Looking for logic in all the wrong places: An investigation of language, literacy and logic in reasoning
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Chapter 4

What’s logic got to do with it?

4.1 Introduction

What counts as human rationality: reasoning processes that embody content-independent formal theories, such as propositional logic, or reasoning processes that are well-designed for solving adaptive problems?

(Gigerenzer & Hug, 1992, p. 127)

This citation opens an article by Gigerenzer and Hug in which they go on to argue for the second alternative. Their position is representative of a widespread tendency to dismiss the role of logic in the psychology of reasoning: Fiddick, Cosmides and Tooby (2000) forthrightly claim that “[s]ocial contract theory . . . has no commitment to logical formulae”, while Evans’ (2002) assessment is that “[f]ew reasoning researchers still believe that logic is an appropriate normative system for most human reasoning” and “researchers have progressively de-emphasized the importance of logic in human reasoning”. In large part this is due to the negative conclusions drawn from empirical findings in the field, such as those reported in the previous chapters, and which have been taken to show systematic non-logical behaviour on reasoning tasks. The feeling is this: ‘Well, subjects clearly aren’t using logic, therefore it has no place in our theories of reasoning’.

Here I set out not so much to root for the first option in the choice offered by Gigerenzer and Hug as to reassess the sense of such an ‘either-or’ understanding of logic’s place in psychology. The professed aim of this dissertation is to contribute to a semantically grounded research programme in the psychology of reasoning, recently campaigned for by Keith Stenning and Michiel van Lambalgen (2001, 2004, 2005, 2008), but also advocated by Guy Politzer (1986, 2004), in Thompson (2000) and incipient as early as Henle (1962). In the first three chapters I dissected the performance of variably schooled subjects and argued that, in the case of less schooled subjects, their problems in interpreting various premise sets in reasoning
tasks plays a large part in explaining their difficulty in the task. I identified semantic factors for which they show concern, and proposed a reinterpretation of their responses as a function of everyday language usage. Implicit and sometimes explicit in the approach was the sense that their responses have been too quickly characterised as non-logical. In this chapter the aim is to make this sense explicit. Note that this is not to say that we expect to re-interpret all subjects as being logical all the time. The claim is rather that judgements of non-logicality have been wrongly directed, because of an understanding of logic which is by turns too narrow, too broad, and almost always too vague. I will show that views about logic’s relation to reasoning employed by reasoning researchers in large part rely on implicit yet outdated theoretical assumptions about the construction of meaning.

So firstly, I claim that empirical findings have been interpreted in the context of a number of theses which form background assumptions about meaning and its working in reasoning tasks, and that these theses should be challenged. Secondly, I would like to make the stronger claim that we are not in a position to dismiss logic’s role in reasoning and that we should in fact expect its role to become only clearer as we understand more about the semantic strategies that subjects employ. These claims will be developed in the context of a critical discussion of Stenning and van Lambalgen’s recent exposition of the relation between logic and psychology, to be found in their forthcoming book, Human Reasoning and Cognitive Science (2008). Most of the analysis presented in the previous chapters fits well into Stenning and van Lambalgen’s programme, but there are also important points of divergence. As we go along, I describe the fit and the divergence of the current account relative to Stenning and van Lambalgen’s work.

The plan of the chapter is as follows. I start by identifying the theses alluded to above. These are then examined one by one, starting with the assumption that logical form is betrayed by grammatical form, then addressing the dichotomy between logical and non-logical elements of language. This leads us to the central argument of the chapter, namely that it is untenable to equate logical reasoning to reasoning ‘solely on the basis of the given premises’. Finally, I consider the implications of this for the normative status of logic in theories of reasoning and rationality.

### 4.2 Logic vs. logic

The rejection of a role for logic in the study of reasoning is premised on a number of interlinked assumptions about the relation between logic, natural language and reasoning. At least the main assumptions are listed below. For a sample of papers which express or embody all or most of them see Wason (1968a), Braine (1978, 1990), Griggs & Cox (1982), Cosmides (1989), Gigerenzer & Hug (1992), Newstead et al. (1992), Johnson-Laird (2001); for each thesis I try to offer an...
illustrative citation from one of these publications.

1. The grammatical form of a natural language sentence directly corresponds to the logical form of the proposition expressed by that sentence (Wason, 1968a, Cosmides 1989), viz (Wason, 1968a, p. 273):

   This investigation is concerned with the difficulty of making a particular type of inference from conditional sentences, statements of material implication of the form, “if $P$ then $Q$” ($P \supset Q$).

   Sometimes, there is even a dichotomy made between syntax and semantics, as if logic was only to be found in syntax. This leads to confused formulations such as (Johnson-Laird, 2001, p. 434):

   Many theorists suppose that the mind constructs syntactic representations of the logical form of assertions and applies the rules of a formal logic to them. There is another possibility: reasoners could rely instead on their grasp of meaning, their general knowledge, and principles akin to those for the semantics of a logic.

   This is a false dichotomy, because validity can be determined either via syntactic operations or by model checking i.e. semantically, and – crucially – these two approaches are equivalent in a sound and complete logic (which both propositional and predicate logic are).

2. Logic is content-blind and domain-independent, often termed topic-neutral; this in turn rests on the division of natural language sentences into logical and non-logical elements; for instance, Cosmides claims with respect to variations on the Wason selection task that

   The correct formal logic response is $P \& \text{not-}Q$, regardless of content. (Cosmides, 1989, p. 199)

   where the only specification of logical formalisms given in this article is to label $P$ and $Q$ ‘logical categories’.

3. Reasoning logically means reasoning without taking world or general knowledge into account; logical inferences are those drawn solely on the basis of the given premises (Braine, 1978; Johnson-Laird, 2001; Newstead et al, 1992). The following excerpt from Braine (1978, p.2) illustrates:

   Practical (i.e., everyday) reasoning uses all the information at a person’s disposal, whereas formal reasoning is concerned with whether conclusions follow conclusions follow from premises. . . . formal reasoning makes two demands not made in everyday reasoning:
(a) Reasoners must compartmentalize information (i.e. restrict the information used to that contained in the premises) and (b) they must take a special attitude in comprehending the premises, by attempting to discover the minimum commitments of the premises as they are worded.

4. The base case (in a sense we’ll make exact later on) for logic is classical propositional logic, or even logic is just classical propositional logic. This is not always made explicit; in many papers reference is simply made to ‘logic’ (e.g. Norenzayan et al, 2002) or to ‘formal logic’ (e.g. Cosmides, 1989\(^1\)). In papers where a specific logical system is mentioned, such as propositional logic, the full machinery is not described (Johnson-Laird, 2001; O’Brien et al 1994). The fact that propositional logic doesn’t provide a formalism for quantified arguments doesn’t seem to bother most researchers.

5. The normative standards of rationality are given by logic, or, as Evans et al (1993) pithily put it, “rationality=logicality”.

This complex of theses, taken together with the empirical results in psychology of reasoning, do indeed form a formidable barrier to sensibly maintaining that experimental subjects are employing logic in their reasoning. We will see, however, that the above theses are, at best, in need of qualification, and at worst, untenable, mostly because they rely on language theoretical frameworks which have been successfully challenged. On closer analysis of the workings of language, it becomes apparent that casual reference to ‘logic’, ‘form’, and ‘the information contained in the premises’ as evident in the above research, is precisely part of the reason we are led to false dichotomies such as that suggested by Gigerenzer & Hug (1992)\(^2\). In the following sections the tenability of the each of the above theses is critically evaluated, and the resulting view is in turn related to Stenning and van Lambalgen’s counter-suggestions to the theses.

But before we start, it is helpful to get an idea of a logician’s contrasting perspective on logic. For this, see the opening comments of the widely-used introductory textbook, *Logic, Language, and Meaning, Volume 1* (Gamut, 1991, pp. 7 – 8):

> Whether logic is seen as the science of reasoning or the science of relationships between meanings, either way there is no such thing as a

\(^1\)In numerous places reference is made to the predictions of ‘formal logic’ and ‘logical structure’; for instance on page 192 “The logical structures of these two Wason selection tasks are identical”; on page 197: “From the point of view of formal logic, only the combination on the same card of a true antecedent (P) with a false consequent (not-Q) can falsify a conditional rule.”

\(^2\)Gigerenzer & Hug (1992) do go some way to dismantling the dichotomy in question at the end of their paper. They admit that “there is no simple and unique division line between structure and content” and that “we can now see that this opposition is not a dichotomy; there is a continuum between these poles”. (p. 168 –169)
universal logic which characterizes all valid arguments or the relationships between the meanings of all expressions. In practice, different logical systems are developed, each with its own particular class of arguments. What class this is depends on the kinds of expressions found in the logical language the logical system uses [i.e. the logical constants of that system]. . . . It should be noted, however, that this is not the only way new logical systems can be developed. We can also consider the same set of logical constants under a new interpretation. This too results in a different class of valid argument schemata . . . . Strictly speaking, then, a logical system is characterised by its logical constants together with the interpretations placed on them (my emphasis).

