# Spatial Prepositions and Functional Relations: The Case for Minimally Specified Lexical Entries

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## Declaration

I declare that this thesis has been composed by myself and that the research reported therein has been conducted by myself unless otherwise indicated.

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# Abstract

In this thesis we present a minimally specified approach to the lexical entries for spatial prepositions based on the recognition of the importance of functional relations. We begin by introducing the problem of separating out senses of a lexeme from occurrences of a lexeme, and with a consideration of methods of sense delineation, including ambiguity tests.

We then consider classical approaches to the lexical entries of prepositions which favour minimal specification of lexical entries, and compare them to cognitive linguistic accounts which favour full specification of lexical entries. It is argued that classical accounts have problems with case accountability, while cognitive linguistic accounts are based on a misinterpretation of prototype theory. We demonstrate that the accounts are very similar in that they delineate senses in terms of different geometric relations in the world.

Functional relations are introduced as an alternative way of understanding spatial relations. It is argued that what is important about objects is how they interact with each other, that is, the *functional relations* between objects. The work of Garrod and Sanford (1989) and Talmy (1988) is considered in this context, and is developed to deal more adequately with case accountability.

A number of experimental studies are reported which demonstrate the existence of functional relations, and cast doubt on ambiguity tests as valid methods of sense delineation. It is proposed that a spatial preposition can be said to have two senses if a language user has a motivated reason for distinguishing between two types of relation. Evidence is provided for a distinction between spatial prepositions which involve functional components, and those that involve purely geometric components. First language acquisition evidence is reviewed which suggests that prepositions involving functional relations are learned first.

Finally, the pragmatic principles of Herskovits (1986) are developed and are allied to minimally specified lexical entries in an analyses of *in, on, at, over, under, above* and *below* which incorporate functional relations.

# Contents

## Chapter 1

# Introduction

## 1.1 Functional relations and Perception

"As has often been said before, perception is simply one phase of the total process of action, and its biological role is to initiate and direct the behaviour of man and animals. It not only provides material for their contemplation, but invites them to action, and allows them, to adjust this action to the world in which they live. The phenomenal world does not consist of a simple juxtaposition of 'detached pieces', but a group of things which act upon each other and in relation to each other. Thus the regulation of conduct requires a knowledge of what things do or can do and what living creatures (and ourselves in particular) can do with them. We need to know that things can be moved, e.g. by pushing them, causing them to slide, lifting them, or turning them over, by hurling, breaking, bending or folding them, by leaning on them, and so on. We need to know, too, that certain gestures, certain looks, or certain words can attract or repel other men and animals, or modify their conduct in some other way. Similarly, it is necessary to understand the influence that things exert on people - hurting us when they bump into to us, pricking or cutting us, resisting our efforts, confronting us with shapes that are easy or difficult to handle, and so on...... Although these events all have a spatial and a kinematic aspect, the most important feature about them is that they imply functional relations between objects. These relations are largely outside the range of the many investigations that have been carried out on the subject of space-perception and the perception of movement. These functional relations, then, constitute the essential fabric of the phenomenal world: they must be considered as a highly important factor in the adaption of activities to their environment...It is these relations which give the things around us their significance since it is by coming to know what things do that we learn what they are. What they are for us is much more than their shape, their size, and their colour; it is above all what they are capable of doing, or what can be done by means of them. The study of these relations, however, has found only a very small place in the work of psychologists of the experimental school."

(A. Michotte. The Perception of Causality. !963, p.3, translation by Miles. Original work, La Perception de la Causalite, published in 1946, 1954).

The above passage, taken from the 'Perception of Causality', reflects Michotte's emphasis on the importance of functional relations in perception. For Michotte, one cannot underestimate the extent to which the essence of things consists in what they are able to do. For example, the information most pertinent to us about a glass is the conception of a glass as a container. Furthermore, one associates a glass as a container of liquids as opposed to gases or solids. This relates to another function of the glass, which is to drink out of. Hence, the functional information appears to be the information most useful to us, in this case relating to the function of ingestion.

Later work in perception has also recognised the importance of functional aspects of perception. Marr (1982), recognising the problems with the work of Barlow (1972) and others, argued that a proper understanding of the jobs that cells are doing in the visual pathway requires the consideration of visual perception at a different, more "computational" level. Much like the point made by Michotte, that the importance of objects lies in what they are for, Marr (1982) argued that a theory of vision must begin with the issue of what the visual system is for. Three different levels of theory must be distinguished if we are able to understand a complex information-processing task such as visual perception. The first level, the level of computational theory is considered by Marr to be the most important. The level of computational theory specifies the job the visual system must do. This consists of information about what a device does and why. Thus, for Marr, the nature of the computations that underlie perception depends more upon the computational problems that have to be solved than upon the particular hardware in which their solutions are implemented. Although the idea that the level of functional explanation can operate in total independence of explanation at the physical level has been harder to maintain recently in cognitive science, for our purposes Marr's contribution is still highly relevant. As Marr states;

> "To phrase the matter another way, an algorithm is likely to be understood more readily by understanding the nature of the problem being solved than by examining the mechanism (and the hardware) in which it is embodied" Marr (1982, p. 27).

Let us consider the case of the visual system of the horseshoe crab (Limulus) as an example of the importance of function in visual perception (cited in Bruce & Green, 1990). For Limulus, one can consider what sort of information about the environment will be important for survival. One such piece of information is information concerning the detection of predators. In the case of Limulus, predators normally come from above (animals swimming overhead). Indeed, such information appears to be well catered for in the visual system of Limulus; the visual system is maximally responsive to rapid spatial changes in light intensity, and to movement. Hence, the function of the visual system of Limulus filters out the changes in the environment which are less important while retaining those which are important in the organisation of the crab's actions (such as defending against a predator).

J. J. Gibson (1966) also acknowledged the importance of functional relations. In particular he rejected the equation of the eye with the camera, and the consequent analysis in terms of the processing of static images. For Gibson, the question to be answered was the one of 'how does one obtain constant perceptions in everyday life on the basis of constantly changing sensations?' (Marr, 1982, p. 29). The approach of Gibson involves the incorporation of the time dimension into perception, such that all perception becomes motion perception. Here Gibson is echoing the viewpoint of Michotte that we cannot consider the phenomenal world as consisting of a simple juxtaposition of "detached pieces". Let us now consider these ideas in the linguistic domain.

## 1.2 Functional Relations and Spatial Language

Turning to spatial language, it would not be unreasonable to assume that functional relations may be important in this domain too, following from the clear evidence that functional relations are of central importance in perception. When one does turn to spatial language, however, functional relations have received little attention. As we shall see, most research into the lexical semantics of spatial terms assumes a view of the world as a series of 'detached pieces'. The nature of objects and what they are for is not considered. The objects in the world are merely conceived of in terms of geometric relations between them, and often these relations are not clearly specified in geometric terms either. As Crangle and Suppes (1989) comment;

> "In spite of the spate of articles in the last decade or so on locative expressions, spatial prepositions, and the like, detailed attention to the kinds of geometry needed to give a semantic analysis of the various locative expressions does not seem to have been [previously] attempted." (Crangle and Suppes, 1989, p. 399).

The central goal of this thesis is to argue that functional relations play a role at several levels in the characterisation of the meaning of spatial language, the most relevant one being the level of lexical semantics. We argue that the function of spatial expressions, and spatial prepositions in particular, enables us to constrain a theory about what the conditions for appropriate use are for these words. In particular, spatial language is used to talk about interactions between objects which are dependent in turn on the function of the objects (functional relations). This entails how objects relate to each other over time, and this in turn is dependent on the nature of the objects, what they are used for, etc. For example, with a simple locative expression, such as 'the cup is on the table', the location remains constant over time unless the cup is moved deliberately, or accidentally. Thus, the answer to a question such as , "where is the cup?" is dependent on the interaction of the objects and the knowledge that the spatial relations will remain constant over time. That is, the location of the cup will be the same in 5 minutes, when the person who asked the question goes to find it based on the reply, "the cup is on the table". It will be demonstrated that lexical semantics, the "skeleton in the cupboard of cognitive science" (Herskovits, 1986), is made a lot easier when one pays attention to functional relations. The thesis will provide different kinds of evidence in support of this case.

Having sketched the background argument for the thesis, for the rest of this chapter our objective is to make explicit those aspects of a theory of word meaning which will be taken as implicit throughout subsequent chapters, and to clearly state the problems we wish to tackle.

**1.3 Decoding and Encoding**

The central background issues governing this enquiry revolve round the desire to deal adequately with questions of decoding and encoding (following Herskovits, 1986). These involve adequately pairing language with situations in the world. The question of decoding involves, given a locative expression used in a particular situation, predicting what it conveys, and how it will be interpreted - assuming that it has been used appropriately. If the expression has not been used appropriately, one then needs to explain the inappropriateness. The encoding question is the converse of this: given a situation with two spatial objects, one wishes to predict the locative expression that can be used appropriately to describe their spatial relation. These ideas are sketched out in figure 1.1 below.

Figure 1.1

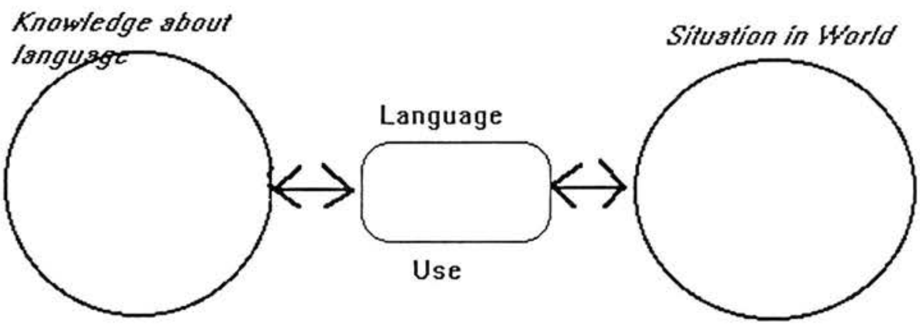


Figure one has three levels of structure, as opposed to two. One is primarily interested, as already stated, in the relationship between language and the world. That is, the first problem is to work out how language and the world covary. The level of structure on the left hand side of figure 1.1 goes one stage further than this. Given the relationship between language and the world, one can ask what information users of language have about the language which they bring to a novel situation. In other words, how do language users know that a word is appropriate or not in a given situation (i.e., spatial situation in the world)? Now, the circle on the left hand side could easily be labelled 'computer'. That is, one may argue that psychological issues are not of relevance here. This is the position taken by Herskovits (1986). All that Herskovits (1986) aims to do is to solve the encoding and decoding problems, that is, without recourse to psychological processes.

The account we will pursue embraces psychological processes; we hold the position that to get at what conditions hold for the appropriate use of a word we have to appeal to systematic observation of language use by language users. In other words, in the case of spatial language use, how do spatial language and the spatial world covary, and what information about the spatial world is relevant to users of the language which may be worth representing in the circle on the left?

In doing this, we are interested in giving an account of the information which is most likely to be represented in some sort of a mental lexicon during the processing of spatial information. This goal raises many issues, not least of which is the issue of whether mental representations can be said to underlie language use, and to represent the world. Winograd and Flores (1985) represent one extreme here in that they argue that one cannot assume that a language user has mental representations of the regularities observed in language use; that language comprehension and production do not proceed by manipulating representations of such regularities. Following Maturana (1978) they describe the nervous system as a closed system:

> "...the system can do only that which is determined by its own structure and activity - its action cannot be understood as a reflection of an external world it perceives".

What can be said in response to this is that language users can have representations of regularities observed in language use as they have common functional needs determined by the "closed system" which are reflected in these very regularities.

### 1.4 Issues in Lexical Semantics

With an interest in how spatial language and the spatial world covary, one must not neglect the relationship that words have with other words. Addressing this question, we can begin with the observation that most semantic theories assume that sentence or utterance meaning is computed by combining the meaning of its parts using some set procedures. This is the principle of compositionality, often referred to as Frege's principle. The principle can be stated as follows:

> (PC) The Principle of Compositionality: The meaning of a complex expression is a function of the meanings of its parts and of their syntactic mode of combination.

The principle is accepted widely as some version of it seems necessary for any account of the ability to understand the meaning of novel utterances on first hearing.

In order to make the principle precise, one must give a specification of at least the following:

(1) The nature of the meaning of the smallest parts - i.e., a theory of lexical semantics;

(2) The relevant whole-part structure of each complex expression - i.e., a theory of the semantically relevant level or levels of syntax;

(3) The "functions" in question - i.e., a theory of what combinatorial semantic operations there are, and how the rules for combining meanings operate on lexical meanings and syntactic structure to produce the meaning of the whole - in short, a theory of compositional semantics.

From our point of view we are interested in the first and third enterprises; namely trying to define the smallest parts giving a viable theory of lexical semantics, and specifying how these units can be combined to come up with the meaning of an expression. In particular we focus on the first enterprise; the characterisation of the smallest parts.

The characterisation of the smallest parts is dependent on the desiderata for theorists involved with different endeavours. The linguist's concern is with the abstract linguistic code, and is to characterise acceptable strings of words in a given language. This entails specifying rules underlying the structure of acceptable strings, and one part of this system is a lexicon specifying which words can co-occur and which cannot, leading to semantic or syntactic anomaly. The lexicographer has the task of defining 'meanings' of words for the compilation of a dictionary. This may involve a mixture of abstraction over contexts, and may also involve ascribing the same word different meanings dependent on the context of occurrence. The computational linguist centres his interest on getting machines to understand language, and modelling possible grammars to investigate computational properties and tractability in such systems. The psycholinguist is interested in language as used by language users. In other words, psycholinguistics is concerned with the mental mechanisms that make it possible for people to use language. Specifically, the question is one of what in semantic memory corresponds to the definitions of words in an ordinary dictionary.

As already stated, what all these approaches have in common is the need to specify at some level what information is represented by the smallest parts. Here the analogy with dictionaries has been appealing for researchers of all desiderata, and as Clark's work shows (Clark, 1983; Clark and Gerrig, 1983; Clark, 1989) the analogy has often been taken as much more. The basic idea is that words have fixed meanings which are combined via compositional rules with other words of fixed meanings to arrive at the meaning of the sentence. For instance, the assumption behind models of human parsing has been that, at some point during parsing, a "mental lexicon" is accessed. Entries in the mental lexicon are compared with the input, segmented into words, in terms of orthographical or phonological properties and, that done, the "sense" associated with the word is "read off" from the dictionary entry. In cases where there are multiple senses for a given word, the appropriate sense is selected from a list of possible senses.

The theory of semantic markers (originating from Katz & Fodor, 1963) is an example of such a dictionary theory. It is clearly decompositional, with the semantic interpretation of a sentence obtained by replacing its words with their semantic representations, and combining these representations according to the underlying syntactic structure of the sentence. The theory holds that the semantic representation of a word primarily comprises a structured set of elements, 'semantic markers', which decompose its meaning into more primitive semantic constituents; ultimately meanings are decomposable into a set of 'linguistically universal' and innate components. For example, an analysis of the meaning of *man* in terms of semantic markers would be akin to;

MAN (noun) HUMAN, ADULT, MALE.

The theory illustrates the central characteristics of dictionary theories in general. Firstly, they associate with words some descriptive content. It is assumed that this content guides linguistic behaviour, that is, it determines the appropriateness or otherwise of a given word. Secondly, such theories take this content to be mentally represented in a certain way. Namely, the assumption is that any sense of a given word is permanently represented, just as in a dictionary, and that parsing constitutes the selection from such senses.

Johnson-Laird (1983) presents some objections to the Katz and Fodor formulation. There are numerous studies which have been conducted on-line which seem to contradict this theory (see Johnson-Laird, 1983, pp. 207-211 for a review). The theory assumes that comprehension requires the meanings of complex words to be decomposed into their semantic constituents. However, Kintsch (1974) did not find any effects of semantic complexity on a number of different measures. He found, for instance, that the sentence 'A man lifts a boy' was no harder to understand than 'An adult lifts a child'. However, we have to be aware that the issue of decomposition as a necessary process in comprehension is a very different matter from the issue of whether there are any semantic primitives (cf. Miller & Johnson-Laird, 1976, p.326ff).

More importantly, Johnson-Laird (1987, p.190) comments that Katz and Postal have:

> "elevated this lowly piece of lexicography into linguistic theory".

Here Johnson-Laird is recognising that there is a difference between lexicography and the concerns of the linguist, psycholinguist (and possibly computational linguist). This is clear when we examine what a lexicographer does in more detail.

If one is interested in lexicography, then one doesn't have to worry about the number of senses that are recognised unless there are restrictions on the size of the dictionary being compiled. This is clear when we examine dictionaries. For example, the Complete Oxford English Dictionary gives seventeen distinct entries for *mother*. If one compares this with the two volume version, only ten entries are given. The pattern follows with the Concise Oxford English Dictionary which gives six entries. Another feature is the amount of space given to each entry. In larger dictionaries more specific occurrences of an entry are given, together with more examples of extended and idiomatic uses of the word.

Thus, we may distinguish (following Dunbar, 1988) between two meanings that a word may be said to have. On the one hand, there is the contribution that the word makes to a perceived meaning or understanding of an utterance. That is, a word plays a role in the cognitive event of comprehension, and its meaning to the comprehender is what it adds to the message. On the other hand, there is the meaning which users of language ascribe to a word through a metalinguistic process of dividing up the overall meanings of utterances among their constituents. This is lexicography. The difficulty with a lexicographic approach is precisely that it tends to view the word in isolation and at leisure, hence omitting from consideration the rapid march of time and the swift intrusion of other words on the scene. We are primarily interested in the first enterprise, as already stated. Thus one must be careful not to take the analogy with the dictionary too far.

Again this difference can be captured with a distinction (following Bennett, 1975) between 'lexemes', 'senses' and 'occurrences' of a word. We also wish to refine this with a distinction between 'lexical units' and 'lexemes'. Lexical units are those form-meaning complexes with (relatively) stable and discrete semantic properties which stand in meaning relations such as antonymy (e.g., long-short) and hyponymy (e.g., dog-animal), and which interact syntagmatically with contexts in various ways. A particular lexical unit expresses its semantic identity through such relations, but its essence cannot be exhaustively characterised in terms of any determinate set of such relations. The meaning aspect of a lexical unit is termed a sense. Lexemes, on the other hand, are the items listed in the lexicon, or 'ideal dictionary', of a language.

The distinction between lexical units and lexemes becomes central when one looks at the constraints on each. Lexical units as Cruse (1986) points out, "need to represent unitary 'quanta' of meaning, but they do not have to be finite". A lexeme, by contrast may well be associated with indefinitely many senses, but the set of lexemes must be finitely enumerable. This of course leads to the conclusion that it is maybe best not to include all senses in the lexicon as there are in principle an infinite number of senses (Cruse, 1986: Clark, 1983).

The distinction between lexical unit and lexeme is often not made. For example, Bennett (1975) associates lexemes with lexical units, and this is, in our view, a serious error. Our task is to describe the meaning of the set of English lexemes that are of interest to us. Again, this is different from "occurrences" of a word, which means exactly what one would expect it to mean. Each sentence involving a particular lexeme will have an occurrence of that lexeme. Finally, a lexeme may or may not have the same meaning on two separate occurrences. When it doesn't, the different meanings are termed senses. The task of describing the meaning of a lexeme becomes that of describing the meaning of the various senses of the lexeme of interest. Bennett (1975), for example, does this by assigning each lexeme a different componential analysis.

Having clearly separated the endeavours of lexicography from theorists with other desiderata, we arrive at the questions of how many senses one should ascribe to a lexeme, and how one should go about doing this. It is to this issue we now turn.

### 1.4.1 Delineation of Senses: Full Versus Minimal Specification of the Lexical Entry

One of the goals of the thesis is to try to separate out the senses of words from different isolated occurrences. This is by no means easy. We can turn to some traditional tests for assistance in order to do this (reviewed below), and we can use intuitions about different uses in different utterances or sentences. We should point out, of course, that the combinatorial properties of words in utterances are constrained not only by their meanings, but also by their grammatical properties. Grammatical constraints may overlap and reinforce semantic constraints, but they may also be semantically arbitrary. In order to be able to use contextual relations for semantic purposes, therefore, we need to be able to recognise and discount combinatorial peculiarities which are purely grammatical in nature. In this vein, we will consider the relationship between prepositions, particles, verb prefixes and adverbs in the second chapter, where we talk about the domain to be considered in the thesis.

The separation of senses of a lexeme and occurrences of a lexeme can be framed within the debate between full or minimal specification of a lexical entry. If we begin with a word, like the word *bank*, there appears to be no problem. *Bank* is a homonym, and thus it is accepted that it has two distinct senses which are unrelated. The problem arises with the treatment of polysemy, where the occurrences of a lexeme are related. Now classical approaches to word meaning (which will be considered in detail in chapter three) favour minimal specification for the lexical entry of words. In doing this they attempt to find something common to all occurrences of a lexeme, and make the assumption of 'Gesamtbedeutung' ('general meaning'; cf Jakobson, 1932, 1936[1] ). Lakoff (1987) claims that this does not deal with polysemy;

> "The classical theory[2] of categories does not do very well on the treatment of polysemy. In order to have a single lexical item, the classical theory must treat all of the related senses as having some abstract meaning in common - usually so abstract that it cannot distinguish among the cases and so devoid of real meaning that it is not recognisable as what people think of as the meaning of a word. And where there are a large number of related senses that don't all share a property, then the classical theory is forced to treat such cases as homonymy, the same way it treats the case of the two words *bank.* Moreover, the classical theory has no adequate means of characterising the situation where one or more senses are "central" or "most representative". (Lakoff (1987), p. 416).

For example, if we take the word *over,* one may assign the core meaning of 'over' as "at a higher location than, but not in contact with". This can be characterised componentially as;

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[1] It should be noted that Jakobson himself did not apply the concept of "Gesamtbedeutung" to lexical items but to the case inflections of Russian.

2 The classical theory as discussed by Lakoff (1987) in reality may be something of a straw man. Traditional lexicography was well aware of the problems of homonymy and polysemy, as well as phenomena such as that of metonymy. We therefore treat the classical theory as an abstract and somewhat extreme view which is useful as a reference point for a consideration of theories of word meaning.

([+vertical], [-contact])

This core sense cannot account for occurrences such as "The man lives over the hill". Brugman (1981) catalogues nearly 100 different kinds of uses of 'over' which would have to treated as idiomatic under this minimal specification, or alternatively are listed separately in the lexicon as different senses. Furthermore, the componential analysis offered here would be the same core meaning that would be presumably required for 'above', but 'over' and 'above' do not have the same distribution. There is only a partial overlap in the distribution of the two words.

As will be apparent by now, the classical theory favours minimal specification rather than full specification for lexical entries. Lakoff (1987) and those working within the framework of cognitive linguistics generally offer what they claim is a different approach, favouring full specification and recognising extensive polysemy. For example, Lakoff (1987) and Brugman (1981) offer a fully specified account for the lexical entry for 'over'. They recognise extensive polysemy, thus treating all of the senses of 'over' as being related. The polysemy is represented by a radial structure in the lexicon with two prototypical senses of 'over' recognised, with the other senses related via chaining rules. This type of approach will be extensively discussed in chapter four.

Bennett (1975) points out that it seems arbitrary how many senses are recognised for an individual word as it is always possible to subdivide more finely. A case in point is that of metonymy. Nunberg (1978) cites a particular case of this:

- One waitress says to another, "The ham sandwich just spilled beer all over himself."

Here the ham sandwich is standing for the person eating the sandwich. The person has none of the properties of ham sandwiches which make them ham sandwiches. Now, if we try to treat ham sandwich as ambiguous we ignore the important relations between its various uses. Additionally, since we can cite numerous similar examples, to analyse these in terms of ambiguity would suppose quite a vast, and implausibly vast, lexicon. Indeed, this is very much the point which Clark (1983) suggests undermines traditional dictionary theories of word meaning. In a similar vein, Lakoff and Johnson (1980) argue that such instances of metonymy are instances of general principles; they do not just occur one by one. This type of problem is also not limited to cases such as metonymy.

Johnson-Laird (1987), like Bennett (1975) argues that one must not place too much emphasis on polysemy. The crucial psychological criterion is whether or not it is necessary to postulate more than one semantic representation for a word in order to account for the interpretation of sentences in which it occurs. Instead of asking how many different meanings can be squeezed out of the word, psycholinguists need to ask what is the minimum number of senses that are necessary to cope with all of its different uses or occurrences. If "eat" were truly polysemous then the sentence:

He eats the food

should be highly ambiguous. It should have wholly distinct senses. Yet it remains unequivocal. Johnson-Laird points out that the indeterminacy of reference is not sufficient to establish ambiguity because, if it were, open-class words would be infinitely ambiguous and their meanings could not be contained by a finite brain. Hence, the sentence above, which truly applies to a number of situations, is referentially indeterminate, but not ambiguous. Its syntax is unambiguous, and its words are unambiguous: they each have in ordinary usage a single sense, but these senses suffice, as do the senses of all words, to embrace many different situations. The sentence requires only a single representation of its meaning.

Johnson-Laird further remarks that a comparable mistake has been made in the standard interpretation of instantiation. Context can, of course, pick out the appropriate sense of a genuinely ambiguous word, for example, "He banked the cheque." However, the instantiation of an unambiguous word such as "fish" by a sentential context does not depend on picking out one sense from a long list of possibilities.

This problem runs further than Johnson-Laird assumes. The problem lies in the methods used to spot different senses. For example, if we take Brugman's analysis of "over" (to be discussed in some detail later in chapter four), we find different senses posited for the preposition in the following sentences:

The bird flew over the field.

The man lives over the hill.

The cow is over the moon.

The problem is that, although the sentences clearly mean different things, it is not necessarily attributable to different senses of the preposition "over" in each sentence. The difference in sentence meaning may well be due to the co-occurrence relations, and the effect that they have on compositionality. Hence, it is all too easy to attribute differences in sentence meaning to the word type of interest. Furthermore, most have gone further and have attributed the difference in sentence meaning to the lexical entry for the preposition.

All of these examples illustrate what Clark (1983) has called "non-denumerability". There can be no limit to the number of explanatory scenarios with which we can furnish a particular contextual expression and so, in principle, there can be no limit to the number of senses of said expressions. Further, the fact that the senses of contextual expressions are so dependent on the context in which they are used suggests that said expressions are akin to indexicals. As Cruse (1986) puts it;

> "One of the basic problems of lexical semantics is the multiplicity of semantic uses of a single word form (without grammatical difference). There seems little doubt that such variation is the rule rather than the exception: the meaning of any word form is in some sense different in every distinct context in which it occurs"
>
> (Cruse, 1986; p.51)

This is what Clark (1983) calls "contextuality".

The options faced here are strong or weak sense selection. The first option is that each and every sense of a given word is listed in the lexicon under the entry for that word and that what is required for successful communication is selection of the correct one in the circumstances in which the word is used. The second option is that few senses (or one sense) are represented in the lexicon, and the specific occurrence is generated on the spot. Cruse (1986) puts the argument a different way. He draws a distinction between two fundamental ways in which the effective semantic contribution of a word form may vary under the influence of different contexts. The first way, termed modulation by Cruse, involves the modification of a single sense by different contexts. For example, a dirty window-pane will allow some parts of the scene beyond to be seen clearly, and will partly obscure other parts, and a different pane will effect the same scene differently. Modulation is therefore the variation within a sense, and is largely continuous and fluid in nature. The other type of variation is that of contextual selection of senses. As the label suggests, the context picks from among senses the one which is appropriate to achieve utterance meaning in context.

The relationship between minimal versus full specification and strong and weak sense selection is not that simple. Although full specification is associated with strong sense selection and minimal specification with weak sense selection, Clark (1983) advocates sense creation as a viable complementation of strong sense selection. This basically means that the meaning for the word in context is generated with the lexical entry complemented by the context. Braisby (1990) offers a slight variation of this called 'sense generation'. These ideas, it will be argued, provide a viable alternative to full specification accounts, and will be considered within our domain of interest in chapter 8.

### 1.4.2 Ambiguity Tests and Psychological Reality

The issue of full versus minimal specification of the lexical entry for a word can be made easier if there are valid criteria for sorting out whether a word is ambiguous or not. Bennett (1975) comments that;

> "ultimately one would like a linguistic description to reflect the psychological facts, but at the present time we have only a rudimentary understanding of the way in which language is stored and processed in the brain. It would seem, a priori, that the notion of separate senses of a lexeme might well have psychological validity, since we presumably do not store every single occurrence of a given lexeme that we have ever encountered."

Here Bennett comments that he is unaware of any technique in psycholinguistics for determining how many senses a given lexeme has for a particular speaker, and therefore he sticks with the methodology of linguistics. One of the aims in this thesis is to develop valid criteria for separating out senses for spatial prepositions based on the relationship between language and the spatial world. The techniques we will discuss (in chapter six) are of a psycholinguistic nature, and offer methodological alternatives to the linguistic criteria we will shortly discuss.

Taking this point further, we can follow Chomsky in the assumption that regularities at the linguistic level must arise from regularities at the cognitive level, but that the relationship between the levels is sufficiently abstract to preclude testing the models from one with data from the other. Rather, they provide complementary data, with linguistic evidence establishing the general framework which behavioural evidence can then refine. From our point of view, we will consider both linguistic and psychological evidence. In the final analysis, it will be demonstrated that consideration of language as an abstract code, and processing evidence, necessarily have to be combined to give a fuller and more accurate account of language. At the end of the day language cannot be separated from the users of that language as language is dependent on the users for judgment of the well-formedness of that language.

We can turn to a variety of linguistic tests which have been formulated for ambiguity. However, as we shall see, these are by no means full-proof. The main problem is that there is not an understanding of why the tests are supposed to work. In the face of examples where the tests fail, one would expect that a motivated account of how they work would be forthcoming. It is left to us to evaluate the tests to try to fill this obvious gap.

Cruse (1986) cites both direct and indirect tests for ambiguity. To take direct criteria for ambiguity first, three such tests are discussed by Cruse. The first centres on the argument that the senses of an ambiguous word form should not in every case be conditioned by their contexts, unlike the interpretations which arise as a result of contextual modulation. This means that an ambiguous word form set in a disambiguating context may well carry more information than can be accounted for in terms of interaction between the context-independent meaning of the word form, and the semantic properties of the context. On the other hand, in cases of contextual modulation, all information is derived from these sources. For example, we can consider the following sentences (from Cruse, 1986, p. 58);

(a) Arthur washed and polished the car.
(b) John lubricated the car.

The most likely interpretation of (a) is that not every part of the car underwent washing and polishing, but the exterior surface only. The basis for this conclusion is derived entirely from the general meaning of *car,* together with the semantic properties of the context. A similar account can be given of the most likely interpretation of *car* in (b).

It is clear that the success or failure of the test is dependent on the choice of substitution for the word of interest. If the wrong substitution is used, then the word passes the test and is deemed to have two distinct senses. This test therefore simply mirrors the problem of minimal specification, in that one has to pick the correct substitution to avoid the delineation of two or more senses. Cruse indeed comments on the difficulty of applying the test in practice, although he seems to think that it is conceptually important.

The second criterion cited by Cruse for ambiguity is that separate senses should be independently maximisable. Under certain conditions, the application of certain terms must be maximised within the current universe of discourse, even at the expense of oddness. This can be illustrated with two independent senses of 'dog', each independently maximisable, as illustrated below (cited in Cruse, 1986, p. 61);

A: Is that a dog?

B: (i) Yes, it's a spaniel.

(ii) No, it's a bitch.

In other words, the fact that the question can be answered truthfully, yes or no, is dependent on the respondent's belief about which sense the questioner is intending.

There are problems with this test also. Kempson (1977) and Lyons (1977) deny that a successful test for ambiguity can be constructed along these lines.

The third direct test for ambiguity is that of zeugma. This test utilises the fact that independent senses of a lexical form cannot be brought into play together without oddness; that is to say two senses of a word are antagonistic to one another. This can operate by coordination, or by anaphora (cited in Cruse, 1986, p.59-60);

(1) ? John and his driving licence expired last Thursday.

(2) ? John's driving licence expired last Thursday; so did John.

Antagonism of senses also lies behind the so-called identity test for ambiguity.In (3) below, each part of the sentence contains an occurrence, either direct, or indirect via anaphora, of the ambiguous adjective 'light', and can therefore in theory be interpreted in two ways

(3) Mary is wearing a light coat; so is Sue.

However, the whole sentence does not have four (i.e., 2x2) interpretations, but only two. This is because the same reading of 'light' must be selected in each part: either both the ladies are wearing "undark" coats, or both are wearing "unheavy" coats. Cross interpretation is prohibited. This prohibition is not a mysterious property of the grammatical process of anaphora; it is simply a consequence of the fact that 'light' resists, as it were, the simultaneous activation of more than one of its senses.

We will discuss some difficulties with zeugma later. In particular, once again no clear account of why the test works is given. Let us give some examples, which demonstrate some of the difficulty;

(i) The flowers and crack are in the vase. The flowers are in the vase : so is the crack.

(ii) The violets and roses are in the vase. The violets are in the vase: so are the roses.

(iii) The flowers and water are in the vase. The flowers are in the vase: so is the water.

(iv) The flowers and lead are in the vase. The flowers are in the vase: so is the lead.

Here the first sentence, using zeugma, would suggest that there are two different senses of 'in' being used. By contrast, in (ii) the test suggests that one sense is being used in both cases. However, things look more tricky when we compare (iii) and (iv). Also, note the differences in acceptability comparing zeugma with the identity test for ambiguity.

Cruse (1986, p.66) himself comments that not all sentence ambiguity originates in lexical ambiguity, and that tests for ambiguity are not capable of discriminating between lexical and non-lexical varieties of ambiguity. Cruse suggests that one should adopt a 'default' definition and characterise lexical ambiguities as ambiguities which do not have a convincing non-lexical explanation. In the case of zeugma, we will provide a possible explanation without recourse to lexical ambiguity in chapter six.

