

# A Suggested Taxonomy of Inferences for the Reading Teacher

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While inference taxonomies have been used in research, they have rarely been used for teaching and assessment purposes. Many instructional programmes (or syllabuses) in reading in a foreign language do include the "skill of understanding the implicit meaning of texts", (i.e. inference) and therefore teachers attend to this aspect of reading comprehension but few of them do so with particular categories of inference in mind. Experience has shown that they ask inferential questions without an idea of the types of inferences that their questions generate. This article presents a taxonomy of inferences which reading teachers may find useful. The taxonomy is drawn up on the basis of three selected taxonomies of Pearson and Johnson (1978); Warren et al. (1979); and Nicholas et al. (1980) which are reviewed in this article.

## INTRODUCTION

Many writers claim that 'inference' is central to reading comprehension (McIntosh, 1985; Farr, Carey and Tone, 1986). A text is never totally explicit. Many of the things a reader needs to know to comprehend the text are not explicitly stated; consequently the reader must be able to make inferences and fill in 'gaps'. For the purpose of this article, 'inference' is defined as the cognitive process a reader goes through to obtain the implicit meaning of a written text on the basis of two sources of information: the 'propositional content of the text' (i.e. the information explicitly stated) and 'prior knowledge' of the reader. Alternatively, the term is taken to mean the end product(s) of such a process.

In an attempt to bring to the fore the crucial role that the process of inference plays in reading comprehension, Trabasso (1981) and Nicholas and Trabasso (1980) have suggested the following functions which they consider are played by this process: (a) Resolution of ambiguous words; (b) Resolution of pronominal referents; (c) Identification of contexts for sentences; (d) Establishment of frameworks for interpretation; (e) Predicting causes and consequences of events; and (f) Recognition of incongruent events.

The fact that inference plays different functions in reading comprehension entails two things. The first is that there are different types of inference – a point that is generally accepted although there is no consensus as yet on the number and their

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analysis. This is evidenced by the existence, in the literature, of various inference taxonomies such as those of Pearson and Johnson, 1978; Warren et al., 1979; Nicholas et al., 1980; Harris et al., 1978 etc. The second is that the mental operations necessary for making inferences differ for each inference type or category (Paris et al., 1976; Urquhart, 1981).

Having said that, it is important to observe that while inference taxonomies are available and have been used in research, they have rarely been used in teaching inferential reading comprehension. Many instructional programmes (or syllabuses) in reading in a foreign language at elementary, intermediate and advanced levels do include the "skill of understanding the implicit meaning of texts" (i.e. inference) but few teachers handle this aspect of reading comprehension with particular categories of inference in mind. Experience has shown that teachers ask inferential questions without an idea of the types of inferences that their questions generate.

Since it is accepted that there are different types of inferences, it is vital for teachers of reading to be aware of the available taxonomies and to decide which one to use for their teaching and assessment purposes. The major value of using a taxonomy lies in the fact that it provides the teachers with a system for constructing their questions for teaching as well as for assessment. When questions based on a taxonomy are used, a record can be kept showing each student's performance on each category of the taxonomy. With this information, a teacher can plan instruction which takes into account the specific comprehension needs of each student.

Alternatively, students whose performance on a particular category is poor can be grouped together for instruction in that particular category. The record of the students' performance can be useful in another way. It can inform the teacher of the most difficult category for his class in general, thus enabling him to spend most of his instructional time on this particular category.

The other use of an inference taxonomy, as Tatham (1978) suggests, is to provide a system for analysing instructional materials. Teachers can assess the degree to which questions in the students' reading materials and accompanying manuals or handbooks are distributed over each category of the taxonomy. It is important for teachers to know whether such materials concentrate on one or two question types at the expense of others. With this kind of knowledge, teachers can design their own questions that will extend the students' response into other areas of the taxonomy.

The purpose of this article is to present a taxonomy of inferences that teachers may wish to use in the light of what has been discussed in the preceding paragraphs. The taxonomy draws heavily on the ideas contained in three selected taxonomies: (i) Pearson and Johnson (1978); (ii) Warren, Nicholas and Trabasso (1979); and (iii) Nicholas and Trabasso (1980). A review of these taxonomies is provided below.