This excerpt is intended to illustrate what “the science of reasoning”, i.e. logic, actually involves, so as to disabuse us of the notion that to label something ‘logical’ is a self-evident thing to do.

Perhaps, as so often seems to be the case when concepts are exported and have a life of their own outside their home disciplines, there is conflation of a folk-theoretic notion with a more scientific understanding of the concept. This ‘folk’ notion of logic would presumably be what enables us to judge right off that only the first argument given below is valid. For we could surely all agree that

(1) All men are mortal.
Socrates is a man.
Therefore, Socrates is mortal.

should be judged valid in any logical system worth its salt, while

(2) All men are mortal.
All horses are mortal.
Therefore, all men are horses.

should not get that status. There are several remarks to be made about this.

Firstly, the folk-theoretic notion that enables us to make this distinction is always applied to examples for which it is seemingly blindingly obvious. For although the modus ponens schema is surely among the most uncontroversial, there are some other less palatable arguments arising from a material implication reading of conditionals. Our intuitions would be much more divided about the following (from Stalnaker, 1975, p. 269):

(3) The butler did it.
Therefore, if he didn’t, the gardener did.

Stenning has shown this to be the case with the notion of ‘innateness’, which has long been replaced with the concept of ‘heritability’ within biology, but which endures in nature/nurture debates outside biology (Stenning, 2007).
Indeed, Stalnaker judges this to be “intuitively absurd”, yet it relies on nothing more than the material implication reading of the conditional in propositional logic to count as valid. Such an argument illustrates what is known as a paradox of material implication. In this case, the paradox is that whenever the antecedent is false, the whole conditional is true. Since making the premise true forces the antecedent of the conditional conclusion to be false, the whole conditional becomes true, and so the argument is valid.4

The collision of our intuitions with the functioning of logical connectives such as the material implication do not only occur with these awkward paradox-based arguments, like that given above, but also with more acceptable premises and no obvious incompatibility in the relation to the conclusion. These can nevertheless result in counterintuitive conclusions, as in the following:

If Jones wins the election, Smith will retire to private life.
If Smith dies before the election, Jones will win it.
Therefore, if Smith dies before the election, he will retire to private life.

As Veltman (1986, p. 147) remarks, “What one calls a logically valid argument form with a few pragmatically correct instances is for another a logically invalid argument form with many pragmatically correct instances”. (Veltman here makes reference to a conventional role division between pragmatics and semantics, which we will question further on in the chapter.) It seems our folk-theoretic, or intuitive, notions of logic, validity, and good argument, are by no means always conservatively represented in common formal logical systems. Conversely, the consequences of formalisms confront our folk-theoretic notion of what a good argument is. So, in the context of judging reasoning, our folk-theoretic judgements about ‘logic’ must either be taken to be just that; or they should be retired to make way for specific logical systems. Much of Stenning and van Lambalgen’s work can be seen as an effort to discover the specific logical systems at work in our reasoning behaviour; much of formal semantics can also be seen as an effort towards this where reasoning is based on natural language. Indeed, any theory of reasoning needs to be built on semantic theory – that’s the bottom line. We now present some arguments which illustrate why this should be so.

4The other paradox is that whenever the consequent of a conditional is true, the conditional is true. This is illustrated in the following argument:

(i) If pigs can fly, then there is life on earth.
Pigs can fly.
Therefore, there is life on earth.
4.3 Determining logical form

An important aspect motivating the rejection of a role for logic stems from the assumption that subjects unproblematically extract the intended logical form from the grammatical form of the premises in a reasoning task. As has been amply illustrated in the foregoing chapters, for syllogistic and conditional reasoning tasks, and as we’ll see in the next chapter in the context of the Wason selection task, this is most definitely not the case. But much previous reasoning research assumed that logical form could be transparently read off grammatical form. That means assuming, among other things, that ‘and’ can always be translated as (propositional logical) conjunction \( \land \), ‘or’ as disjunction \( \lor \), and, perhaps most problematically, ‘if ... then’ as the material implication \( \rightarrow \). This is evident in the very first sentence of Wason’s (1968a) article on the selection task (my emphasis):

This investigation is concerned with the difficulty of making a particular type of inference from *conditional sentences, statements of material implication* of the form, “if P then Q” \( (P \supset Q) \).”

This is simply a case of broken telephone between disciplines. Semanticists who study the logical structure of natural language make no such assumptions about even the possibility of straightforward and unique translations into logical form. Veltman’s (1985, p. 3) comments illustrate:

As a logician, you can do no more than devise a logic for conditionals and try to persuade your readers to adopt it. ... It cannot be [the best logic for conditionals], not because this actual logic would not be good enough, but simply because there is no such thing.

Now this is quite an extreme opinion; many logicians would beg to differ, but the point is made. For semanticists, it is an open research question what the appropriate logical form is for many natural language constructions, not least conditionals.

Since Wason’s 1968 article there has certainly been more attention given to the difference between grammatical and logical form; sometimes merely lip-service – for instance allowing that conditional assertions in natural language may also be read biconditionally (Johnson-Laird, 2001, p. 438)\(^5\) – but sometimes also proper

\(^5\)The difference between grammatical and logical form is related to the more general distinction between a sentence and a proposition. Awareness of the distinction is not always lacking. In Johnson-Laird & Savary (1999), for instance, we find the following cautionary note (p. 193):

A point to bear in mind, however, is the difference between a sentence or clause and the proposition that it expresses. Most sentences can be used to express many different propositions, ...
consideration, as we have seen in the discussion of Chapter 1 of the similarities and differences between Politzer (2004) and Stenning and van Lambalgen (2008) regarding logical form for the conditional.

**Grammar ≠ form**

Empirically, Fillenbaum’s striking studies (1978, as discussed in previous chapter) illustrate precisely subjects’ refusal to make exact ‘translations’ automatically, or even with prompting. Recall that Fillenbaum’s subjects converted such sentences as

*(4) Clean up the mess or I won’t report you*

into sentences such as

*(5) If you don’t clean up the mess I’ll report you.*

The thing to notice is the switched negation in the second sentence; a ‘strict’ paraphrase would be the counterintuitive

*(6) If you clean up I’ll report you.*

Fillenbaum labels this phenomenon ‘pragmatic normalization’; here we can subsume it into what Stenning and van Lambalgen (2008) termed ‘reasoning to an interpretation’ and take it as evidence that normal language speakers do not glean logical form directly from grammatical form. The issue of normativity – to what extent the process of pragmatic normalization exhibited by Fillenbaum’s subjects is warranted and thus what status such a process should get – is taken up more fully later on in the current chapter. For now, it should be clear that phenomena like normalization need to be accounted for in a theory of reasoning no matter what normative status they get. In contrast to assuming that reasoning subjects simply read logical form off grammatical form, and as mentioned previously, Stenning and van Lambalgen emphasise that there are two basic stages to reasoning behaviour, namely reasoning to an interpretation and reasoning from an interpretation. The former stage is concerned with establishing “the domain about which one reasons and its formal properties” – including making decisions about logical form; then one can go on to reason from an interpretation, which

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... e.g. the disjunction [‘Either there wasn’t a king in the hand or else there was an ace in the hand’] refers to different hands of cards depending on the circumstances of its utterance. It is laborious to keep writing, ‘the proposition expressed by the sentence’ and so unless the distinction matters we will use ‘assertion’ to refer to sentences or the propositions they express.

And that’s all that Johnson-Laird & Savary have to say about the difference between sentence and proposition.
is “guided by formal laws”. These two stages fit well onto the analysis of subject behaviour given in the previous chapters: both Chapter 1 and Chapter 2 can be seen as investigations of the considerations involved in imposing logical form, that is, reasoning to an interpretation. We have explained differences across schooled and unschooled subjects as largely differences at this stage of the reasoning task. Note however that it’s not always so much a difference in interpretation which matters, but a difference in the conditions under which the subject imposes one or other interpretation. For example, we saw that with syllogistic materials unschooled subjects appear reluctant to ascribe a (descriptive) law-like reading to the quantified premises on a universal domain; they often looked for further restriction of the domain before allowing the quantification to serve as a basis for predicting about instances. The difference between law-like and contingent versions would not show up in logical form for the proposition but in the semantics accompanying it – i.e. the variability allowed in the domain.