Let us now turn to indirect tests as described by Cruse. Yet again Cruse cites three indirect tests, which are less reliable than the direct tests. However, we still wish to arm ourselves with all the methods available to separate out senses as best as we can. The tests then merit a brief mention, and are listed below;

(I) If there exists a synonym for one occurrence of a word form which is not a synonym of a second, syntactically identical occurrence of the same word form in a different context, then that word form is ambiguous, and two occurrences exemplify different senses.

(II) If there exists a word or expression standing in a relation of oppositeness to one occurrence of a word form, which does not stand in relation to a second, syntactically identical occurrence of the same word form is a different context, then that word form is ambiguous, and the two occurrences exemplify different senses.

(III) If there exists a word which stands in a paronymic relation to one occurrence of a word form, but does not stand in the same relation to a second, syntactically identical occurrence of the same word form in a different context, then that word form is ambiguous, and the two occurrences exemplify different senses.

Cruse (1986) himself comments that indirect tests are less reliable than direct tests, and therefore we will follow Cruse and will use only direct tests when appropriate. However, we proceed with extreme caution; as already stated there is not a clear account of why the tests appear to work. In particular, it can be argued that the tests are based on syntactic criteria, namely coordination phenomena where the general principle holds that only constituents can be conjoined; nonconstituent sequences cannot be conjoined. Therefore a syntactic test has been applied to a semantic domain. Furthermore, this type of test has been used to spot homonyms, such as the two senses of *bank* mentioned earlier. It is less clear whether this type of test can be used in the case of polysemy. It will be demonstrated in chapter six that it cannot.

### 1.5 Preview of the Argument

In this chapter we have introduced the problems we wish to tackle in the thesis. Namely we wish to address the question of how the spatial world and spatial language covary. In doing this, we aim to tackle the issue of how many senses one should ascribe to a spatial preposition. Furthermore, we ask that we give an account of the information that users of language are likely to mentally represent during language processing. In other words, what are the conditions for the use of a spatial preposition, and how does this relate to mental representation?

Before we can proceed any further, we must clearly map out the domain of interest. Chapter two does precisely that. We narrow down the area of spatial prepositions to a focus on a few of (what are often regarded as) the simplest, including *in, on, at, over, under, above* and *below*. In doing this, we consider the relationship between this group and other prepositions, as well as the same words used across syntactic categories.

In chapter three we consider the classical treatment of the meaning of spatial prepositions. In particular we focus on the account of Bennett (1975) as an example of componential analysis, among others. It will be demonstrated that many of the criticisms made of the classical theory (e.g., Lakoff, 1987) only apply to some aspects of the theory, and that there may be aspects of the theory which are worth preserving. In particular, we argue that minimally specified accounts of the lexical entries of spatial prepositions makes sense. In order to do this, componential analysis isn't an option which has to be ruled out. It will be demonstrated that many of the criticisms reflect the wrong choice of minimal specification for the lexical entry.

In Chapter four we consider approaches which favour full specification. In particular we examine prototype theory, and the motivation for using the radial structure of categories directly in the lexical representation for the meaning of each preposition. It will be argued that prototype effects have been largely misinterpreted, and that they can easily be seen as by-products of sense generation from a minimally specified lexical entry, rather than representations of meaning per se. This chapter also presents in some detail two examples of accounts which employ prototypical structure and full specification. Firstly we consider the account of *over* given by Brugman (1981, 1988), Lakoff (1987), and Brugman and Lakoff (1988). It will be argued that the approach to polysemy is ill-founded in that the criteria used to separate out senses are a by-product of constraint satisfaction. In particular, it will be argued that it is the information about the most commonly occurring nouns which leads to prototype effects. Secondly, we present the theory of Herskovits (1986) and argue against the notion of ideal meanings and use types. However, her use of pragmatics, it is argued, should be taken further within a semantic framework. Elements of her theory are worth preserving, although in a slightly different form.

Chapter five begins with the assertion that all the approaches thus far discussed (i.e., in chapters three and four) are incorrect in their assumption that spatial prepositions refer to geometric relations between objects. It is argued that what is important about spatial language is how objects interact with each other, and not where they are in relation to each other in geometric space. In this light, the work of Talmy (1988) and Garrod and Sanford (1989) is considered, and this leads to a rejection of what we call (after Michotte), the 'detached pieces approach' to explanatory lexical semantics. How one can accrue evidence for this will then be discussed. Garrod and Sanford (1989) argue that geometric descriptions underspecify the conditions when a particular preposition can and cannot be used. In place of this, they suggest one possible solution; the notion of situation-specific functional geometries. We unwrap precisely what Garrod and Sanford mean by this, and present several inconsistencies apparent within their argument. At the end of the chapter we present a theory of the relationship between functional relations and geometric relations, which is an extended version of the Garrod and Sanford analysis, and outline a set of hypotheses to be tested in the following chapter.

Chapter six sets out to directly test the hypotheses relating to the existence of functional relations outlined in chapter five. Five experimental studies are presented which support the existence of functional relations. Importantly, these studies (and in particular the main study; study five) examine directly how the spatial world and spatial language covary by systematically varying spatial scenes presented along two parameters; geometric positioning, and functional interaction.

Chapter seven considers a second source of evidence for functional relations; evidence from first language acquisition. We reinterpret developmental work on the first language acquisition of spatial prepositions, and it is demonstrated that this provides compelling evidence for the functional relations analysis. In particular, the work of Stevens and Coventry (in preparation) is discussed at some length. This work provides clear empirical support that prepositions involving functional relations are learned first, and that geometric relation prepositions are learned later.

Chapter eight takes functional relations and presents initially a reclassification of the use types of Herskovits (1986), reducing the number of use types required in the lexicon. This analysis is then developed, and further reduces the number of senses required for *in, on, at, over, under, below* and *above*.This is a more formal specification of the lexical semantics for spatial prepositions, and employs the notion of a semantic field. We also review different ways of dealing with co-occurrence relations, and provide a formal framework for compositional semantics involving minimal specifications for the lexical entries of the prepositions.

Finally, chapter nine presents the conclusions of the analysis and the ramifications of the analysis for other word classes.

## Chapter 2

### 2.1 Introduction

In this chapter we specify the domain of interest and map out the terminology to be adopted for the rest of the thesis.

### 2.2 The Domain to be Considered

The thesis deals with spatial prepositions in standard English, which are among the simplest and shortest words in the English language, and in most languages. In classifying the functions of prepositions it is customary to distinguish between 'grammatical' uses and 'local' uses (Lyons, 1968; Bennett, 1975). Under the banner of 'local' uses come spatial and temporal uses of prepositions.

Spatial uses of prepositions may be divided into 'locative' or 'relational' (Clark, 1973) prepositions and 'directional' prepositions (Bennett, 1975). 'Locative' or 'relational' prepositions are used in order to describe the location of one object in relation to another, for example;

Keith is in his office

'Directional' prepositions are used to describe a change of position. For instance;

Simon went to the eye-tracker room (a few minutes ago).

To give a more complex example (from Bennett, 1975, p.18);

We went from Waterloo Bridge along the Embankment to Westminster.

can be considered to contain three directional expressions in its semantic representation: a source expression, a path expression and a goal expression. Hence, we have a starting point, a change of location, and a description of the path taken on the way to the change of location.

The division between directional and locative prepositions will be reviewed later in the thesis. In our analysis directional and locative prepositions are treated as being linked. A locative preposition such as 'in' involves information about how the objects interact with each other, and hence how they remain stable over time. A directional preposition can simply be viewed as the converse of this.

The present thesis deals with locative prepositions.

Locative prepositions occur within locative expressions. It is therefore essential to examine differences between locative expressions, of which there are many types. The simplest form is composed of three constituents: the preposition and two noun-phrases as in ;

The nail in the board

The *nail* is the subject of the preposition and the *board* is the object. The subject refers to the located entity, and the object to the reference entity. There are many alternative terms given for subject and object catalogued by research in table 2.1 below. For the rest of the text, we will follow Langacker (1986) in the use of figure and ground for subject and object. This avoids the syntactic connotations associated with subject and object; figure and ground are used exclusively in the semantic domain.

Such expressions can be structured around a copulative verb or an existential quantifier:

The snail is in the garden

There is a snail in the garden

Locative expressions also exist where the subject of the preposition is a clause:

The snail is chewing lettuce in the garden.

The subject of the expression is *the snail is chewing lettuce,* as this clause describes the event that is taking place *in the garden.*

A spatial prepositional phrase may also fit in the case frame of a verb (Fillmore, 1968). For example,

The dog put the bone in the kennel.

What is being located *in the kennel* is not any object, state or event, but the "destination" of the action "to put", that is, *in the kennel* is the end place of the trajectory of the bone, which will be considered the located entity.

Retz-Schmidt (1988) offers a further breakdown of locatives into those such as *in, at* and *near,* which she claims only refer to topological relations between the objects, and others such as *in front of, behind, left of, right of, beside, above* and *below* which also convey information about the direction in which one object is located with respect to the other. The latter group are called *projective* prepositions (Herskovits, 1986) or *directional prepositions* ((Richtungspraposítionen)(Wunderlich and Herweg, 1988).

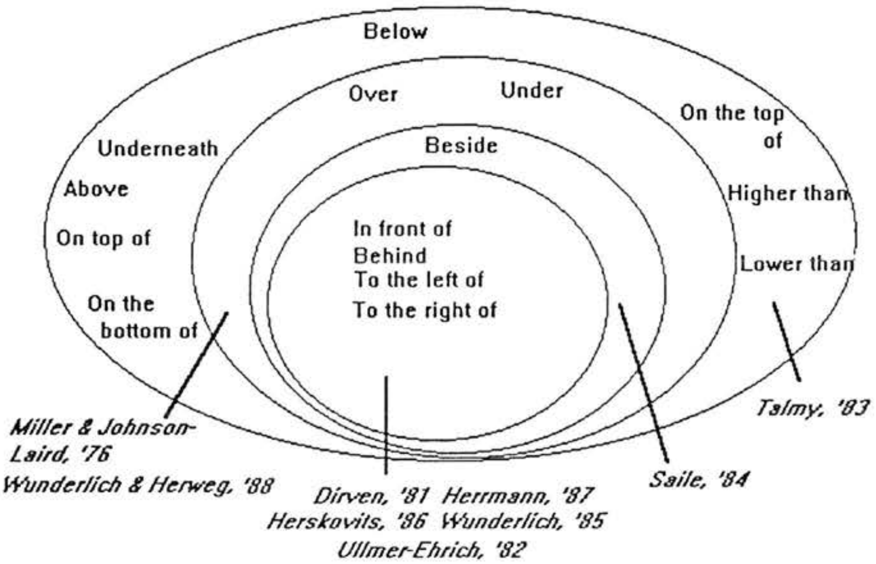
Table 2.1 Other terms for Subject, Object, and Point of View (adapted from Retz-Schmidt, 1988).

| AUTHOR(S)/RESEARCHER(S) | SUBJECT | OBJECT | POINT OF VIEW |
|---|---|---|---|
| Bennett, '75, p.83 | | | reference point |
| Buhler, '82, p.13ff | | | origo |
| Burkle et al., '86, p.4 | | anchor | perspective, point of view, reference point |
| Hays, '87, p.6 | located object | reference object | |
| Herskovits, '86, | | reference object | point of observation |
| Jackendoff, '83, p.202 | theme | reference object | |
| Jackendoff, '87, p.202 | figural object | landmark | |
| | theme | reference object | |
| Kautz, '85, p.2-33 | figure | ground | |
| Klein, '78, p.20 | | | origo, reference point |
| Klein, '82, p.162 | | | origo, reference point |
| Klein, '83, p.291 | | | origo |
| Lakoff, '87, p.419 | trajector | landmark | |
| Langacker, '86 | figure | ground | |
| Levelt, '86, p.188 | Verweisobjekt | Bezugsobjekt | |
| Nirenburg, Raskin, '87, p.366 | figure | ground | |
| Schulze, '87 | figure | ground | |
| Sennholz, '85 | | | origo |
| Talmy, '83 | primary object | secondary object | secondary |
| | figure | ground | reference object |
| | figure | ground, reference object, primary | reference object |
| Ullmer-Ehrich, '82, p.288 | | | origo, reference point |
| Vandeloise, '84, p.3f., 187f. | trajector | landmark | point or reference (consciously taken on) or (virtual) viewpoint (unconsciously taken on by the speaker) |

Projective prepositions can be used in different ways. Following Wunderlich (1985) Retz-Schmidt (1988) distinguishes between deictic use, intrinsic use, and extrinsic use. For example, with the expression "The bike is in front of the lorry" deictic use would locate the bike in relation to the lorry from the point of view of the speaker, intrinsic use with respect to the orientation of the lorry itself, and extrinsic use with respect to the actual direction of the motion of the lorry[1]. Thus projective prepositions rely on different points of view (also termed variously as displayed in table 2.1 above). The duplicity of systems for spatial reference is quite general for other world languages as well as English, though there are many differences of detail .

Projective prepositions are the only prepositions (in English) which allow deictic, intrinsic, and extrinsic use. However, there is not complete agreement as to which prepositions can fall into these categories. Figure 2.1 summarises different viewpoints on membership of the set of projective prepositions.

Figure 2.1 Membership of the Set of Projective Prepositions by Author(s)/Researcher(s)

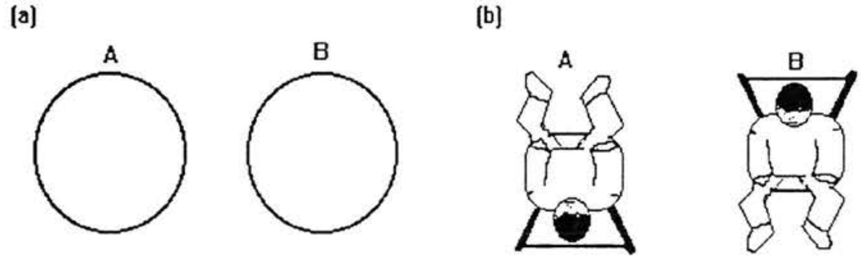



As can be seen from the figure, there is complete agreement that *in front of, behind, to the left of*, and *to the right of* belong to this group. However, considerable disagreement exists with others such as *on the top of.* Of relevance here is the disagreement over *over, under, below* and *above.* As can be seen seen from figure 2.1, these are treated by Talmy (1983) as prepositions which can be used intrinsically, deictically and extrinsically. This is because they describe relations in the vertical axis, and thus allow intrinsic and extrinsic uses, but not deictic use. Intrinsic use involves the intrinsic top and bottom of the reference object (intrinsic verticality; Clark, 1973), and extrinsic use involves geological or gravitational verticality (Clark, 1973), based on the gravitation of the earth.

[1] For a subset of English speakers it should be noted that "The bike is in front of the lorry" does not have an intrinsic interpretation. For that they require "The bike is at the front of the lorry".

Levelt (1984) offers a detailed discussion of the deictic and intrinsic systems of referring to spatial relations. Several important differences emerge from his analysis. Comparing deictic versus intrinsic use of *left* and *right,* converseness holds for the deictic system but not the intrinsic system. This is clear when we compare the scenes in figure 2.2 (below);

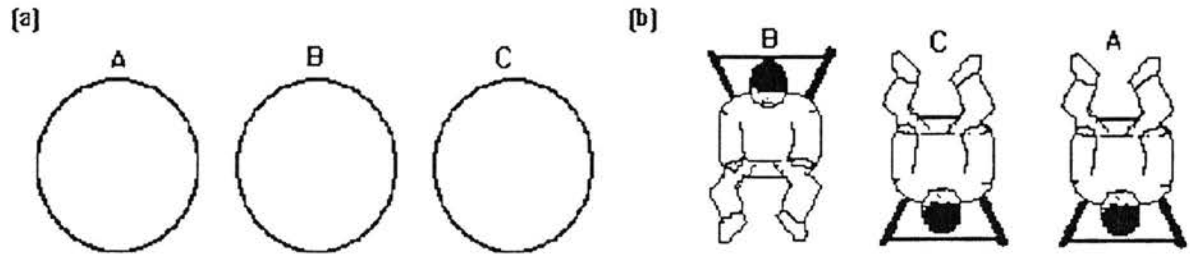
Figure 2.2




In (a) if one says that 'A is to the right of B', then it holds that B is to the right of A for both deictic and intrinsic use. However, this is not true with (b); with deictic use the converse does hold, but with intrinsic use it does not. With the intrinsic use in (b) A is to the right of B and B is to the right of A[1] .

Similarly, the deictic system is transitive, but the intrinsic system is not. Consider figure 2.3 (below);

Figure 2.3




Again, from the perspective of the viewer (deictic frame of reference) one can say in picture (a) that A is to the left of B, and that B is to the left of C, therefore A must necessarily be to the left of C. Transitivity also holds for picture (b) with deictic use. However, transitivity for intrinsic use does not hold for picture (b); A is to the left of

---

[1] Hence, with intrinsic use one can say "A is on B's right".

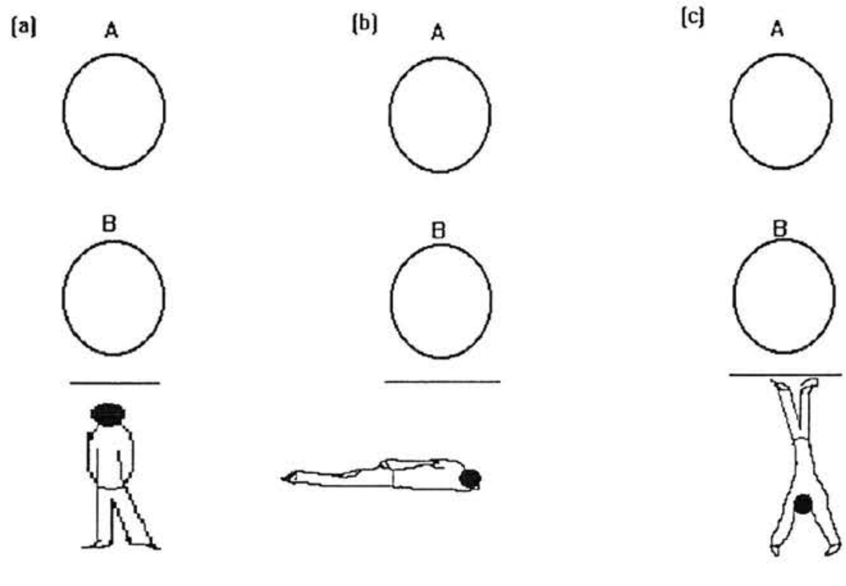
B, B is to the left of C, but A is not to the left of C. Levelt comments (1984, p.330) that a consequence of the intrinsic system's local intransitivity is the difficulty with which one finds reasoning with *left* and *right* using the intrinsic system. Indeed, this has lead Johnson-Laird (1983) to postulate that one must create and manipulate mental-models of the scenes to cope with the difficulties involved.

Of most relevance for us here is Levelt's discussion of intrinsic and deictic uses of *over* and *above*. These uses, involving the vertical dimension, differ from the *in front/behind* and *left/right* dimensions (see Levelt, 1984, pp. 331 - 347 for extensive discussion). For deictic use of *above* and *below* the point of view of the observer is irrelevant; that is, the position of the observer with the respect to the scene is of no importance. Thus converseness and transitivity apply to deictic uses of *above* and *below*. However, the vertical orientation of the speaker's perspective is only one factor. Levelt argues that a number of cues operate on the perception of a scene from the viewer's perspective. These are (Levelt, 1984, p.348) verticality perceived in terms of;

(1) its being aligned with the retina's vertical meridian
(2) its orientation with respect to some visual frame (horizon or whatever), and
(3) its alignment with the vestibular vertical

These variables can be seen to be brought into play in figure 2.4 (below);

Figure 2.4



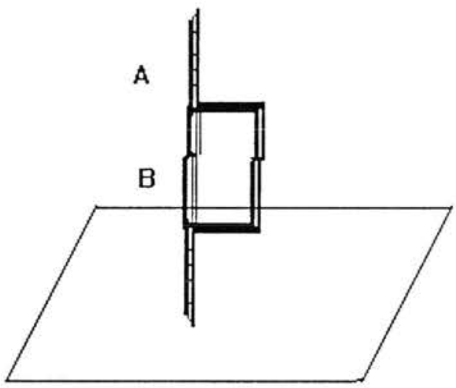

The first type of cue is apparent in (a), but not in (b). The second type of cue comes into play with (a) and (c). The vestibular cue works in (a) and (b). However, (c) represents a case where retinal and vestibular alignment cues are in conflict. It is not clear in this case whether one would say that 'A is above B' or that 'B is above A'.

Intrinsic uses of *above* and *below* are extremely limited due to what Levelt (p. 345) refers to as the *principle of canonical orientation.* This runs as follows;

> "For the intrinsic system to refer to a reference object's intrinsic dimension, that dimension must be in canonical position with respect to the reference frame of orientation of the located object."

Hence, in figure 2.5 (below) one cannot say 'chair A is below chair B' but one can say that 'chair B is below chair A'.

Figure 2.5




There can only be genuine intrinsic use of *over* and *above* for frames of reference other than the perceived vertical. However, these later cases are quite limited as well; it is for instance still impossible to violate converseness or transitivity.

This thesis deals with what are generally regarded as the simplest of relationals/locatives to deal with; what have been termed 'topological' prepositions. However, the label 'topological' will be brought into question as a suitable label for these prepositions. Specifically we will deal with *in, on, over, under, above, below* and *at.* This restricted choice is partly reflected by the fact that these prepositions have been examined most extensively in the past, and thus we have numerous existing accounts to consider. We will also stick within two grammatical frames;

NP + (Prep + NP), as in *The lamp on the table*

and;

NP + VP(V + PP(P + NP)) as in *The turtle is in the aquarium*

We will stick mainly to the verb *to be* in this second grammatical frame, although we will also consider other verbs. The reason for this is that we wish to separate out the information the preposition brings to the sentence from effects of constraint satisfaction, or contextual modulation. For example, let us consider the following sentences;

Kathryn walks over the hill
Kathryn lives over the hill

In the first case there is a path with the figure in contact with the ground. In the second case Kathryn lives on the other side of the hill from the viewpoint of the speakers. Thus the sentences, involving different verbs, depict quite different spatial relations. It could be that the word *over* brings different information to each sentence (as Lakoff, 1987 argues; i.e, it has two distinct, though related, senses), or it could be the verb adds to the information given by *over,* thus reaching a different spatial depiction as a function of the compositionality. Focussing on a neutral verb, namely *to be,* we are able to avoid this problem. That is, we can get at the information a spatial preposition brings to a sentence without modification.

### 2.3 Relationship Between Types of Preposition and Other Syntactic Categories

The same (realisation of a) phoneme string can be used in many different ways. For example, *in* is a preposition in;

In the harbour

which is a prepositional phrase. But a prepositional phrase can occur either as the complement as a verb, as in;

It sank in the harbour

in which case it plays an adverbial role, or as the complement of a noun, as in;

The channel in the harbour

in which case it plays as adjectival role. Of course, *in* can also be used intransitively as well as transitively.

Miller and Johnson-Laird (1976, p.379) comment that;

"to assign *in* (for example) always to its correct syntactic category suggests diversity where there is considerable semantic uniformity"

Miller (1985) indeed argues that prepositions, adverbs, particles and prefixes should be treated as belonging to the same semantic categories, categories he terms *entity* and *relator*. In doing this, he has examined the relationship between prepositions, particles, prefixes and adverbs. Firstly, particles are identical in form with prepositions. Secondly, some adverbs are identical in form with prepositions or contain prepositions, as in *The children went out* or *The children went outside*. Thirdly, prepositions, particles and adverbs are all relevant to statements of co-occurrence restrictions applying to the same verbs, as in (a) - (d) below (from Miller, p.59);

(a) Angela put the cat
(b) Angela put the cat in the basket
(c) Angela put the cat out
(d) Angela put the cat outside

PUT takes as complements an object NP and PP, (a) is incomplete syntactically, but can be completed by the addition of a prepositional phrase (as in (b)), a particle (as in (c)) or an adverb (as in (d)).

A fourth fact is that prepositional phrases, particles and adverbs can all occur in sentence-initial position, with transposition of the verb and subject noun (again, examples from Miller, 1985);

(a) In the door lolloped a friendly ridgeback
(b) In lolloped a friendly ridgeback
(c) Inside lolloped a friendly ridgeback

Jackendoff (1973) concludes that the distinction between prepositions, particles and locative adverbs is not worth drawing ; particles may be classified as prepositions that don't take complements (intransitive prepositions). Particles are also often determined in their respective positions. Miller (1985) additionally presents evidence from other IndoEuropean languages which supports this unified syntactic treatment, and further argues that this is paralleled by a unified semantic interpretation, because the concepts needed for the semantic interpretation of prepositions are also needed for the interpretation of particles and locative adverbs, and indeed for verb prefixes in other languages. Furthermore, these semantic structures (structures under the banner of localism) are separate from the syntactic structures. The latter show distributional categories, the dependency relationships between them and groupings of constituents. The semantic structures show spatial relations between entities.

Another group of uses of prepositions which are important to account for in any theory are prepositions used in non-spatial contexts such as metaphor. One can't omit these occurrences from the analysis without giving a principled account of why they exist at all. Indeed, one may argue that an understanding of non-literal uses may give great insight into the use of prepositions in more literal contexts. Coventry (1991) and Coventry and Ludwig (1991) pursue this point. However, the present thesis will only give this category of uses a fleeting mention.

## 2.4 Prepositions in English and Other Languages

The thesis deals only with prepositions in English. Ideally one would wish to consider spatial prepositions in a variety of languages in the hope of the possibility of discovering (possible) semantic universals. However, it was decided early on to focus on English to provide a detailed analysis of one language, rather than a less detailed analysis of several. Again, this is partly as English spatial prepositions have been studied more extensively than prepositions in other languages. Later in the thesis we will have something to say about how the current analysis of English prepositions provided may (or may not) generalise to other languages.

Dialect variations are considered only to the extent to which they are produced by subjects in the experiments to be reported in chapter six. It is taken largely as a matter of faith that the use of English prepositions remains invariant throughout areas of use of standard English. It should be noted that we do acknowledge differences between standard English and American English, however. All examples have been thus checked with native British speakers, and therefore there may be apparent differences with American English.

For study of prepositions in other languages the interested reader should consult, for example, Vandeloise (1984) for prepositions in French, Janda (1984) for verb prefixes in Russian (*za-*, *pere-*, *do-*, and *ot-*), Rudzka-Ostyn (1983) for a comparative study of Polish *vy* and Dutch *uit*, Friedrich(1969) for Tarascan suffices of space, Bierwisch (1988) for a thorough discussion of German, and Coventry and Ludwig (1991) for a consideration of Rumantsch spatial language.

## Chapter 3

### 3.1 Introduction

In this chapter we consider what have been termed 'classical' treatments of the meaning of spatial prepositions (Lakoff, 1987). It should be mentioned that these approaches, contrary to the belief of Lakoff (1987), are less prevalent in the history of lexical semantics than what are now termed 'cognitive linguistic' approaches (see Geeraerts, 1988 for a discussion). Hence the label 'classical' is slightly misleading. Nevertheless, they merit close consideration. After a general discussion of classical approaches, we will consider the work of Bennett (1975), which is an example of the use of componential analysis. Later in the chapter we will present arguments, largely lodged from the cognitive linguistic camp, against the classical approach. We will be concerned in particular with a detailed account of the assumptions made using such an approach. Lakoff (1987) argues that minimal specification is part and parcel of the classical approach, and that 'experientialism' (as he calls it) favours full specification. It will be demonstrated that it does not follow that if one adopts minimal specification, one must follow the classical framework. Furthermore, it will be proposed that the classical framework offers some attractive properties which will be worth preserving in our account. At the end of the chapter we provide a brief discussion of semantic fields, and conclude with an overview of classical accounts.

At the outset it should be clearly stated that we accept that there is not a clear boundary, as some would claim (e.g., Langacker, 1988), between so-called 'classical' and so-called 'cognitive linguistic' accounts. We stick we these labels as useful structuring tools for our present discussion. The following chapter will begin with an exposition of exactly how these accounts are supposed to differ.

### 3.2 Classical Accounts

Classical accounts in lexical semantics favour a clear division between semantics and pragmatics. Each word in an expression brings a fixed content to the expression which combines with other word contents. In the case of spatial prepositions, this has worked in terms of a simple relation, such as;

$$\text{In}(X, Y) \text{ iff Located } (X, \text{Interior}(Y))$$

This first order logic formula represents the necessary and sufficient conditions for an expression of that form to be true. For example, if we consider the expression;

The fish is in the tank

*Fish* would be substituted for X, *tank* would be substituted for Y, and the expression would only be true if the fish is located interior to the tank. Such meanings together with the compositional rule constitute the model.

Cooper (1968) gives an ideal meaning of *in* which is almost identical with this;

IN: X in Y: X is located internal to Y, with the constraint that X is smaller than Y.

where X is the figure, and Y is the ground.

Leech (1969) also gives a similar definition, but drops the explicit requirement that the figure be smaller than the ground;

IN: X in Y: X is "enclosed" or "contained" either in a 2D or 3D place Y.

However, by virtue of the fact that an object must be physically smaller than a container to fit in a container, this is implicit in Leech's definition.

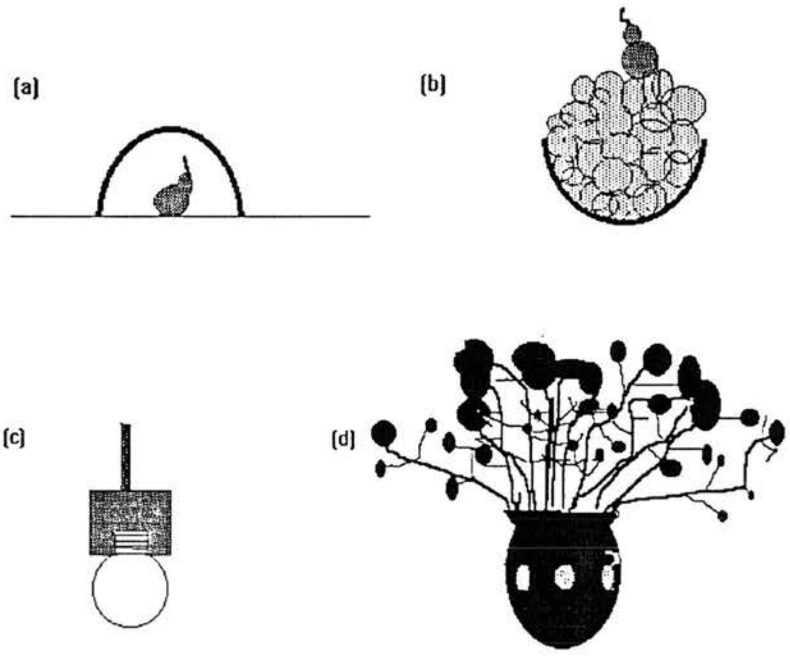
Now, instantly one can see problems with these 'definitions' of *in* as there are many counterexamples where the conditions for use do not hold, but the use of *in* is still acceptable. For example, in Figure 3.1(b) (below) the 'pear is in the bowl' is felicitous, but the condition that the figure is interior to the ground has been flouted. This is also true of (c), where the light-bulb is not interior to the socket, but *in* is still appropriate.

Figure 3.1(d) represents a case which flouts both the requirement that the figure be smaller than the ground (flowers are normally larger than the vase, certainly in terms of height), and the requirement that the figure be located internal to the ground (flowers normally stick out the top of a vase).

There are also cases where the definition of *in* given does hold, but the use of *in* is not appropriate. One such example is figure 3.1(a) where *under* is the most appropriate preposition to use although the pear is located internal to the bowl. This situation is complicated by the fact that *in* is the most appropriate preposition to use in the case of figure 3.1(c).

Figure 3.1

(a) The pear is in the bowl.
(b) The pear is in the bowl.
(c) The light-bulb is in the socket.
(d) The flowers are in the vase.




These examples are not simply isolated counterexamples; one can cite numerous others such as;

The walking stick in the hand
The nail in the board
A man in a red hat
My son is in college
The supermarket is in the neighbourhood

Miller & Johnson-Laird (1976) recognise the problems that the figure does not necessarily have to be smaller than the ground, and that the figure may not be completely contained within the ground. Thus they propose the following definition for *in*;

IN(X, Y): A referent X is "in" a relatum Y if:
(i) [PART (X, Z) & INCL (Z, Y)]

where INCL represents 'included spatially in'.

This definition accounts for some of the cases which the Cooper (1968) and the Leech (1969) definitions seem to have difficulty with, such as figure 3.1(c) and (d). However, this definition cannot account for the cases of figure 3.1(b) where the definition doesn't hold but the use of *in* is appropriate, and 3.1(a) where the definition does hold, but the use of *in* is infelicitous.

This state of affairs, that is, the ease with which one can come up with counterexamples to the simple definitions given, is not limited to the case of *in*. Cooper (1968) gives the following definition of *on*;

> ON: X on Y: A surface X is contiguous with a surface of Y, with the constraint that Y supports X.

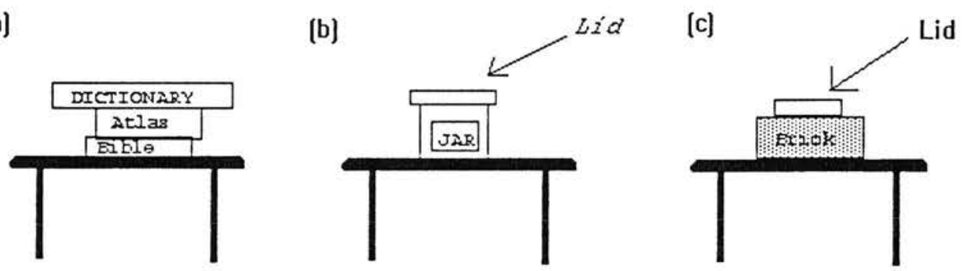
Leech (1969) focuses more on contiguity than Cooper (1968) and offers the following definition of *on*;

> ON: X on Y: X is contiguous with the place of Y, where Y is conceived of either as one-dimensional (a line) or two-dimensional (a surface).