## TWO MAIN CATEGORIES

First, I would like to consider two broad categories of inferences as put forward by cognitive psychologists. Broadly speaking, in making inferences a reader must perform two operations, namely 'text-connecting' and 'slot or gap filling'. Text-connecting requires the reader to find logical relations between propositions or events expressed in a text; slot-filling requires the reader to fill in missing information by recourse to knowledge about the world. There are, thus, two broad categories of inferences: 'text-based' and 'non-text based' inferences.

Working along these lines, psychologists have drawn a distinction between what they have called 'propositional' and 'pragmatic' inferences (Chaffin, 1979; Harris et al., 1978).

Propositional inferences are regarded as necessarily true inferences because they can be derived from the semantic content of the explicitly stated propositions in the text. Harris et al. (1978) use a different label. They call these inferences 'logical' because they follow logically from the writer's directly asserted message. In other words, they are arrived at through logical deduction of the explicitly stated propositions in the text. A characteristic property of these inferences, then, is that they are hundred percent certain. They are similar to what Smith et al. (1974) would call 'convergent' inferences – convergent in the sense that no two readers would disagree on the cogency of a propositional inference.

Pragmatic inferences, on the other hand, are regarded as only plausible inferences since they are not necessarily true. Graesser (1981) makes the point that these inferences are generated by virtue of two sources of knowledge. One is a set of schemata that a reader identifies when reading a text. The other is a set of conversational rules that are shared by speakers and listeners of a message or writers and readers of a text. Thus, these inferences are derived from knowledge sources beyond the linguistic input of a text. Some scholars e.g. Hildyard (1979) have called such inferences 'invited' inferences – invited in the sense that they are merely suggested by the content and context of the statements or propositions, and are based on the individual's prior knowledge concerning the described events in the text, and not on logical deduction. A characteristic property of these inferences, then, is that, in contrast to propositional inferences, pragmatic inferences are less than one hundred percent certain (Singer, 1980). It is possible for two readers to disagree as to the cogency of a particular inference because of possible differences in prior knowledge. Smith et al. (1974) call such inferences 'divergent' inferences. It must be said that although pragmatic inferences are not necessarily true, as stated above, they are, however, critical for understanding the meaning of prose texts (Adams et al. 1979). Here are examples of 'propositional' and 'pragmatic' inferences based on the following story adapted from Graesser (1981):

An ant went to a river. He became carried away by the rush of the stream and was about to drown. A dove was sitting in a tree overhanging the water. The dove plucked a leaf and let it fall. The leaf fell into the stream close to the ant and the ant climbed onto it. The ant floated safely to the bank. Shortly afterwards, a bird catcher came and laid a trap in the tree. The ant saw his plan and stung him on the foot. In pain the bird catcher threw down the trap. The noise made the bird fly away.

**Question:** Why did the dove let the leaf fall into the stream?

**Answer (Inference):** Because he wanted to save the ant.  
(Propositional inference)

**Question:** What, do you think, did the dove use to pluck the leaf?

**Answer (Inference):** He used his mouth (beak) or one of his feet.  
(Pragmatic inference)

## REVIEW OF SELECTED TAXONOMIES

Having looked at the two broad categories of inferences: 'propositional' and 'pragmatic', I can consider now the three selected taxonomies considered to be viable (see Johnston, 1984; Farr et al. 1986) for instruction and assessment: Pearson and Johnson's (1978), Warren, Nicholas and Trabasso's (1979) and Nicholas and Trabasso's (1980).

### Pearson and Johnson's Taxonomy (1978)

This taxonomy is designed to capture the relationship between information in the text and that which has to come from the reader's store of prior knowledge. It classifies relations that exist between 'questions' and 'responses'. The data (i.e. the text, the reader's head or both) by which a reader generates a response (in this case, inferences) is critical to this taxonomy. There are three kinds of responses: *textually explicit*, *textually implicit* and *scriptally implicit*.

A response is classified as *textually explicit* if it is right there on the page. A response is classified as *textually implicit* if both the question and the answer are present in the text, *but* at least one step of logical inference is necessary to justify the answer as a reasonable response to the question. In other words, the response is there on the page *but* is not obvious as in the case of a textually explicit response.

Finally, a response is classified as *scriptally implicit* if the question is derived from the text but the response is not. That is, the data base of the response is in the reader's store of prior knowledge. A reader has to use his or her script or schema in order to come up with the answer (Pearson and Johnson, 1978). Or as

Johnston (1984) says, 'the reader must combine some information from the text and some from background knowledge'.