Grammar ≠ form: some implications

Once the space between grammatical form and logical form has been noticed, all sorts of other things start to shift and dissemble. For instance, we can see that the proposition’s elemental status in propositional logic does not transfer to the sentence in natural language. Consider the suppression effect task results, as reported in Byrne (1989). Byrne’s main thesis is that “in certain contexts subjects reject instances of the valid modus ponens and modus tollens inference form in conditional arguments” (p. 61). This is demonstrated by what Byrne labelled the “suppression effect” which becomes visible (in her study) only in between subject comparisons on different conditions. The different conditions are described in more detail in Chapter 1, here an example suffices. When subjects are presented with the conditional premise ‘If she meets her friend then she will go to a play’, and the categorical premise ‘She meets her friend’ then rates of modus ponens elicitation are very high – 96%. When subjects are presented with these premises accompanied by an extra conditional such as ‘If she meets her family then she will go to a play’ the elicitation rates remain high. However, in groups where the materials presented contained an extra premise like ‘If she has enough money then she will go to a play’, the elicitation rate drops to 38%. Now for this pattern to count as evidence of “suppression” of an inference, you have to assume, among other things, that the grammatical features of the premises – specifically that the two conditions are presented in different sentences – are maintained in the logical form attributed to them. However, it is much more plausible (as even Byrne acknowledges in her formulation of premises as “additional” or “alternative”) that subjects roll the two conditional premises into one proposition with a complex

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6 Relevant here is the finding, reported in the previous chapter (Kurvers, 2002), as well as in other studies (e.g. Garton & Pratt, 1998) that concepts such as ‘word’ and ‘sentence’ are the products of literacy.
antecedent, as it were, which vary in form according to the type of relation specified in the second conditional premise (see next section for discussion on the role of ‘content’ in determining form). So for instance, in the case given above, we would expect the combination:

If she meets her friend then she will go to a play.
If she meets her family then she will go to a play

to be represented as

If she meets her friend or her family, she will go to a play.

and similarly, for the additional condition ‘If she has enough money then she will go to a play’:

If she meets her friend and she has enough money, she will go to a play.

Indeed, the only reason not to do this would be if you paid special attention to the sentential presentation of the premises – something which more than a third of the subjects appear to have done. Again, we do not call this so much a logical achievement as a literal stance towards the materials, which some subjects take, and others apparently don’t.

4.4 Is it really content xor form?

A central argument against the role of logic in human reasoning is based on the content-blindness of logic; the argument is that logical rules are purely formal and thus apply whatever the content is, if they apply at all. This is concisely expressed in Evans (2002, p. 983):

Such influences [of content and context] are necessarily nonlogical because the deduction paradigm requires people to make inferences based on logical form for arguments whose particular content and context is irrelevant.\(^7\)

But, or so the argument goes, human reasoning is highly sensitive to content, and thus cannot involve recourse to logic. This reasoning is often used in defence of domain-specific theories of reasoning – viz. (Fiddick et al, 2000, p. 2):

A central method used to test domain-specific reasoning theories has been to see whether the inferences people make vary as a function of the content they are asked to reason about.

\(^7\)The equivocation of a specific experimental area ‘the deduction paradigm’ with logic is itself an interesting equivocation!
The assumption of content-blindness (or topic-neutrality) of logic is closely related to the division of language into logical and non-logical elements. For example, in the sentence “All bears are white”, it is assumed there are two sorts of lexical items: logical ones, i.e. “all”, and non-logical ones such as “bears”, “white”. Content is given by the non-logical elements of a sentence. And the logic of the sentence is given by the logical elements (as you may have guessed), so that “All A are B” has the same logical meaning whatever you substitute for A and B.8

This is an appealing view on natural language but it is too simplistic. Firstly, as we’ve discussed above, grammatical form does not always straightforwardly portray logical form, so the logical elements cannot just be read off a natural language sentence. Secondly, natural language does not cleft so neatly into ‘logical’ and ‘non-logical’ elements as one might hope. There are many words and constructions which carry logical inferences – not just implicatures – as part of their meaning.9 Again, we see this articulated in the opening pages of the logic textbook (Gamut, 1991, p. 8), where it is made clear that the ‘logical’ elements of natural language form a much bigger set than the propositional connectives, and a not easily delimitable set at that:

Logical constants other than those mentioned so far [i.e. those of propositional and predicate logic] are, for example, modal expressions, like possibly and necessarily, which are treated in modal logic . . . , and temporal expressions and constructions like it was the case that, it will be the case that, sometime, never, and the tenses of verbs, which are treated in tense logic . . . . The set of possible logical constants is an open one. . . . A sharp boundary cannot be drawn between purely descriptive terms and the rest . . . . [Rather,] there seems to be a gradual transition from structural aspects of meaning, which fall within the range of linguistic theories, and descriptive content, which does not.

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8 This point has also been taken up by Stenning and van Lambalgen. For them it is related to “a superficial reading of the classical definition of validity, say for a syllogism such as

All A are B.
All B are C.
Therefore, all A are C.

The validity of the schema is taken to mean something like ‘whatever you substitute for A, B and C, if the premises are true for the substitution, then so is the conclusion” (Stenning and van Lambalgen, 2008, p. 28). This is a superficial reading because it ignores the domain-dependence of the applicability of such a schema.

9 Here again I make reference to a conventional distinction in the semantics-pragmatics literature between inferences and implicatures. The term ‘implicature’ was coined by Grice (see Grice, 1975, reprinted in Grice, 1989) to explain the difference between speaker and sentence meaning. An implicature is suggested, intended, or meant, by what is said. Later in the chapter we evaluate the tenability of a principled distinction between ‘what is said’ and ‘what is meant’.

The key phrase in the above excerpt is that “[t]he set of possible logical constants is an open one.” There is more to logic than that captured with disjunction, conjunction, implication, negation, universal and existential quantification. Terms and phrases such as only and ‘*x* knows that *p*’, illustrate. Both of these have logical properties which formal semanticists have studied extensively. Take the case of only. It may not strike one as ‘logical’ immediately. Yet only interacts with the focus of the sentence – determined by phonology – to fix the logical form of a stressed sentence. So for example, the following two sentences:

(7) Sarah only WRITES books.

(8) Sarah only writes BOOKS.

express different propositions: the first is true in situations where Sarah reads for instance magazines but no books, the second in situations where Sarah has quit her job as a gossip columnist. This is not mere pragmatic adjustment – we are talking here about the truth-conditions of the expressed propositions. From an inferential point of view, from the first example we can conclude ‘Sarah does not read books’; from the second the conclusion ‘Sarah doesn’t write newspaper columns’ follows. A roughshod conclusion would encode the two sentences as having the same form, perhaps simply into *p*, since the grammar does not suggest any differing ‘logical’ aspect – we have to take phonology (or context) into account to see that – thereby losing these essentially logical differences between them. (Second-order) predicate logic could fare better but since most psychology of reasoning studies have dealt with propositional logic, and to illustrate the point, we can stick with it.

For a rather trivial but comparable example, reflect on the fact that the Barbara syllogism comes out in propositional logic as:

\[
\begin{align*}
p. \\
q. \\
\text{Therefore, } r.
\end{align*}
\]

Evidently, there is continuous discrimination in what needs to be encoded into logical form and what not, from natural language contexts. That discrimination is exercised when we translate quantified sentences into the formal language of predicate logic, while for conditional-based arguments it often suffices to translate them into the much simpler language of propositional logic. It is equally exercised

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10 This view is called the ‘First Order thesis’ by Barwise (1989, p. 37).

11 Compare ‘*x* knows that *p*’ with ‘*x* thinks that *p*’, which does not have the property of veridicality for the embedded clause *p*. A variety of epistemic logics have been developed which capture such properties of knowledge and belief. For a nice example of how far you can get with this kind of approach, see Baltag, A., Moss, L.S., Solecki, S. (1998).

12 Matts Rooth’s dissertation gives the logical analysis of ‘only’ (Association with focus, 1985), in which he argues that it has a quantificational structure.

13 Capitals here indicate a pitch accent.
by our reasoning subjects who are trying to figure out what logical distinctions are important for the task at hand. The distinction between logical and non-logical in natural language is not simply given by the constants of propositional logic.

But surely this independence from specific content is exactly what defines logic? *Within* specific logics, we do achieve topic-neutrality, in the sense that only the logical constants contribute to the logical relations between propositions. In a formal logical language such as that of propositional logic, sentence letters represent ‘content’ and do not directly contribute to logical structure. One way to characterise logical constants in a language is to see which parts of the language are invariant under permutation of the domain (Tarski, 1936); the idea is that those parts that are not affected by permutations of the objects in the domain under discussion are the parts that are neutral with respect to what the language is representing. This is a technical property of the logic, and to take it as a defining feature of logic needs further justification by appeal to some non-technical property (McFarlane, 2000, p. 19). The non-technical property to which recourse is usually made to is *formality*. But what does it meant to say that logic is formal?