For counterexamples to these definitions of *on* one can consider figure 3.2.

Figure 3.2

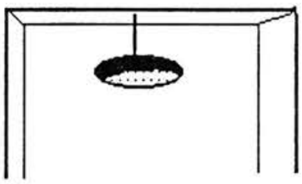
(a) The dictionary is on the table
(b) *The lid is on the table
(c) The lid is on the table




The dictionary is *on* the table in (a), but the *lid* is not *on* the table in (b), although it is nearer the table surface than the dictionary in (a). However, the **lid** can be said to be *on* the table in (c). The definition of *on* given by Leech (1969) does not cover (a) and (c) as the dictionary and the book respectively are not contiguous with the table. The definition given by Cooper (1968) seems to fare better with the recognition of support as a factor in the use of *on* (thus potentially accounting for (a) and (c) on the grounds that the table is supporting the dictionary and lid (respectively) although the support is indirect), but still cannot account for the felicitous use of *on* in (c), though not in (b).

Another problematic case is that in figure 3.3 below.

Figure 3.3 The light is on the ceiling.



This is another example of the flouting of the condition of contiguity which is required in the definitions given by Cooper (1968) and Leech (1969).

Miller and Johnson-Laird (1976) improve slightly on the definitions given by Cooper and Leech. They give the following definition for on;

> ON: ON(X, Y): A referent X is "on" a relatum Y if:
> (i) (INCL(X,REGION(SURF(Y))) & SUPRT(Y, X)); otherwise go to (ii)
> (ii) PATH(Y) & BY(X, Y)

where INCL represents 'included spatially in', SUPRT represents 'supports' and SURF represents 'has the (total) surface'

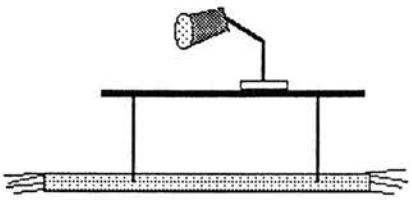
This definition recognises cases such as;

The house on the river

where the house is *beside* the river, but not *on top of* the river.

They explain the examples in figure 3.2 by treating *on* as a "transitive relation with peculiar limitations" (Miller & Johnson-Laird, 1976, p.387). They thus explain the limitations on transitivity as limitations due to the subdomain of search for "on" which they claim is the region of interaction with the surface of the relatum, rather than merely the surface. For example, if we consider the following case;

Figure 3.4



one can say the following *on* relations are admissible;

The lamp is on the table
The table is on the rug
The rug is on the floor
The table is on the floor

but the following is not;

*The lamp is on the floor

Miller and Johnson-Laird's explanation of this is that we can say that the table is *on* the floor even though it is not touching it because when we search in the region of the floor we will encounter table legs. We cannot say the lamp is *on* the floor because when we search in the region of the floor we will not encounter it. Hence, the limited transitivity of *on* as used to describe a pile of objects. Thus Miller and Johnson-Laird rely on the idea that the purpose of locative expressions is to narrow down the domain of search for a referent, and take this 'function' to be represented directly at the perceptual level.

This explanation still fails to account for the examples in figure 3.2 however. As indicated before, the lid in 3.2(b) is nearer the table than the dictionary in 3.2(a). Therefore, there must be more to an explanation of this phenomenon than simply a limited notion of transitivity based on region of interaction.

Thus we have seen, using the examples of *in* and *on,* that there appear to be many cases which simple relations approaches cannot account for. One could easily pick other prepositions and demonstrate similar counterexamples to such simple definitions. There are two main classes of these. The first is where the definition overgenerates cases which should fit; these are decoding overgenerations. The second involves cases where the simple relations definition does not fit a situation where the preposition is in fact appropriate; these are encoding inadequacies.

Before we discuss objections to the classical view in more detail, we will consider one theory in detail; the work of Bennett (1975). This will obviate the charge that we have not thus far given classical definitions a thorough enough treatment. Aside from this, the choice of Bennett's analysis of spatial prepositions is for two reasons. Firstly, Bennett (1990) argues for a reinterpretation of his theory in terms of prototype theory (to be considered in the following chapter). Bennett's theory therefore serves as a vehicle for comparison between different theoretical approaches. Secondly, Bennett's account will serve as an introduction to semantic fields, which we will consider in a little more detail at the end of the present chapter.

### 3.3 Bennett: Componential Analysis and Minimal Specification

Bennett (1975) proposes an account of the meaning of prepositions presented in the framework of stratificational semantics. He argues for minimal specification of the meaning/lexical entry of each preposition as a reaction against the approaches of Lindkvist (1950), Sandhagen (1956) and Wood (1967) which appear arbitrary in the number of senses which are recognised. Bennett claims that it is, "both unnecessary and undesirable to postulate as many senses of each preposition as are listed by Lindkvist, Sandhagen, Wood, and in the larger dictionaries" (Bennett, 1975, p.5). He undertakes to postulate a set of underlying components of meaning which can fit together to provide an adequate semantics for all spatial prepositions.

Bennett's motivation for the use of componential analysis is driven by the fact that it provides a very straightforward means of characterising the semantic relationship between different vocabulary items. Thus Bennett at the outset is keen to emphasise the relationship between words in terms of shared meaning, for example. This means that Bennett can claim that *over* and *above* are nearer each other in meaning than *above* and *in,* for instance. The componential analysis used invokes five cases (within stratificational grammar); locative, source, path, goal and extent. Spatial prepositional meanings for locative prepositions are characterised in table 3.1 (below).

Here we are primarily interested in Bennett's characterisations for the meanings of *in, on, at, over, under, above* and *below.* To begin with the case of *over,* we can consider the occurrences of *over* in figure 3.5 (below; left hand side). Each sentence is given a semantic representation by Bennett, based on an assignment of case, and Bennett then sees the problem as one of deciding how much of these semantic representations are realised as the preposition *over.* To put the problem slightly differently, Bennett has to decide what particular string, or strings of semantic elements *over* gets mapped onto.

Table 3.1 Bennett's (1975) Componential Analysis of the Locative Prepositions

| | |
|---|---|
| *above:* | 'locative higher' |
| *(a)round:* | 'locative surround' |
| *at:* | 'locative' |
| *behind:* | 'locative posterior place' |
| *below:* | 'locative lower' |
| *beyond:* | 'locative path locative' |
| *by:* | 'locative proximity' |
| *in:* | 'locative interior' |
| *in back of:* | 'locative posterior place' |
| *in front of:* | 'locative anterior place' |
| *inside:* | 'locative interior of side' |
| *on:* | 'locative surface' |
| *outside* | 'locative exterior of side' |
| *over:* | 'locative superior' |
| *under:* | 'locative inferior' |

The sentences with occurrences of *over* in them (in figure 3.5; below, left hand side) are assigned the following semantic representations Bennett (p.50), displayed on the right hand side of figure 3.5;

Figure 3.5

| | |
|---|---|
| (a) My hand is over the table | [L [ superior of table] ] |
| (b) I removed my hand from over the table | [S [L [superior of table] ] ] |
| (c) Can you jump over the table ? | [P [L [superior of table] ] ] |
| (d) Please put the lamp over the table | [G [ L [superior of table] ] ] |
| (e) The post office is over the hill | [L [P [L [superior of hill] ] ] ] |
| (f) A car appeared from over the hill | [S [L [P [L [superior of hill] ] ] ] ] |

where L=locative, S=source, P=path and G=goal.

The semantic representation of (a) contains a simple locative expression; (b), (c) and (d) contain directional expressions (source, path and goal respectively); (e) contains a locative expression of the more complex, deictically interpreted kind; and in (f) the locative expression of (e) is embedded inside a source expression.

This illustrates a positive point with this approach; Bennett recognises the importance of the full expression in the understanding of the preposition. For example, in (f) a simple locative expression is embedded inside a path expression which is itself embedded inside a complex locative expression. Finally, the complex locative expression is embedded inside a source expression. Thus Bennett is aware that although *over* can be said to have difference occurrences in the above sentences, this is perhaps a result of the modification of a single sense of *over* by other words in each sentence.

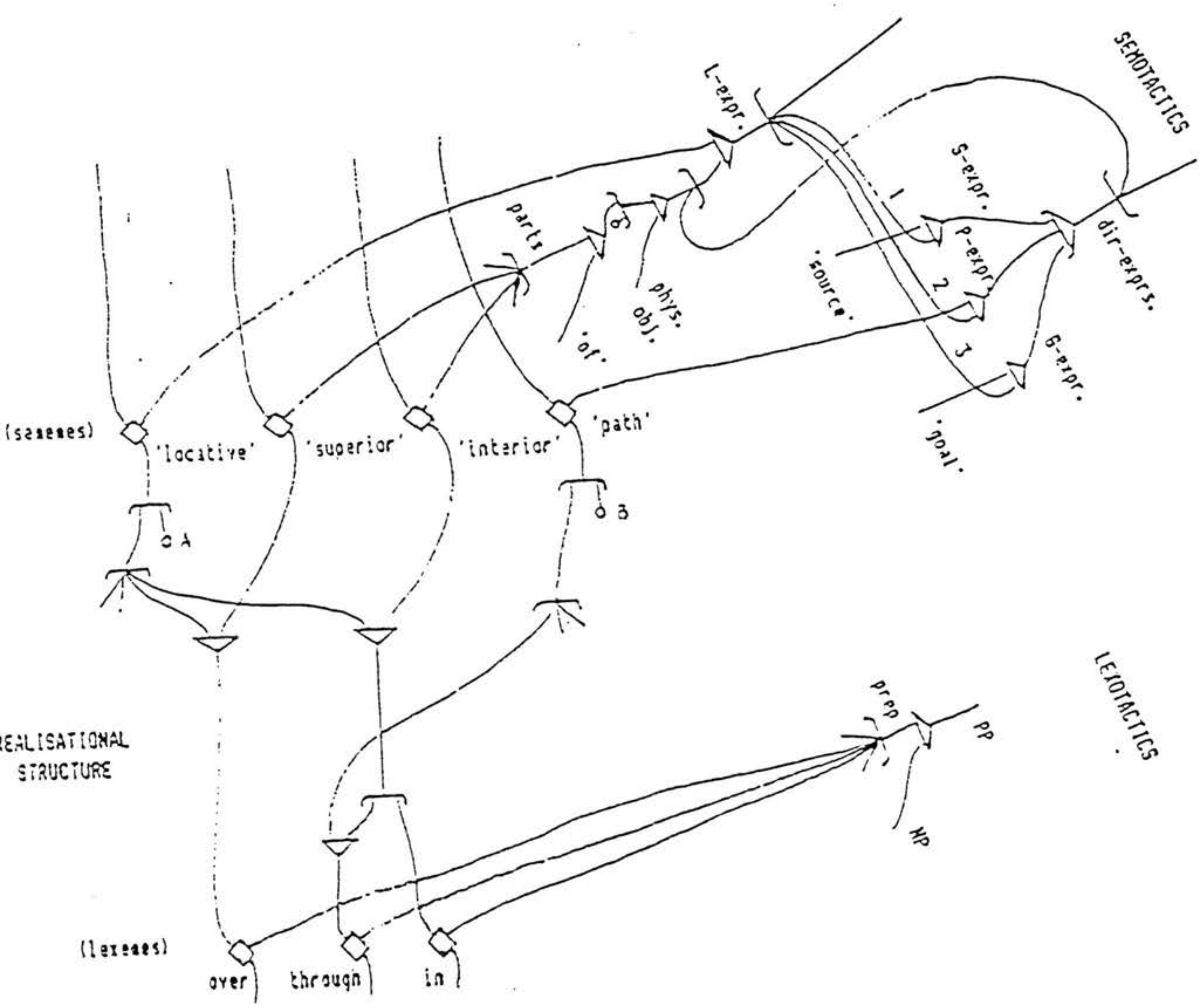
Bennett distils from this type of semantic analysis the componential representation 'locative superior' for *over* and the complementary analysis, 'locative inferior', for *under.*

The question that one can raise instantly is the one of what these components actually mean. Now, Bennett (1975, p.4) explicitly states that his interest is on intra-linguistic semantic relationships, rather than on the relationship between semantic items and the world. This is what we can view as one of the main problems with most classical treatments of spatial prepositions; there is almost exclusive focus on the relationship between words and other words, rather than on the relationship between language and the world. What Bennett gains mapping out shared components of meaning, he loses with respects to clarifying exactly what an individual component means. As a result, the types of meanings given are even less detailed that those considered in the previous section by Cooper (1968), Leech (1969) and Miller and Johnson-Laird (1976).

In light of the fact that Bennett uses the simplest of simple relations definitions for the components for spatial prepositions, one has little difficulty coming up with counterexamples. For example, the definition of *in* as 'locative interior' raises all the counterexamples already cited above (figure 3.1).

What Bennett's account does offer is a clear description of the aspects of meaning of one preposition that are shared by another. Figure 3.6 represents a fragment of a network grammar which illustrates how components of meaning are shared across prepositions. Three separate levels of structure are represented : the 'semotactics', which is a syntax of 'sememes' and specifies possible combinations of elements such as 'path' and 'interior' ; the 'lexotactics', which is a syntax of 'lexemes' (or lexical items) and is equivalent to a surface structure syntax ; and the 'realisation structure' between the semotactics and the lexotactics, which specifies how particular combinations of sememes are realised as lexemes (the terminology here is not of relevance; the interested reader should consult the original source).

Figure 3.6 Fragment of a Network Grammar of English (Bennett, 1975)




At this point we will leave Bennett's (1975) analysis and return to general objections that can be lodged against accounts within the classical framework. However, we will reconsider this analysis in the next chapter in light of the revised version of Bennett's analysis (Bennett, 1990) which was modified to gel with prototype accounts.

## 3.4 Objections to the Classical View

### 3.4.1 Objections to the Classical View; Case Accountability

We have arrived at what we consider to be the main objections to the simple relations definitions equated with what Lakoff (1987) has called the 'classical view of categories'; such definitions yield wrong or insufficient predictions about the set of situations described by a locative expression. Herskovits (1986, pp. 12 - 17) lists the phenomena that the model fails to explain;

(1) Contrast between converses, and unacceptability of some converses.

Meanings of the simplest type described do not differentiate between *the house in front of the church,* and *the church in front of the house,* though the two expressions are clearly not interchangeable. Nor do they explain why one cannot say **the jar in the lid,* but must say instead *the jar with a lid on it.*

(2) Geometric descriptions

At best, the geometric relations apply in fact not to the objects themselves, but to various geometric figures (points, surfaces, or volumes) associated with the objects. For instance, in *the bird in the tree,* the bird is not *in* the interior of the reference object, as in *the bird in the oven,* but in the interior of the outline of the part of the tree made of the branches. This point raised by Herskovits (1986) brings up the issue of whether semantic analysis applies to the objective world directly, or to perceptions/conceptions of the objective world. Moreover, we will discuss in chapter five whether one wishes to characterise the meaning of spatial prepositions in terms of geometric relations at all.

(3) Divergence from the simple relations

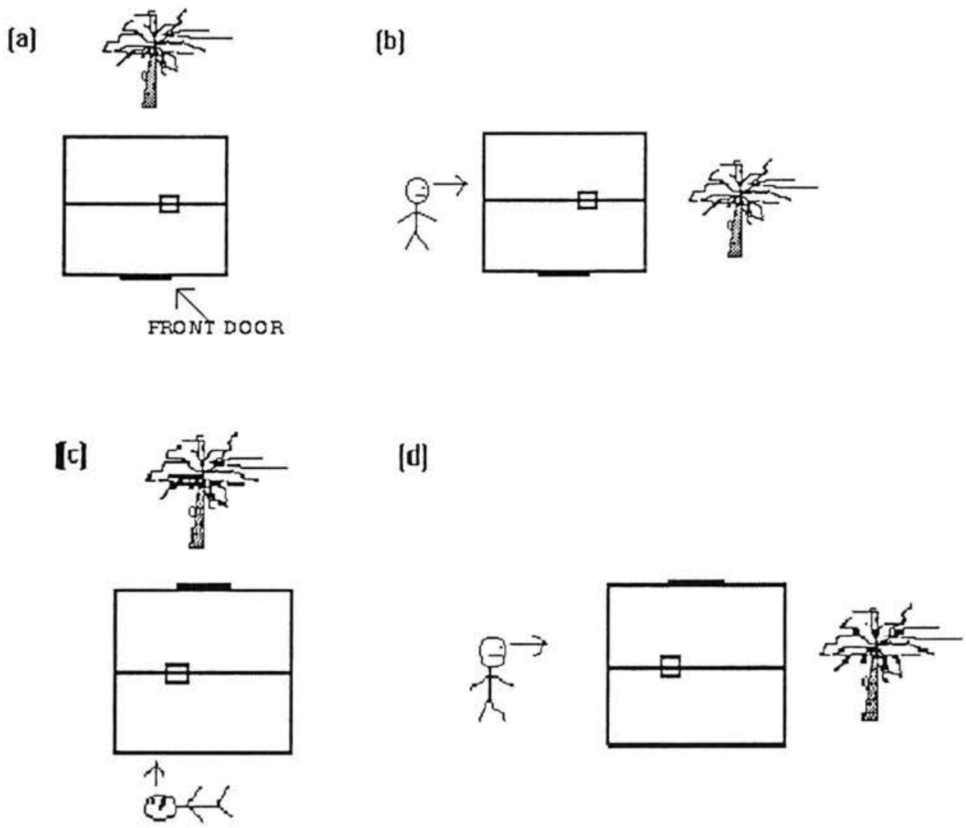
The simple geometric relations do not even hold for the geometric descriptions. We have already considered two cases of this; in figure 3.1(b) where the pear can still be said to be *in* the bowl although it in not in the interior of the bowl, and in figure 3.2(a) where the one can say that the dictionary is *on* the table although the dictionary is not contiguous with the table.

(4) Unexpected context dependencies

The best examples of these involve deictic, intrinsic and extrinsic use. Simple relation meanings do not take account of such context dependency (Fillmore, 1971; Clark, 1973). An example of this is the use of *behind,* for example, where the position of the figure in relation to the ground is dependent on the view of the observer, and the canonical axes of the ground. 'The tree' in *the tree is behind the house,* therefore, can be located in either of the positions below (figure 3.7) depending on the existence and position of the observer.

We have provided a discussion of these different systems of reference in chapter two, particularly with reference to the work of Levelt (1984).

Figure 3.7 The tree is behind the house.




(5) Unexplained restrictions

Herskovits (1986) cites many cases where the simple meanings indicate that an expression should be acceptable when it is not. For example, one can say;

Joe is in the field

but not;

*Joe is in the football field.

Again, we can refer back to figure 3.1(a) where we cannot say that *the pear is in the bowl* although the criteria for a simple notion of containment appear to be met. Instead we would say;

The pear is under the bowl.

Figure 3.1(c) provides another by now familiar example. One can say;

The bulb is in the socket.

but not;

The bulb is under the socket.

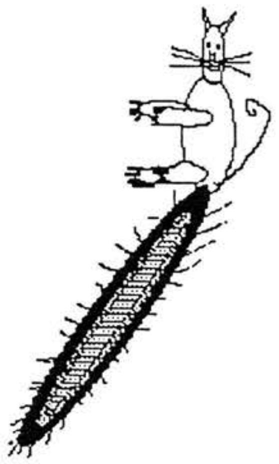
The simple relations model cannot explain why *under* is appropriate in one case and not in another ( and vice versa for *in*).

(6) Additional constraints

Constraints beyond those implied by the simple relations meanings must be met for a locative expression to be used appropriately. For example, the use of *above* presupposes the existence of a vertical direction, and of gravity, etc. Searle (1979) gives an example of such 'background conditions' with the expression 'the cat is on the mat'. Searle (1979) argues that the expression only has meaning relative to the background condition that that there is a gravitational field. As an example of this, Searle presents the following scenario (with the cat and mat as depicted in figure 3.8 below);

> " suppose the cat's owner is in the next room, while I unbeknownst to him have drugged his cat and stiffened his mat with my special stiffening solution. "Where is the cat?" asks the owner from his position next door. "The cat is on the mat", I answer. Have I told the truth?" (Searle, 1979, p.124).

Figure 3.8



Searle answers his own thought experiment with the argument that the answer is misleading at best and probably should be described as an ingenious lie. However, if one considers the situation where the mat is in its stiffened position and is part of a row of objects similarly sticking up at odd angles, and both speaker and hearer know these facts, then if the cat is jumping from one object to another, and the question, "Where is the cat?" is asked, the answer, "The cat is on the mat" is appropriate.

Searle takes this as an argument that the notion of the literal meaning of a sentence only has application relative to a set of background conditions. The truth conditions of the sentence 'the cat is on the mat' will vary with variations in these background assumptions; and given the absence or presence of some background assumptions the sentence does not have determinate truth conditions.

This type of argument can be pitched in another way; in terms of the effect of context on truth conditionality. These effects are well documented in psycholinguistics with many studies which manipulate context and monitor the effect this has on the understanding of a target sentence. For example, we can consider the sentence (taken from Bransford and Johnson, 1973);

The haystack compensated for the fact that the cloth tore

This does not have a determinate meaning unless we furnish it with a context. For example;

The parachutist fell towards the field.

leads to an interpretation of the above sentence. As there are innumerable different contexts possible, then to talk about truth conditionality outwith context does not make much sense.

Aside from this last objection, it will be demonstrated that the criticisms made by Herskovits (1986) apply to only the simplest 'classical' attempts to come up with meanings for prepositions. Indeed, we will argue that there are possible solutions to most of these objections which still retain the features of simple relations accounts. In particular, our objections to Herskovits's objections reside in the Herskovitsian search for geometric relations in the world. This information, in many cases, can be viewed as redundant. This view will be explicated fully in chapter five. We will turn now to some other criticisms of this type of approach which are lodged at a more fundamental level.

### 3.4.2 Objections to the Classical View; The Assault from Cognitive Linguistics

One can address the deeper issue of why the classical account fails to deal adequately with the encoding and decoding problems. This assumes that there are good reasons for rejecting the classical account regardless of its success. The area which has been come to be known as 'cognitive linguistics' (formerly 'space grammar') has provided what can be viewed as a deep-rooted alternative to the classical view of categories. George Lakoff, a proponent of the cognitive linguistic approach, has been one of the most outspoken critics of the classical view of categories. In Women, Fire and Dangerous Things (1987) he launches a vehement attack on what he calls 'objectivist semantics'.

Lakoff begins his case with the charge that the classical view of categories is a philosophical one which was arrived at on the basis of a priori speculation, and therefore does not take into account the results of empirical study. Many empirical studies demonstrate that concepts/categories are graded. That is, many categories do not have fixed boundaries. Furthermore, some exemplars of a concept are more typical than others. For example, the word *dog* comes to mind more easily as an example of the category *pet* than the word *stick insect* although both words can be members of the category *pet.*[1] This theoretical position can be branded as prototype theory, which we will consider in detail in the next chapter. For now, let us consider how such effects affect the classical approach.

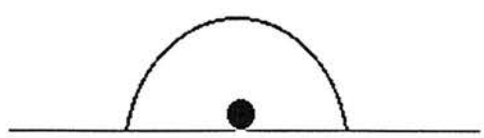
[1] That is, *dog* and *stick insect* are words which refer to animals which can be members of the category denoted by the word *pet*.

Prototype effects do not preclude the existence of minimally specified lexical entries. The effects themselves can be viewed as the result of sense generation (Braisby, 1990), sense creation (Clark, 1983; developed in Clark and Gerrig, 1983), or in terms of the manipulation of idealised cognitive models (Lakoff, 1987). Thus it is not necessary to adopt lexical representations which employ prototypical structure. However, one must give an account as to why such effects exist.

An argument along similar lines in favour of the classical view is that one cannot deny that there is something simple and basic to the meaning of the word *in,* for example. Here when asked the question of what *in* means, the respondent will frequently insinuate that there is something basic and simple to the meaning of *in.* Prototype accounts need to take this into consideration. However, this again is an effect of processing; one can say nothing about lexical representation based on this information alone. We will develop these issues in the next chapter.

More problematic for the classical view is the point that membership of a category is not all-or-none. This poses problems for simple relations accounts which rely on truth conditions attached to the simple definitions given. This inflexibility demands a complex set of pragmatic principles (Herskovits, 1986) allied to the simple definitions. For example, with the picture in figure 3.9 (below) one cannot say that the *ball is in the bowl,* but rather *the ball is under the bowl.* The classical approach accounts for this by asserting that *the ball is in the bowl* is true, but that the statement is misleading from the point of view of pragmatics. If this was the case, then it can be argued that both *in* and *under* should be possible candidates for the spatial relations depicted, and that *under* is only the preference[1] . This is not the case. *The ball is in the bowl* is viewed as false by most language users.

Figure 3.9



Again, the defender of the classical view may argue that the example just given reflects a problem with the semantics and that the problem has nothing to do with

[1] A related problem is that of situations where there are perhaps a limited number of prepositions which have limited application (i.e., do not fit the situation directly), and where the least inappropriate preposition may be the choice.

pragmatics. Therefore, one can look for a definition of *in* which would be false in the case of figure 3.9, but not in the case of *the light-bulb is in the socket.* This lays down the gauntlet for the classicist.

One can come up with an attempt to deal with these cases (based on a development of the Miller and Johnson-Laird definition of *in*) as follows;

> IN(X, Y): A referent is "in" a relatum if:
> (i) [PART (X, Z) & INCL (Z, Y)]
> and Y is in its canonical orientation.

This at first glance can account for the fact that the use of *in* is inappropriate in figure 3.9, but appropriate in the case of *the light-bulb is in the socket.* The bowl in figure 3.9 is not in its canonical orientation, and thus the *in* relation is not appropriate. However, if we consider figure 3.10 (below) this revision to the Miller and Johnson-Laird definition seems less attractive. Here the socket is not in its canonical orientation, but *in* is still appropriate. Clearly, then, the addition of a condition to do with canonical orientation is not a solution.

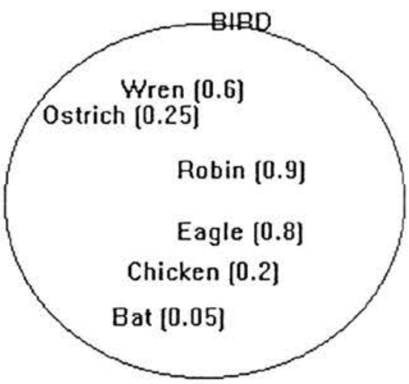
Searle (1979) may argue that the definition of an expression involving *in,* for example, does not have a determinate set of truth conditions unless background conditions are specified, one of which would involve canonical orientation relating to how the referent is 'normally' situated in a gravitational field. This does not solve the problem, as one therefore has to work out a more complex set of background conditions.

Of course, another solution is to simply list exceptions to a definition in the lexicon. However, as was intimated in chapter one, the list may become rather long, and this again contradicts the assumption that has been made by Bennett (1975), for example, suggesting that there is something basic to the meaning of *in.*

Figure 3.10

Zadeh's (1965) fuzzy set theory offers an attempt to adapt the classical account in order to cope with prototype effects; the idea that a category is graded. Fuzzy set theory involves grading of members of a category by ascribing members different degrees of membership. In a classical category, membership is all-or-none, with members rated with membership value 1 and non-members rated membership 0. Zadeh (1965) adds additional values between 1 and 0 therefore accounting for the fact that some men are neither tall or small, for example. It is relatively easy to see how this approach may work for nouns. If we take the category *bird,* one can simply assign more representative members of the category higher truth values. We may envisage a set as follows (representing the category *bird*);

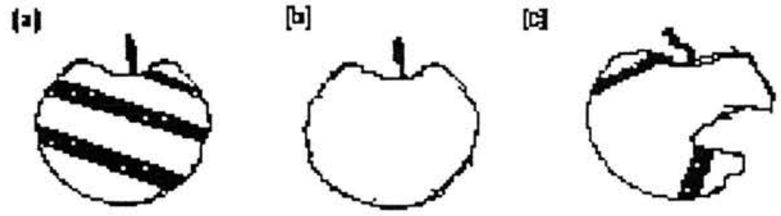
Figure 3.11




Indeed some authors (notably Osherson and Smith, 1981) have taken such representations involving fuzzy set theory as a valid method of modeling prototype effects. However, as we shall see, Lakoff (1987) maintains that fuzzy set theory is in fact not at all consistent with a valid interpretation of prototype theory.

There are numerous problems with this type of approach. Firstly, it is counterintuitive to argue that *robin* is more a bird than say an *ostrich.* Both are clear members of the category *bird,* and thus it appears incorrect to assign different degrees of truth to each. Secondly (although less crucial for our purposes), fuzzy set theory does not provide an adequate account of concept combination. Osherson and Smith (1981) provide the following case where fuzzy set theory clearly makes a wrong prediction. Consider apples (a), (b) and (c) in figure 3.12 below.

Figure 3.12




Picture (a) is a good example of a striped apple, but is not a good example of an apple since apples are not normally striped. It is also not a good example of a striped thing since apples are not among things which are generally striped. From this it follows that the apple in drawing (a) will have a high value in the category *striped apple,* a low value in the category *apple* and a low value in the category *striped.* However, fuzzy set theory does not come to this conclusion. The intersection of two categories in fuzzy set theory is given as the minimum value of the constituent concepts. Since the minimum of two low values is a low value, it follows from fuzzy set theory that drawing (a) should have a low value in the category striped apple. As this is not the case, fuzzy set theory is clearly flawed.

Again such an approach fails to deal adequately with vagueness; the idea that membership of a category is not an all-or-none thing. There may be some clear positive cases, some clear negative cases, but there are many unclear cases in between. Thus there are no sharp lines between the positive and negative cases, and between the clear and unclear cases. Fuzzy set theory, like standard set theory (and standard first-order logic) abstracts away from the problem of vagueness and is applicable only to those predicates that can be regarded as definitely true or definitely false of any given object.

Now we will leave objections to the classical approach aside for a minute, and focus on a great virtue of classical accounts in the form of semantic field theory.

### 3.5 Semantic Fields

Thus far in this chapter we have largely considered attempts to define what a word means in terms of necessary and sufficient conditions. We must not neglect here another factor which can be considered a feature of the classical view; the way that words relate to one another. Here the intuition is that some words are more closely related in meaning than others. This intuition has been developed theoretically such that words are organised into "semantic fields." As Miller and Johnson-Laird (1976, p.237), proponents of this view, comment;

> "This approach at least gives the phenomenon a name. It enables us to rephrase our question; how are words related in semantic fields?"

The origins of the concept can be traced back to Ipsen (1924) who coined the term "Bedeutungsfeld" (semantic field) to mean a group of words that form some kind of semantic unity. Trier (1934) offers a more systematic realisation of this idea with the notion that every word's meaning depends on other words in the language, and that different languages divide up reality among their words in a different way. Thus the meaning of each word depends on its position in a conceptual field relative to other words in that field.

The idea of a semantic field has not been adequately formalised. For more detail see Lyons (1977, vol. 1, chapter 8). Miller and Johnson-Laird (1976) attempt to use these ideas within the domain of spatial language, but do little more that put spatial terms partly within a semantic network-type framework. As we have seen, Bennett (1975) also makes a stab at this notion with the recognition that words can have shared features, and that words are somehow competing for use.

We will have little more to say about semantic fields again until chapter six. For the moment we wish simply to recognise that words may be competing for use during the processing of language, and that words can maybe be defined in terms of other words.

### 3.6 Summary

We have discussed both merits and problems with classical accounts. In the next chapter we assess alternative accounts within the framework of cognitive linguistics; accounts which claim to differ dramatically from the accounts thus far considered (Lakoff, 1987). We shall see that these accounts are not in fact radically different from the accounts considered in this chapter.

At the end of chapter four we will compare classical and cognitive linguistic approaches in some detail. At that time we will provide a recap of the positive and negative points of the types of account we have considered in this chapter.

## Chapter 4

### 4.1 Introduction

Prepositions and their meaning have been studied most extensively within the subject matter of 'cognitive linguistics'. In this chapter we examine approaches to the meaning of prepositions which fall within this framework. In order to evaluate these approaches, we must focus on the assumptions made by cognitive linguists, and therefore we will begin the chapter with an overview of cognitive linguistics, carefully isolating the assumptions that these approaches make. One of these assumptions will then be singled out for scrutiny - the nature of prototype effects - which serves as a structuring tool for the analyses of *in, on* and *at* (Herskovits, 1986) and *over* (Brugman, 1983, 1988; Lakoff, 1987; Brugman and Lakoff, 1988) to be considered. We then focus more specifically on the work of Herskovits (1986), Brugman (1981, 1988), Lakoff (1987) and Brugman and Lakoff (1988). Herskovits's (1986) analysis of *in, on,* and *at* is considered first as it provides a half-way-house between classical and prototypical approaches. Brugman's (1981) analysis of *over,* developed in Lakoff (1987) and subsequently developed in Brugman (1988) and Brugman and Lakoff (1988) is then examined as a direct application of prototype theory. The chapter concludes with a discussion of cognitive linguistic approaches versus classical approaches, with a critical assessment of the theoretical constructs which we wish to preserve for the rest of the thesis.

### 4.2 Overview of Cognitive Linguistic Approaches

The approach of cognitive linguistics, it is claimed (e.g., Lakoff, 1987; Langacker, 1988), differs markedly from that of the classical view of categories, which was discussed in the last chapter. While the proponents of this refocussing have emphasised different linguistic problems, they concur in rejecting two major tenets of Chomskyan linguistics: the separateness and specialness of language (Chomsky's hypothesised "innate mental organ") and the modularity of different types of linguistic information (syntax, semantics, morphology, phonology, etc.). In this framework the proponents argue that the form or the meaning of expressions cannot be adequately described without reference to speakers' encyclopedic knowledge, their construction of mental models, their ability to map concepts from concrete to abstract domains, and their use of superpositional representations and constraint-satisfaction schemes to integrate multiple sources of information.

