing outside and he wants to eat some more cake. He goes to look in the blue cupboard.

Q1) Why is Martin looking in the blue cupboard?

Q2) Does Martin know that the cake is in the red cupboard?

Q3) Why is Martin looking in the blue cupboard?

**1.3 Appendix 3**

Second vignette from the “partial” group in study 2

One day, not long before Christmas, Daniel and his mummy and daddy went shopping in a big toy shop. They had lots of things to buy because this year, all of Daniel’s cousins were coming to stay, and so they had to buy presents for all of them. Look, their trolley is already quite full of toys isn’t it? While he was away looking around, his mummy saw a toy dinosaur on the shelf and she said to daddy “Daniel would really like this for his present”. Daniel didn’t see them or hear what they were saying. When they paid for the toys, Daniel saw the dinosaur amongst all the other toys, but he didn’t ask whether any were for him.

In the car, Daniel jumped into the back seat, knocking over one of the bags of toys. His dad said to his mum, “He should be careful, does he know that his present is in the bag?”

Q1) Does Daniel know that his present is in the bag?

His mum said “No, he just *saw* the dinosaur, he can’t have guessed that it was his present”.

Q2) Did Daniel see the dinosaur?

Q3) Did Daniel hear that it was his present?

Q4) Can he tell just by looking that it’s his present?

Q5) Does Daniel know that the dinosaur is his present?

Q6) Does he know that *his present* is in the bag?

Second vignette from the “total” group of study 2

Sam and his mum are staying at his gran’s house. One afternoon, Sam wants to do some drawing so he asks his gran if he can borrow some pens. He doesn’t know that his gran keeps all her pens in an old biscuit tin. His gran says “of course you can borrow some pens, you’ll find them in the cupboard in the lounge.”

Sam goes to look in the cupboard and he sees lots of books some boxes with games in them and an old biscuit tin. He calls back to his Gran saying “I don’t think the pens are in the cupboard”

His gran says to his mum “doesn’t he know that the pens are in the biscuit tin”?

Q1) Does Sam know that the pens are in the biscuit tin?

His mum says “maybe he doesn’t know”

Q2) Did Sam see the biscuit tin?

Q3) Can he tell just by looking that it’s got pens inside?

Q4) What does Sam think is in the biscuit tin?

## 1.4 Appendix 4

### Vignettes from post-test battery.

1) Lucy has just moved house into a new area. On Sunday, before her first day at school, she and her mum are at the local shop. A lady in a blue jumper is also in the shop buying a newspaper. Lucy doesn't know yet, but that lady is a teacher at her new school.

When they come out of the shop, Lucy sees a purse on the ground. The lady in the blue jumper hasn't walked very far, and Lucy's mum says "the purse must be hers, if you run you can catch her up and give it to her".

- 1) Can we say that Lucy knows that the lady in the blue jumper is a teacher?
- 2) Can we say that Lucy is thinking "I must give the teacher back her purse"?
- 3) Can we say that Lucy was thinking "I must give the lady in the blue jumper back her purse"?

2) Jenny's mum and dad wanted to move house. One Sunday afternoon, they took Jenny to a part of town that she had never seen before, near a big park, They walked along the streets looking at all the houses in the area that had "For Sale" signs outside them, There was one house that Jenny liked ever so much. Unlike all Thai other houses in the street its walls were painted white. However, none of them knew that this house belonged to the Lord Mayor of the city.

- 1) Can we say that Jenny knew that the house she liked belonged to the Lord Mayor?
- 2) Can we say that Jenny was thinking "The Lord Mayor's house is the nicest one we've seen"?
- 3) Can we say that Jenny was thinking "The house with the white walls is the nicest one we've seen"?

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