The formality of logic

As we’ve seen, reasoning researchers are inclined to demarcate logical from non-logical reasoning by making recourse to the formal nature of logic. That is to say, that logic concerns itself only with the “form” of statements, abstracting from content. This is by no means a view peculiar to reasoning researchers. It is a pervasive view of logic. McFarlane (2000, p. 63) goes so far as to say that “This kind of talk is so common as to be nearly invisible.” The problem is that we don’t know what we mean when saying logic is formal. Historically, formal consequence has been differentiated from material consequence, to explain the difference between, for instance (Read, 1994, p. 237), the source of validity in

\[14\] Historically, the equivocation of syntax with logical form can be seen as deriving (albeit in a distorted fashion) from a particular view of logic: namely that logic is about implication relations between propositions. On this view, logic inheres in the formal structure of language. This can be contrasted with an older understanding of logic as the study of judgements and inferences, where both are mental notions. Logic in this sense is an epistemic tool: inference is an act in which a judgement is made on the basis of other, already made judgements. (The content of a judgement is a proposition.) Sundholm (1994) locates the shift as far back as Bolzano, whom he says makes the two key reductions, namely “(i) that of the correctness of the judgement to that of the truth of the propositional content and (ii) that of the validity of an inference between judgements to a corresponding logical consequence among suitable propositions [namely those which form the content of the judgements].” This is interesting from our point of view because it indicates a change in the locus of logical authority: the internal perspective of an epistemic agent is stripped away. Logic’s subject matter becomes the relation between propositions, or even well-formed formulae, which Sundholm calls “meta-mathematical objects of an uninterpreted formal language”.

All cats are animals.
All animals have tails.
So cats have tails.

Iain is a bachelor.
So Iain is unmarried.

Traditionally only formal consequence falls under the jurisdiction of logic; again, this is difficult to make precise. Read will go on to argue that the distinction between formal and material consequence does not delineate validity correctly, but even if it was correct, in principle, the line is difficult to draw in practice.\(^{15}\) As we have seen above, the difference between logical and descriptive aspects of natural language is a sliding scale rather than a dividing line.

In reasoning research ‘formality’ is sometimes even identified in descriptive content. Take for example, the question which opens Norenzayan, Smith, Kim and Nisbett’s (2002) article on cross-cultural differences in reasoning behaviour: “Is the Pope a bachelor?” According to the authors, answers to this are representative of one of two reasoning styles. Responding “no” indicates an intuitive, similarity-based approach to the problem (the Pope isn’t like other bachelors), while “yes” (the “correct” answer) indicates an analytic rule-based approach (he’s an unmarried male). Evidence for a broader style difference thus (Norenzayan et al, 2002, p. 654):

The ‘bachelor’ problem illustrates an important theoretical distinction in the psychology of reasoning. According to this distinction, human thinking is guided by two separate classes of cognitive strategies that implement different computational principles. One can be described as intuitive, experience-based, or holistic, whereas the other can be

\(^{15}\)Going even further than this, McFarlane (ibid, p. 51) shows, that the even notion of formality attributed classical logic is a slippery one, being used in at least three common senses:

- To say that logic is **1-formal** is to say that “its norms are constitutive of concept use as such”
- **2-formal**: “its characteristic notions and laws are indifferent to the particular identities of different objects. 2-formal notions and laws treat each object the same (whether it is a cow, a peach, a shadow, or a number). Mathematically, 2-formality can be spelled out as invariance under all permutations of the domain of objects.”
- To say that logic is **3-formal** “is to say that it abstracts entirely from the semantic content or ‘matter’ of concepts”

McFarlane will go on to argue that logic is best understood as formal in the first sense – perhaps surprisingly. Here it suffices to realise that simply making reference to the formality of logic, and judging an argument to be logical on the grounds that it is formal, will not do, unless it is specified further what formal should be taken to mean!
4.5. **CLASSICAL FIRST-ORDER LOGIC AS BASIC**

described as formal, rule-based or analytic.

The authors go on to relate the two systems hypothesis mentioned here to the widespread research interest into “dual process” theories of reasoning (Wason & Evans, 1975, Evans, 2003). And further on, in more detail (Norenzayan et al, 2002, p. 678):

Formal reasoning is rule-based, emphasizes logical inference, represents concepts by necessary and sufficient features, and overlooks sense experience when it conflicts with rules or logic. Intuitive reasoning is experience-based, resists decontextualising or separating form from content, relies on sense experience and concrete instances, and overlooks rules and logic when they are at odds with intuition.

They go on to report two studies in which East Asian student subjects relied more heavily than their American counterparts on ‘intuitive’ processes, leading to less accurate responses – seemingly raising the possibility that East Asian students are less logical. Qualms about such general dichotomies aside, what’s interesting to note is that the locus of logic has widened in this study, to cover material inferences. The normative force of the ‘logical’ answer has also widened accordingly.

In other words, for Norenzayan et al, material consequence judgements such as that the Pope is a bachelor count as evidence for logical reasoning, while in other psychology of reasoning studies, asking the question “Is the Pope a bachelor?” would not be seen to have a logical component at all. Here again we see the problems of relying on folk-theoretic concepts in an academic domain: they can be inconsistently applied and thereby make diverse results seem convergent.

One last point on formality: taking permutation invariance to be the hallmark of the formal elements might seem to rule out many natural language counterparts of logical constants – the different interpretations of conditionals across the abstract and thematic variations of the Wason selection task provide a good example of this. But if one allows for the relevant logical differences in the selection task, such as the difference between deontic and descriptive conditionals, this problem disappears. Again, the matter of the status of different interpretations is taken up later on in the chapter.

### 4.5 Classical first-order logic as basic

Classical logic has been immensely successful. But this very success has enshrined certain formats and procedures, that also have drawbacks. For instance, many themes suffer from what may be called ‘system imprisonment’. We have to discuss the behaviour of [say] negation inside specific formal systems, such as propositional or predicate logic – even though these systems do not correspond to meaningful distinctions in the ‘open space’ of actual reasoning.
Almost all empirical results on reasoning have been the victims of ‘system imprisonment’, in the sense that the meaningful distinctions have been presupposed to be those of propositional or at most predicate logic, and not those apprehended by subjects in the tasks. This is because outside – and inside – logic it has generally been assumed that classical logic is logic, or at least provides the ‘basic case’ – a view expressed for instance in Cherniak’s influential book (1986), on the thesis that the “acceptance of logic” is a precondition for rationality (p. 76):

I will deal almost entirely with classical logic. This is not to prejudge the issue of the adequacy of nonstandard logics; the case of classical logic is basic, and the argument should be generalizable to other logics.

Cherniak goes on to describe the complexity of classical logic, and in turn uses this as to argue against the acceptance of logic as a precondition for rationality.

Meanwhile, inside logic we get the following kind of opinions: Barwise, on the proper place of first-order logic in logic in general:

[First order logic] is just an artificial language constructed to help investigate logic, much as the telescope is a tool constructed to help heavenly bodies. From the perspective of the man in the street, the [first-order] thesis is like the claim that astronomy is the study of the telescope.\(^\text{16}\)

I don’t want to create the idea that logicians ‘know better’; rather I want to point out that logicians study different logics. Classical logic is one of the many exportable products of that study, not the answer; it is a topic of lively discussion in what sense, if any, it is more ‘basic’ than other logics.

More importantly, there are two senses in which propositional logic can be argued to be basic: basic relative to other logics, or basic relative to the logic of natural language. Classical logic can be basic relative to other logics, in the sense that other logics are built on it (e.g. quantified predicate logic makes use of the same set of logical constants and semantics at the sentence level), without being basic relative to natural language. And even in this sense, classical logic is not basic, for other logics, such as intuitionistic logic, are not embeddable in it.\(^\text{17}\)

The fear is that letting classical logic go as a norm will bring on a relativist

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\(^\text{16}\) The first-order thesis is the claim that “logic is the study of the properties of and, or, not, implies, every, some and identity and that anything that cannot be defined in terms of these is outside the domain of logic” (Barwise, 1989, p. 37).

\(^\text{17}\) Intuitionistic logic was developed by the mathematician L.E.J. Brouwer with the aim of modelling the constructive reasoning of intuitionistic mathematics. The basic premise in this style of reasoning is that \textit{reductio ad absurdum} should not be used to prove the existence of something. For example, one should not conclude from the impossibility of, say, no object having the property A, that there is indeed an object with the property A. In this logical system the law of the excluded middle (i.e. that \(p \lor \neg p\) is a tautology) no longer holds (Gamut, 1991, p. 140).
free-for-all: if any reasoning (good or bad) can be cast in a custom-made logic, then what can logic possibly tell us about what good reasoning is? But pluralism in logics need not lead to relativism, or at least not a vicious relativism. It may be perfectly appropriate to apply different logics depending on the aims and possibilities of the situation: in co-operative conversation a default logic is most useful; in legal debate or scientific reasoning a more rigorous interpretation process may be necessary, recruiting a more classical-type logic. In both cases, it’s not the case that anything goes. A perspectival view does not preclude criteria of rightness in reasoning within a chosen validity definition, and even inherent rightness in choosing this. A normative system can be appropriate relative to parameters without being relativistic.

If classical logic provides the norm, the next question is how the normative interpretations of premises have been supposed to be reached. We critically examine this issue in the following section.