Specifically the clear division between semantics and pragmatics has been eradicated in cognitive linguistics, together with the division between linguistic and psychological accounts of language. This second unification goes hand-in-hand with the use of prototype theory as a structuring tool for lexical representation, with the emphasis on the recognition of extensive polysemy.

As we have seen in the previous chapter, Lakoff (1987) rejects what he calls 'objectivism', which is equated with the classical view of categories. Instead Lakoff advocates 'experientialism', which can be equated with the cognitive linguistic view, as an alternative philosophical standpoint consisting of the following major points:

> Thought is embodied, that is, the structures used to put together our conceptual systems grow out of bodily experience and make sense in terms of it; moreover, the core of our conceptual systems is directly grounded in perception, body movement, and experience of a physical and social character. (p.xiv)
>
> Thought is imaginative, in that those concepts which are not directly grounded in experience employ metaphor, metonymy and mental imagery - all of which go beyond the literal mirroring, or representation, of external reality. It is this imaginative capacity that allows for "abstract" thought and takes the mind beyond what we can see and feel. The imaginative capacity is also embodied - indirectly - since the metaphors, metonymies, and images are based on experience, often bodily experience. Thought is also imaginative in a less obvious way: every time we categorize something in a way that does not mirror nature, we are using general human imaginative capacities.(p.xiv)
>
> Human reason is not an instantiation of transcendental reason; it grows out of the nature of the organism and all that contributes to its individual and collective experience: its genetic inheritance, the nature of the environment it lives in, the way it functions in that environment, the nature of social functioning, and the like. (p.xv)

The present purpose is not to provide a discussion of the merits of objectivism or experientialism as philosophical positions, but instead is to clearly spell out the ramifications of this approach for a treatment of spatial prepositions. Indeed Lakoff (1987. p.460), in summarising the similarities in the approaches of Lindner (1981, 1982), Janda (1984), Brugman (1981), Vandeloise (1984), Hawkins (1984) and Lakoff (1987), does this for us;

(i) The expressions studied (*up, over, za-,* etc.) are all polysemous; they cannot be represented by a single core meaning that accounts for all and only the various senses.

(ii) Image schemas and metaphorical models are required to represent the meanings of the expressions.

(iii) The senses of each expression form a radially structured category, with a central member and links defined by image-schema transformations and metaphors.

(iv) The noncentral senses cannot be predicted from the central senses, but are nonetheless not arbitrary. Rather, they are motivated by less central cases, image-schema transformations, and metaphorical models.

Thus we clearly see that cognitive linguistic accounts favour full specification for the lexical entry of a word, in contrast to classical accounts which recognise as few senses as possible. Indeed, as a reaction against the 'core sense' approach, Lakoff proposes that observations about prototypical uses of lexical items can be united with other data on natural categorisation by viewing lexical items as constituting natural categories of senses. This means that some senses of a word may be more representative than other senses.

We can distil from the above discussion that there are the following corner-stones of the cognitive linguistic approach. Firstly, the approach relies on prototype effects to illustrate the graded nature of concepts, and thus focuses on processing effects (which is reflected in the assumption that the division between semantics and pragmatics is arbitrary). Following from this, cognitive linguistic approaches to the semantics of spatial prepositions focus on extensive polysemy, viewing the representation of the meaning of a word as a 'natural category of senses' rather than a more limited single (or more) core meaning with exceptions listed in the lexicon.

Secondly, the approach claims (implicitly) that one can best understand a concept with reference to how that concept has developed. This claim is less clear with respect to the specific approaches we will consider shortly. However, the evidence for this view is lodged by Lakoff (1987), who argues that prototype effects relate directly to 'experientialism'. For example, Brown (1965) argues that 'basic-level' concepts have a special cognitive status. The claim is that categorisation for the child begins at the level of "distinctive action", the level of flowers and cats and dimes, and then proceeds upward to superordinate categories (like *plant* and *animal*) and downward to subordinate categories (like *atom*). An extrapolation of the claim is that one should study language acquisition in order to get a handle on word meaning, and how these meanings are represented. Indeed, we will consider the acquisition of spatial prepositions in chapter seven to see what can be gleaned in relation to what information about spatial language is primary, and how one can delineate senses. However, Lakoff (1987) and the other cognitive linguistic approaches to spatial prepositions do not adequately consider this type of evidence, which is surprising given this claim.

As we have seen, the application of prototype theory to linguistic phenomena is a general trend in the area of cognitive linguistics. Now we will focus more clearly on prototype effects, and where they come from.

### 4.3 Prototype Effects Considered

#### 4.3.1 The Nature of Prototypicality

Prototype theory is best seen as a set of approaches rather than one approach. However, the motivation for prototype effects comes from a common source. Here we begin by examining the original work on prototypicality.

Wittgenstein can be credited with the observation that categories do not fit the picture of the classical category. In the Philosophical Investigations, Wittgenstein remarks that there are no common properties shared by all members of the category *game*. Some involve competition, some involve group participation, some involve luck, some involve skill, but they all do not share all of these properties. The result of "look[ing] and see[ing] if there is something common to all" is "a complicated network of similarities overlapping and criss-crossing: sometimes overall similarities, some times similarities of detail" (Wittgenstein, 1953, remark 66). Wittgenstein coined the term "family resemblances" for the various resemblances between members of a family, such as game, which resemble each other in various ways, but do not share common properties with all the other members.

It was Eleanor Rosch who took the notion of family resemblance and allied it to what she termed 'prototype theory'. The theory of Rosch is based on a multitude of empirical studies, the majority of which she conducted in the '70s. In a series of experiments she demonstrated that the central tendency of categories exhibited what we might think of as enhanced cognition. So for example, subjects' judgement of whether or not various instances of *bird* fall under the concept *bird* are made reliably and significantly faster in the cases of typical birds as opposed to atypical birds. Robins, being fairly typical birds, are judged to be birds faster than, say, an ostrich.

Indeed, on the basis of these reaction time studies, one can deduce an ordering among exemplars, from those eliciting the shortest response time to those eliciting the longest. Rosch also gleaned the same goodness-of-fit examples from subjects across a variety of other experimental paradigms (listed in figure 4.2 below). For example, Rosch (1973) asked subjects to rate instances drawn from different categories, using a scale from 1 to 7 to indicate how well each instance corresponded to their idea as a typical class member. none of her subjects found the request at all unusual and tended to agree among themselves on the distribution of ratings (shown in Figure 4.1 below).

Figure 4.1 Ratings for different class instances (from Rosch, 1973)

| Category | Instance | Rank |
|---|---|---|
| (Bird) | Robin | 1.1 |
| | Eagle | 1.2 |
| | Wren | 1.4 |
| | Chicken | 3.8 |
| | Ostrich | 3.3 |
| | Bat | 5.8 |

The results of reaction time experiments and ratings of class instances exhibit, unsurprisingly, remarkable correlations. Indeed the findings across the variety of experimental paradigms have been replicated many times, and therefore the effects can be viewed as robust.

The view that emerges from Rosch's work is that various aspects of our cognizance of atypical exemplars is dependent on our cognizance of typical ones. More properly, though, it depends on the similarity between the entity and the central tendency of the category, what has become known as the prototype. So, prototypes, themselves, are not necessarily descriptions of any particular exemplar, but they are descriptions embodying the most typical attributes and values associated with that category. Rosch's work has assumed a central role in the psychology of concepts but it seems likely that in a very important sense, it has been misunderstood. The misunderstanding revolves round the question of what the findings actually mean.

Rosch in the early to mid 1970s made the claim that prototype effects may provide a characterisation of the internal structure of the category. This lead Rosch (1975) to claim that the effects do in fact characterise the structure of the category as

Figure 4.2 <u>Examples of Experimental Paradigms Used by Rosch (adapted from Lakoff, 1987, p. 41 - 42)</u>

(1) **Direct rating:** Subjects are asked to rate, say on a scale from one to seven, how good an example of a category (e.g., BIRD) various members are (e.g., a robin, a chicken, etc.)

(2) **Reaction time:** Subjects are asked to press a button to indicate true or false in response to a statement of the form "An [example] is a [category name]" (e.g., "A chicken is a bird"). Response times are shorter for representative examples.

(3) **Production of examples:** When asked to list or draw examples of category members, subjects were more likely to list or draw more representative examples.

(4) **Asymmetry in similarity ratings:** Less representative examples are often considered to be more similar to more representative examples than the converse. Not surprisingly, Americans consider the United States to be a highly representative example of a country. In experiments where subjects were asked to give a similarity rating for pairs of countries, the following asymmetry arose. Subjects considered Mexico to be more similar to the United States than the United States is to Mexico.

(5) **Asymmetry in generalisations:** New information about a representative category member is more likely to be generalised to nonrepresentative members than the reverse. For example, it was shown that subjects believed that a disease was more likely to be spread from robins to ducks on an island than from ducks to robins.

(6) **Family resemblances:** Rosch showed that what philosophers took as a matter for a priori speculation could be demonstrated empirically. Characterising "family resemblances" as perceived similarities between representative and nonrepresentative members of categories, Rosch showed that there was a correlation between family resemblances and numerical ratings of best examples derived from the above experiments.

represented in the mind, and that the prototypes constitute mental representations. Indeed, this is the view that the majority of cognitive linguists working with prototype theory take for granted, and this brand of prototype theory has also been attacked most vigorously.

Lakoff (1987) distinguishes between the prototype effects which Rosch's experiments demonstrate, and the claims of representation made on their basis. He distinguishes two interpretations of prototype effects (Lakoff, 1987, p. 43);

(1) The Effects = Structure interpretation: Goodness-of-example ratings are a direct reflection of category membership.

(2) The Prototype = Representation Interpretation: Categories are represented in the mind in terms of prototypes (that is, best examples). Degrees of category membership for other entities are determined by their degree of similarity to the prototype.

Lakoff recognises that most versions of prototype theory assume one or other, or sometimes both, interpretations of prototype theory. For example, two versions of prototype theory which clearly fall under this category are the "Knowledge Representation Model" of Cohen and Murphy (1984) and the "Selective Modification Model approach of Smith et al. (1988). More importantly, however, Lakoff acknowledges that both interpretations are not entailed by the existence of prototype effects (thus discrediting most versions of prototype theory).

Both points are valid. Prototype effects cannot be directly revealing of mental representations as interpretation two would have us believe. Similarly, the issues of goodness-of-example ratings and membership are logically distinct. The work of Armstrong, Gleitman and Gleitman (1983), for instance, demonstrates that subjects will readily order instances according to their perceived typicality, regardless of the facts of their category membership. In particular, one of Armstrong, Gleitman and Gleitman's tasks involving asking subjects for typicality judgements for odd numbers. So, they would be asked to rate various odd numbers for their typicality of the category of odd numbers. The fact that subjects do this, while knowing full well that the category has sharp boundaries, that there are clear conditions of membership and that membership itself is either all or none, indicates the fallacy in assuming that goodness-of-example ratings directly reflect graded membership.

We can cite other empirical evidence of a different nature, which suggests that prototypicality is not necessarily fixed for a word/concept, but is affected by context. For example, Roth and Shoben (1983) base a study on a finding of Garrod and

Sanford (1977) that the speed of anaphoric resolution depends on the semantic relatedness of anaphora and antecedent, as if membership involved category membership verification (when the antecedent is more general than the anaphora). Roth and Shoben examined whether reading times were affected by a single goodness-of-exemplar structure in differing contexts, or whether context could affect speed of resolution by changing goodness-of-exemplar structure. They found that the resolution for typical exemplars (typical for the category in isolation) was slower when the context was biased to make that exemplar a bad fit than when the context was neutral. Thus we can extrapolate from this that *robin* is a poor example of the category *bird* in the context *the bird walked across the barn-yard.*

A second study by Barsalou and Sewell (1984, reported in Barsalou, 1985) found that goodness-of-exemplar structure can change dramatically when people take different perspectives on a concept. Subjects rated exemplars (e.g., *robin, ostrich, swan*) for typicality as *birds,* but assigned them different degrees of centrality according to the cultural perspective ('American', 'African', or 'Chinese') they had been asked to assume. These results were found for both taxonomic and goal-derived categories. Thus one can flexibly generate different concepts in different contexts.

Again, if we assume incorrectly that prototypes are directly mentally represented, then a third type of problem that arises is that of concept combination. We cited in the last chapter the evidence from Osherson and Smith (1981) that prototypes cannot be adequately conceptually combined. In other words, to compose a complex concept exemplars from the constituent prototypes would have to be combined (Lyon and Chater, 1990). For example, a representation of the complex concept *pet fish* would be composed by the combination of a prototypical exemplar for *pet* and a prototypical exemplar for *fish.* However, if one does this, it is unlikely that the combination of *dog* and *cod* will produce the intended meaning of *pet fish.* A *guppy* is a good example of a *pet fish,* but it isn't prototypical of either *pets* or *fish.* Thus it is necessary for the exemplar view to stipulate that supposedly complex concepts are represented independently. This is highly unlikely for two reasons, Firstly, one still has to understand novel concept combination. This view doesn't give an account of how this is possible. Secondly, this view seems improbable on grounds of cognitive economy.

Relevant evidence from yet another angle comes from Sternberg (1966; cited in Flanagan, 1991). Sternberg sets out to address the question of how recently encoded memories are retrieved. His experimental procedure involved having subjects memorise lists containing some subset of the numbers 1 to 10. On each trial the subject saw a randomly generated list, for example, 4, 7, 2, 8. The list was visually displayed for just over one second. After a two-second delay a test digit appeared (e.g., 2). The subject was to pull lever A if the test digit was on the memorised list, or lever B if it was not. Sternberg's data consisted of measurements of the time it took from presentation of the test digit to the pulling of the appropriate lever. The important point here is that subjects intuitions (reported in Flanagan, 1991, p.188) of what they do differs from what they actually do. Sternberg found evidence in the way of reaction times for exhaustive and serial scanning in memory, but subjects predicted against this exhaustive serial search model. One therefore cannot place much reliability on introspective reporting.

There is, then, a considerable body of evidence to suggest that prototypes are not directly mentally represented (at least, in isolation), and that goodness-of-example ratings are not a direct reflection of category membership. The real irony with Lakoff's (1987) objections to fallacious interpretations of Rosch's work is that Lakoff himself (as we shall see later in this chapter) falls into the trap of using prototype effects directly as structuring tools in the lexicon with his analysis of 'over' (Lakoff, 1987, pp.416 - 461). This is a serious error.

Although it can be taken as read that prototypes are not direct reflections of lexical representations, the issue remains as to where prototype effects come from, and how far they extend. Looking ahead to the experimental work to be considered in chapter six, it is desirable to know a priori where prototype effects come from, if we are adequately to develop paradigms which get beneath superficial processing effects. In other words, in order to distinguish between occurrences and senses of a word, we must find a reliable way in which to do so. Linguistic intuitions on the part of researchers or subjects alike reflect similar sorts of data to that apparent with prototype effects. Thus we need to know when a distinction between two senses of a word is made by a subject or researcher whether this distinction is based on a superficial prototype-type (processing) effect which is itself dependent on the task required of a subject, or whether the distinction does actually reflect a difference in the mental lexicon. We will therefore spend some time examining possible causes of prototype effects, and how widely such effects are spread.

### 4.3.2 Where Do Prototype Effects Come From and How Far Do They Extend?

Geeraerts (1988) proposes several explanations as to why prototypicality exists. He terms the four hypotheses the *physiological,* the *referential,* the *statistical,* and the *psychological.* Let us briefly consider these hypotheses, and then we will add our own explanation.

The *physiological* hypothesis says that prototypicality is a result of the physiological structure of the perceptual apparatus (Rosch, 1973). This hypothesis falls out of the work on colour terms. There is evidence that prototypical colour terms have a one-to-one mapping with the structure of the colour visual system, which is maximally responsive to red, green and blue. Geeraerts points out that the scope of this explanation may only be applicable to concepts immediately referring to perceptual phenomena, or at least to bodily experiences which have a distinct physiological basis.

The *referential* hypothesis states that prototypicality results from the fact that some instances of a category share more attributes with other instances of the category than certain peripheral members of the category (or share attributes with more other instances than these peripheral cases). This is the family resemblance model of prototypicality (Rosch & Mervis, 1975); in psychological terms, it states that the prototypical instances of a category maximise cue validity. By this view, prototypicality is a secondary phenomenon: it is a side-effect of the mutual attribute relations among the instances in the referential range of application of the concept.

*Statistical* explanations of prototypicality state that the most frequently experienced member of the category is the prototype. This can be combined with the family resemblance model; the weight of an attribute within a concept is then not only determined by its role within the family of applications constituting the category, but also by the relative frequency with which it is experienced (Rosch, 1975).

The *psychological* hypothesis is a functional one. It states that it is cognitively advantageous to maximise the conceptual richness of each category through the incorporation of closely related nuances into a single concept because this makes the conceptual system more economic. Because of the maximal conceptual density of each category, the most information can be provided with the least cognitive effort (Rosch, 1977).

Lakoff (1987) offers a different interpretation of prototype theory, and one which is broadly consistent with the stance we wish to adopt on this matter. The position maintains that prototype effects can arise as the result of many factors. The basic claim of Lakoff (1987), Murphy and Medin (1985) and others is that prototype effects result from the nature of what Lakoff calls 'cognitive models', which can be viewed as "theories" of some subject matter. Evidence for this position comes from Barsalou's (1983, 1985) study of what he terms "ad hoc categories" - categories that are not conventional or fixed, but rather are made up on the spot for some immediate purpose. Examples of these types of categories are *things to take from one's home during fire, what to get for a birthday present, things to do at a convention,* etc. The observation made by Barsalou is that such categories have prototypical structure. Now, these categories did not exist before they were created (i.e., they are presumably not stored permanently in some sort of mental lexicon), so it follows that prototype effects can arise as a result of the manipulation of theories, or cognitive models.

Murphy and Medin (1985) expound the view that representations of concepts are best thought of as theoretical knowledge that embodies a theory about the world. Lakoff (1987) proposes the same view, only with reference to what he calls idealised cognitive models. Fillmore (1982) earlier provides the argument that lexical concepts are represented in terms of idealised cognitive models. For example, the concept *bachelor* can be defined as an unmarried adult male (as it might be with a simple classical view), in the context of human society in which certain (idealised) expectations about marriage and marriageable age are realised. The existence of poor examples of this concept - for example, homosexual men, Catholic priests - does not mean, Fillmore argued, that the concept itself is ill-defined. Rather the claim is that the idealised cognitive model does not fit the actual world perfectly. An entity may deviate from the concept (i.e., may be atypical) either because it fails to satisfy "unmarried adult male" or because the idealised cognitive model is imperfectly realised.

With these prototype effects under our belt, we can now examine exactly how these effects have been used as structuring tools for the lexical representations of spatial prepositions.

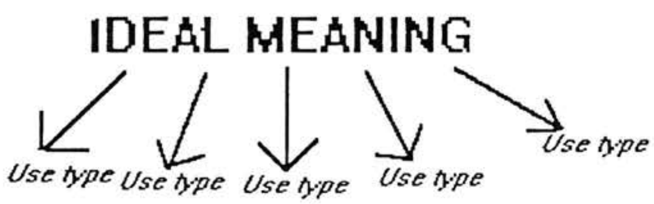
**4.4 Herskovits Considered**

Annette Herskovits, in 'Language and Spatial Cognition', provides an account of *in, on* and *at* which relies heavily on a set of pragmatic principles which she develops. In this respect, one can view her account as being similar to classical accounts, only with a (hitherto undetailed) clear specification of pragmatic principles. However, the lexical representations adopted bear close resemblance to those of prototype accounts, and thus we include Herskovits in the present chapter. Indeed, it will be demonstrated that her account does not differ much from those of Brugman, Lakoff and others, which will be discussed in the following section. However, Herskovits's account does represent a considerable development from these accounts. Nevertheless, some fundamental problems with the account will be brought into focus, together with suggestions for an improved modified version of her treatment. This modified version ends up looking very much like the account presented in the thesis, without the use of functional relations.

### 4.4.1 Herskovits : The Case for Ideal Meanings

The starting point for Herskovits (1985, 1986, 1988) is the type of classical 'simple relations' account which we considered in the last chapter. Herskovits acknowledges the lack of success of previous semantic accounts which assign meaning to prepositions as 'simple relations' (see Herskovits 1986, p. 13-16 for a review; discussed in last chapter). She takes each simple relation to be a geometric ideal (but as something akin to a prototype, not as a truth-conditional meaning), and her theory is based on deviations in various ways from such 'ideal meanings'. Word meaning is defined in an ideal world - in the spatial domain, a world of lines, points, surfaces and of definite relations of inclusion, contact, intersection, and so forth. These meanings are bent and stretched to describe and communicate facts about the complex and imperfect world that surrounds us. Flexibility in the use of the ideal meaning is apparent and adaptability to expressive needs are manifest in several ways. Deviations from the ideal meaning lead to polysemy, which Herskovits terms *sense shifts*. Additionally, the ideal relation, or the sense-shifted ideal relation can be almost true by virtue of what she calls *tolerance* phenomena.

Figure 4.3




Two levels of abstraction are proposed to define lexical meanings (see figure 4.3). These are the ideal meaning (geometric ideal) and use types. The ideal meaning abstraction is not sufficient to build truth conditions, but is a necessary anchor, Herskovits maintains, that organises the overall set of uses of the preposition. The use type abstraction, with several use types being derived from the same meaning, is much richer and provides material that arrives nearer a definition of truth conditions. However, it is possible to break even use type constraints in "out-of-the-ordinary" circumstances.

According to Herskovits, use types are very different from "senses" particularly as a use type is not required to bring a constant contribution to the truth conditions of expressions derived from it. Use types may also be more elaborate than senses, and can be viewed as classes of normal situation types where a normal situation type is a statement of the normal conditions under which speakers use a certain locative expression. The normal interpretation of a use type is different from its geometric meaning in that it includes contextual constraints of a pragmatic nature and also depends for its interpretation on the associated expression (thus including unresolved indexicals). Figure 4.4 lists the use types and ideal meanings proposed by Herskovits for *in, on* and *at.*

A detailed example of the theory in action will help to clarify Herskovits's framework. Herskovits proposes that the ideal meaning of the preposition "in" is :

in: inclusion of a geometric construct in a one-, two-, or three dimensional construct.

All uses of *in* gravitate around this ideal meaning. For example, if we consider the following sentences (Herskovits, 1986, pp. 41 - 42);

(1) The water is in the vase
(2) The crack is in the vase
(3) The crack is in the surface
(4) The bird is in the tree
(5) The chair is in the corner
(6) The nail is in the box
(7) The muscles in his leg
(8) The pear in the bowl
(9) The block in the box
(10) The block in the rectangular area
(11) The gap in the border
(12) The bird in the field

*in* conveys an idea of inclusion or surrounding in all these examples. However, in each case this idea applies to geometric objects in different ways - in some cases, strictly speaking, it may not apply at all. For Herskovits geometric conceptualisation, sense shifts, tolerance, and metonymies, allow one and the same lexical item (the ideal meaning for *in*) to serve in a variety of ways.

The first five examples illustrate what Herskovits terms "the use of geometric imagination". In each case the located object is mapped onto the same geometric description: the *place* of the object. In each case the mapping is different, however. The water in example one is within the volume of containment defined by the concavity of the vase - a volume limited by the inner side of the vase and by a plane through its rim. The crack in example two, by contrast, is within what Herskovits

Figure 4.4 Herskovitsian Ideal Meanings and Use Types for *In*, *On* and *At*

**Ideal Meaning:** *In:* inclusion of a geometric construct in a one-, two- or three-dimensional geometric construct.

**Use Types:** *In:*

Spatial entity in container
Gap/object "embedded" in physical object
Physical object "in the air"
Physical object in outline of another, or a group of objects
Spatial entity in part of space or environment
Accident/object part of physical or geometric object
Person in clothing
Spatial entity in area
Physical object in a roadway
Person in institution
Participant in institution

**Ideal Meaning:** *On:* for a geometrical construct X to be contiguous with a line or surface Y; if Y is the surface of an object $O_y$, and X is the space occupied by another object $O_x$, for $O_y$ to support $O_x$.
**Use Types:** *On:*
Spatial entity supported by physical object
Accident/object as part of physical object
Physical object attached to another
Physical object transported by a large vehicle
Physical object contiguous with another
Physical object contiguous with a wall
Physical object on part of itself
Physical object over another
Spatial entity located on geographical location
Physical or geometrical object contiguous with a line
Physical object contiguous with edge of geographical area

**Ideal Meaning:** *At:* for a point to coincide with another
**Use Types:** *At:*
Spatial entity at location
Spatial entity "at sea"
Spatial entity at generic place
Person at institution
Person using artifact
Spatial entity at landmark in highlighted medium
Physical object on line and indexically defined crosspath
Physical object at a distance from point, line, or plane

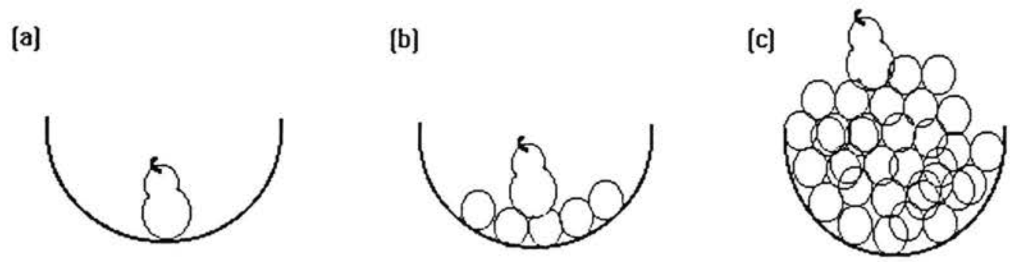
calls the "normal" volume of the vase, that is, within part of the space of the vase that the vase would occupy if there was no crack. In example four, the bird is in a volume bounded by the outline of the tree's branches.

Example six illustrates how a phrase can be ambiguous when two different geometric descriptions of the reference object are equally plausible (lacking further specification by context). The nail could be embedded into the side of the box (either "normally", that is, sticking out of the side of the box, or completely embedded into the wall of the box) or contained within the box.

Example seven illustrates what Herskovits calls a *sense shift*. The actual relation between muscles and leg, Herskovits claims, is not one of containment, but is instead the relation "part of".

Example eight is an example of *tolerance*. This pragmatic factor is Herskovits's solution to the case we discussed in figure 3.1(b) above. If we consider the cases in figure 4.5 (below), one can still say that the pear is *in* the bowl in (b) and (c) although the ideal meaning does not hold (at least, not in the case of (c)). If an object is part of a group of objects supported by the bowl, some of which are strictly *in the bowl,* then

Figure 4.5




it can be said to be *in* the bowl.

Now, allied to ideal meanings is a set of pragmatic "near" principles which provide constraints on the interpretation of a locative expression.

*Salience* explains the direction of metonymic shifts; and is formulated thus (Herskovits, 1986, p.73);

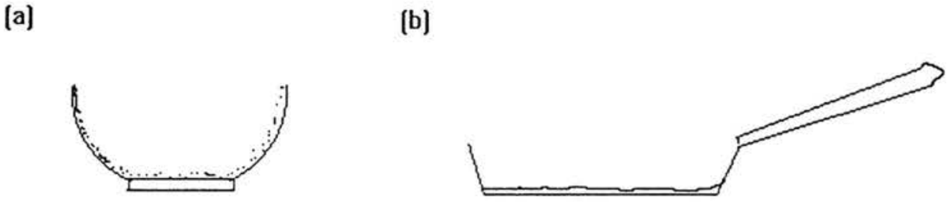
> "One can use a noun which basically denotes a whole object to refer to the region occupied by a part of it that it typically salient."

For example, in *the cat under the table,* the cat is under the surface of the table (the table top), and not under the legs. *Table* thus stands for the top of the table in this expression. Salience can be viewed as referring to the types of foregrounding of objects or object parts that arises in our interactions with and perception of our environment.

*Relevance* has to do with communicative goals, with what the speaker wishes to express or imply in the present context. This pragmatic principle comes into play in cases such as that depicted in figure 4.6 below. One can use either *in* or *on* with (a) or (b), but the use is dependent on the context; according to whether containment or contact is most relevant.

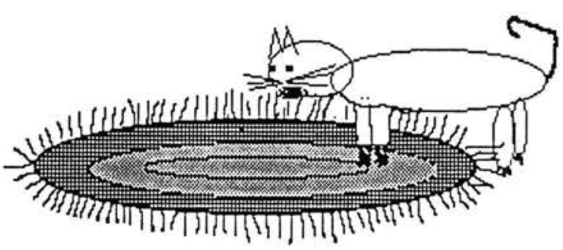
Figure 4.6

(a) The dust is in/on the bowl
(b) The oil is in/on the pan




Besides motivating the choice between two prepositions, relevance is also involved when a situation does not fit clearly into the normal situation type associated with an expression. For example, the expression *the cat is on the mat* is dependent on whether the speaker is concerned with getting cat hair on the floor or on the mat. Thus if the cat was positioned as in figure 4.7 (below), if one was worried about cat hair getting on the mat, then one could say, *Move the cat off the mat* (thus implying that the cat is

Figure 4.7



*on* the mat). On the other hand, if one was worried that the floor could get messed up with cat hair, one could meaningfully say, *Move the cat onto the mat* (thus implying that the cat is *not on* the mat).

These pragmatic near principles in Herskovits's account provide constraints on the interpretation of a locative expression, but still leave many phenomena unaccounted for. Thus Herskovits resigns herself to the assertion that some facts of use will remain a matter of convention (Herskovits, 1986, p. 87);

> "....all conventional facts of use - facts that are neither determined by the ideal meaning of the preposition and the meanings of the subject and object of the expression, nor pragmatically inferrable - will have to be somehow specified in the lexicon, as characteristics of additional senses of the preposition or of idiomatic forms. The kind of lexical representations I suggest, the use type, preserves the relation of the various senses of the preposition to the ideal meaning(s)."

This brings Herskovits to address the issue of how many use types to ascribe to a preposition. Here she fares no better than any approach thus far discussed; she relies heavily on speaker's intuitions and the occasional mention of identity tests. However, she does make the point that a locative expression will correspond to two different use types if some distinction is generally important to a language user. This is a point with which we concur.

She also relies heavily on the claim that the use types are derived from the ideal meaning, although she has difficulty in providing an explanation as to how the use types are derived.

### 4.4.2 Herskovits Reconsidered; Critique of Ideal Meanings and Use Types

Herskovits's account can be viewed as an improvement on the classical accounts thus far discussed. She effectively adds to the definitions given in the last chapter with an extensive discussion of a pragmatics required to approach truth conditionality. However, there are a number of serious errors with her account.

The notion of ideal meaning lacks justification. The sole motivation for this construct appears to come from the intuition of language users that *in,* for example, means something basic (that is, one has an intuition on introspection initially that *in* has a simple definition to cover all cases). Several criticisms can be made of this. Firstly, although we acknowledge that such intuitions exist, there is no evidence that this is an abstract 'ideal' meaning conceptualised in an ideal world of lines, points, etc. Another plausible explanation is that a basic notion of containment arises as it is most representative of all uses of *in*. Again, however, we have discussed the problems with this kind of statement in section 4.3 above. Herskovits assumes the STRUCTURE = REPRESENTATION interpretation of prototype effects, where the ideal meaning is a prototype in the lexicon which structures other exemplars, namely the use types. Secondly, with the recognition of use types, Herskovits basically divides meaning up in terms of different geometric relations between objects. It seems that the ideal meaning therefore is some sort of generalisation across all the possible geometric relations associated with a word. Why Herskovits begins with an ideal meaning in light of this is bizarre. She appears to have put the cart before the horse; she ends up with a set of types of geometric relations starting from an abstraction across geometric relations. Thirdly, there would appear to be little point in using such an abstract construct as central in the representation of meaning, particularly as use types vary often quite considerably from the ideal meaning. Fourthly, as the use types are lexicalised anyway, the processing of language therefore does not require that the ideal meaning be lexically represented too.

We find problems too with the use types. At a theoretical level, Herskovits provides no adequate evidence for distinctions between use types. The main motivation rests on cutting up the world into different types of geometric relations. One would expect, then, a detailed discussion of the kinds of geometry involved. Herskovits does not attempt this.

There are more readily demonstrable problems with the use types. *On* and *in* have a use type that is identical, namely "accident/object part of physical object", but the prepositions don't have the same distribution :

The freckles on his face
*The freckles in his face

The handle on the basket
*The handle in the basket

The mark on the scale
*The mark in the scale

Additionally, if one is to postulate a listing of senses in the lexicon, as Herskovits does, one would expect an account as to how a sense is selected in context. Herskovits provides no such account.

Herskovits falls into the trap of postulating many separate use types as she focuses on the lexical semantics of the preposition (despite her keenness to talk about locative expressions). Herskovits simply has objectively looked at locative expressions involving each spatial preposition and has attributed the differences to the meaning of the preposition.

One can also mention some positive points with the approach of Herskovits. The emphasis on pragmatics presents a view of meaning as something that is generated in context. Thus it may be possible to extend the pragmatics of Herskovits to reduce the amount of information that needs to be represented in the lexicon. The use types of Herskovits seem to take away much of her good work focussing on how meaning is stretched and bent in context. The focus on the purpose of language from the point of view of language users is part and parcel of this approach.

Let us now turn to the Brugman and Lakoff (Brugman, 1981, 1988; Lakoff, 1987; Brugman and Lakoff, 1988) analysis of *over*.