It should be noted that the first category of this taxonomy (textually explicit) does not, in fact, involve any inferencing but literal comprehension. This, then, means that Pearson and Johnson's taxonomy has only two types of inference: *textually implicit* (text-based) and *scriptally implicit* (non-text based) which correspond to 'propositional' and 'pragmatic' inferences respectively.

Although Pearson and Johnson find this taxonomy (which they refer to as a question taxonomy) intuitively appealing, it leaves much to be expressed. This is a fact they themselves overtly accept: '... we have added a question taxonomy with only three categories. As such, it hardly qualifies as a taxonomy' (page 157). However, its greatest value lies in its ability to capture the relationship between information presented in a text and information that has to come from the reader's store of knowledge – a relationship based on schema theory.

Attempts to classify inferences into more than two categories have been made by Warren, Nicholas and Trabasso (1979) and Nicholas and Trabasso (1980) who have tried to classify inferences according to the 'Event Chain Formalism' based on narrative structure.

### Warren, Nicholas and Trabasso's Taxonomy (1979)

Warren et al. posit that there are three sources of information in the narrative structure for the making of inferences. The first source stems from *logical* relations between the events specified in the text. These relations (logical) involve the causes, motivations and conditions which enable events and are made in response to the questions WHY? and HOW? The second source of information stems from the *informational* relations between events specified in the text. Informational relations involve people, objects, instruments, times, places and context of events and these inferences are made in response to the questions WHO? WHAT? and WHEN? The third source is that of the reader's prior knowledge (schemata) about the objects, actions, and events specified in the text. Prior knowledge of the reader bears upon both logical and informational relations (Warren et al. 1979). The taxonomy by Warren and his associates has three basic categories: *logical* inferences, *informational* inferences and *evaluative* inferences.

#### (i) *Logical Inferences* (Why? How?)

These inferences deal with motivations, causes and conditions which enable events or states specified in the text to take place. There are, thus, three main subtypes under this basic category of logical inferences: motivational, causative and enablement inferences. *Motivational* inferences involve inferring the causes for characters' voluntary actions, thoughts and feelings e.g. 'Mutinta arose

early in the morning. After dressing, she had her breakfast and then went to the nearby market'. A motivation question would be: Why did Mutinta get up early? This question requires a motivational inference. Although the reason for Mutinta's getting up early is given, it is, however, not marked explicitly. *Causative* inferences are like motivational inferences except that they involve inferring the causes or consequences of events and states given in the text. *Enablement* inferences involve inferring the conditions necessary for given events or actions to take place.

(ii) ***Informational Inferences (Who? What? When? Where?)***

These inferences determine the people, things, time, place and general context of given events. They enable the reader to appreciate who is doing what, to whom, with what instrument, under what circumstances, at what time and place (Warren et al. 1979). Some subtypes under this basic category are: pronominal, referential, spatio-temporal and elaborative. *Pronominal* inferences specify the antecedents of pronouns such as 'he', 'they', 'it', 'that', etc. in other propositions. *Referential* inferences specify the related antecedents of given actions. Their basic function is to clarify the roles of people and objects. *Spatio-temporal* inferences locate events and actions in place and time e.g. 'The police officer raised his hand to stop the car and ordered the driver to switch off the lights'. Upon reading this sentence, a reader may infer that this event occurred on the highway or street (spatial inference) and that it probably occurred at night (temporal inference) depending on the cultural background of the reader. *Elaborative* inferences are straight additions of world knowledge, reasonable guesses about some aspects of the story.

(iii) ***Evaluative Inferences***

These inferences assess the significance, normality, morality and validity of events, characters' actions etc specified within the text. They are extremely sensitive to the reader's knowledge base and belief system.

**Nicholas and Trabasso's Taxonomy (1980)**

This taxonomy has four basic inference categories: lexical, spatio-temporal, extrapolative and evaluative inferences.

(i) ***Lexical Inferences***

According to Nicholas et al., these inferences include pronominal references and resolution of ambiguous words.

(ii) ***Spatio-Temporal Inferences***

These inferences are the same as those suggested by Warren et al. (1979) except that in this taxonomy they constitute an independent category whereas in Warren et al.'s taxonomy they appear under 'Informational Inference'.

**(iii) *Extrapolative Inferences***

These inferences deal with conditions and causes of events as well as motivations, intentions and goals of characters. As can be appreciated from this very brief description, these inferences are similar to Warren et al.'s 'enablement', 'causative' and 'motivational' inferences featuring under the basic category of 'Logical Inferences'.