4.6 Just what are the given premises?

In the foregoing I have been continuously making reference to ‘literal meaning’ and claiming that this is the notion that schooled subject access but which unschooled subjects do not have available in reasoning tasks. But what do I mean by ‘literal meaning’ and how does it relate to other notions of meaning? And what normative status does it have in the context of the reasoning task, if any? Firstly, let us be clear about the role such a notion has in reasoning tasks. Recall the summary offered in Braine (1978, p. 2), epitomising a still dominant view inside (and outside) psychology of reasoning:

Practical (i.e., everyday) reasoning uses all the information at a person’s disposal, whereas formal reasoning is concerned with whether conclusions follow from premises. . . . formal reasoning makes two demands not made in everyday reasoning: (a) Reasoners must compartmentalize information (i.e. restrict the information used to that contained in the premises) and (b) they must take a special attitude in comprehending the premises, by attempting to discover the minimum commitments of the premises as they are worded

This excerpt sketches a picture in which the logical reasoner, reasoning solely on the basis of the given premises, must make use only of the literal meaning of the premises, or, phrased in Braine’s terms, as the “minimum commitments of the premises as they are worded” (ibid). Subjects who fail to do this bring in world knowledge and make use of extra assumptions which are not entailed by the premises. Making this distinction, as Braine requires of the logical reasoner, requires being able to draw a sharp line between information contained in the
premises and that merely implied by them. As we will see in the following, this line can only be drawn relative to a theoretical perspective.

4.6.1 Literal meaning in everyday use

The notion of ‘literal meaning’ has an everyday sense. Often it is used in differentiating from non-literal meanings such as in metaphor or irony. Indeed, the Oxford English Dictionary defines ‘literal’ as “taking words in their usual or most basic sense without metaphor or exaggeration.” Iglesias (2006) has shown that this function hides a multi-faceted notion. This is primarily because literality is always used in contrast with non-literality; Iglesias calls the literal/non-literal distinction “a cluster of productive analogical dichotomies”, each of which is applied differently in different settings, including disambiguation, transfer, extension (including conventionalized figurative language, metaphors), indirect speech acts, and implicature.\(^{18}\) He identifies a common structure in these contexts of use in which the first interpretation is non-literal, and a literal meaning is calculated only afterwards, because of some additional information which leads to a cancellation of the original interpretation. This is illustrated in the following exchange, a case of disambiguation (Iglesias, 2006, p. 137):

A is in Granada sitting in front of the Alhambra and says to B:

(11) This in front of us is a marvel.

B interprets that A is talking about the Alhambra and later reports A’s words to C in the following way:

(12) A said that the Alhambra is a marvel.

Then C replies that he finds this implausible, for A is particularly insensitive to this kind of architecture. In this moment B remembers that A is particularly fond of cars and that, when A uttered (11), a Rolls Royce was parked in front of them. B then says:

(13) Well, what A \textit{literally} said is ‘This in front of us is a marvel’.

Presumably B would then go on to explain that there was also a Roll-Royce in full-view when A made his utterance. In this case, ‘literal meaning’ reduces to verbatim citation, and it differs from the original reported speech in that it unfixes the original reference. In other uses of the term ‘literally’, ‘verbatim’ would not be an adequate explanatory substitute term; think here of metaphors in which ‘literal’ means rather ‘non-figurative’, for example. Furthermore, Iglesias emphasises, the different uses are mutually irreducible, because they operate on different levels of interpretation, and thus that there is no paradigmatic sense of ‘literal’ from which other uses lend their meaning.

\(^{18}\)We can understand the difference between the two answers to Norenzayan’s ‘bachelor problem’ as a preference for literal vs figurative/metaphorical readings of the question.
In a similar usage to the everyday sense – i.e. to differentiate from non-literal language usage – literality has also played an important role within philosophy of language discussions about the structure of meaning. But here it is attached to a theory of meaning, which assumes that literal meaning is not only always interpreted first – but it also forms the deductive core of the interpretative process. Both processing priority and semantic or informational precedence are adduced to literal meaning in contrast to intended, perhaps non-literal, meaning.

An influential illustration of this view of meaning is found in Searle’s paper *Metaphor* (1979) in which the view is propounded that an initial sentence meaning is computed and only then, after a mismatch with the context of use, is a metaphorical meaning generated, on the back of the literal meaning as it were; an early rebuttal of such an account of meaning is Bartsch’s (1984) widely cited rejection of the suitability of Searle’s account to explain how metaphor works.\(^{19}\)

### 4.6.2 Literality in theories of meaning

Recently the role of the notion of literal meaning in theories of meaning has been addressed by François Recanati in his book of the same title, *Literal Meaning* (2004). I will make use of the language-philosophical arguments he lays out in this book, as they are concise yet precisely equipped to elucidate, and challenge, the assumption that subjects should – or even can – reason ‘solely on the basis of the given premises’; an assumption which, as we have seen, is evident in most psychology of reasoning research.

In fact, this is a reasonable assumption given the view which has dominated philosophy of language in the last decades, as exemplified in Searle’s account of metaphor (see above). According to this view, knowledge of the meanings of words, plus knowledge of compositional rules of the language, allows the hearer to interpret any utterance, at least ‘literally’. This gives ‘sentence meaning’. But sometimes the speaker wants to communicate something other than what has literally been expressed. At this point pragmatics, in the form of conversational maxims, can be employed, to generate a meaning other than the initial literal meaning – namely, ‘speaker meaning’. Take as an example the sentence “I’ve had breakfast”. Under normal circumstances, on the dominant ‘literalist’ view, the speaker meaning is that the speaker “has had breakfast today”, but this is an enriched version of the semantic core of the utterance: the literal or sentence meaning, i.e. the speaker “has had breakfast at some point previously”, since, to anticipate slightly, this latter statement already expresses a full proposition.\(^{20}\)

Yet it would be true even if the speaker had only had breakfast “twenty years ago and never since” (Recanati, p. 8). (On top of this there is what the speaker

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\(^{19}\)In fact Bartsch was probably one of the first theorists in the tradition to acknowledge “that there is not always a sentence meaning available to start with.” (1984, p. 29).

\(^{20}\)The matter of the pronoun ‘I’ is addressed in the next paragraphs.
conveys by uttering “I’ve had breakfast”, namely perhaps an answer “No, thank you” to the question “Would you like a croissant?”

Essential here is that it is assumed that “we can legitimately ascribe determinate contents (such as truth-conditions) to natural language sentences, independently of what the speaker actually means” (Recanati, p. i). This entails a basic distinction between ‘sentence meaning’ and ‘speaker meaning’\(^\text{21}\), as described above, even when they coincide, and ascription of a certain status to sentence meaning, as the deductive core of meaning. Against this, and along similar lines to those described by Iglesias for everyday use of ‘literal’, Recanati will argue that the basic notion is ‘what is said’, that this is determined on the basis of content and context, as we’ll specify further later on; and that ‘literal meaning’ is at best a post-hoc theoretical construction.

Recanati describes how the difference between sentence meaning and speaker meaning has been seen to cleave parallel to semantic and pragmatic contributions to interpretation. The semantic part of interpretation proceeds deductively, because “knowing a language is like knowing a theory by means of which one can deductively establish the truth-conditions (or the proposition expressed by) sentences”; on the other hand, pragmatic interpretation is characterised by its defeasibility, primarily because “there is no limit to the amount of contextual information that can affect pragmatic interpretation” (p. 54).

Now this picture as stated has obvious gaps, because certain linguistic elements rely on contextual information to get their semantic meaning – think of indexicals such as ‘here’, ‘I’, or unarticulated constituents such as in ‘it’s raining’ (which we take to mean it’s raining here rather than just somewhere\(^\text{22}\)). In other words, semantic interpretative processes don’t always deliver propositions, but rather what Recanati calls ‘semantic schemata’, and they need to be augmented by contextual input to reach the level of proposition, the proposition expressed by the sentence. This type of (mandatory) process whereby the meaning of the sentence is completed, made propositional, is called saturation.

But the literalist still has a case to make for purely semantic interpretation: she can include the standard contextual inputs needed for saturation by making them semantic rules. For instance, ‘I’ can be standardly be considered to refer to the speaker. Such contextual input has been distinguished from more unruly pragmatic input, involving world knowledge for instance by Ken Bach\(^\text{23}\), whom

\(^21\) Actually Recanati goes on to discuss a triadic distinction (Recanati, p. 5):

sentence meaning

vs

what is said

vs

what is implicated.

I won’t use this division as it’s not needed to make the point at hand.

\(^22\) Example from Perry.

\(^23\) Kaplan’s (1978) distinction between content and character has the same aim. For him, the
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Recanati quotes:

There are two quite different sorts of context, and each plays quite a different role. Wide context concerns any contextual information relevant to determining the speaker’s intention and to the successful and felicitous performance of the speech act... Narrow context concerns information specifically relevant to determining the semantic values of [indexicals] ... Narrow context is semantic, wide context pragmatic.\(^{24}\)

The problem is that there is no sharp line to draw between these two types of context. Even pure indexicals such as ‘here’ require Bach’s wide context to acquire the appropriate semantic value: “as is well known, ‘here’ can refer to this room, this building, this city, this country, and so on…” (Recanati, p. 58) so that although there maybe be a rule for automatically determining the content from the narrow context, which narrow context must be used, is determined by pragmatic processes concerning the speaker’s intention and the wide context.