## 4.5 The Approach of Brugman and Lakoff

### 4.5.1 Brugman and Lakoff : Prototypicality and the Case of *Over*

The analysis of *over* provided by Brugman (1981, 1988) and developed by Lakoff (1987) and Brugman and Lakoff (1988) represents the most direct application of prototype theory to the domain of spatial language. We will begin with a general overview of the approach, and will then provide detailed illustration with examples involving *over*.

As should be clear by now, Brugman (1981) and Lakoff (1987) reject the "core sense" approach to polysemy, which frequently resorts to the representation of a matrix of putatively universal semantic primitives. Taylor (1988) points out that given highly polysemous lexical items such as prepositions, the core meaning approach breaks down for failure to meet one (or both) of two conditions. Firstly, the approach demands that the core meaning of an item is sufficiently general such that all of the uses of the item are accounted for; at the same time, the core meaning must be sufficiently specific so as to uniquely distinguish the item from all others. For instance, if one proposes the core meaning of *over* as being "at a higher location than, but not in contact with" (i.e., the features [+ vertical], [- contact]) one is forced to list many uses as idiomatic (e.g., *He lives over the hill*). The other problem is that the same core sense would presumably be required for 'above'. One then has a problem to explain the only partial overlap in the distribution of the two words.

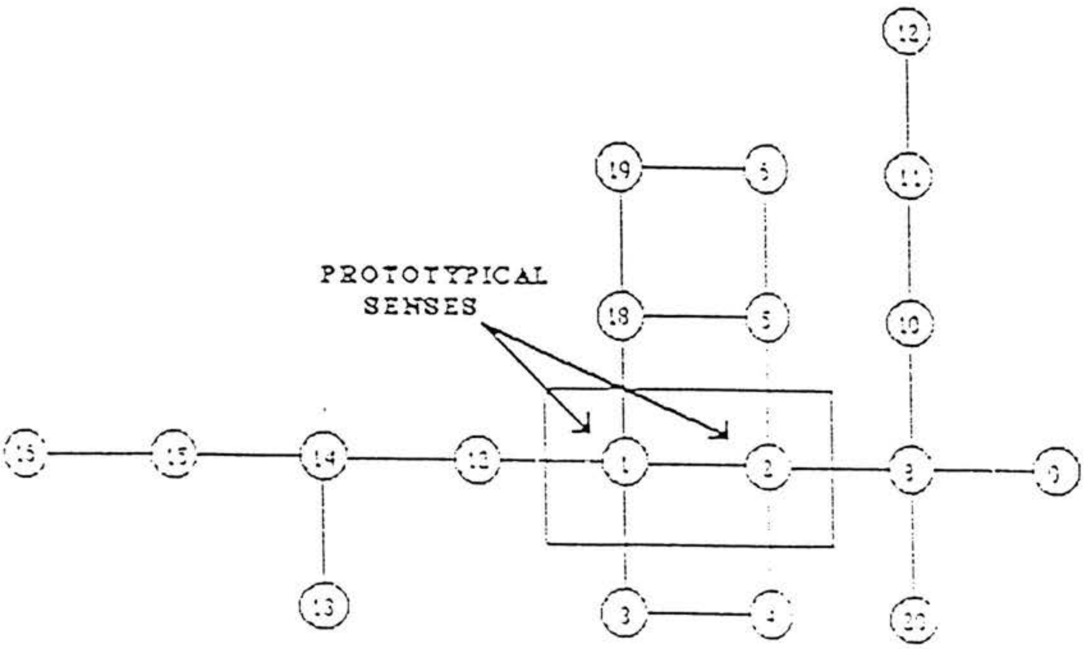
As an alternative to the core sense approach, Brugman (1981, 1988), Lakoff (1987) and Brugman and Lakoff (1988) propose a meaning chain analysis. For each preposition, a central or prototypical sense is recognised. The prototypical sense, rather than being highly general, may well profile a very specific configuration. Polysemy comes about when the preposition is closely related to, but distinct from, the prototypical instance. For example, a condition which is central to the prototype may not be met; a feature which is optional to the prototype now assumes central importance, or vice versa; or some additional feature might be required. By the same process, this derived meaning may in turn give rise to a further extension, and so on. The various senses of the word can therefore be thought to be analogous to the spokes of a wheel radiating out from the hub (the prototypical sense). Senses at the periphery might well have little in common, either with each other, or with the central sense; they are merely related by virtue of the intervening members in the meaning chain. Brugman (1981) catalogues nearly 100 different kinds of uses of *over,* which gives a clear idea of the extent to which the account recognises polysemy.

The meaning chain analysis at first sight seems very different from the approach of Herskovits (1986), and from core sense approaches. Brugman and Lakoff do not wish to claim that every time one uses a non-primary sense of a polyseme one abstracts from a primary sense. (Contrast figure 4.8 below, which is an illustration of a meaning chain analysis, with figure 4.3, illustrating Herskovits's position). Instead she claims that the processes which lead a word to have synchronically distinct senses are the same ones which lead to diachronically novel uses. This is important as one wants to give a motivated account of how new senses are developed, and in the historical vein, this is a notion of diachronic change.

The link between senses occurs, not only through shared components, but in three other ways (Lakoff improved on Brugman's account by "showing the precise relations among the spatial senses", Lakoff, 1987: 418). These are *instance* links, *similarity* links and *transformational* links. Schema transformations are not arbitrary, but instead are "direct reflections of our experiences, which may be visual, or kinesthetic." (Lakoff, 1987:443). Lakoff takes the existence of such links as evidence for fully specified lexical entries.

Focusing now on *over,* the discussion presupposes that polysemes have "primary" senses from which are extended non-primary ones, and that both primary and non-primary senses exist as categories in the mind of the user. The description for *over,* is similar to the elements that have been hypothesised to exist for the semantic category *lie* (Coleman and Kay, 1981); not a set of necessary and sufficient conditions which must be met for any grammatical use of *over,* but defining elements which determine

Figure 4.8 Representation of the Radial Structure of the category *Over* (Brugman, 1981)




(where each number indicates a different sense)

the degree to which a configuration can be appropriately described using *over*. It also rests more directly on Rosch's work in that the category *over* contrasts with other semantic categories (for instance, *across* and *above*), whose existence constrains the range of applicability of *over*.

Brugman suggests that there is one higher level category *over* which is comprised of all senses named by the word *over*, and each sense is a lower-level category, a few of which are central members of the higher category, but all of which are nevertheless full members. This is the result of looking at a polyseme, which is in essence a category of categories, whereas *lie* is a category at a single level (i.e., it has only one sense) and thus deviations from the prototype case will also be deviations from pure grammaticality.

This description, then, rests heavily on the work done in prototype, semantics (discussed above). Indeed, Brugman (1988) and Brugman and Lakoff (1988) identify three main ways in which *over* indicates a spatial relationship between figure ("trajector", TR) and ground (landmark, LM). These are (visually represented in figure 4.9);

Figure 4.9

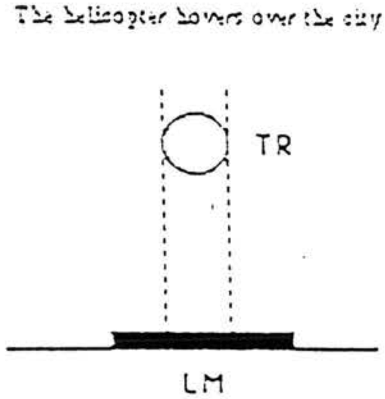
(a) The helicopter hovers over the city

(b) The plane flies over the bridge

(c) The line stretches over the wall

(d) The cloth is over the table

A

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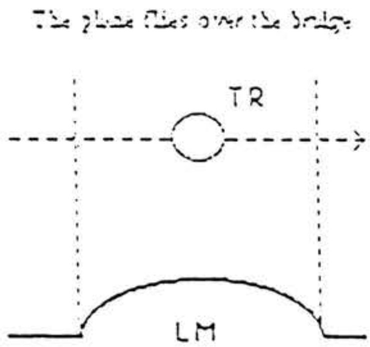


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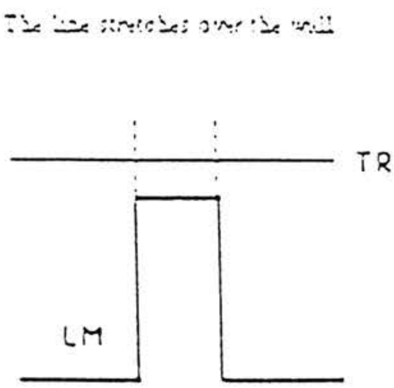
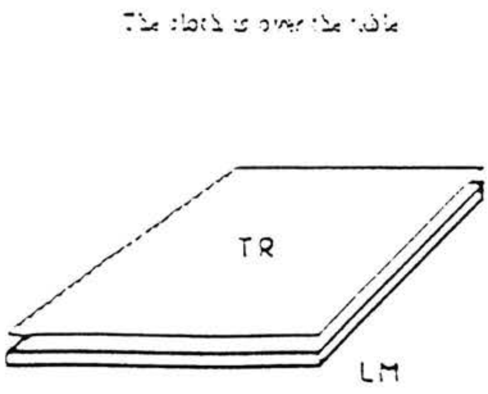



D



(1) The *above-across* schema: The trajector is an object moving on a path above, and extending beyond, the boundaries of the landmark, as in *the plane flies over the bridge* (figure 4.9(b)). Alternatively, the trajector could be a stationary, 1-dimensional object, as in *the line stretches over the wall* (figure 4.9(c)). In this schema, contact between the trajector and the landmark is allowed.

(2) The *above* schema: The trajector is vertically above, but not touching, the landmark, as in *the helicopter hovers over the city* (figure 4.9(a)).

(3) The *cover* schema: The trajector is an object whose 2-dimensional extent covers the landmark (extends to the edges of or beyond the landmark). In most cases, the trajector is construed as being vertically above, and in contact with, the landmark, as in *the cloth is over the table* (figure 4.9 (d)).

It is from these prototypical spatial relations that all the other senses of *over* are arrived at (albeit indirectly in many cases).

It should be mentioned that spatial uses of prepositions are recognised as being primary in the Brugman and Lakoff analyses; the primary, prototypical senses of *over,* as can be seen from figure 4.9, are purely physical relations. Thus Brugman and Lakoff, in accordance with the cognitive linguistic view, share the primacy of spatial concepts over other concepts. However, it is by no means the case that all of the senses of *over* are physical ones. Nevertheless, even the abstract or metaphorical cases like *we talked over lunch,* Brugman claims, are spatialisations of abstract relations. Thus Brugman (1981, 1988) proposes that all nonprepositional uses of *over* are derived from one or another (spatial) sense of the preposition. This is reflected in the distinction Brugman (1981) makes between *polysemy* and *functional shift.* While polysemy is a shift of sense within one lexical category, functional shift recognises the possibility of sense shifts across lexical categories. Brugman sets out to demonstrate that all nonprepositional uses of *over,* and other spatial uses, are derived from one or another sense of the preposition. However, she is not claiming that the language user goes through a series of image transformations from the central sense each time he uses the word *over* in a noncentral sense. Rather, she is trying to explicate what it is that makes us feel that the senses are related, and to suggest the means by which a language user abstracts from some already existing schema when he uses *over* in a novel sense.

When Brugman speaks of the "word" *over* she generally refers to the conceptual category which overrides the several lexical categories utilised. The imaginal representations of spatial relationships, such as those depicted in figure 4.9, Brugman

(1981) argues, are necessary for explaining the various senses of a word. These representations, for Brugman, do bear some resemblance to the corresponding mental representations, and thus Brugman argues against feature or propositional representations of semantic concepts in the mind. Her descriptions are;

> "not abstractions made for theoretical elegance; rather they are descriptions reflecting processes which the language user is capable of using" (Brugman, 1981, p. 4).

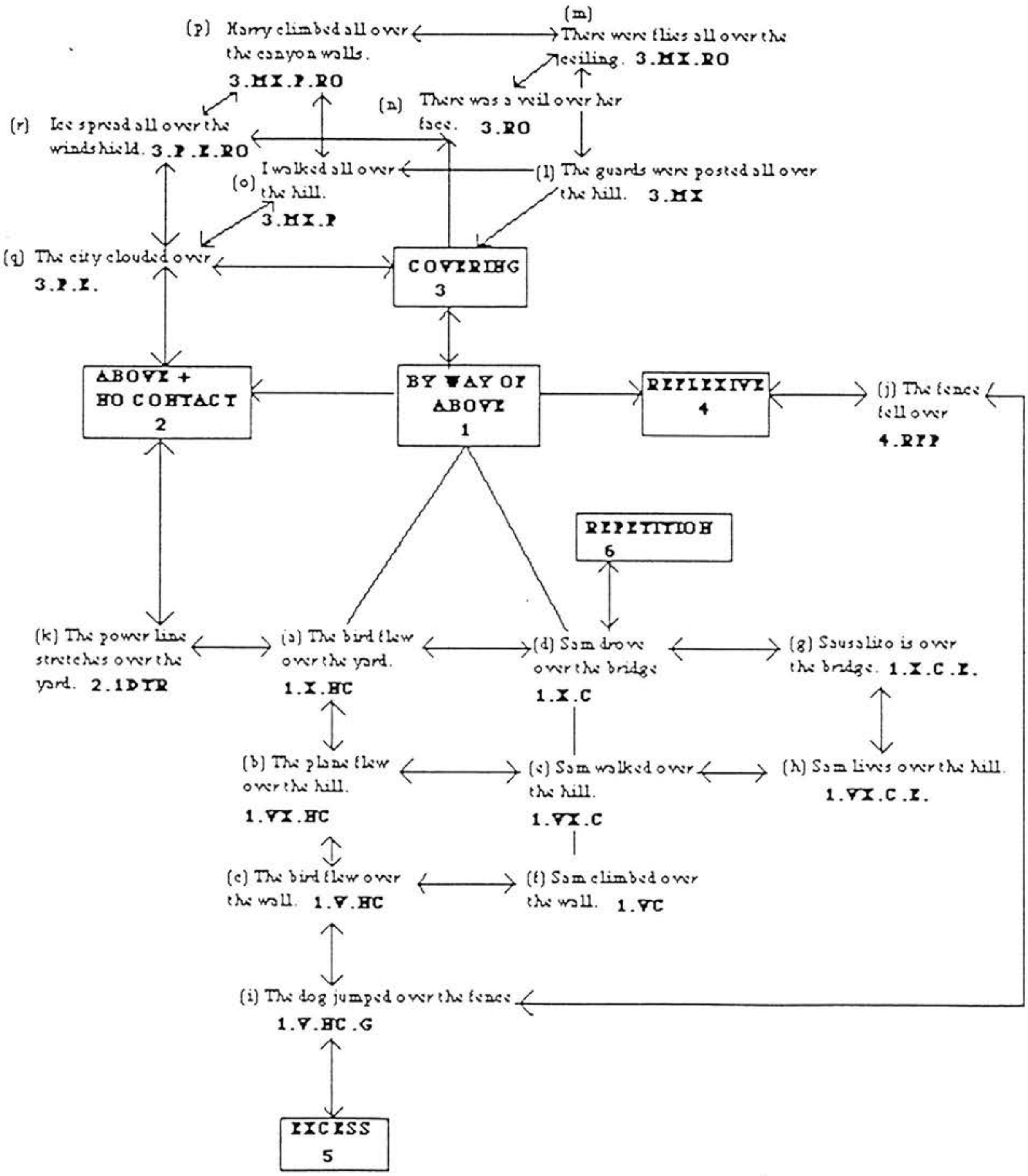
Casad (1982) has shown how complex the conceptualisations of spatial concepts are in the language Cora and how necessary imaginal representations are for explicating the spatial concepts.

The central prototypical meaning of *over* for Brugman and Lakoff involves the *above-over* schema ((1) above). An example of this is *the plane flew over the field.* Here, according to Brugman (1981) the trajector is a single point relative to the landmark. The landmark itself can have any topological characteristics - its shape is not important in this particular sense. The trajector is in a position vertical to, and not in contact with, the landmark, and these two elements constitute the core of the category *above.* Similarly, the trajectory traced by the trajector corresponds to one dimension of the landmark: that is, the line segment traced by the trajectory defines one dimension of the landmark, and canonically crosses one or both boundaries of the landmark. These elements are exactly those which characterise the category *across.* Either *above* or *across* can be substituted for *over* in the sentence above (with grammatical results), but either *across* or *above* provide less information about the event than *over* does, since it incorporates both the other concepts.

Figure 4.10 represents the meaning of *over* according to Brugman and Lakoff.

Now, from this central schema, other more specific schemas are arrived at by further specifying the nature of the landmark and by specifying whether or not there is contact. Examples (a) to (i) in figure 4.10 (below) are examples of these more specific schemas. They also illustrate what is meant by an *instance link*; that is, an instance link is a link which relates a schema to a more specific instance of itself. Senses (a), (b), (c) and (i) involve no contact between trajector and landmark, whereas senses (d) - (h) involve contact.

Figure 4.10 Lakoff's (1987) Analysis of *Over* (adapted from Bennett, 1990)



Lakoff (1987) presents the case that one can make a choice as to whether or not these more specific schemas should be lexicalised (i.e., full specification of the lexical entry), or alternatively whether one should adopt a minimally specified entry where the more specific schemas arise as a result of the addition of information from the other words in the expression. Lakoff (1987) favours full specification on account of the chaining analysis he adopts. Only through full specification, Lakoff (1987, p.422-423) claims, can the links between senses be emphasised.

Example (k) in figure 4.10 is an example of image schema (2), which involves a static *above* relationship with no contact between trajector and landmark. This example, Lakoff (1987) argues, is closely related to example (a), representing image schema (1), because of a so-called *transformational* relationship (hence *transformational links*) between a one-dimensional trajector and a path over an extended landmark.

The third type of link Lakoff (1987) discusses is a *similarity* link. This is where two schemas share a property. For example, (b) and (e) are related via a similarity link as they both involve the landmark being vertical and extended.

One could similarly give examples of each type of link with image schemas (3) and (4). However, we will now move to a critique of this approach having outlined its major features.

### 4.5.2 Critique of the Brugman and Lakoff Analyses of *Over*

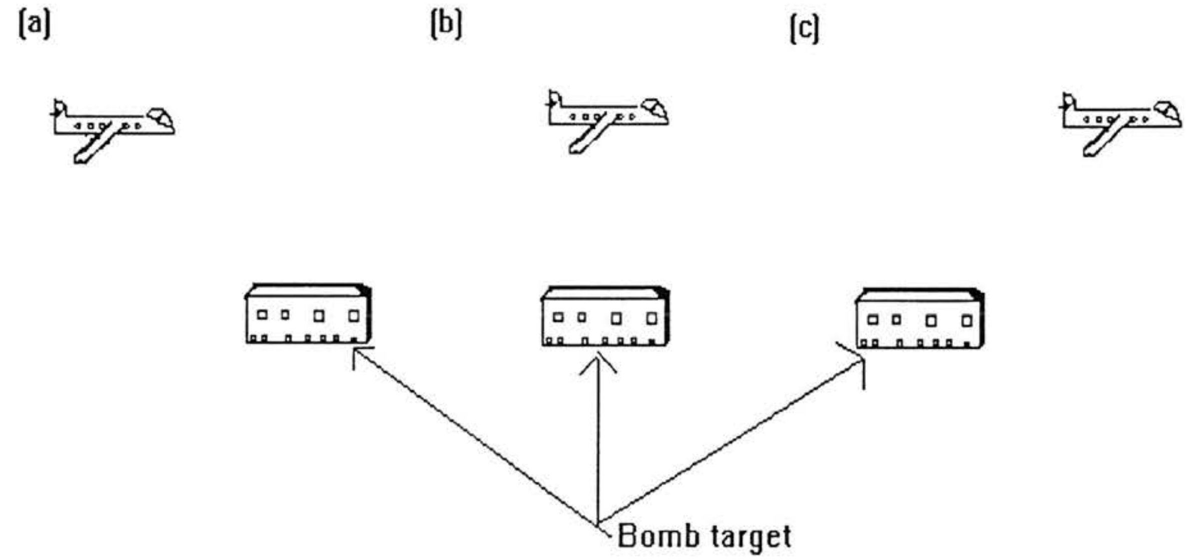
To begin with, we can consider some relatively trivial problems with the Brugman and Lakoff analysis of *over*. One immediate problem with this analysis is the sureness with which Brugman attributes the *across* schema to the word *over*. That is, the domains of appropriateness for *over* and *across* appear to be the same. The use of the verb *flew* may have this component associated with it without having it with as a component in the meaning of *over*. For example, if we compare the following ;

The plane flew across the field.
The plane flew over the field.

it would appear that with the use of *across* there was a direct path. With *over*, the flight path doesn't have to be a straight direct path. This is a difference which may have a motivation if *flew* involves the notion of a path. Thus *over* may merely point to a relationship between the path and a landmark (a functional relation; explanation will be forthcoming later). *Across* involves the notion of a path, and hence when put together with the verb *flew,* the path is reinforced (assumed to be a direct, straight path). Hence the path with the use of *across* is a straight one, but not necessarily in the case of *over.* This example is reinforced if we consider figure 4.11 (below). Here we are interested in the use of the following sentences;

The plane flew over the (bomb) target
The plane flew above the (bomb) target
The plane flew across the (bomb) target
The plane is over the (bomb) target
The plane is above the (bomb) target
The plane is across the (bomb) target

Figure 4.11




There are even more apparent problems with the case of "the plane flew over the bomb target". This is an appropriate expression to use in either of the cases in figure 4.11. (a) is acceptable given that that is the correct position for the plane to be in in order to drop the bomb. Notice that *flew above* does not capture this point, and *flew across* is simply infelicitous in this case. If we remove the verb, we can say that "the plane is over the bomb target". It is wrong in this case to say that *over* means *above* or *across* as neither can be substituted appropriately. The sentence can depict the relations in figure 4.11(a), as already stated, whereby the plane is not directly above the target, but is in the right position to hit the target with a bomb from the plane. This suggests that *over* has something to do with the notion of a path in this case, but the information from this comes from the nouns in question (i.e., plane and bomb target). The explanation of this put forward later in the thesis uses this analysis as a starting point).

Bennett (1990) argues that Brugman and Lakoff are wrong in the selection of sense (1), involving a path leading above the landmark, as the central sense of *over,* rather than the static locative meaning of sense (2). Lakoff (1987, p.425) claims that sense (2) is roughly equivalent to *above* and that there is a requirement of no contact between landmark and trajector. He points out, for instance, in relation to *the helicopter is hovering over the hill*, that if the helicopter lands, it is no longer *over* the hill but *on* the hill. Bennett (1975; cited in Bennett, 1990) considers the same issue in relation to the examples;

My hand is over the table
My hand is on the table

where the first seems more appropriate if the hand and table are not in contact, but concluded that the facts do not require us to attribute a component of 'no contact' to the meaning of *over.* Instead Bennett invokes pragmatic factors to account for the fact that *on* is preferred to *over* in certain situations. Where a static locative situation involves both contact and superiority, contact (Bennett argues) normally takes precedence in commanding the speaker's attention, so that he/she comments on the former relationship rather than the latter (using *on* rather than *over*). This interpretation is supported by the fact that under certain circumstances the normal priority of contact over superiority may be reversed. For example, if the issue is simply whether the hand is *over* the table or *under* it (i.e., if the superiority of *over* is being contrasted with the inferiority of *under*) then the fact that the hand happens also to be in contact with the table would not rule out the possibility of using *the hand is over the table.* Here Bennett is invoking the type of pragmatic principles that we can associate with the account of Herskovits (1986) considered earlier in the chapter.

In defending his choice of the core meaning of *over,* Lakoff writes (1987, p.425):

> "From time to time, linguists have suggested that schema (2) is the core meaning of the preposition *over,* that is, that schema (2) is present in all the uses of *over* as a preposition. It should be clear from what we have seen so far that this is false. Since schema (2) requires no contact, it cannot be present in those cases where contact occurs, for example, in schema 1.X.C exemplified by *Sam drove over the bridge.*"

In the light of Bennett's discussion of *over* and *on* just cited, it is clear that there is no objection to taking the (static) relationship of 'superiority', unspecified for 'contact'; or 'no contact', as the core meaning of *over*.

We can move on to consider some slightly more serious problems with the Brugman and Lakoff analysis. Bennett (1990) importantly recognises the deficiency of the Brugman and Lakoff account in that they don't distinguish between those aspects of the polysemy of *over* that it shares with other prepositions and those which are specific to *over*. In Bennett's analysis those aspects of the meaning of *over* that are shared by other prepositions are represented in (what he terms) the semotactics. Thus, Brugman's (1981) awareness of relatedness stops at the boundary of an individual phoneme string (that is, the *realisation* of an individual phoneme string). We feel it necessary to examine polysemy, functional shift and also relations between words.

Some rather more crucial objections to the Brugman and Lakoff analysis lie in the charge that their approach is fundamentally flawed in a number of critical ways. As we have seen earlier in the chapter, the existence of prototype effects does not mean that the structure of representation in the lexicon is in terms of one (or more) prototype(s). We have commented already that Lakoff (1987), despite arguing against such fallacious interpretations of prototype effects early on in 'Women, Fire and Dangerous Things', uses precisely this interpretation with his analysis of *over*. Lakoff (personal communication), in defence of this position, has argued that this analysis has resorted to prototypical lexical representation and full specification simply because a minimally specified lexical representation cannot account for the data (what we have termed earlier *case accountability*). However, one can adopt full specification without commiting such an error. Lakoff (personal communication) retorts that the use of radial structure does highlight the relationship between senses, and thus deals with polysemy, rather than treating related senses like homonyms.

Related to this objection is the motivation for the choice of central senses in the analysis. To begin with, one can ask the question of why spatial senses are considered primary in this analysis. Presumably this is based on the intuition that this type of sense is primary. Therefore the motivation for the central sense is itself a prototype effect; the sense that most readily comes to mind. However, it is quite a different matter to claim that other senses are derived from this central sense given the tenuous nature of the evidence that the spatial sense is the central one.

Again, related to this problem is the specification of which spatial sense is the central sense. Bennett (1990), as we have seen, contests the claim that the *above-across* *schema* is the central sense. However, one can consider the evidence that either sense is central as ultimately trivial; it is a matter of faith to a large extent in either case[1].

For Brugman and Lakoff the issue of which sense of *over* is most central is perhaps less important than we are implicitly contending. The important feature of the Brugman and Lakoff account is the way in which they conduct their analysis, tying together many disparate senses of *over* via similarity, instance and transformational links. However, if one decides to start from a different central sense, the analysis does look rather different.

What can be seen as the strength of the analysis, however, can be seen as its greatest weakness. What Brugman and Lakoff have done is to take geometric relationships between objects in the world and cut them up when there appears to be a reasonable difference. For example, Lakoff treats contact versus noncontact, and whether the landmark is extended or not, as two features of the world which characterise different senses of *over*. They are thus claiming that there is a one-to-one mapping between geometric relations in the world and spatial language. The components which are viewed as distinguishing geometric variables then constitute the different senses of *over*. This methodological breakdown of the analysis is beginning to sound very similar to the classical view, and componential analysis in particular. It is difficult to discern anything essentially 'experiential' about the account. In fact, considering the spatial uses in the analysis in isolation, Brugman and Lakoff are advocating a position of realism, associated with the type of objectivist analysis Lakoff (1987) spends so much time demolishing.

Furthermore, the use of similarity links, instance links and transformational links is entirely post hoc. The world is cut up into pieces, mapped directly onto sense schemas, and then it is claimed that these senses are related to each other via links which appear arbitrary. The existence of such links seems a necessary thread to justify the Brugman and Lakoff claim that all senses of *over* are related, and thus we pinpoint a degree of circularity in their argument. It is no surprise that, if one cuts up the spatial world (where use of *over* is appropriate), then one finds that these geometric relations are in some ways similar. What one must do is to give an account as to *why* these relations are similar. It is not enough to argue that the similarity is reflected by radial structure in the head.

1 In chapter 6 we consider experimental evidence which, it will be argued, can arbitrate between the choice of central senses, thus removing the need for a matter of faith with central sense selection.

## 4.6 Overview; Classical Versus Cognitive Linguistic Accounts; What We Wish To Preserve from Each

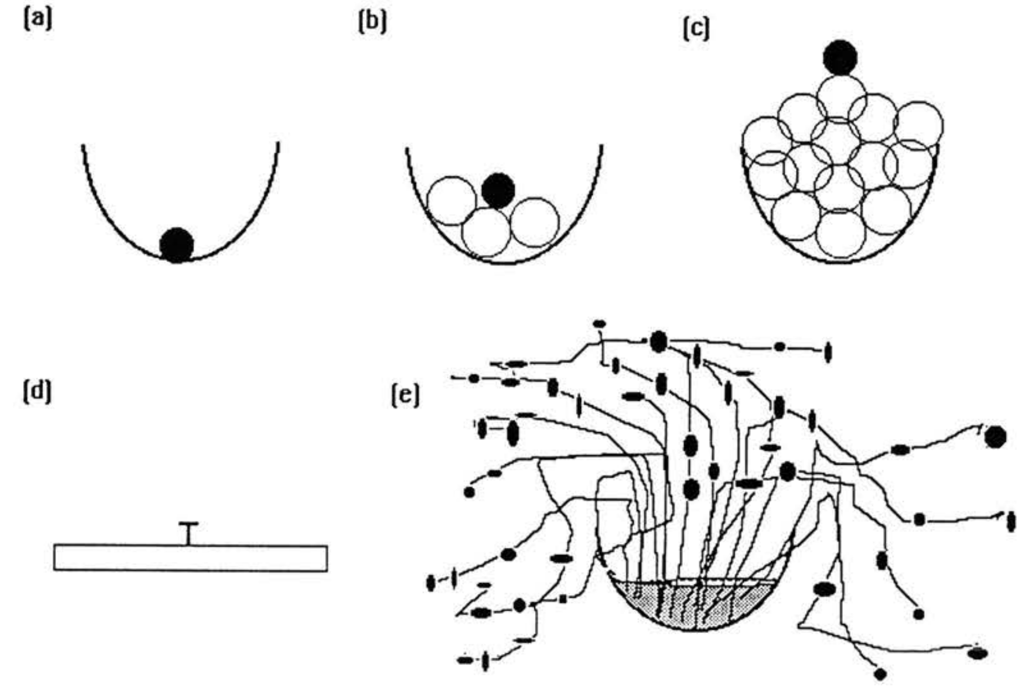
In this chapter and the last we have provided examples and discussion of theories which can be said to fall into the classical and the cognitive linguistic moulds. We are now in a position to compare these two approaches, with a view to isolating the theoretical constructs worth preserving for the type of analysis we wish to adopt.

The initial observation we wish to make is one of the similarity between all the approaches that have thus far been considered. The positions outlined above have been reviewed largely on their own terms in order to give them a fair hearing. They therefore may appear very varied in their approach. We believe that this is not the case, and that all the above approaches suffer from fundamental problems which it is one of our goals to resolve.

The first main problem involves the method of sense delineation used. The classical approaches, involving minimally specified lexical entries, favour a general meaning in the form of a definition for the lexical entry of a spatial preposition, and as we have seen, the motivation for this comes from the intuition that there is something basic to the meaning of a preposition. Cognitive linguistic accounts also do this, only in this case as a method of working out what the prototypical representation of a radial lexical structure should be. We have questioned the reliability of this type of information on several grounds. Such intuitions are akin to prototype effects themselves, and the work of Armstrong, Gleitman and Gleitman (1983), Roth and Shoben (1983), Barsalou and Sewell (cited in Barsalou, 1985) and Osherson and Smith (1981) provides conclusive evidence that one cannot assume that prototypes are directly lexically represented and that the structure of the lexicon is radial. We also, citing Sternberg (1966), argued from a slightly different angle that introspection is not to be trusted as a method of getting at mental representation.

Related to this first point is the objection that both types of approach delineate senses in terms of different geometric relations in the world. That is, a word is said to have two distinct senses if the geometric relations associated with a spatial expression differ. This objection at this present time has to be taken as a matter of faith; the next few chapters present detailed evidence for an alternative approach involving functional relations. However, for the moment we can still give some reasons for this objection. One of the problems is the number of senses that one can recognise. It is possible to cut up the spatial world in a number of different ways, at different levels of detail. In a sense, the geometric relations between objects vary in every situation with which they occur. For example, if we consider the scenes in figure 4.12 (below), we can readily see this point.

Figure 4.12




One can readily see that the geometry in each picture is different. The spatial relations in (a) and (b) seem most related, but (c), (d) and (e) are slightly different. Herskovits accounts for (c) using pragmatic principles to extend the meaning of (a) and (b). Brugman and Lakoff, extrapolating from their treatment of *over,* would recognise (c) as a different schema for *in,* with this schema related to the schema for (a) and (b) via an instance link. The classical view would fare less well as a simple relations definition in terms of geometric relations cannot account for all cases. Therefore one has to treat (d) and (e) as separate senses, whether they are treated like polysemes or homonyms.

Thus we recognise a problem which directly parallels the problem we mentioned earlier of separating out senses from occurrences of a lexeme. At the level of the spatial world, one has difficulty working out how to cut up the world into manageable cognitive slices, which may be represented as senses. At the same time, at the level of language, one has to separate out the information the spatial preposition brings to a spatial expression from the occurrence of that preposition in each context. Bennett (1975) deals most adequately (that is, as compared with other accounts) with this latter question, although this is very much to the exclusion of focus on how language and the spatial world covary.

We are faced, therefore, with the problem issue we have been aware of since chapter one; that of deciding how many senses a word should have. Theoretically, we can follow the principle that one should only recognise as few senses as are necessary, as Johnson-Laird (1987) has argued. The problem is the one recognised by Bennett (1975), Clark (1983) and Cruse (1986) that in principle there are an infinite number of senses. If we consider the work of Brugman and Lakoff in light of this, we see just how arbitrary and post hoc their analysis is. Presumably any new sense is added to the lexicon in this type of account, although Brugman and Lakoff would argue that the development of new senses would follow from the radial structure in the lexicon and the types of links that are possible. There seems no limit to the number of senses that can be recognised with this type of analysis.