**(iv) *Evaluative Inferences***

These are the same as those suggested by Warren et al. (1979).

Two things need to be said about the two narrative-based taxonomies. The first is that they are basically similar. They differ in certain category headings, but keep similar descriptions of the categories. This is not surprising since they share a common base. The second thing that needs mentioning is that they are educationally interesting – interesting for two reasons. Firstly, the narrative genre on which they are based is commonly used in schools and so they stand a good chance of being applied. Secondly, they are better structured in contrast with Pearson and Johnson's (1978) taxonomy which, as we saw, is rather simplistic since it comprises only two inference categories, 'textually implicit' and 'scriptally implicit'. However, it is worth pointing out that Pearson and Johnson's taxonomy is attractive, too, in two ways. It is easier to understand because it is simple in structure; this is perhaps why a number of researchers (Pearson, Hansen and Gordon, 1979; Raphael, 1982) have used it in their studies in preference to the other two taxonomies described. These comprise more categories, some of which, however, are too complex for easy use, especially so for readers with little knowledge about how narratives are typically organised.

The second reason why Pearson and Johnson's taxonomy is attractive is that it clearly captures, as we noted earlier on, the distinction between inferences that are constrained by the information from the text and those that are constrained by the information from the reader's store of prior knowledge – a distinction that is crucial according to the schema-theoretic view of reading which views reading as an interaction between text and reader. In the case of the two narrative-based taxonomies, this distinction is not clear-cut.

In view of the problems raised above regarding the two narrative-based taxonomies, especially the lack of clear distinction between text-based and non-text based inferences, the following taxonomy is suggested for reading teachers which of course still draws heavily on the ideas contained in the two taxonomies. An attempt has been made to distinguish between inferences that are constrained by the information in the text from those that are constrained by information from the reader's knowledge base or a combination of the two information types. This has been achieved by incorporating, in the taxonomy, Pearson and Johnson's (1978) ideas and the dichotomy made by psychologists between 'propositional' and 'pragmatic' inferences.

## THE SUGGESTED TAXONOMY

This taxonomy has three basic categories: lexical, propositional, and pragmatic or scriptural inferences (see Chikalanga, 1991).

### (i) *Lexical Inferences*

These inferences involve inferring the referents of pronominals and meanings of ambiguous and unfamiliar lexical items through contextual clues (i.e. searching the surrounding environment of such items for clues). Some of the inferences in this category e.g. 'pronominal' inferences, are sometimes dependent on world knowledge (see Brown et al., 1983) and sometimes on information in a text since the referents in many written texts are found within texts (i.e. endophoric reference, Halliday et al., 1976). For this reason, inferences in this category are regarded as 'textually' or 'scripturally' implicit in Pearson and Johnson's (1978) terms.

### (ii) *Propositional Inferences*

These are regarded as inferences that are *logically* derived from the semantic content of the text. They may be based on information expressed in one or two propositions or paragraphs. Two types of propositional inferences are suggested: (a) 'informational' inferences as suggested by Warren et al. (1979) minus pronominal inferences which feature under the above category and 'elaborative' inferences which are treated under pragmatic inferences below since they are dependent on world knowledge of the reader; (b) 'explanatory' inferences which Warren et al. call 'logical' inferences. It is suggested that the term 'logical' should be used to refer to both 'informational' and 'explanatory' inferences since they are both logically derived from the information stated in the text. So, with this change the two types become: 'logical informational' inferences and 'logical explanatory' inferences. Logical informational inferences involve specific people, instruments, objects (i.e. referential) places, times and context of events or actions (i.e. spatio-temporal) and are thus made in response to the questions Who? What? Where? and When? Logical explanatory inferences, on the other hand, involve motivations of characters (motivational), causes and consequences of events or actions (causative) and conditions which enable events to occur (enablement) and are thus made in response to questions Why? and How? Propositional inferences are regarded as 'textually' implicit in Pearson and Johnson's (1978) terms.

### (iii) *Pragmatic Inferences*

These are inferences based largely on the information outside what is actually stated in a text, that is, on the information from the reader's store of prior knowledge (schemata). There are three inference types under this basic

category: informational, explanatory and evaluative inferences. As can be noted, the first and second types are the same as the ones presented above under the basic category of propositional inferences – except that here they are based on the reader’s schemata. In order to distinguish them from their text-based counterparts, these two types are referred to as ‘elaborative’ informational inferences and ‘elaborative’ explanatory inferences. Evaluative inferences have been considered under this basic category because of their sensitivity to the reader’s knowledge base and belief system (Nicholas et al., 1980).