Moreover, Recanati argues, most context-sensitive expressions are not indexical but rather simply *semantically underdeterminate*\(^{25}\). He gives the example of the possessive phrase ‘John’s car’, which means something like “the car that bears relation $R$ to John, where ‘$R$’ is a free variable”, which is assigned a value, not on the basis of of a rule, or as a function of narrow context, but one determined by wide context, what the speaker means for it to intend.\(^{26}\) Crucially, this process is mandatory, because you cannot reach the level of proposition without settling on a value for ‘$R$’.

I think that a similar argument can be used against the idea that conventionalised conversational maxims can be included in the deductive process to reach an enriched meaning. To take the “I’ve had breakfast example” example described above, a Gricean could argue that the conventionalised conversational maxim of content of a given expression “is always taken with respect to a given context of use”, while the character of an expression “determines how the content is determined by the context” (pp. 83–84, emphasis added). In the case of ‘I’, its character would be represented “by the function (or rule if you prefer) which assigns to each context that content which is represented by the constant function from possible worlds to the agents of the context” (p. 84, his emphasis).

\(^{24}\)This is from a handout of a presentation given by Bach, ‘Semantics vs Pragmatics’, in 1996. In the published paper ‘You don’t say?’ (2001, p. 21) he reiterates this point: what the sentence says, in the semantic sense, “excludes anything that is determined by [the speaker’s] communicative intention (if it included that, then what is said would be partly a pragmatic matter)” – and we can’t have that!

\(^{25}\)Computational semanticists have shown the implausibility of ambiguity as an alternative explanation. Ambiguous expressions are computationally intractable; indeterminacy is much better-behaved computationally. See for example Kamp & Reyle (1993) for a discussion of this.

\(^{26}\)I imagine candidates for the relation $R$ would be, for instance, ownership; temporary assignment such as on a bumper car ride; design copyright if John is a car designer, etc. One might call these varieties of ‘ownership’, but the process of deciding which one applies would be a pragmatic process, one that Recanati calls ‘loosening’, in which the application of the (unarticulated) predicate ‘ownership’ is widened (see p. 26 of Recanati).
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relevance offers at least a quasi-deductive explanation of why we usually interpret the sentence to mean “I’ve had breakfast today” (and further conversational implicature could deliver us the conveyed sentence). But then the Gricean would have to use a different argument to explain why a sentence like “I’ve had measles” doesn’t get the same treatment, and, again, wide context – i.e. world knowledge – will here be needed to distinguish the two cases. The point is that the use of world knowledge cannot be excluded by attempts to explain the stable nature of certain implicatures.

To return to Recanati: if he is right about the pervasiveness of semantic underdeterminacy, then sentence meaning becomes a problematic notion. In fact, the underdeterminacy does not even have to be pervasive; all we need to show is that in some ordinary ‘literal’ (i.e. not metaphorical) usage, in Recanati’s words, there is “no such thing as ‘what the sentence says’ in the literalist sense, that is no such thing as a complete proposition autonomously determined by the rules of the language with respect to the context but independent of the speaker’s meaning.” (p. 59) This is enough to fatally undermine the literalist picture.

There are still possible interpretations of the notion of ‘sentence meaning’, in terms of a pragmatically-informed notion of ‘what is said’ (see p. 59). Certainly the first candidate, what Recanati calls the ‘minimal proposition’, seems to align well with the interpretation that Stenning and van Lambalgen assume the sceptical reasoner is using. The minimal proposition is defined in terms of the fully integrated pragmatic notion of ‘what is said’, but minus the contextual ingredients – especially the optional ones, as conversational implicatures would be. One abstracts, as it were, over contexts, to distill the semantic content from the fleshted out pragmatic-semantic content. In Recanati’s words this proposal is that the minimal proposition forms a kind of ‘common denominator’, namely “what is asserted in all contexts in which the sentence is uttered and the indexicals are given the same semantic values as in the current context” (p. 61). The problem is, this ‘minimal proposition’ is not always part of what is said. Recanati offers the example ‘The ham sandwich left without paying.’ The speaker who utters this does not minimally mean that ‘the ham sandwich left without paying’, but a different proposition altogether, namely, ‘The person who ordered the ham sandwich left without paying’\(^{27}\). So it’s not the case that the minimal proposition can be seen as the semantic ‘core’ of the sentence.

A second candidate is Perry’s notion\(^{28}\) of ‘reflexive proposition’, which is the semantic content of a sentence prior to saturation. For the utterance \(u\) of a sentence ‘I am French’ the reflexive proposition would be ‘the utterer of \(u\) is French’. Again, this is emphatically not to be understood as somehow part of what is said, but is a theoretical construction, where content is specifically solely determined by the rules of the language, and it is not intended to be considered

\(^{27}\)This relies on the (optional) pragmatic process of ‘loosening’ again.

\(^{28}\)Although Recanati notes it stems originally from Reichenbach’s *Elements of symbolic logic.*
as constituting a distinct stage in normal language comprehension. Hence this account predicts a ‘one-step’ model of language processing, a claim to which we will return.

If one accepts that ‘what is said’ is not determined solely by semantic processes which take recourse to context only to assign values to variables via semantic rules, what would be the alternative? Recanati proposes that ‘what is said’ is characterised by the availability principle, that is, the hearer must be consciously aware of what was said. ‘What is said’ is equated with “[the semantic content of] the conscious output of the complex train of processing which underlies comprehension” (Recanati, p. 16). Semantic and pragmatic factors have equal share in determining propositional content. This is certainly a more psychological stance and as mentioned already, seems more psychologically plausible than the dominant view in which semantic factors generate an initial core sentence meaning which is then subject to pragmatic adjustment.

4.6.3 Literal meaning dethroned

Taking this perspective on meaning, however, turns psychology of reasoning results on their head. It’s a much more democratic sense of meaning and does not automatically grant the experimenter’s intended meaning logical superiority because it is based ‘solely on the given premises’; or in other words, on ‘literal meaning’, with no contextual factors, background knowledge, or attribution of speaker intention allowed to interfere with interpretation. If anything, the experimenter’s interpretation is here seen to be an artifact of a particular moment in the history of theorising about language. Let us relate in more detail this perspective on meaning to the empirical results already presented. We have the two core notions we need: ‘what is said’ in Recanati’s fully-fledged pragmatic sense of the notion, and the specification of ‘sentence meaning’ as a post-facto theoretical construction, for example that of the ‘reflexive proposition’. We can now explain the difficulty unschooled subjects have with the given premises, not as a lack of ability to reason with abstract material, as Luria would have had, but as a lack of controlled ability to extract a decontextualised ‘reflexive proposition’ from the premises; we can explain their apparent elaboration on the premises as the normal interpreter’s strategy of taking context into account in attributing truth-conditions. In turn, it is precisely such an ability which explains the highly schooled undergraduate’s ability to reason with semantically undetermined premises. A concrete example would be the necessary interpretation for the syllogistic task, as described in Chapter 2: the subject needs to reason with a generalisation on an unspecified domain; we might say the domain selecting pa-

29The mechanism by which this occurs could possibly be a result of explicit knowledge of language — although what exactly is important is unclear, because Luria’s subjects were able to reason with quantified premises after only a brief period in education, while in Scribner and my studies subjects with even some years of schooling did not always choose this type of response.
arameter remains unsaturated and in this sense the subject needs to reason with a ‘minimal proposition’. The key difference is that we would not term the difference styles of answering as more or less logical, but rather as more or less savvy to the theoretical construct that is ‘literal meaning’.

In fact, the difference between what was said and how it is to be taken is one which even highly literate individuals apparently struggle to make. Support is provided by Astington and Olson’s (1990) finding of undergraduates’ insensitivity to the distinction between assertion and implication in interpretation. They presented university undergraduates with the following material:

It’s Adam’s birthday tomorrow. Barbara is just sneaking out of the house to buy a present for him when he sees her and asks her where she is going. Barbara says, “We’re out of milk. I’m going to the store.”

A Barbara means that she is going to buy milk.
B Barbara concedes that she is going to buy milk.
C Barbara asserts that she is going to buy milk.
D Barbara implies that she is going to buy milk.

The majority of the subjects chose “asserts” as the appropriate verb. Notice that this result was garnered even though the story could be argued to prime the correct choice “implies”, by suggesting that Barbara wants to mislead Adam. Choosing “asserts” is an indication either that the subject has not differentiated between what was actually said and what they interpreted it to mean, or if they do have this ability, it has not been connected to knowledge of specific metalinguistic concepts such as ‘assertion’ and ‘implication’.