The preference for minimal specification of the lexical entry has to be balanced with the factor of case accountability. As we suggested in chapter three, the types of minimal specification that have been proposed for spatial prepositions generate what we have called decoding and encoding errors. We must be careful that the types of minimal specification we choose to adopt ultimately account for the facts. If this turns out not to be the case, then the cognitive linguistic strategy of using (incorrectly) prototypes as structuring tools for radial lexical representations may be more attractive than the above critique has cared to assume.

One way in which we can do this is to take the idea from cognitive linguistics that a represented meaning does not have to be truth conditional. In other words, we do not want to treat minimal specifications as definitional. The way to bypass this difficulty is to look for the regularity that a word brings to an expression from the point of view of the language user. It is only after noting how language and the spatial world covary can we make claims about the information which remains constantly associated with a word during language use; i.e., make a transcendental inference that the user has a representation of information associated with a word which is brought to bear during processing irrespective of context.

Herskovits (1986) is perhaps the closest to providing a palatable method with which to distinguish between senses. She claims that a locative expression will correspond to two different senses (use types) if some distinction is generally important to a language user. This position is essentially a relativistic one, following in the footsteps of Sapir and Whorf. The claim is that language structures space, rather than the spatial world structuring language. This runs contrary to Herskovits's general approach, which is dependent on cutting up the world in terms of different spatial relations.

Following from this, the question that one should ask a priori is the one of what information about the spatial world is important to the language user. It is only after this question has been adequately tackled can we address the issue of what information language users associate with a spatial preposition, which is brought to bear during language processing. As it happens, the account we will pursue involves the use of theories (or cognitive models, as cognitive linguists would have it) about objects in the world, their function, and how they interact with each other.

At this point, we must leave ourselves open to the possibility that, under different circumstances, the information that a word brings to bear in a sentence may vary. Again, we can refer to the work of Armstrong, Gleitman and Gleitman (1983) who demonstrate that the solution to a problem is dependent on the way in which the question is pitched. More specifically, if one asks someone to make a distinction they will make it although ordinarily such a distinction may not have much utility. We make this point with particular reference to empirical attempts to get at information in the way that we have described.

We also note the importance of semantic-field type effects which any adequate account of a linguistic domain must provide. For example, one may not use a particular preposition in a given context, not because it is inappropriate, but because there is another spatial term which is more appropriate. Additionally, on grounds of cognitive economy, it would appear to make sense to somehow characterise shared meaning that some spatial terms may have.

At this point we should say some more about the type of minimal specifications we choose to adopt. We have intimated that these are not to be definitional meanings, but instead should be viewed as partial representations which can be built upon in context. In this respect we espouse an approach akin to that of sense generation (Braisby, 1990) or sense creation (Clark, 1983). We will advocate a minimal specification for the lexical entry of each preposition to be considered, and from this we will expand Herskovits's pragmatics factors which take the minimal specifiation via constraint satisfaction to the level of truth conditionality.

However, before we can develop the analysis we must give an account of the type of information about the spatial world language users may want to represent. This will also provide us with some possible theoretical grounds for delineating senses of a lexeme (therefore providing us with a method to isolate senses from occurrences). We will now do this in chapter five.

Chapter 5

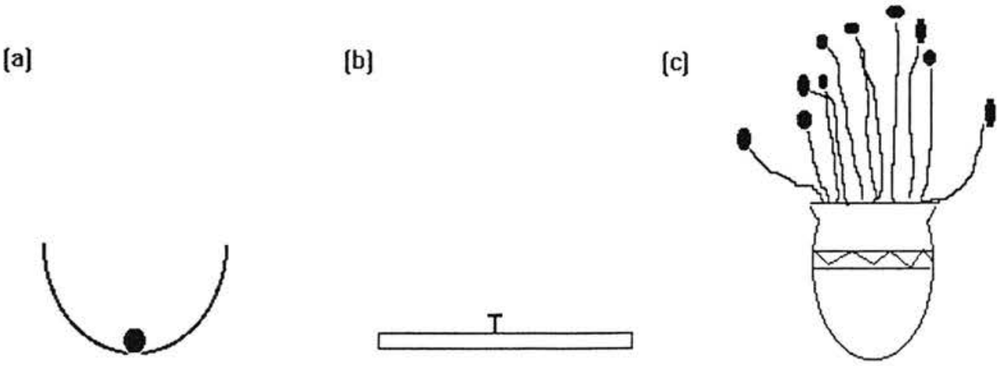
## 5.1 Introduction

This chapter introduces functional relations and gives principled reasons why they are important, and why they should be the choice for what we argue are minimally specified lexical entries. The chapter begins with a discussion of the types of geometry that would be required for an adequate semantic treatment of spatial prepositions with the sort of accounts we have considered thus far. We then introduce the work of Talmy (1988) and Garrod and Sanford (1989), and will extend and refine their analysis so as to give a working definition of what functional relations are. This will lead to a set of hypotheses at the end of the chapter about functional relations, and their roles, which will be taken into the testing room in the following two chapters.

## 5.2 The Importance of Space

As we have seen, the approaches of Lakoff (1987), Herskovits (1986) and others treat spatial uses of prepositions as primary, and invoke spatial concepts (as does Bennett, 1975, although the concepts used by him are general between space and time). For example, Bennett (1975), in his componential analysis, labels components such as *interior, superior, anterior,* etc. (see above for detailed discussion), and Herskovits (1986) refers to various geometrical notions such as *interior, outline, contiguous,* etc.. All these approaches categorise senses in terms of different geometric relations in the world. Thus, a spatial preposition in all these accounts has more than one sense if the geometric relations change in the world. For example, if we consider the pictures in figure 5.1 (below), we may postulate that *in* (which may be used to describe the relationship between the objects concerned) means something different in each picture, and thus has three distinct (though related) senses.

Figure 5.1



Certainly the ball in picture (a) is positioned differently in relation to the bowl as compared with the nail in relation to the board, and the flowers in relation to the vase. The question that follows is one of characterising the nature of this difference. If spatial prepositions really refer to types of geometric relations in the world, then one should be able to characterise precisely what these different geometric relations are. However, as Crangle and Suppes (1989) state;

> " In spite of the spate of articles in the last decade or so on locative expressions, spatial prepositions, and the like, detailed attention to the kinds of geometry needed to give a semantic analysis of the various locative expressions does not seem to have been previously attempted." (Crangle and Suppes, 1989, p 399).

One reason they give for this lack of interest in precise geometry is that linguists in this field have been concerned with the relationship between words and other words, rather than the relationship between words and the world. Crangle and Suppes argue that a detailed understanding of geometry is required before an adequate characterisation of the meaning of spatial language can take place. This position does not assume that a purely geometric analysis can provide a satisfactory account of the meaning of spatial prepositions, but only wishes to adequately define the geometric aspects that are present. Indeed Crangle and Suppes claim that different types of geometry underlie the basic meaning of different spatial prepositions. It is to a brief discussion of these geometries that we now turn.

### 5.2.1 Geometries Classified

The kinds of geometry needed for an adequate semantics of spatial prepositions span several types, according to Crangle and Suppes (1989) and Suppes (1991). Suppes (1991) provides a breakdown of these geometries, with examples of prepositional usage (reproduced in figure 5.2 below). The striking feature here is the level of complexity required to describe even the most basic of geometric relations, and the variety of types of geometry that exist. This of course entails that the spatial language user, dealing with the encoding and decoding problems in a spatial situation (i.e., with a spatial scene, or with a spatial expression) has to have a grasp of this kind of geometry in order to correctly locate or describe locations of objects.

The most basic and familiar of the geometries is Euclidean geometry, or Orthogonal or Metric geometry, to use alternative titles. The defining characteristic of this geometry is that metric dimensional properties of figures - size, distance, and angles -

<u>Figure 5.2</u> <u>Kinds of Geometry and Examples of Prepositional Usage (from Suppes, 1991, p.37).</u>

| | |
|---|---|
| Topology | *The pencil is the box (Box closed)*<br>*One piece of rope goes over and under the other.* |
| Affine geometry | *The pencil is in the box (box open)*<br>*Mary is sitting between Jose and Maria* |
| Absolute geometry | *The pencil is near the box* |
| The geometry of oriented physical space | *The book is on the table*<br>*Adjust the lamp over the table* |
| Projective geometry | *The post office is over the hill*<br>*The cup is to the left of the plate* |
| Geometries that include figures and shapes with orienting axes | *The dog is in front of the house*<br>*The pencil is behind the chair* |
| Geometry of classical space-time | *She peeled apples in the kitchen* |

are preserved across the transformations. There are only three possible transformations in Metric geometry:

1. *Translation,* which is the displacement of the figure in the plane - up, down or sideways

2. *Rotation,* which is the spinning of a figure in a plane around some fixed point called the centre of rotation

3. *Reflection,* which is flipping a figure over in a plane through a line or point.

The level of mathematical complexity required suggests that the language user must have considerable mathematical ability, realised in the ability to apply different geometries in different situations. The types of mathematical ability required are not conscious, that is, one is not aware of going through complex mathematical computations involving different geometric notions when one uses spatial language. One then has to postulate that the computations underlying the use of spatial language are unconscious. The position that one arrives at following this line of reasoning is that, given a spatial expression such as *the cat is on the mat,* one linguistuically works out what the sentence means at a crude level, and then one applies the appropriate geometry associated with the preposition to the expression to work out the relative positions of the objects in space.

One can argue, in opposition to Crangle and Suppes (1989) and Suppes (1991) that one does not need to refer to precise geometry to give an account of the semantics of spatial prepositions. Following Gibson (1966) we can argue that perception takes place within a frame of reference. For example, the room in which you are (probably) currently sitting is moving all the time. However, we need not characterise this mathematically as it is not relevant from the point of view of the perceiver. In the same vein, we can view the geometry underlying a frame of reference as being arbitrary. Frame of reference has as much to do with (as the work of Levelt, 1984 suggests) information concerning canonical orientation associated with the vestibular organ and the gravitational field. In essence, a frame of reference is rooted in the experiences of perceivers, and is not simply based on an understanding of spatial geometry.

### 5.3 Functional Relations Introduced

Thus far we have only considered spatial relations in terms of geometric relations of one form or another. It has been shown that, whether we consider prototype representations, componential analyses, etc. all approaches concerned have relied on distinguishing between senses of words in terms of different geometric relations in the world. Furthermore, the opening section of this chapter suggested that the types of geometry required for such a semantic analysis are more complex and diverse than these theories care to admit. It was postulated, following Gibson, that we don't in fact need to refer to this type of complex geometry at all; that is, one doesn't go through a series of complex computational processes in order to find out what a spatial preposition refers to in a given context. The ramifications of this have been discussed for spatial prepositions. We now move to consider a different angle on the problem; the idea that geometry has less to do with spatial language than has been previously thought. More radically, we will consider the claim that geometry has nothing to do with some spatial prepositions.

### 5.3.1 Force Dynamics

Talmy (1988) argues for the existence of a semantic category, scarcely previously recognised, which he terms "force dynamics". This category refers to how entities interact with respect to force, and includes such concepts as exertion of force, resistance to such force, the overcoming of such resistance, blockage of the expression of force, and the removal of such blockage. This suggests the existence of relations beyond geometric relations. Furthermore, the conceptual system of force interaction that appears to be built into language structure, Talmy claims, can permeate other cognitive domains; the linguistic system shows close parallels with the conceptual systems for force interaction both in naive physics and psychology. Indeed, Talmy proposes that;

> "F[orce] D[ynamics] emerges as a fundamental notional system that structures conceptual material pertaining to force interaction in a common way across a linguistic range: the physical, psychological, social, inferential, discourse, and mental-model domains of reference and conception" (Talmy, 1988, p.50).

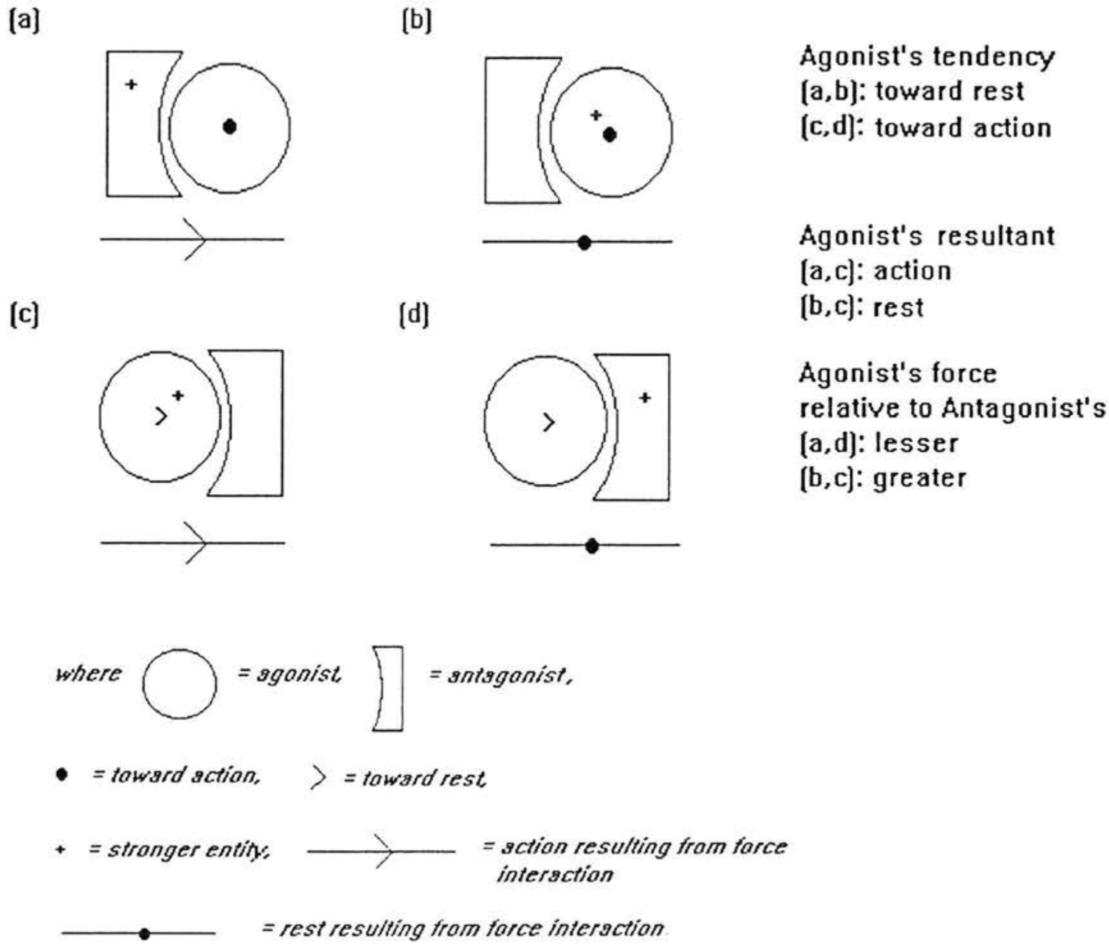
Underlying all force dynamic-patterns is the steady-state opposition of two forces. These involve different types of interaction between what Talmy terms (1988, p.53) the *agonist* (the focal force entity) and the *antagonist* (the force element that opposes it). The salient issue in this interaction is whether the agonist is able to manifest its force tendency, or, on the contrary is overcome. The antagonist is considered for the effect that it has on the agonist, effectively overcoming it or not. Talmy (p. 54) outlines what he considers to be the four most basic force dynamic patterns (displayed in figure 5.3 below).

Figure 5.3(a) involves an agonist with an intrinsic tendency toward rest that is being opposed from outside by a stronger antagonist. which thus overcomes its resistance and forces it to move. This pattern is one of those which Talmy classes as 'causative,' in particular involving the extended causation of motion. The sentence in (a) illustrates this pattern with a ball that tends toward rest but that is kept in motion by the wind's greater power. In (b) the agonist still tends toward rest, but now it is stronger than the force opposing it, so it is able to manifest its tendency and remain in place.This pattern, Talmy claims, belongs to the 'despite' category, in this case where the agonist's stability prevails despite the antagonist's force against it. In (c), the agonist's intrinsic tendency is now toward motion, and although there is an external force opposing it, the agonist is stronger, so that its tendency becomes realised in resultant motion. This pattern, too, is of the 'despite' type, according to Talmy, here with the antagonist as a *hindrance* to the agonist's motion. Finally, in (d), while the agonist again has a tendency toward motion, the antagonist is this time stronger and so effectively *blocks* it, rather than merely hindering it: the agonist is kept in place. This pattern, again represents a causative type, the extended causation of rest.

Of these four basic force-dynamic patterns, each pair has a factor in common. As the diagrams are arranged in the matrix in figure 5.3, each line captures a commonality. In the top row, (a,b), the agonist's intrinsic tendency is toward rest, while in the bottom row (c,d), it is toward action. In the left column, (a,c), the resultant of the force opposition for the agonist is action, while in the right column, (b,d), it is rest.

<u>Figure 5.3</u> <u>The Four Basic Steady-State Force-Dynamic Patterns</u>

(a) The ball kept rolling because the wind was blowing on it.
(b) The shed kept standing despite the wind blowing against it.
(c) The ball kept rolling despite the stiff grass.
(d) The dog kept lying on the incline because of the ridge there.



More significantly, the diagonal at top left, (a,d), which represents the cases where the antagonist is stronger, captures the factor of extended causation. These are the cases in which the resultant state is *contrary* to the antagonist's intrinsic tendency, results because of the presence of the antagonist, and would otherwise not occur. And the diagonal starting at top right, (b,c), which gives the cases where the agonist is stronger, captures the 'despite' factor. In fact the very concept of 'despite/although', Talmy claims, can be characterised in terms of the common factor in this subset of force-dynamic patterns. Here the resultant state is the same as that toward which the agonist tends, results despite the presence of the antagonist, and would otherwise also occur. Thus, the force-dynamic analysis captures certain basic general concepts, for example, 'despite' as counterposed to 'because of', as well as certain particular concepts, for example, 'hindering' and 'blocking'. In doing so, an advantage of the present analysis becomes evident: it provides a framework in which a set of basic notions not usually considered related are brought together in a natural way that reveals underlying character and affinity.

Talmy applies the principles of force dynamics to a number of different types of word classes and domains. The examples in figure 5.3 demonstrate that certain force-dynamic concepts have grammatical (i.e., closed class) representation. With the antagonist appearing as subject, the role of the stronger antagonist can be expressed by the conjuction *because* or the prepositional expression *because of,* while the role of the weaker antagonist can be expressed by the conjunction *although* or the preposition *despite.* Force-dynamic opposition in general can be expressed by the preposition *against,* as seen in figure 5.3(b).

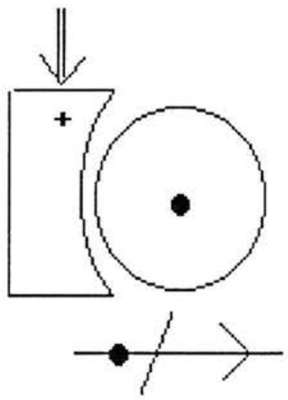
Talmy develops the basics of force-dynamics thus far outlined to account for change through time, and therefore the steady-state force-dynamic patterns introduced above give rise to a set of change-of-state patterns. Thus Talmy's analysis is extended to cases such as that represented in figure 5.4 (below).

This case involves a stronger antagonist that comes into position against an agonist with an intrinsic tendency toward rest, and thus causes it to change from a state of rest to one of action. Thus, this is another pattern which Talmy classes as causative, only this time it is the prototypical form associated with this category.

Although less germaine from our point of view, it is interesting that Talmy further extends his analysis to include non-literal use of language, for example, to the domain of psychological reference. This can naturally be seen with examples such as *he held himself back from responding.* In this case the sense of the expression is that there is one part of the self that wants to perform a certain act and another part that wants that

Figure 5.4

The ball's hitting it made the lamp topple from the table



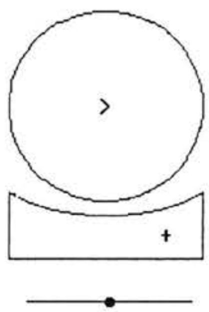
not to happen, where that second part is stronger and so prevents the act's performance.

Although Talmy does not deal explicitly with spatial prepositions, one can easily envisage how force-dynamics may come into play in such contexts. With the assumption of a gravitional field, one can view an object *in* a container as an agonist with a tendency toward motion, and the container as the antagonist with a stronger force srength required to hold the agonist stationary and in place. Thus one can represent the relationship between an object and a container as depicted in figure 5.5, adopting Talmy's diagrammatical representations.

With this type of analysis one can claim that a container is successfully fullfilling its function if it exerts a strong enough force to constrain the location of the object concerned.

Figure 5.5

The object is in the container.



At this point, with will leave force dynamics to consider the work of Garrod and Sanford (1989). They deal explicity with spatial prepositions, and their analysis is very similar to that of Talmy (1988), although they do not cite any of Talmy's work. We will return to consider force dynamics again later in the present chapter in slightly more detail.

### 5.3.2 Garrod and Sanford : Discourse Models as Interfaces Between language and the Spatial World.

Garrod and Sanford (1989) discuss the prepositions *in, on* and *at,* following from the analyses given by Herskovits (1986), and add to the ideal meaning analysis given by Herskovits in two ways. Firstly, they modify the ideal meanings proposed by Herskovits through the introduction of what they term *functional control relations.* It is this analysis with which we are primarily concerned. Secondly, they argue for a discourse model as an interface between language (the ideal meaning) and the spatial world. We will start with an examination of this second claim.

Garrod and Sanford argue that discourse models are used as interfaces between language and the spatial world. Furthermore they claim that language only relates to the world in a principled way through the mediation of mental models of that world. Utterances can only be given precise meanings in relation to models which can then be variously mapped onto the world to yield a variety of distinct interpretations. To understand what this means, Garrod and Sanford examine performance on spatial dialogue maze tasks (cf Garrod and Anderson, 1987).

Garrod and Anderson (1987) presented mazes (of the types in figure 5.6 below) to a pair of conversants. The task was for one of the pair to describe the location of a point on the maze to the other. The results are explained with recourse to mental models. Each description scene exhibited in the spatial dialogue pairs, it is claimed, is based on a particular mental model of the maze configuration, which in the case of effective communication would become "agreed upon" by the participants. Thus subjects were observed to adopt distinct but consistent description schemas which they readily classified into four basic types : *path* descriptions, *line* descriptions, *co-ordinate* descriptions and *figural* descriptions. Each of these descriptions treats the maze in a different way, illustrated by the following (taken from Garrod and Sanford, p.48-49);

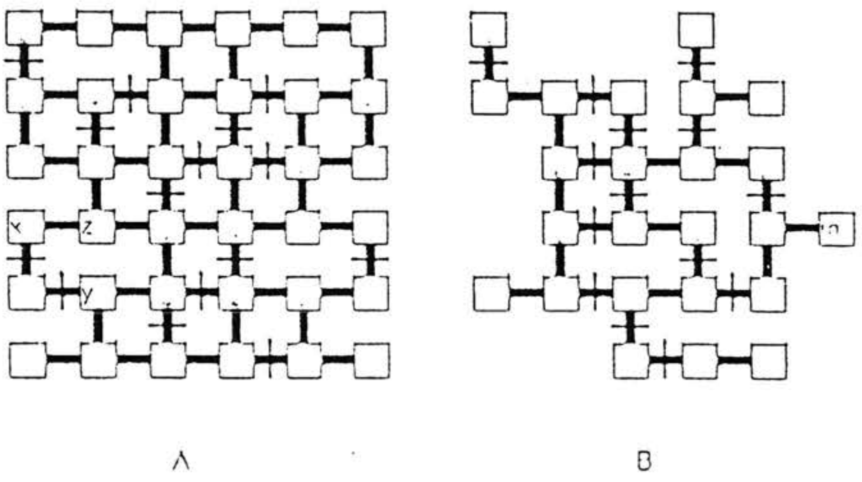
> *Path* description - "See the bottom left, go along one and up one, that's where I am"

*Line* description - "I'm on the second level, second from the left"

*Co-ordinate* description - "I'm at E two"

*Figural* description - "See the rectangle at the bottom left, well I'm in the middle box of the bottom of it"

Figure 5.6




Such mental models are defined as consisting of the following;

1) some set of autonomous objects which map onto the situation and give it an 'ontology' (Greeno, 1983), and

2) a tight set of relations between the objects in the domain which capture the 'topology' of the situation and bear a strong structural correspondence to the actual functional relations between real objects in that situation (de Kleer & Brown, 1983; Forbus, 1983).

Thus they claim that mental models of space have the effect of breaking down the scene into significant spatial entities - lines, points, regions, or volumes of space - associated with the various objects in the scene, and then representing spatial relations between those entities. In other words, spatial models represent what Garrod and Sanford call the *functional geometry* of scenes, that is, the spatial relations by virtue of which objects interact with each other. In certain respects this corresponds to the simple Euclidian geometry, but at the same time it must also capture the transformational possibilities, the way in which spatial relations may change or remain stable according to our concept of how the objects in the scene can interact with each other and we as participant observers can interact with the objects in the scene.

If models underlie the description schemas used in the maze game dialogues, as Garrod and Anderson claimed, then they should also impose strict constraints on any description, both in terms of what spatial entities are being talked about and how these spatial entities might be discriminated from each other within the description. Indeed, when a pair of conversants adopt some particular model of the maze configuration this was observed to have the effect of constraining their locative descriptions to the extent that the 'local' meaning of any expression can only be derived through the model itself. Such an example would be the sometimes long-winded and bizarre descriptions resulting from the use of a particular model. With the maze in figure 5.6, for example, speakers that adopted the path model produced a dialogue to describe point X thus ;

A : Right, see the bottom left-hand corner.
B : The bottom left.
A : There's a box and then there's a gap.
B : Uh-huh.
A : And there's a box and there's another box.
B : Uh-huh.
A : I'm right here.

Furthermore, it was found that dialogue pairs developed quite specialised description subschemes based on a single type of model. For example, Garrod and Anderson found evidence for at least three variants of the basic horizontal line type of model.

Garrod and Sanford argue that analysis of locative descriptions which emerges when people play the maze game clearly implicates mental models of space in locative descriptions. Such models, they propose, are not simply perceptual representations but reflect distinct functional geometries imposed on the maze and come from the players' joint conception of what they are looking at and interacting with. Such models are equally important in understanding the use of locative prepositions in more everyday situations, it is claimed, which leads into a discussion of how these models work for *in, on* and *at*.

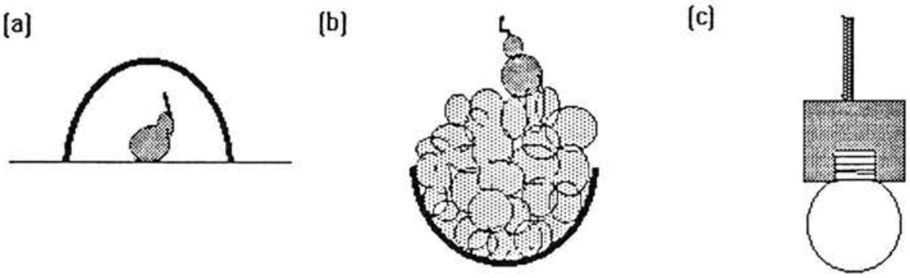
The ideal meanings suggested by Herskovits (1986) are the starting point for Garrod and Sanford's consideration of spatial prepositions. They begin with the observation that the ideal meanings provided by Herskovits (1986) do not adequately cover all cases where use of the prepositions concerned is appropriate. In other words, there is the claim that the ideal meanings fall down on grounds of case accountability. At the same time Garrod and Sanford wish to preserve the intuition that *in,* for example, expresses some straightforward concept of containment which is either present or absent in the examples they give. Garrod and Sanford, applying the notions introduced from the maze games, argue that what is required is a clearer notion of the functional geometry, in order to elucidate the intuition that the uses of prepositions are related.

Garrod and Sanford present some examples which they claim are not covered by the Herskovitsian ideal meaning relevant in each case. If we consider *in,* to begin with, four spatial examples are presented which are not adequately dealt with by Herskovits's ideal meaning for *in* (reproduced below);

> *In*:inclusion of a geometric construct in a one-, two-, or three-dimensional geometric construct.

Three of these cases have been cited earlier in figure 3.1 (p.33, above) in the chapter discussing classical approaches. These are reproduced below in figure 5.7.

Figure 5.7




In the first case, the ideal meaning does hold, but *in* is not the appropriate preposition to use. In (b) and (c) the ideal meaning does not hold, but the use of *in* is appropriate. In fairness to Herskovits (1986), the ideal meaning was not intended to cover all cases, but serves merely as a prototypical geometric ideal, structuring use types in the lexicon. Therefore, one may argue that the intuition that all uses of *in* are related is preserved in Herskovits's account in the form of the ideal meaning, while specific cases are covered with the lexicalised use types. Indeed, (c) is covered this way as an example of the *Accident/object part of physical or geometric object use type.* (b) is explicable in terms of the pragmatic factor of *tolerance.* (a) is the only example which remains problematic for Herskovits's account as the use type *Spatial entity in container* corresponds to the example, but *in* is still not appropriate. However, Herskovits (1986, p.77) again provides a pragmatic solution to this problem in the form of the principle of relevance;

> "The [pear] is *under,* not *in* the bowl, because *in* is typically associated with the bowl functioning as a container. If it is important for the addressee to know that the bowl is not in a position to function as a container (i.e., if its function is most relevant), then one must not use a preposition that will suggest that it does. Note that two facts condition the choice of under: first, function is important to the addressee; second, *in* is closely associated with the bowl's normal function, where the bowl faces upwards."

Thus Garrod and Sanford are incorrect to criticise Herskovits's account in terms of case accountability. What they should have argued is that one can provide an alternative ideal meaning for *in,* for example, which covers more cases without recourse to representation of use types in the lexicon, or a complex set of pragmatic principles to bail the ideal meaning and use types out of case accountability difficulties.

In fact the modifications to the ideal meanings suggested by Garrod and Sanford bear a close resemblance, not only the the force dynamics of Talmy (1988), but to the explanation Herskovits provides for the case in figure 5.7(a) (provided above). The key to finding a common meaning to the types of examples discussed is functional geometry. For example, one can say that *the bulb is in the socket* in figure 5.7(c) if one considers a functional geometric relationship whereby the socket (the controller) functionally controls the location of the bulb (the controlled object). Thus *in* signifies a causal relationship such that a controller functionally contains a controlled/contained object.

To give another example, one can say that;

The light is on the ceiling.

Here appropriate use can be explained by again evoking the notion of a controller and a controlled object. In the case of *on* there is the causal relation of functional support such that the controller (the ceiling) is functionally supporting the light (the controlled, supported object). Hence, one can say meaningfully that *the light is on the* *ceiling* without requiring a different sense of the preposition from cases such as *the table is on the floor.*

Garrod and Sanford do not modify the ideal meaning for *on* provided by Herskovits (1986) as this already has a geometric component - contiguity - and an interactional component - support;

> *On*: For a geometric construct X to be contiguous with a line or surface Y. If Y is the surface of an object Oy, and X is the space occupied by another object Ox, for Oy to support Ox.

The only caveat they add is that the notion of support is situation-relative.

The Herskovitsian ideal meaning for *at,* like that for *in,* does require modification in the Garrod and Sanford analysis, again simply with the introduction of a functional component. The modified ideal meaning for *at* is thus;

> *At:* For a point to functionally coincide with another

This modification covers cases such as;

The pupil at the desk

which expresses more that just a geometric relation. The important point here is the functional coincidence such that the pupil is interacting with the desk; he is using the desk. This meaning is not conveyed with the use of the word *by* or *near,* which do not imply such interaction.

To return to the cases cited above in figure 5.7, the following ideal meaning of *in* presented by Garrod and Sanford, they propose, covers all these cases;

> *In:* inclusion of a geometric construct in a one-, two- or three-dimensional functionally controlling space.

Thus in figure 5.7 (b) one does not need to resort to the pragmatic factor of tolerance to bend or stretch the ideal meaning into a use type as the bowl is functionally controlling the location of the pear, such that if the bowl moves the pear moves with it.

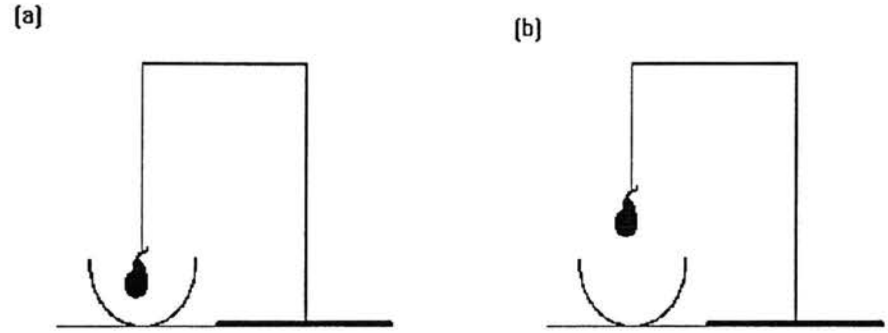
Causal relations are central to the notion of functional geometry and control. This means that changes in state have a lot to do with our attribution and understanding of locatives. Furthermore, this undoubtedly leaves the question of the importance of the involvement of a temporal factor. Inferences about causal relations bear a strong relationship with time as one may have to distinguish between immediate changes in a state of affairs and more gradual changes. One may then want to introduce ideas such as the likelihood of change occurring in situations and the types of changes that may occur (i.e., qualitative and quantitative change).

Garrod and Sanford argue that one can retain the notion that the meaning of a preposition are related and still account for the wide range of applications by "taking such spatial terms as denoting relations within mental models of space which capture the functional geometry of the scenes being described" (Garrod and Sanford, 1989, p.154). Hence, any adequate characterisation of the use of the terms will depend upon a clear account of the variety of models which can be constructed of any scene and the way in which the spatial terms can be directly related to the entities or relations within such models.