The suggested taxonomy is summarized in Table 1:

*Table 1: The Suggested Taxonomy*

<b>Basic Category</b>	<b>Specific Types</b>	<b>Question-Answer Relationship</b>
<b>LEXICAL</b>	(a) Pronominal Inferences (b) Ambiguous/unfamiliar word meanings	<b>Textually/scriptally Implicit</b>
<b>PROPOSITIONAL</b>	(a) Logical Informational – referential – spatio-temporal (b) Logical Explanatory – motivational – causative – enablement	<b>Textually Implicit</b>
<b>PRAGMATIC/ SCRIPTAL</b>	(a) Elaborative Informational – referential – spatio-temporal (b) Elaborative Explanatory – motivational – causative – enablement (c) Evaluative	<b>Scriptally Implicit</b>

As a way of sampling this taxonomy, here are example questions and responses (inferences) based on the following text taken from Warren et al. (1979):

It was Friday afternoon. Carol was drawing a picture in the classroom. David felt mischievous. David decided to tease Carol. When Carol was not looking, he tied her shoelaces together. Carol tripped and fell down.

1. *Question:* Why did David decide to tease Carol?  
*Response:* Because of his mental state of feeling mischievous.  
*Inference Type:* Logical Explanatory (motivational) inference.  
 (Note that the motivation for David's decision to tease Carol is specified in the text but it is not linguistically marked and so it is implicit).
2. *Question:* Why, do you think, was Carol drawing a picture?  
*Response:* Because artwork gave her pleasure or satisfaction and this perhaps explains why she was not aware of what David was trying to do to her.  
*Inference Type:* Elaborative Explanatory (motivational) inference.  
 (Note that, in this case, the motivation for Carol's action is not specified in the text. The reader has to fill it in).
3. *Question:* What instrument was Carol using in drawing the picture?  
*Response:* A pencil, crayon or pen (Since the predicate is 'draw', not 'paint'.)  
*Inference Type:* Elaborative Informational (referential).
4. *Question:* Why did Carol trip?  
*Response:* Because her shoelaces were tied together.  
*Inference Type:* Logical Explanatory (causative)
5. *Question:* Why was it possible, do you think, for David to tie the shoelaces together without being noticed?  
*Response:* Because Carol was too absorbed to notice what David was doing.  
*Inference Type:* Logical Explanatory (enablement) inference.
6. *Question:* What were Carol and David, do you think?  
*Response:* Probably school children.  
*Inference Type:* Elaborative Informational (referential) inference.
7. *Question:* What kind of shoes was Carol wearing?  
*Response:* Lace-up shoes.  
*Inference Type:* Logical Informational (referential) inference.
8. *Question:* Where did this incident occur?  
*Response:* At school (we are told Carol was drawing a picture in the classroom).  
*Inference Type:* Logical Informational (spatial) inference.

9. *Question:* What does *he* refer to?  
*Response:* David.  
*Inference Type:* Lexical Inference (pronominal) inference.
10. *Question:* Was David mean?  
*Response:* Perhaps not, assuming that the two were friends and that they probably teased each other from time to time.  
*Inference Type:* Evaluative.

The purpose of these examples has been to illustrate the different kinds of inferences as summarized in the above table and to demonstrate the workability of the taxonomy itself. I believe this has been achieved.

## CONCLUSION

This article has stressed the need for teachers to use inference taxonomies for their teaching and assessment purposes. To this end, a taxonomy of inferences based on three selected taxonomies which have been reviewed in this article has been suggested and its workability demonstrated. The major advantage of this suggested taxonomy is that it clearly captures, unlike its forerunners, the distinction between inferences that are constrained by the information in the text from those constrained by the information from the reader's knowledge base – a distinction that is crucial according to the schema-theoretic view of reading which views reading as an interaction between text and reader. However, this taxonomy has one drawback. Because it is linked firmly to narrative structure, its application is consequently limited to narrative texts. It cannot be meaningfully applied to other types of text e.g. science texts, which are not suitable for the making of certain types of inferences included in the taxonomy, namely motivational inferences. Despite this limitation, it is my belief that the taxonomy presented in this article will prove useful in the construction of teaching as well as assessment questions and in analysing inferential questions found in commonly-used comprehension textbooks.

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