4.6.4 Subjects are savvy and confused

Johnson-Laird & Savary (1999) makes explicit a telling assumption in current psychology of reasoning in claiming that “the [mental] model theory of sentential reasoning aims to characterise the deductions of naive individuals, that is, those with no training in logic” (p. 193, my emphasis). Implicit in this statement is the assumption that by quizzing only undergraduates who haven’t followed logic courses, one gets to see ‘natural’ cognition, which is presumably also universal. Logic, by contrast, is here seemingly a technology which we can become skilled at using (and which would give us an unfair advantage in reasoning tasks), but which we acquire in a process of explicit learning. This formulation brings out the strangeness of the standard psychology of reasoning paradigm. We want to see if people can do logic; but we don’t want to look at people who have actually learnt to do logic.
Moreover, the usual subjects aren’t naive. The educational context plays a large role in preparing subjects for the discourse of a logical reasoning task, as the foregoing chapters have highlighted. It is reasonable to conjecture that undergraduate subjects have learnt that divorcing personal experience (to some degree) from cognitive processing is a vital element of success in the academic context – they successfully play the role of the ‘universal’ cognitive agent. The emphasis here is on role – their minds may not be representative of the universal specification of what a human mind is supposed to be like – but they have some idea of what’s peculiar to their cognition and what’s not, and bear this in mind when responding. In this sense, perhaps, their response in reasoning tasks can be taken to be universal.

Stenning and van Lambalgen express the differences between subjects in terms of sceptical or credulous attitudes towards the discourse (Stenning & van Lambalgen, 2008, p. 29). For Stenning and van Lambalgen, a credulous attitude involves constructing a model of the discourse which is the same as the speaker’s intended model, while a sceptical attitude means not using any information “save the explicitly stated premises” and entertaining “all possible arrangements of the entities that make these statements true”. While the credulous reasoner uses closed world reasoning, the sceptical reasoner would be more inclined to use classical logic to generate conclusions, according to Stenning and van Lambalgen. This is tied up with the sceptical reasoner’s aim of “finding only conclusions which are true in all interpretations of the premises” (p. 29), and not making use of “whatever general and specific knowledge we have” to narrow interpretative possibilities, as the credulous reasoner would do.\textsuperscript{30}

Although certainly the credulous attitude tallies well with how I have described unschooled subjects’ concerns, I would disagree that schooled subjects ‘logical’ performance especially in the syllogistic task is sufficiently explained by Stenning and van Lambalgen’s sceptical stance. As Stenning and van Lambalgen elsewhere point out, the premises in a reasoning task “vastly underdetermine the information to be extracted” – i.e. the conclusion (p. 300). In fact, they go on to add, “the psychology of reasoning has suffered as a consequence of its neglect of this fundamental fact.” Yet, in supposing that sufficiently sceptical subjects can reach conclusions by using only information given in the premises, they seem to be ignoring this insight with regards to their own research.

As we’ve seen, it is problematic to suppose that sceptical or classical logical reasoning is simply reasoning on the basis of the given premises, exactly because the givenness of the premises needs further specification. Moreover, speaking in these terms engenders an idea of language processing in which a core semantic meaning is initially computed, and is subsequently subjected to pragmatic ad-

\textsuperscript{30}In fact using simply using general knowledge does not guarantee a specific fixed interpretation; interpretation is much more free to roam than this suggests. The opposition is really between what types of general knowledge and how they constrain available interpretations.
justment. This is a view we have seen successfully challenged by Recanati, and
one that Stenning and van Lambalgen themselves later disagree with, where they
conclude that “Current evidence from neuroimaging seems to point to a one-step
model”, where in a one-step process “all the available information [semantic and
pragmatic] is brought to bear on the computation of the meaning and sentence
boundaries do not have a privileged role” (p. 304).

The classical logical reasoner can better be described as interpreting the
premises in a highly artful way, to reach what we have termed ‘literal mean-
ing’. But, again, we should be clear that literal meaning is not some kind of basic
or core (semantic) meaning, to which supplementary (pragmatic) adjustments
are made when reaching the ‘intended’ or ‘speaker’ meaning. Literal meaning
is rather the outcome of a peculiar stance towards language in which certain
parameters of interpretation are ignored – the language processor is run on an
incomplete input as it were – such as when subjects reason with a quantified
statement on an underspecified domain, as we saw in Chapter 2, or with hang-
ing anaphora, for instance. Hence the distinction between ‘literal meaning’ and
‘intended’ or ‘speaker meaning’ should not be understood as a reflecting a differ-
ence in processing stages, rather literal meaning should be understood as a very
specialised variety of intended meaning. If this is correct, it would mean that
sceptical interpretation is a two-step process – which is not to say that credulous
interpretation would always have to be one-step.31

Another difference between what I call ‘literal’ meaning and the outcome of
a sceptical stance to interpretation would be the range of possibilities that a
subject considers. Whereas for Stenning and van Lambalgen, a sceptical reasoner
considers “all possible arrangements of the entities that make these statements
ture”, a ‘literal’ reasoner would only do this in a very circumscribed circumstances
and would more generally be liable to rely on a pre-given, learned, interpretation
of a premise – possibly because of its resemblance to materials used in educational
contexts. The ‘literal’ reasoner is thus considered to be much less independently
capable of considering all possible interpretations of the premises and much more
reliant on a learned language genre which supplies these ‘literal’ meanings. This
view is supported by Fillenbaum’s studies which show that even highly literate
subjects find it difficult to retain a ‘literal’ meaning when it describes an insensible
situation, and plenty of examples from my own data, as well as in other studies.32

31 The sentence “I was writing a letter, but then I spilled coffee on it” would be an example
of a case where repair processes are employed in a credulous interpretative mode.
32 When a term is replaced with a semantically similar but incorrect term, people have diffi-
culty in detecting the distortion. This tendency to overlook distortions in statements is known
as the Moses Illusion (Park & Reder, 2004), because it has been discovered in studies where
subjects are asked “How many animals of each kind did Moses take on the Ark?”. Most subjects
simply respond “two”, even while they know that it was Noah, not Moses, who took the animals
on the Ark (Erickson & Mattson, 1981)! The tendency is very robust, even when subjects have
been forewarned about possible mistakes in the sentences, read the materials aloud beforehand,
and are under no time pressure.
To differentiate more precisely this idea of ‘literal meaning’ from ‘sceptical’ meaning, we use Stenning and van Lambalgen’s own example. They consider the following discourse:

Once upon a time there was a butcher, a baker and a candlestick maker. One fine morning, a body was discovered on the village green, a dagger protruding from its chest. The murderer's footprints were clearly registered in the mud. . . .

For this discourse, according to Stenning and van Lambalgen, we would adopt a credulous stance and would be inclined to think there are at least three distinct people in the domain, i.e. that the butcher is not the baker is not the candlestick-maker. And it’s an “active question” whether any of them are the murderer or even the corpse (Stenning and van Lambalgen, p. 28). This is to be contrasted with the discourse below:

Some woman is a baker. Some woman is a butcher. Some woman is a candlestick-maker. Some person is a murderer. Some person is a corpse. All women are men.

Now according to them, “cued perhaps by the ‘logical puzzle’ style of the discourse”, the discourse is likely to be understood with a sceptical attitude: subjects would be inclined to entertain many possibilities about how many people there are, considering for instance even the possibility that there is only one person who is all the things mentioned above. I would think that in general subjects would be prompted not so much to be sceptical, as to be confused, by the second discourse, because it has little or no discourse structure or coherence – it’s unclear what discourse relations connect the sentences to each other, and thus also whether there is any relation between the five sequentially introduced referents.33 World knowledge (i.e. that a person usually has only one occupation) would suggest that the first three referents are distinct. On the other hand, world knowledge tells us that it’s very unusual to have a female butcher; at the very least we must be talking about modern times – but candle-making is an archaic occupation, so that doesn’t mesh well. In short, it’s difficult to find a way to fit these sentences to a single discourse model. This lack of discourse cohesion is a means to make subjects aware of interpretational processes and enable them to steer off well-worn interpretational paths but this would be more veering off than consciously exploring the interpretational landscape! I would thus predict that subjects have much more difficulty in reaching the sceptical stance for discourses such as the one given above – and certainly subjects who are not as literate as the university undergraduates from which Stenning and van Lambalgen draw their subjects. Contexts can be thought up for all possible combinations of predicates

33Basic discourse relations are considered to include narration, elaboration, background, result, restatement. Notice that world knowledge is often needed to infer which discourse relation holds between two sentences.
and individuals which make them the best fit interpretation-wise – imagine an interrogation in which the respondent is not at liberty to explicitly mention names but can volunteer one the above sentences when presented with an individual’s name – but even the sceptical subject would not explicitly consider all of these. Rather the sceptical stance is awareness of interpretational ‘scaffolding’ (such as inferring of discourse relations) – i.e. automatic but non-lexicalised elements of discourse processing, which can be sequentially examined but cannot always be done without, perhaps even for computational reasons. Witness for example, in the upcoming chapter, undergraduate subjects in the Wason selection task who could be enticed to remove the assumption that the anaphoric element in the rule, i.e. ‘one side/other side’, reduced to the definite ‘front/back’ – but only when relying on a biconditional reading of the conditional.