According to this account, then, the effective use of a locative involves both the particular model that is being imposed on the scene and also the appropriateness of the functional geometric relation expressed by the preposition. These factors are not, despite their separability, wholly independent in practice. Garrod and Sanford contend that one of the main advantages of putting models between the language and the spatial world is to allow for the multiplicity of interpretations that may be imposed on the same scene.

It is important that the meaning of the preposition remains the same, although different perspectives on the same scene may or may not affect the attribution of a preposition. An example Garrod and Sanford give is of a pear suspended from a frame by a piece of string such that the pear is only just located within the circumference of the bowl when viewed from above (see figure 5.8(a)). Ordinarily, Garrod and Sanford contend, one would not say that *the pear is in the bowl.* However, if one was playing a game which involved manipulation of the frame such that one had to place the pear within the circumference of the bowl then one could meaningfully say that *the pear is in the bowl* as the imposition of this perspective on the scene allows the functional containment relation to hold as one has to move the pear so that it is functionally contained by the bowl.

Figure 5.8




This is a rather unfortunate example as one may say for figure 5.8(a) that *the pear is hanging in the bowl.* Figure 5.8(b) is a better example where one certainly cannot say that *in* is appropriate. Perhaps a better example still comes from Stevens and Coventry (forthcoming). One can imagine the situation where a crane-driver is moving a load so that it can then be dropped into a container; a foreman down below by the container shouts up "It's in now!" The position of the load is controlled by that of the container.

The notion of functional geometry, as already has been suggested above, can be broken down into two components; a purely spatial component and a more general interactional one. For example, with *in* the geometric relation is the spatial realisation of one's object's inclusion within the space of another object and the interactional state is that the space is being controlled in some sense by the controller. *In* is seen as asserting a particular kind of direct control of some controller over appropriate entities in its control space, with the idea of control space being entirely dependent on the mental model of the situation adopted. Thus it is not the meaning of *in* which varies over situations, but the notion of functional control.

Garrod and Sanford suggest that the notion of functional control may itself suggest a spatial model. This is an important point. For example, the expression *the pear is in the bowl* may suggest a particular relationship whereby the bowl functionally controls the position of the pear. Similarly, (although Garrod and Sanford do not mention this possibility) the influence of prevalent or previously highly occurring spatial models may suggest the attribution of a particular preposition.

One final point about the work of Garrod and Sanford is worthy of mention. Like Talmy (1988) Garrod and Sanford argue that functional control relations can explain the use of prepositions in more extended cases, such as;

John is in a bad mood
Paddy is in good health

These cases can be explained as they both depict states which directly control what a person can do, and hence the preposition exhibits the control relation content in each sentence.

### 5.3.3 Critique of Garrod and Sanford

As we have seen, Garrod and Sanford make two claims. The first is that mental models are used as interfaces between language and the spatial world. The evidence presented for this comes initially in the form of a discussion of subject pairs' performance on the Garrod and Anderson (1987) maze task. The first question we need to ask is whether this provides evidence for the existence of mental models.

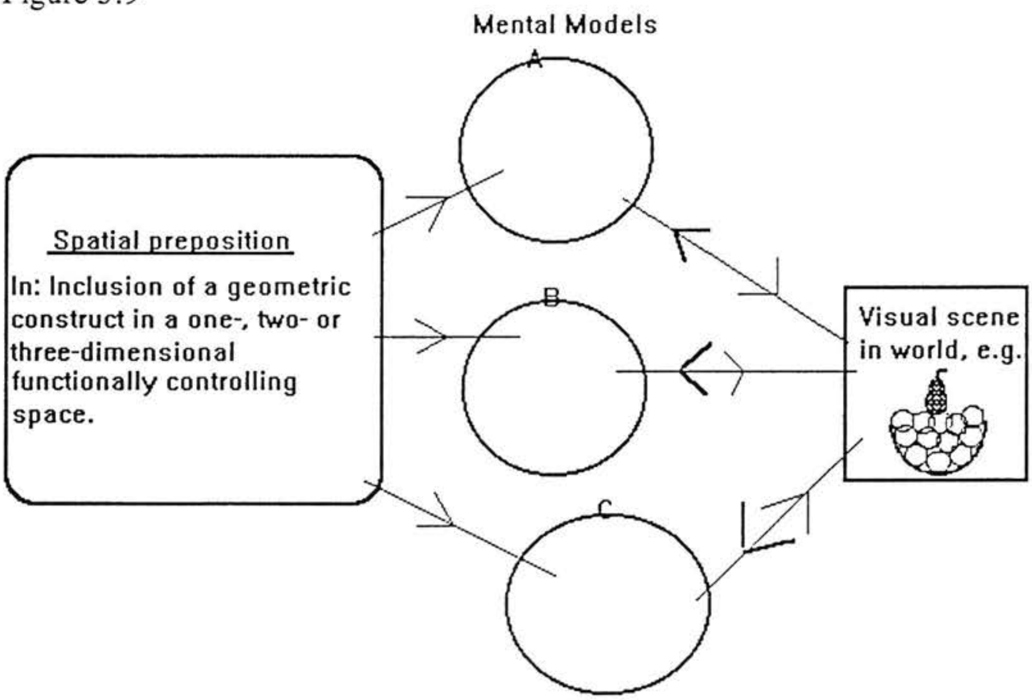
A first criticism involves the maze task cited as evidence for the existence of mental models. It is relatively obvious that one can talk about the mazes used in different ways as the task is a novel one. Hence it is a sensible strategy for pairs of conversants to decide upon a mutual way of seeing and talking about the maze. This was indeed found to be the case. The fact that subjects developed quite distinct maze descriptions and reverted to long-winded and sometimes bizarre descriptions merely suggests that subjects define what they see in such tasks individually (or of course mutually in pairs) and are reluctant to redefine the terms half-way through the experiment. The reluctance to change the mode of description doesn't mean that conversants are not capable of changing their conception of the maze half-way through. Furthermore, Garrod and Sanford do not say whether or not subjects were given feedback about the tasks in that feedback may induce changes of strategy. Similarly, it is not specified how many difficult mazes were given in sequence. One would maybe predict that if a sequence of difficult mazes were presented, then subjects may change description schemas quite easily.

If the term *mental models* is used in the sense just described, then one can view them as temporary structures in working memory which serve as surrogate representations between language and the world, and nothing more. Subjects in the task agreed on a particular way of talking about mazes, and therefore it seems sensible to infer that such agreed schemas are kept in working memory during the duration of the communication. Of course, if subjects have difficulty using this temporary schema, then they can simply switch schema by bringing a new one into working memory, replacing the old.

Such models should be viewed in the same way as theories are viewed in science. One clear example of this comes from Gentner and Gentner (1983). It was found that subjects used different analogies to understand and reason about problems concerning resistance and current in simple electrical circuits. The answers to the problems were found to be different depending on the analogies that were used by the students. The difference here is that in the Gentner and Gentner task subjects did not have an alternative schema to bring to bear in the task, and therefore exhibited systematic errors. Additionally, there was no feedback given to let subjects know when they had given the wrong solution to a problem. This illustrates that a different perspective, or model adopted on a problem or situation leads to a different answer to the problem. What needs to be done is to examine just what different models are.

Garrod and Sanford (1989) do not clearly specify what role mental models play in relation to spatial prepositions and spatial scenes. They state that spatial terms denote relations within mental models of space which capture the functional geometry of the scenes being described. The implication here is that the spatial preposition is applied according to the representation given in figure 5.9 (below).

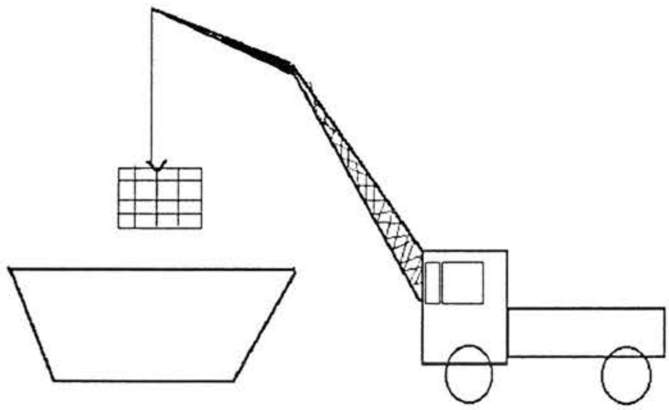
Figure 5.9




This diagram is similar to that presented in figure 1.1 (chapter one, p. 4), with the addition that language use relates to the middle layer of mental models, rather than directly to the world. If we take the encoding problem, we have a spatial scene in the world from which a variety of mental models can be derived (denoted by the bold arrows). The appropriatness or not of the spatial preposition is then dependent on the appropriate mental model adopted. With the decoding problem, the language itself can suggest a particular model of a scene. The mental model constructed can then be imposed on an actual given scene in the world, at which point the visual scene in the world can be said to be a valid, or invalid, visual representation of the language used.

We can take an example as further illustration of our interpretation of Garrod and Sanford's claim. The situation involving the crane-driver and foreman depicted above can be put into this framework. If we consider the scene in figure 5.10, one can ask if the sentence *the crate is in the skip* appropriately describes the spatial relations concerned.

Figure 5.10

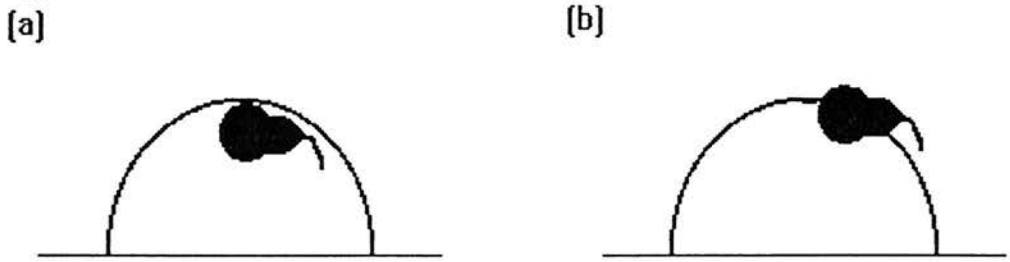


There is no doubt that it does not. This, according to this account, entails that no model can be constructed, based on the information given, in which the meaning of the preposition holds. However, given further information relating to the achievement of a goal, a different mental model of the situation may provide an appropriate mapping relation for the preposition, in this case an extended notion of functional containment. The issue remains as to how such a model is constructed to make this possible (assuming that *in* is appropriate to language users in even the contextual case; we indeed show that this is the case in the following chapter).

If we take mental models as meaning what we have described above, then they appear to be a useful and necessary interface between language and the spatial world. However, what has been described thus far is purely descriptive; Garrod and Sanford do not explain how mental models are constructed, or how prepositional meaning is to be mapped onto such representations. We must consider the ideal meanings provided to get a handle on these problems, and hence we will now consider their second claim.

Turning to the modified ideal meanings analysis provided by Garrod and Sanford, an important question to address is whether it actually deals more adequately with case accountability than other theories which we have considered. One can question that this is the case. If we consider the example cited in figure 5.7(a). Garrod and Sanford suggest that if the bowl is moved that the pear will not move with it, and therefore *in* is not appropriate. This is not necessarily the case. The pear may well move with the bowl if the bowl was pushed, remaining in contact with the surface on which it rests. Even if this was not the case, we can consider the examples in figure 5.11 (below).

Figure 5.11



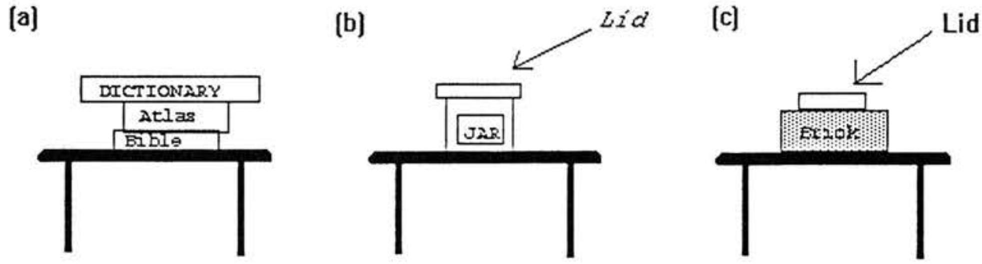

In (a) the pear is glued to the bowl, and thus when the bowl moves the pear will move with it. According to the Garrod and Sanford analysis *in* should then be appropriate as the bowl is controlling the location of the pear. However, in this case the use of under is more appropriate, rather than the use of *in*. In (b) the pear is part of the edge of the bowl, in the same way that a crack is *in* the bowl. Again the pear will move with the bowl if the bowl moves, but use of *in* is not appropriate.

Cases of transitivity provide another problem for the Garrod and Sanford analysis, only this time with the case of *on*. We can refer back to the example we gave in figure 3.4 (reproduced below in figure 5.12).

If one moves the table in (a), (b) and (c) the book, lid and lid respectively will move with the table. If one has to assign a degree of probability as to which of the figures will fall off the table if the table is moved, then the position of the figures in (a) and (c) is more precarious. Therefore, one would expect that *on* should be more appropriate in case (b) than in (a) or (c).

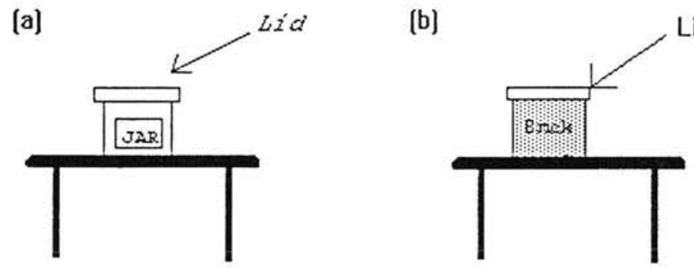
Figure 5.12

(a) The dictionary is on the table
(b) *The lid is on the table
(c) The lid is on the table




One way round these problems is to argue that the mental model in each case would be different. In the case of (b), somehow in the model the fact that the lid is being functionally controlled immediately by the jar may be represented. However, this does not make much sense as this is also true for (a) and (c). Another option is to argue that a stronger functional relation in present in (b) as compared with (a) and (c). The lid in (b) is wrapped round the jar, whereas the relation of support, a weaker relation, is present in (a) and (c). Following from this, one can argue that *on* may be used transitively in relation to a figure and ground unless there is a stronger functional relation present between the figure and another potential reference object. One can see in figure 5.13 that this explanation is still not adequate. The lid in 5.13(b) is wrapped

Figure 5.13




round the brick in exactly the same way that the lid is in 5.13(a). Use of *the lid is on the table* in (b) is still felicitous, thus rendering this explanation inadequate.

The examples which we have cited are counterexamples to the following claims, which are explicit in the Garrod and Sanford account;

(1) A figure is said to be *in* a ground if the ground functionally contains the figure, such that if the ground moves there is (or will be) contiguity of movement of figure with ground.

(2) A figure is said to be *on* a ground if the ground functionally supports the figure, such that if the ground moves there is (or will be) contiguity of movement of figure with ground.

The examples we have discussed are also counterexamples to an explanation residing in force dynamics, which would rely on forces in opposition, with the container and supporting surface supplying the greatest force.

The examples have demonstrated that notions of functionality are not enough to tackle case accountability. However, Garrod and Sanford, as we have seen, argue that there is a geometric meaning to *in, on* and *at* as well. Therefore, it could be that with cases where (1) and (2) do not hold, that the geometry is the reason for appropriate use. This cannot solve the problems with transitive uses of *on*. The geometric criterion of (direct) support is flouted in each case, which only leaves the functional control component left. Similarly, figure 5.11(a) illustrates a case where both the criteria of containment and functional control are met, but *in* is still inappropriate.

More problems exist for Garrod and Sanford with their treatment of *at* as functional coincidence. Here the geometric and functional components are together in the ideal meaning, just as they are for the ideal meanings of *in* and *on*. The problem is that the functional component often is not apparent with use of *at*. If we consider the following;

The snail is at the stone
The man is at the piano

then it is clear that there is a functional component with the second sentence such that the man is playing the piano (usually), but no such inference is apparent with the first sentence. In fact it is difficult to discern any kind of functional component for *the snail is at the stone*. Instead this relation seems to be purely geometric, where the snail is *near* or *by* the stone. The fact that *by* or *near* cannot be substituted in the first sentence without a clear loss of information provides some support for this.

We are faced with two choices for *at*. We can recognise two different senses of *at*, one which has a functional component and one which does not. Alternatively we can stick with the ideal meaning provided by Garrod and Sanford and argue that some uses of *at* realise the functional component and some do not dependent on the mental model of the situation. In the next chapter we provide evidence to suggest that the first interpretation is the correct one.

Clearly, then, it appears that Garrod and Sanford's analysis still has problems on grounds of case accountability. In the next section we will address these problems directly, offering a possible solution. However, Garrod and Sanford (directly) and Talmy (indirectly), provide ample evidence to suggest that spatial prepositions cannot be defined solely in terms of geometric relations.

To end this section we can mention some other problems with the Garrod and Sanford analysis. The approach is based on;

> "the intuition that *in* [for example] expresses some straightforward concept of containment which is either present or absent in these various examples." (Garrod and Sanford, 1989, pp. 153-154).

In the last chapter we discussed at length the problems with this kind of evidence and drew a tie between prototype effects and this kind of introspective observation. In this case, we can question even the observation. As with all our examples cited in this thesis, we checked introspective claims against a sample of at least five subjects on each occasion. In this case not all subjects, when asked what they thought *in* meant, came up with this intuition. The majority initially came up with examples involving containment, but, after a few seconds (and a few examples later) decided that the concept was not so straightforward. It should be obvious by now that to distinguish between senses and occurrences of a lexeme, we need a more reliable method. We also wish to explain where the kind of intuition Garrod and Sanford refer to comes from.

A final problem, with the Garrod and Sanford analysis is that the functional control analysis does not, contrary to their claims, explain prepositional usage in more extended cases. As this is a peripheral issue here, the interested reader should consult Coventry and Ludwig (1991) for discussion of this point.

### 5.4 Functional Relations Revisited

Functional relations, in the sense used by Garrod and Sanford (1989) and Michotte (1963; see chapter one for a discussion), involve how objects interact with each other over time, and place spatial language in a world where speakers interact with objects, and objects interact with other objects. This approach highlights dynamics in a world of action, and is removed from the static 'time-slice' prepositional analyses involving abstract geometric relations discussed in previous chapters. However, Garrod and Sanford miss one element of functional relations which Michotte (1963) emphasised, and is illustrated with the following quotation;

> "It is by coming to know what things do that we learn what they are. What they are for is much more than their shape, their size, and their colour; it is above all what they are capable of doing, or what can be done with them." (Michotte, 1963.)

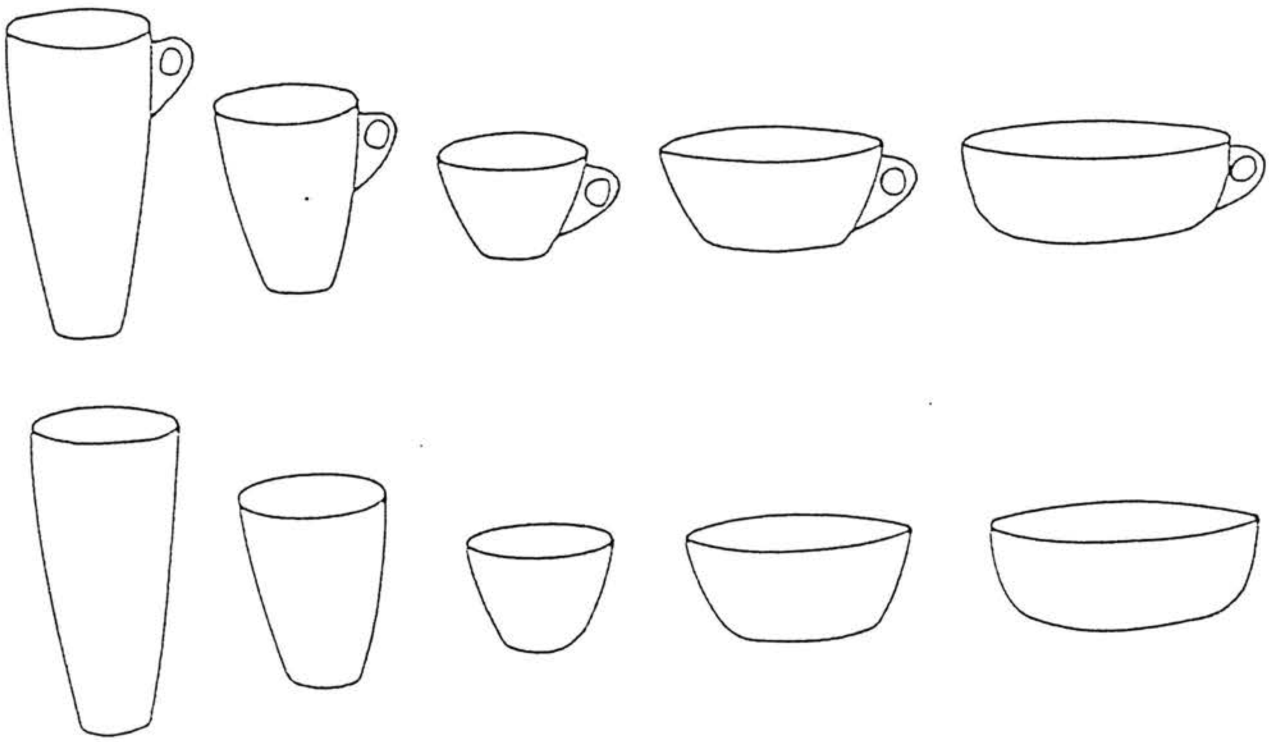
It is this sense of functionalism, what Sober (1991) calls *teleological functionalism,* that we can consider to be the most important. For example, the heart is best defined in terms of its function - to pump blood around the body. Similarly, (to regurgitate an example from chapter one), the function of a glass is to contain things, namely liquids (as opposed to gases or solids). This relates to another function of a glass, which is to drink out of, which again relates to the function of ingestion (which is necessary for survival).

The inference we wish to make here is that functional relations between objects are dependent on the functions that the objects have. Following from this we can view *in* for example as relating to the function of the ground. We propose that an figure can be said to be *in* a ground if the ground is fullfilling its function. That is, the purpose of a container is to control the location of objects it contains. If it does this successfully, then it is a good example of a container. Furthermore, containers may have specific functions; that is, their purpose may be to contain specific types of objects. This does not mean to say that a container can be said to *only* contain certain types of objects, but simply that containers can (and do) have specific functions.

Labov (1972; cited in Miller and Johnson-Laird, 1976) provides direct evidence for these claims with his study of containers (examples of which are presented in figure 5.14 (below).

The first part of his study demonstrated that the labelling of containers is not all-or-none. There are cases of containers which can be labelled either a *vase* or a *bowl,* for example. However, when the ratio of width to height is about 1:1, people use *cup*; when the width is much greater than the height, they use *bowl*; when the height is much greater than the width, they use *vase*. The proportion of judgements in each category varied as a function of the height: width ratio, with *cup* and *bowl* being about equally probable when the ratio was 1:2, and *cup* and *vase* being about equally

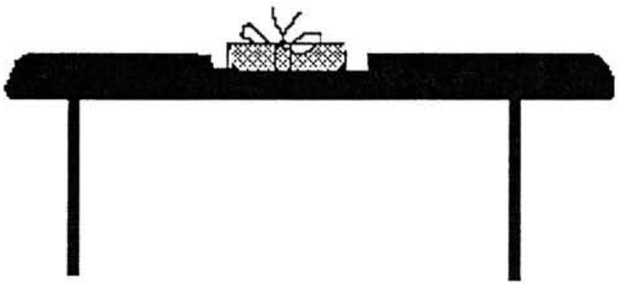
Figure 5.14 Examples of Containers Used By Labov (1972)



probable when the ratio was 2.5:1. The 'best' cups in the series were around 1:1 to 1.2:1, which are presumably closest to the prototypical cup. In the second part of the study, Labov asked his judges to imagine that the same pictures they had labelled in a neutral context were now used in various ways. For example, they were asked to imagine they saw someone holding the object, stirring in sugar with a spoon, and drinking coffee from it. Or they might be asked to imagine that it was on the dinner table filled with mashed potatoes, or sitting in a shelf with cut flowers in it. Labov reports that imaginary contexts (in addition to the presence or absence of a handle) had strong effects on category boundaries. Imagining that a container was functioning as a vase significantly increased the probability that it would be labeled *vase*. What an object is used for has measurable effects on what people are likely to call it. Hence this study provides evidence that information about function helps separate out one container from another.

A second example to support our analysis is provided in figure 5.15.

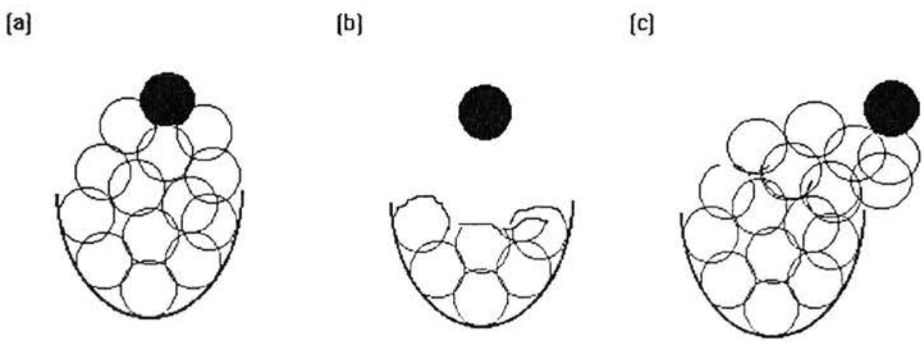
Figure 5.15



Here one would not say *the box of chocolates is in the table* although the conditions of containment and functional control are met. This information appears to be secondary to the fact that the function of table is to support objects, and therefore *on* is the appropriate preposition to use. This is also evidence against the hypothesis that one will use the strongest control relation preposition whenever possible in preference to weaker control relation prepositions.

To return to our proposed definition for *in,* several factors follow naturally from this ideal meaning. Of most importance is the fact that the functional control relations follow naturally from this sense of functionality we are espousing. Contiguity of movement is a clear demonstration that a container is fulfilling its function. Similarly, geometric relations fall out of this analysis too. If we consider the scenes in figure 5.16, then we see that the use of *in* is appropriate in (a) and (c) but not in (b). The black ball is geometrically in the same position in each scene, but the use of *in* is clearly infringed in (b). In (a) the bowl is fulfilling its function in the sense that Garrod and Sanford describe. If one was to move the bowl, then the black ball would move with it. In (c) the black ball is outside an imaginary extended control space for the bowl. However, use of *in* is still felicitous under normal circumstances.

Figure 5.16



The above examples demonstrate that geometry falls out of the sphere of functional control that a container can be said to have. In (b) above the black ball is not in contact via other balls in order to suggest that the bowl is fullfilling its function. In (c) this possible position of the ball again is dependent on the assumption that the bowl is fullfilling its function. Hence, geometric relations associated with *in* are dependent on the criteria that are adopted to demonstrate that the container is fullfilling its function.

The kind of account we are introducing here is perfectly compatible with the experientialism of cognitive linguistic accounts, and with prototype effects. Before we develop this analysis any further, we will test some of the claims that have been made thus far. We therefore move to consider sense delineation in light of the present discussion using a variety of experimental paradigms.

Chapter 6

# Experimental Evidence for Functional Relations and Minimal Specification

## 6.1 Introduction

In this chapter we involve ourselves with empirical investigation of some of the claims that were made in the last chapter, which suggested the validity of the claim that a minimally specified account of the lexical entries for spatial prepositions based on the recognition of the importance of functional relations is preferable to fully specified lexical entries based on geometric relations. However, the acid test of this analysis lies in correct predictions concerning the use of the prepositions being considered. In other words, we wish to be able to solve the encoding and decoding problems to a satisfactory degree.

This chapter presents some experimental evidence which, it will be demonstrated, supports the introduction of functional relations into the lexical semantics for spatial prepositions. Furthermore, the evidence presented, it is argued, is consistent with a minimally specified approach to the semantics of spatial prepositions.

## 6.2 Experiment One

### 6.2.1 Rationale

In previous chapters we have argued for a distinction between occurrences and senses of a prepositional lexeme, and we have suggested that we need to find a way in which to reliably delineate senses. Previous accounts have been criticised for their lack of ability to do precisely that, and this was (following Crangle and Suppes, 1989) related to the lack of focus on the relationship between language and the spatial world.

Thus far we have considered two possible methods with which to separate out senses. The first one relies on the identity tests for ambiguity introduced in chapter one. It was claimed that ambiguity tests are unreliable and ill-motivated, and that we should find a better method/set of methods. The other method, proposed by Herskovits (1986), postulated that a spatial preposition will correspond to two different senses if some distinction is generally important to a language user. Taking each of these methods in turn, we can consider ambiguity tests first.

It was argued in chapter one that ambiguity tests are ill-motivated in that they take a syntactic phenomenon, namely the fact that constituents of two different kinds cannot be coordinated, and apply them to polysemy. The examples of the test in action, (Zwicky and Sadock, 1975; Cruse, 1986) and working with seeming success, have largely dealt with homonymy. Here we provide evidence that identity tests do not work as methods of sense delineation.

### 6.2.2 Introduction

If we consider the use types of Herskovits (1986), which (as we have seen) are akin to senses, one can predict that sentences involving coordination of nouns selecting two different use types will be treated as unacceptable, whereas two nouns selecting the same sense of the preposition should be treated as acceptable. We can consider examples of this with two use types of *in* and *at* (Herskovits, 1986);

> *At* Use Type: Physical entity at location
> Example: *The cat is at the piano*(i.e., the cat is beside/near the piano).
>
> *At* Use Type: Person using artifact
> Example: *The man is at the piano* (i.e., the man is playing the piano).
>
> *In* Use Type: Spatial entity in container
> Example: *The flowers are in the vase* (i.e., the flowers are contained in the interior of the vase).
>
> *In* Use Type: Gap/object "embedded" in physical object
> Example: *The crack is in the vase* (i.e., the crack is part of the vase).

If these use types are indeed separate senses, then, one would expect that the following (zeugmas) are unacceptable;

The flowers and crack are in the vase.
The man and cat are at the piano.

This experiment was designed to test acceptability of this type of coordination, namely zeugma. It was hypothesised that, if this kind of identity test works, then sentences cojoining nouns selecting the same use type of the preposition should be viewed as acceptable, whereas conjoined nouns which separate two different senses of the preposition should be viewed as unacceptable.

### 6.2.3 Subjects

Subjects were ten native English speakers. All subjects were male.

### 6.2.4 Materials and Method

Nine sentences were presented to each subject (within subjects design). Five of the sentences involved coordination of nouns selecting the same sense of the preposition, and four involved nouns selecting two different senses of the preposition. These are displayed in table 6.1.

Table 6.1

| | In | At |
|---|---|---|
| Same sense | The flowers and water are in the vase.<br>The crack and nail are in the vase.<br>The flowers and lead are in the vase. | The teacher and pupil are at the piano.<br>The secretary and typist are at the typewriter. |
| Different sense | The crack and flowers are in the vase.<br>The crack and lead are in the vase. | The man and cat are at the piano.<br>The woman and cat are at the typewriter. |

Sentences were presented individually with a Lickert scale from 1 to 7, where 1 = completely unacceptable, and 7 = completely acceptable. Subjects were provided with the following written instructions;

> "Please score the following sentences in terms of acceptability (on the scales provided), where 1 = completely unacceptable and 7 = completely acceptable".

After completion of the test, each subject was interviewed in order to test understanding of the sentences, and to get an idea of the criteria used to judge acceptability by each subject.

### 6.2.5 Results

Mean acceptability ratings for each sentence are reported in table 6.2.

Table 6.2

| Sentence | Mean Rating | Standard Deviation |
|---|---|---|
| The flowers and water are in the vase | 6.5 | 0.71 |
| The crack and nail are in the vase | 1.7 | 0.82 |
| The flowers and lead are in the vase | 1.6 | 0.97 |
| The crack and flowers are in the vase | 1.0 | 0 |
| The crack and lead are in the vase | 1.2 | 0.42 |
| The teacher and pupil are at the piano | 7.0 | 0 |
| The secretary and typist are at the type-writer | 6.7 | 0.48 |
| The man and cat are at the piano | 6.1 | 0.51 |
| The woman and cat are at the typewriter | 3.4 | 1.51 |

Thus the ordering of acceptability from most acceptable to least acceptable is as follows;

(1) The teacher and pupil are at the piano (same sense)
(2) The secretary and typist are at the typewriter (same sense)
(3) The flowers and water are in the vase (same sense)
(4) The man and cat are at the piano (different sense)

(5) The woman and cat are at the typewriter (different sense)

(6) The crack and nail are in the vase (same sense)
(7) The flowers and lead are in the vase (same sense)
(8) The crack and lead are in the vase (different sense)
(9) The crack and flowers are in the vase (different sense)

The gaps between (4) and (5) and similarly between (5) and (6) represent the fact that the top four and bottom four mean acceptability ratings are almost identical (i.e., they cluster together), with the mean rating for sentence five in the middle.

The ratings for (6) and (7) reflect low acceptability ratings almost identical with those for (8) and (9). Notice also that (4) and (5) are rated higher than (6) and (7).

The acceptability rating mean scores comparing (5) and (6) are significantly different at the $p<0.01$ level (two-tailed t-test, $df=9$, $t=3.04$).

Comparing the acceptability ratings of (4) and (5), there is also a significant difference at the $p<0.001$ level (two-tailed t-test, $df=9$, $t=5.45$).