So although it is clear that there has been a detrimental neglect of interpretational processes, as Stenning and van Lambalgen maintain, they do not go far enough in repairing this. They have not yet put enough emphasis on the role of language usage and conventions, conversational or otherwise, and especially at the level of discourse, in shaping reasoning behaviour. This entails that they do not distinguish enough between unintentional interpretational obstacle courses – as leading to ‘repair’ processes in interpretation (p. 117) – and language genres which cue a perhaps school-based ‘symbolic processing’ approach to the material. Their description of the sceptical stance covers a host of finer distinctions that can be made about cautious interpreters. Anticipating slightly, this enables us to understand how it is that unschooled subjects can reason sceptically, or rather, classically, without necessarily taking the ‘literal’ meaning of a sentence, when prompted by the appropriate context (such as in a debate or law-court).

4.7 The normativity issue

Recall our explanation of the difficulty unschooled subjects had with the given premises not as a lack of ability to reason with abstract material, as Luria would have had, but as a lack of controlled ability to extract a decontextualised ‘reflexive proposition’ from the premises; we can explain their apparent elaboration on the premises as the normal interpreter’s strategy of taking context into account in attributing truth-conditions. In turn, it is precisely the ability to extract a ‘reflexive proposition’ which explains the highly schooled undergraduate’s ability to reason with semantically underdetermined premises, as we saw in Chapter 3.

Who’s more logical? On this account it would seem that the savvy, schooled

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34 This is indeed much in line with Stenning & van Lambalgen’s description of ‘system 2’ reasoning processes – see Chapter 4 of their book.
35 In fact, one could even maintain the schooled and unschooled subjects are employing the same strategies but within different contexts, with resulting different possibilities for interpretation.
subject at best is able to take a logical ‘stance’ towards the premises but is not inherently more logical. A criticism which the reasoning researcher (or ideal language philosopher) might level at this account, is the lack of objectivity it seems to bring with it – indeed the dismissal of logic as irrelevant because of its topic neutrality runs along these very lines. But the ‘loss of objectivity’ criticism loses bite once one realises that ‘sentence meaning’, supposedly the source of objectivity, is a theory-driven notion. This enables us to see that any objectivity we had before was a result of theoretical choices made in determining sentence meaning. Here we come very close to describing the theory-grounded sense in which logic has normative status, as defended by Stenning and van Lambalgen (after Husserl). That is, in brief, that any specific logical system has normative status only within a choice of interpretation which supports it; logic only provides “consequences of choices of parameters” (Stenning & van Lambalgen, 2008, p. 301). That makes normativity within any given domain an empirical issue. Only once this has been specified does any specific logic have normative force.

But again, the sentence-oriented theorist might object that meanings are being multiplied beyond necessity. If you grant that context plays a role in determining truth-conditions, then the same sentence, in different contexts, can get different truth conditions. Depending on your theoretical viewpoint this is problematic. Grice argued that sentences can be attributed definite truth conditions even though there is apparent variability, because the variability is external to the truth conditions and part of generalised conversational implicature. The example of the natural language sentence ‘p and q’ illustrates. Strawson (1952, pp. 80-81, referenced by Recanati) claims that this sentence is not equivalent to $p \land q$ because in the former case the order of the clauses can affect the truth conditions (‘They had a child and got married’ vs ‘They got married and had a child’); Grice (1989, pp. 47-50, also referenced by Recanati) responds:

[W]e may consider the temporal implication in ‘They got married and had a child’ as a conversational implicature, external to what is said, rather than considering it part of the truth-conditions of the utterance in a certain type of context. In this way, we are able to maintain that the truth-conditions of ‘p and q’ are determined by the truth-table for ‘$\land$’, independently of the context of the utterance.\footnote{Grice is here relying on the sub-maxim ‘Be orderly’, part of the maxim of Manner.}

Recanati’s response is that Grice is here begging the question – the linguistic ambiguity he must avoid by attributing definite truth conditions is a product of his assumption that variation in propositional content must be accounted for in terms of variation in linguistic meaning. This is not so for the contextualist, who can happily allow variation in propositional content without linguistic meaning varying, precisely because the contextualist is not committed to propositional content being determined solely by traditionally semantic processes.

\footnote{This can be contrasted with an ontologically- or epistemically-grounded account.}
The reasoning theorist might counter that reasoning studies are concerned with *normative*, not *descriptive* forms. Unlike formal semanticists, who aim to uncover the *actual* logical form people attribute to natural language sentences, reasoning researchers aim to uncover and understand the gap between actual behaviour and the norm. But this does not go through, because there is no basis – other than perhaps simplicity – for assuming that, for instance, the material implication is the normative form for a conditional construction in natural language. We might wonder why it seems to have acquired this status. Why did Wason assume he could presume that ‘if \( p \) then \( q \)’ is always equivalent to ‘\( p \supset q \)’ when any first-year logic course teaches otherwise? In fact many theorists seem committed to the assumption that material implication maintains its status as correctness norm, while allowing subjects other interpretations. The experimenter needs to assume she has (privileged) access to the normative form in hand in order to judge behaviour as divergent; yet the basis for this normative knowledge is unclear. It might seem to have acquired this status because the implication has been represented into a formal system – i.e. formality serves as a basis for normativity. Rather a mixture of historical and instrumental reasons has wrongly been taken to endow normative status on specific interpretations of natural language constructions.

In addition to this, I think that the source of literalist endowment of normative status on certain interpretations stems from the way semantics and pragmatics are seen to cleave on this account; namely, semantic processing is logical because it uses only deductive processes, while pragmatics is considered extra-logical because it involves defeasible processes. This is an assumption rather than an observation. In fact, as we’ve seen, semantic processing is by no means deductive and in cases of underdetermination involves mandatory recourse to ‘wide’ contextual factors.

### 4.8 Summary, conclusions, and outlook

In this chapter the conceptual scaffolding behind the ‘deduction paradigm’ which has dominated psychology of reasoning studies has been revealed and partially dismantled. This is achieved by confronting assumptions about the construction of meaning and the relation between natural language and logic with the differing perspectives from logicians and philosophers of language on these topics. We saw that logical form is not simply read off grammatical structure, and that what is coded into logical form is determined relative to a goal in an ongoing process of discrimination – this is indeed exactly what Stenning and van Lambalgen have called “reasoning to an interpretation”. Next, I challenged the centrality of the notion of literal meaning in theories of reasoning, where reasoning logically requires using ‘only information contained in the premises’. Privileging this interpretation, i.e. the ‘literal meaning’ of a premise, among possible interpretations, is justified only within a theory of meaning which takes it to be the semantic
core of meaning. But this is an untenable thesis because it turns out that this semantic “core” cannot be determined without reference to contextual factors. As such, ‘literal meaning’ is dethroned in explanations of logical reasoning. Finally, a monolithic view of logic which presumes all logical reasoning can be captured in the classical logical systems of predicate and propositional logic is challenged.

Turning again to Gigerenzer and Hug’s question (1992, p. 127):

“What counts as human rationality: reasoning processes that embody content-independent formal theories, such as propositional logic, or reasoning processes that are well-designed for solving adaptive problems?”

it should now be clear that the answer can very well be: both! What we’ve seen is that subjects are able to focus on ‘literal meaning’; we might have called this a ‘Logical stance’ towards language. These subjects are being Logical with a capital ‘l’. On the other hand, much more basic is the logical nature of language use, but this does not associate simply with the logics which have so far made it out into the world. Meanwhile, logicians continue to systematize the logic of natural language and of human interactions. This logic, with a little l, is simply the mechanics of informational exchange. As much as information exchange is considered an adaptive problem, our ability to manipulate symbols in reasoning processes shows we meet Gigerenzer and Hug’s second criterion. And in this sense, we are all mostly logical with a little ‘l’. That this does not mean we reason logically all the time is demonstrated in the next chapter.

4.8.1 Predictions and experimental suggestions

The current proposal yields specific experimental predictions about unschooled subjects having more difficulty with premises with definite articles, such as “the man had three dogs”, than premises with indefinite articles “a man had three dogs”, because “the man” cannot get a semantic value; the premise must be evaluated from the ‘reflexive proposition’ in which saturation has yet to occur. We might expect subjects who cannot easily access this construct to find definite version of premises more difficult than their indefinitely formulated counterparts. Note that it is an open question whether we should expect to find this only in unschooled populations. Given Dabrowska’s (1997) results (see previous chapter for details) we might find the difficulties with taking the ‘Logical stance’ to be much more widespread that previously supposed.

More generally, viewing literal meaning as a theoretical construct throws up many questions about the undergraduate’s expectations regarding language use in reasoning tasks, and how these differ from their understanding of language use in other situations. Relevant work in this regard is already being carried out in the field of experimental pragmatics (see Gibbs & Moise, 1997, and Geurts, 2002), but it does not yet look at changes in interpretational strategies across task domains, as this account predicts. Further research here would be very valuable.