On questioning after completion of the task, subjects made comments which can be grouped into two classes. Firstly, all subjects commented that the reason they gave sentences (6), (7), (8) and (9) low ratings was because "the objects don't go together". In other words, subjects reported giving sentences a low rating if the figures concerned were conceptually incompatible in relation to the ground. Secondly, sentences (4) and (5) were interpreted in three different ways by subjects. Four of the subjects treated sentence four as selecting the same sense such that the cat and the man are playing the piano. Four of the subjects took the interpretation that the cat and man are positioned beside the piano, and thus selected a different same sense from the first group. The remaining two subjects thought that the man was playing the piano with the cat beside him.

### 6.2.6 Discussion

The ordering of acceptability ratings observed strongly suggests that the criteria used by subjects to judge acceptability of the sentences concerned reflect more that mere sense selection. In particular, acceptability judgements of *in* appear to be effected by the nature of the objects which do not go together. For instance, *the crack is in the vase* and *the nail is in the vase* correspond to the same sense (at least in Herskovits's account), but a *crack* and a *nail* seem conceptually very different, and thus lead to low acceptability judgements, akin to those where two different senses are selected.

There are problems choosing examples with the case of *at*. The problem is that *the man and cat are at the piano* allows the use of the same sense. Some subjects reported the interpretation that both the man and the cat are *playing* the piano, and some reported that both were *beside* the piano, hence suggesting that there are two senses for *at* involved here.

However, with the sentences involving *in* there was a different pattern. Degree of acceptability is not a direct reflection of ambiguity. It was found that *the flowers and lead are in the vase* was as unacceptable as *the crack and flowers are in the vase.*

Similarly, *the crack and nail are in the vase* was as unacceptable as *the crack and flowers are in the vase.* The evidence provided thus presents concern as to the viability of zeugma as a successful test of sense delineation.

Another possible explanation for the finding could be that Herskovitsian use types do not in fact represent different senses at all. This is an explanation we will pursue with experiment two. Nevertheless, with *the flowers and lead are in the vase* the flowers and lead clearly represent the same sense of *in* in that both are contained interior to the vase. A low acceptability rating is still apparent in this case. Clearly, then, the acceptability ratings cannot be explained in terms of problems solely with Herskovitsian use types.

One last point worthy of mention reflects the graded nature of acceptability ratings. Acceptability is not all-or-none. The findings we have yielded are similar in this respect to other work which has found grammaticality to be a matter of degree (e.g., Berry, 1975; Givon, 1979; Kuno, 1987). For example, Langacker (1982) argued that the sentences below fall on a cline of increasing felicity;

> *A bicycle is wanted by me.
> *?That bicycle is wanted by me.
> ??That bicycle is wanted by my son.
> ?That bicycle is very definitely wanted by my son.
> That bicycle is very definitely wanted by every young boy.

One further point concerns the reasons for the acceptability judgements. In other words one can ask if the judgements arise as a result of semantic ill-formedness (as identity tests suggest) or pragmatic ill-formedness. As Quirk et al (1985, p.16) comments;

> "The borderline between between grammar and semantics is unclear, and linguists will draw the line variously...Similarly, the borderline between grammar and pragmatics (and even more so between semantics and pragmatics) is unclear."

Indeed the evidence of the present study suggests the irradication of the division between semantics and pragmatics in cognitive linguistic accounts (e.g., Langacker, 1988) is a valid one.

It can be concluded that zeugma does not provide an adequate method of sense delineation as it cannot separate out failures which may result from two different senses of the lexeme of interest being selected, and failures which result from processing involving conceptual incompatibility/conflict between the objects and functional relations concerned. (We develop this line of explanation at the end of the present chapter). Thus we follow Cruse (1986) in the characterisation of lexical ambiguity as those ambiguities for which there are no convincing non-lexical explanations. We have found that an explanation residing in conceptual incompatibility and functional relations may be more parsimonious. It follows that one can question the validity of ambiguity tests in general as methods of sense delineation as zeugma is considered to be one of the most reliable tests. We therefore have to turn to the second method of sense delineation.

### 6.3 Experiment Two

#### 6.3.1 Rationale

The first experiment has demonstrated that there are serious problems with the first method of sense delineation proposed, which forces us to seek more adequate methods. However, the results of the first experiment have themselves provided some clues to a more effective methodology. It was noted that some of the difficulties with ambiguity tests reside in the lack of information about the spatial relations involved (the case of *the man and cat are at the piano*). This suggests that visual scenes should perhaps be provided to pair spatial language with the spatial world, thus facilitating an understanding of what the spatial language should refer to. We also wished to exploit the importance of the situation in grasping a sense of a phrase. Johnson-Laird (1987, p.190) makes a similar point;

> "Determining reference......usually depends on knowledge of the situation, knowledge of the speaker, knowledge of the conventions governing discourse, and the ability to make inferences".

With this point in the background we can consider the second method of sense delineation that was proposed earlier.

The second method we proposed, that of Herskovits (1986), has been given a possible realisation in the last chapter. We suggested that there may be motivation for providing a distinction between a sense of *at*, which involves a functional coincidence relation and a sense which involves a purely geometric relation. This is in contrast to *in* and *on* which always involve a functional component as the geometric position of figure in relation to ground is always dependent on the container and supporting surface (respectively) fulfilling their function. Thus we are hypothesising that there is motivation in terms of distinctions language users may make (functional versus non-functional cases) which are reflected in two senses for *at,* but only one sense for *in* and *on.*

### 6.3.2 Introduction

The aim of the present study is to examine the attribution of locative prepositions within sentences paired with visual scenes. The purpose is to examine the effects of the use of one preposition on the use of subsequent prepositions. In other words, the study is an observational one designed to tap for co-occurrence relations. At the same time, we wish to test the hypothesis that a preposition can be said to have two senses if there is a distinction between a functional sense and a purely geometric sense.

Specifically, the study again deals with the use of the three prepositions that have been extensively studied by Annette Herskovits (1986). Herskovits describes and maps out the different uses of the prepositions *in, at* and *on.*

More specifically the study concentrates on two use types for each preposition.

The following are proposed as two distinct use types for *in, on* and *at* ;

*In:* "Spatial entity in container" versus "gap/object 'embedded' in physical object".

With the "spatial entity in container" use type the three-dimensional reference object has an interior, in which the located object, also three-dimensional, is fully or partially contained. Examples of this are *the flowers in the vase* and *the man in the chair.* With the second use type, the located object is included in the normalised region defined by the reference object, that is, in the part of space its shape would occupy prior to penetration. Examples of this are *the nail in the chair* and *the crack in the bowl.*

*On:* "Spatial entity supported by physical object" versus "accident/object as part of physical object".

An example of the former is *the ball is on the foot* and an example of the later is *the lines are on the forehead.*

*At:* "Person using artifact" versus "spatial entity at location".

An example of the former is *the woman is at the typewriter*. An example of the latter is *the bus is at the church*.

Another way of cataloguing the use and meaning of prepositions, as we have seen, is in terms of functional control relations (Garrod and Sanford, 1989). In each of the above examples, one can view one of the use types as exhibiting a stronger control relation than with the other type. For example, one can contrast the case of *the flowers are in the vase* and *the crack is in the vase* in terms of strength of control relation. The former is a weaker control relation as the flowers can fall out of the vase if the vase was tilted over 90 degrees. By contrast, the crack is not susceptible to such manipulation.

Garrod and Sanford, as we saw in the last chapter, point to two parts of the meaning of prepositions. One is the geometric relation highlighted by Herskovits. The other is a stronger notion of functional control, which highlights how objects interact with each other. We are keen to keep this distinction in mind in the present study. Indeed, as well as using the distinctions for the purpose of the design of materials to help tap co-occurrence relations, there is the possibility of relating actual use of the prepositions concerned to the theoretical underpinnings of Herskovits, Garrod and Sanford, and others. This point is worthy of discussion.

Herskovits maintains that her formulation of the encoding/decoding problems sidestep some problems of psychological validity; it makes no reference to psychological processes. For Herskovits, all that is required is that situations and expressions be appropriately paired. Therefore the analysis of decoding and encoding adopted should be viewed more as paving the way for designing algorithms that would behave like language users, assuming such algorithms possible, rather than tapping the psychological processes directly at this stage.

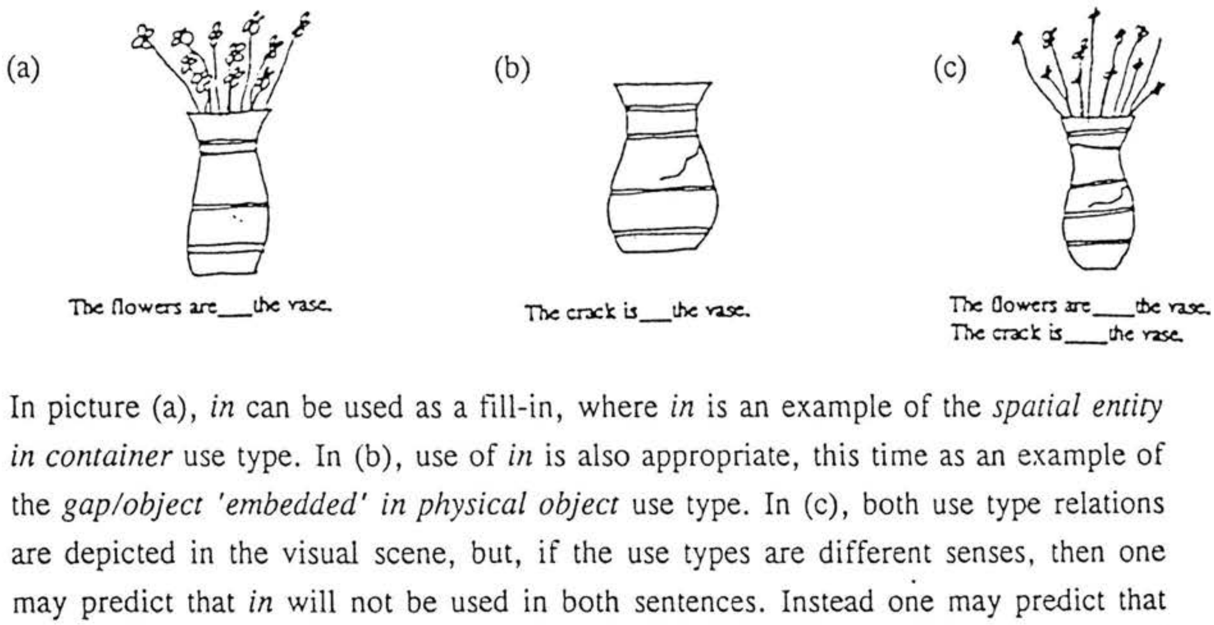
It is our view that it is impossible, nor even preferable, to separate the issues of decoding and encoding from the psychological processes involved in the use and understanding of locative expressions. If we take the encoding question, for example, it is a difficult issue to assess how one would evaluate whether or not a locative expression has been used appropriately in a particular situation. The issue of appropriate use relates completely to the situation at hand.

We do not wish at this point to get into a discussion of the relationship between processing and linguistic accounts of prepositions, as these have been discussed in chapter four. This will be picked up again at the end of the present chapter. Let us now discuss the materials of interest.

The materials of interest here are sentences with blanks which are paired with pictures. The blank is where a preposition can be added, although verbal modification and longer phrases are still candidates for addition. Sentences are presented with a picture. The effect of interest is to monitor the pairing of two simple sentences with two simple pictures versus one complex picture (the simple pictures combined) with the sentences presented together. This is of interest with respects to whether people switch preposition (where possible) in the complex picture as a consequence of the same preposition being used in two different ways (use types). An example will make this clearer.

If we consider the pictures in figure 6.1, one can compare the fill-ins given in the simple and complex conditions, where (a) and (b) are simple conditions and (c) is the complex (a concatenation of the simple conditions).

Figure 6.1




In picture (a), *in* can be used as a fill-in, where *in* is an example of the *spatial entity in container* use type. In (b), use of *in* is also appropriate, this time as an example of the *gap/object 'embedded' in physical object* use type. In (c), both use type relations are depicted in the visual scene, but, if the use types are different senses, then one may predict that *in* will not be used in both sentences. Instead one may predict that subjects may use an alternative preposition for one of the sentences. That is, of course, dependent on the claim that the two use types of *in* are different senses (a claim which Herskovits (1986) does make; she uses identity tests to provide evidence that use types are distinct senses).

The question for investigation can be phrased as follows ; does the use of one preposition have any effect on the use of other prepositions? This can still be refined further as; does the use of a preposition used with a specific use type effect the subsequent use of the same preposition with a different use type?

From the discussion in the previous chapter one can hypothesise that subjects will be more likely to switch preposition in the case of *at* where two different use types are involved as they represent a distinction between a geometric and a functional component, whereas, subjects will be less likely to switch preposition with *in* and *on* as both use types involves a functional component (and, it will be argued later, these use types are not different senses of a lexeme, but different occurrences).

### 6.3.3 Materials

For *in* and *at* four sets of pictures and sentences were used. For *on* five sets were used. Each set consisted of two simple pictures each with one sentence underneath, and one complex picture (the simple pictures combined) with both sentences underneath (of the form presented in figure 6.1 above). All materials are in appendix 1.

Two questionnaires were used consisting of simple pictures with one sentence and complex pictures with two sentences. Corresponding complex and simple pictures and sentences were not issued in the same questionnaire to avoid transfer of answers (memory effects). Consequently several weeks were left before the issue of the second questionnaire to subjects. The individual items were spaced out as far as was possible using a stratified random sampling technique to avoid transfer between sentences involving the same prepositions. A pilot study was conducted to assess whether such transfers were liable to take place (5 subjects). No obvious transfers were observed (assessed by frequency of use in relation to possibilities for use).

The order of presentation of scenes is displayed in appendix 2.

A further manipulation was the control of order of presentation of the sentences presented with the complex pictures. This was counterbalanced for strength of control.

### 6.3.4 Subjects

120 adult subjects were used. The subjects were split into two groups with one group receiving the strong control items first, and the other receiving the weak control items first (that is, in the complex condition). All subjects received the same simple items. A counterbalanced design was used such that half of each group received questionnaire one first, and half received questionnaire two first.

### 6.3.5 Procedure

Subjects were given a first questionnaire with the following instructions;

> "Below are pictures with either one or two incomplete sentences underneath. What you have to do is to simply look at each picture and imagine that you are describing the picture to someone else. Then fill in each blank so that each sentence matches the picture. Don't spend too much time on each picture. What is important is your immediate reaction (there are no right answers!), just as if you were describing each scene to someone over the telephone."

After a period of several weeks the second questionnaire was administered with the same instructions.

### 6.3.6 Results

All 120 subjects fully completed both questionnaires. No subjects reported direct awareness of the similarity in materials with the questionnaires, such that subjects did not (unless unconsciously) remember their answers from the previous questionnaire and copy them in the second questionnaire.

The frequencies of fill-ins using the prepositions of interest were compared between the strong and weak groups (i.e., order of presentation of use type with the complex pictures). No significant differences were found (2-tailed independent t-test) either with the completions for the simple or complex items (single sentences versus paired sentences).

As no differences were found due to order of presentation of the sentences in the complex condition, the rest of the between subjects analysis deals with pooled data.

Overall the responses of the sentences in the simple condition were compared with the equivalent sentences in the complex condition. With all the items, no significant difference was found (related two-tailed t-test, t value=0.353, two-tailed, $p < 0.73$). When comparing the three prepositions individually (by materials), the following results were found ;

(comparison of each sentence completion rates pooled in simple versus complex condition);

*On,* Total (all items); t value (two-tailed) = -0.722, probability < 0.49 (nonsignificant).

*On,* weak ; t value (two-tailed) 0.61, probability < 0.58 (nonsignificant)

*On,* strong ; t value (two-tailed) 0.372, probability < 0.73 (nonsignificant)

*In,* Total (all items) ; t value (two-tailed) = -3.62, probability < 0.72 (nonsignificant)

*In*, weak ; t value (two-tailed) = 0.111, probability < 0.9185 (nonsignificant)

*In,* strong ; t value (two-tailed) = -0.551, probability < 0.62 (nonsignificant)

*At,* Total (all items) ; t value (two-tailed) = 1.888, probability < 0.1 (nonsignificant)

*At,* weak ; t value (two-tailed) = 13175, probability < 0.0009 (significant)

*At,* strong ; t value (two-tailed) = -02.224, probability < 0.1126 (nonsignificant)

The number of different types of fill-ins for each of the sentences was recorded. Overall there were significantly (comparison of means) more different types of responses to the sentences involving *at* than with *in* and *on*. This was confirmed by a sample of independent raters who found significantly more overall possibilities for *at* than *in* and *on*. However, an examination of individual materials revealed that no significant difference was found with all of the *at* materials. Indeed some of the *in* and *on* materials were observed to have fewer possibilities than some of the *at* materials.

Finally, all of the subjects (100%) who used *at* in the complex materials in the strong control sentence switched preposition in the weak control sentence.

### 6.3.7 Discussion

It can be argued that no obvious transfers occurred across items or questionnaires. This was controlled as far as it is possible to do so. However, some comments can be made about the nature of the materials.

No differences were found between the subjects who were given strong items first versus whose who were given weak items first in the complex condition. This may be due to the fact that both sentences were presented together, and consequently subjects may have read both sentences before completion. This may have obscured an effect future studies should be designed to tap more carefully.

The actual pictures used can be refined further to elicit the desired use of preposition in the simple conditions. Some of the pictures left open a large number of responses which may have obscured effects of interest. Another option would be to fix the use of the preposition in the first sentence initially and simply monitor response (or reaction time/error rate) to the second sentence.

Despite the problems briefly mentioned above, the study has yielded some useful findings. There is strong evidence to suggest that with *on* and *in* subjects stick to the same preposition in the complex condition (across both sentences, that is) . This may be related to the dialogue maze tasks studied by Garrod and Anderson (1987). They found that people tend to settle on description schemas when talking about directions in the maze games. Although the tasks described are dealing with dialogue, one can argue that a similar process is happening with the use of prepositions in this study. If a preposition appears to be appropriate to describe two situations it is not necessary to switch preposition. This is much the same as subject pairs agreeing on a suitable description schema and continuing its use. If is working well, there is no reason to switch schema.

In contrast to *in* and *on*, however, there is a clear difference with the case of *at* in which there is a highly significant switch of preposition in the weak control sentence in the complex condition. This cannot be explained in terms of a greater selection of alternatives (greater number) with the *at* pictures and sentences than with the *in* and *on* materials. Firstly, some of the *in* and *on* materials had a comparable (or greater) number of options than some of the *at* materials and still subjects stuck to the same use of preposition with *in* and *on* and switched with *at*. Secondly, even if the number of choices available was a factor, this cannot explain why the change of preposition

always occurred with the weak control relation irrespective of order of presentation. Indeed we believe that there is a motivated reason for this effect.
The use types chosen for *at* exhibit a clear difference in the control relation. The strong control relation is a strong functional control relation highlighting interaction between the person in each case and the respective object. Hence, saying that *a man is at the piano* is tantamount to saying that he is playing the piano. This suggestion is strengthened by the large number of subjects who actually used a verb (e.g., *playing*) in this case. With the weak condition, no such claims can be made. Hence, it would appear necessary to switch preposition as two clearly different uses for *at* are being demonstrated.

This explanation leads us from a discussion of the use of prepositions to a discussion of the meaning of prepositions. One could argue that the present finding is simply one of processing, and has nothing to do with meaning, and the theories which purport to address these issues. However, if subjects are most keen to recognise a difference between two use types versus two other use types, or alternatively differentiate between different types of control relation (simple geometric relations versus strong control) and not other gradings of control relations, when should this not be reflected in theories which deal with meaning and the lexical representation of meaning ?

Herskovits, although trying to avoid psychological issues, makes some implicit claims about representation, and the processing and use of prepositions. The meaning of a preposition is the ideal meaning, but the ideal meaning can be conventionally exploited in different ways, which must be recorded in the lexicon. When it comes to the discussion of encoding and decoding by Herskovits after having outlined the description of uses, problems start to appear. To give an example, Herskovits talks about selection of the appropriate use type in decoding. She gives the case of *the nail in the board*. She states;

> "after having selected the appropriate use type [(plucked from the lexicon)] which is *gap/object 'embedded' in physical object,* what we know about the use of nails, about the properties of wood, and how a nail is inserted into it, make some interpretations of the use type very unlikely."

We propose an alteration of Herskovits's theory which can encompass the difference in use types discussed, without relying on explicit representation in the lexicon. The important distinction in use type with *at* must surely be a candidate for lexical representation, and this is perhaps reflected in the encoding observed by subjects. However, the distinction between many of the use types, such as between the ones considered here for *in* and *on* are lesser candidates for explicit lexical representation as they can be derived from the same information about use of objects, properties, etc, that Herskovits deems necessary for deployment anyway. This line of reasoning is a starting point for a detailed analysis of *in, on, at, over, under, above* and *below* in chapter eight.

What we have essentially done in this study is to argue for a pruning-down of the use types of Herskovits based on the method of sense delineation suggested by Herskovits herself. It was proposed that a lexeme can be said to have two distinct senses if there is a distinction which language users regard as important. In this study we have provided evidence for such a distinction.

## 6.4 Experiment Three

### 6.4.1 Introduction

This experiment is a replication of experiment two only with slightly improved methodology. In particular the sentences in the complex condition were presented, not together as in experiment one, but on different pages. Additionally, the picture was presented on a page without a sentence underneath. The subjects were instructed not to turn back in the questionnaire booklet. Additionally, the pictures were improved so as to maintain identical spatial relationships between the figures (subjects of each sentence) and the ground (object for each sentence). The same pictures (with slight modifications) were used as the ones used in experiment two (see appendix 1).

Once again the experiment dealt with *in, on* and *at.*

### 6.4.2 Subjects

Subjects were 120 native English speakers.

### 6.4.3 Method

Exactly the same as for experiment two, with the corollary that subjects were requested not to turn back pages in the booklet once they had filled-in a response.

### 6.4.4 Results

The results of this study are almost identical with those in experiment two, and therefore are not reported here. Comparison of sentence completion rates pooled in simple versus complex conditions replicated those of experiment two, with the only significant result appearing in the *at* weak condition.

### 6.4.5 Discussion

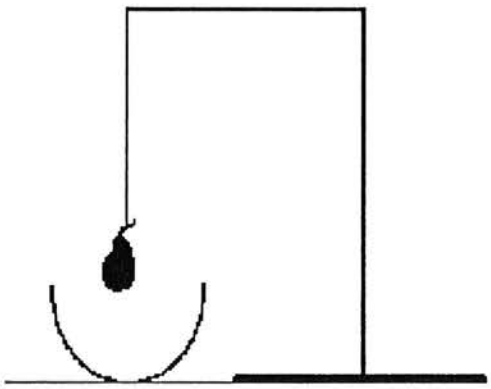
The results of this experiment merely serve to replicate those of study two, suggesting that the materials and method used in study two were adequate.

## 6.5 Experiment Four

### 6.5.1 Rationale

This experiment takes a slightly different approach to prepositions from those thus far described. Here we look at the effects of discourse on the attribution of a preposition to a sentence paired with a picture which relates to the discourse. In particular, we pick up on an example given by Garrod and Sanford (1989), which we discussed in the last chapter, as an argument for control relations. Additionally, the example is cited as an argument that, although the meaning of the preposition remains the same, the mental model adopted on a visual scene will effect whether or not the sentence is appropriate. The example is that depicted is figure 6.2 below.

Figure 6.2



To repeat the example, ordinarily one would not say that *the pear is in the bowl.* However, if one was playing a game which involved manipulation of the frame such that one had to place the pear within the circumference of the bowl then one could meaningfully say that the pear is in the bowl as the imposition of the model on the scene allows the functional containment relation to hold as one has to move the pear so that it is functionally contained by the bowl.

The purpose of this experiment is to test whether this does in fact happen. That is, given the context of a game, do subjects deem the use of *in* as appropriate?

### 6.5.2 Method

A discourse was designed to describe the game situation, paired with the scene. We were careful to avoid priming effects for the preposition *in,* so the use of a preposition in the discourse was avoided.

### 6.5.3 Subjects

Subjects were ten adults. All subjects were male. All were native speakers of English.

### 6.5.4 Procedure

Subjects were presented with the discourse below, with the picture underneath (in figure 6.2. The instructions were simply to read the discourse and fill in the sentence appropriately.

> Freud and Dostoevsky are playing a game. The object of the game is to move the frame such that the pear and bowl are positioned as depicted below. At the end of the game, Freud (the first to try) shouts : "I have won: the pear is___the bowl!"

### 6.5.5 Results

Of the ten subjects, three subjects completed the sentence with the preposition *in.* Six of the other seven subjects completed the sentence with the preposition *over.* The remaining subject used *above* as the completion.

### 6.5.6 Discussion

The results show that the use of *in* in the context of game does seem to be appropriate as three of the subjects were happy to complete the sentence accordingly. It is also clear that the subjects that completed the sentence in this way, without the presentation of the discourse, do not view *in* as an appropriate candidate for the completion of the sentence. Let us discuss this result.

However, the use of *in,* it can be argued, could have appeared for two reasons. Firstly, a notion of extended functional control could be operating, as Garrod and

Sanford (1989) suggest. Alternatively, it could be that constraint satisfaction at the level of the sentence (with the blank) constrained the choice of the preposition in favour of *in* so much that this negated any information apparent in the visual scene. In either case, one can argue that functional relations are operating. In the second case, the objects themselves provide a model of how the pear and bowl are interacting, and thus the information present in the picture is viewed from a different model.

Despite the alternative interpretation, we wish to suggest that this result provides evidence that there is a dynamic control relation sense for the meaning of the preposition *in*. The example of the cranedriver and foreman presented in chapter five lends credence to this claim. Furthermore, this sense is lexically represented. In the null context *in* is not appropriate as the normal criteria for control relation do not hold. As we shall see, our account requires that one has to cross-check the information available about figure and ground before an analysis of the appropriateness of an expression at the semantic level can take place. Normal satisfaction of the containment control relation specified with *in* suggests that containment is a high criterial candidate for the correct use of *in* with the subject and object as pear and bowl respectively. In order to elicit the preposition *in,* it is necessary to focus on the control relation so that the picture is described as representing a change of state. In the context of a game, the end result differs from past states in that there is a control relation apparent. Hence, in this context, the use of *in* is felicitous. Thus this also supports the existence of mental models as interfaces between language and the spatial world.

Again, we will develop this explanation in chapter eight.

### 6.6 Experiment Five

#### 6.6.1 Rationale

All the above experiments clearly relate to the use of language. However, our theory suggests another type of manipulation which would provide direct evidence for our analysis. Ferrier (1991) has conducted one study along these lines. The study involved video recordings of visual scenes which subjects were then asked to rate, (using a Likert scale) for the appropriateness of a preposition to the scene in question. Hence, the study directly tackles the issue of how spatial language and the spatial world covary. What is of interest here is that many of the scenes involved some movement prior to the judgment. For example, let us consider one case (which was not used) to illustrate the idea.

It is equally felicitous in the case of a cup and a saucer to say that *the cup is in the saucer* or *the cup is on the saucer.* Presumably one can say that both relations hold, and therefore that they are both appropriate prepositions to use. However, following this line of reasoning, if one was to increase the depth of the saucer, one would expect that *in* would be used more as the containment relation is more accentuated. Thus, as the depth of the saucer increases, one would expect that *in* will be used more and more. However, if we introduce the notion of a control relation, the situation looks much more complicated. If one was presented with a saucer and cup with no depth in the saucer, and the cup and saucer were seen moving around together with the cup glued to the saucer, then one would say more often that *the cup is in the saucer.* This is open to speculation, and is something that is worth testing, as the only way to explain the result is to draw recourse to control relations.

### 6.6.2 The Ferrier Experiment

Ferrier (1991) investigated experimentally for the existence of control relations. The rationale behind the study is that if control relations are vital to the use of the prepositions (in particular, *in, on* and *over*), then the absence or presence of such factors should affect the judgements of the relevant prepositions.

Several such factors were investigated by Ferrier;

(1) Position of the ball

(2) Presence of other balls

(3) Transitivity; presence of another bowl containing the target bowl.

(4) Continuity; target ball the same or a different colour to the other balls

(5) Dynamic versus static situations

Additionally the relationships between *in, on* and *over* were examined.

Thirty subjects (N=30) were presented with a video tape and a five page booklet with an instruction sheet. The visual scenes consisted of combinations of glass bowls and ping-pong balls. Various scenes were manipulated, and subjects were asked to score on a Lickert scale whether the ball (x) was *in, on* or *over* the bowl (y). Forty visual scenes were used.

The scales were presented paired with each video scene as follows;

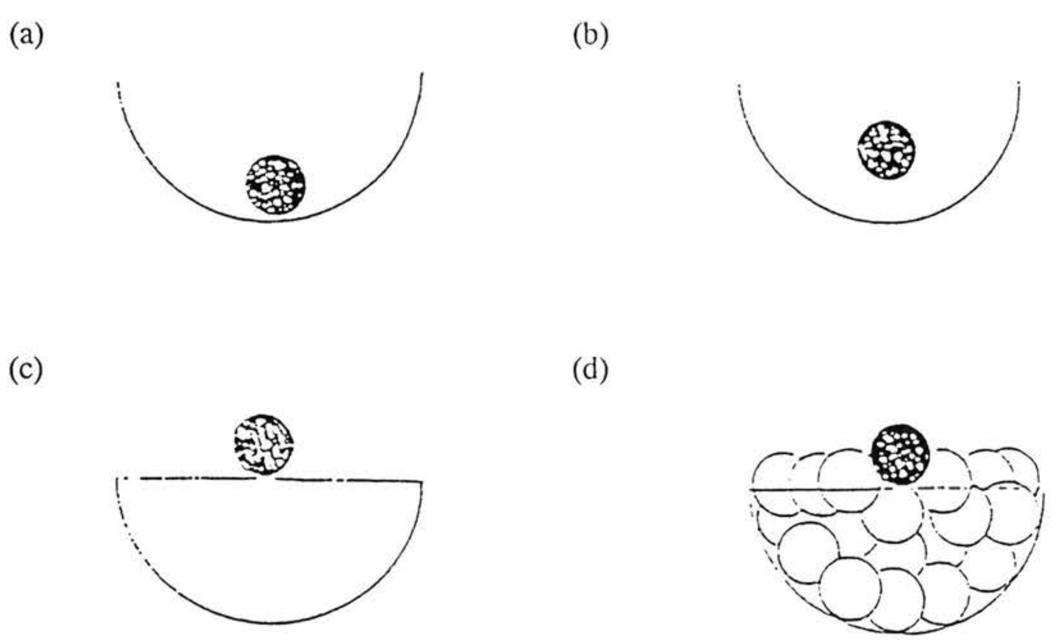
| | |
|---|---|
| The ball (x) is in the bowl (y) | 1 2 3 4 5 |
| The ball (x) is on the bowl (y) | 1 2 3 4 5 |
| The ball (x) is over the bowl (y) | 1 2 3 4 5 |

where 1 = (fits the scene) not very well and 5 = (fits the scene) very well.

Ferrier's findings broadly provide evidence for functional control relations, although there are a number of serious problems with her study. We will discuss the results first, and then the problems.

Ferrier found that the position of ball and the presence/lack of presence of other balls both affected *in* judgements. These were found to interact. For example, figure 6.3 (c) was judged to be less *in* that (b), which was in turn was rated less *in* than (a). With contact of the target ball with other balls there was an interaction (i.e., contact in the form of figure 6.3(d)).

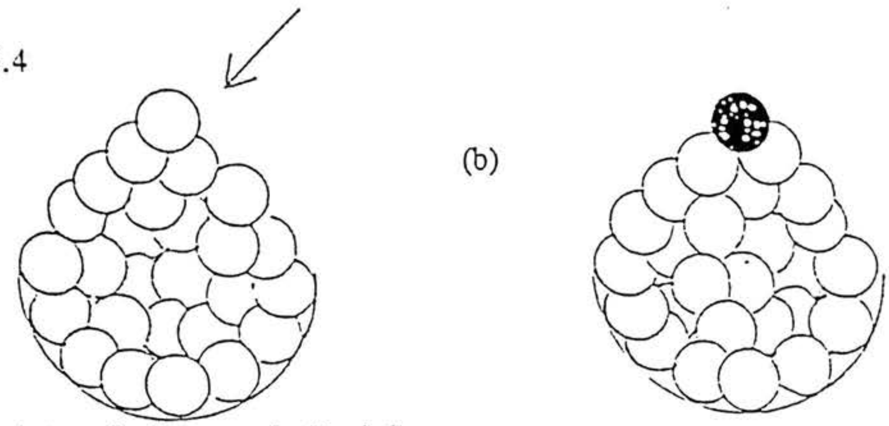
Figure 6.3




Continuity was found to have a significant effect on the use of *in*, with *in* being judged significantly more appropriate in figure 6.4(a) (below) than in figure 6.4(b).

Figure 6.4

(a) (b)

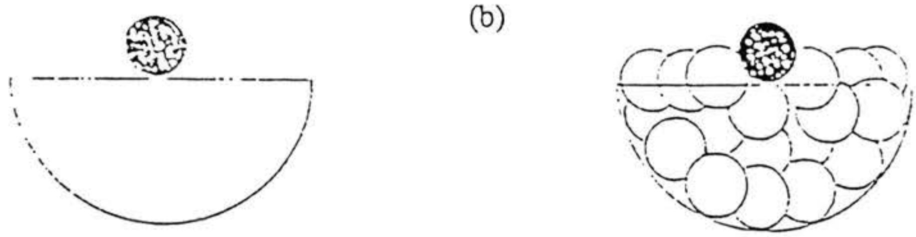


Pointer indicates ball (x)

Comparing figures 6.5(a) and (b), where the ball is touching the rim of the bowl, judgements of *on* were effected by the presence or absence of other balls. Similarly,

Figure 6.5

(a) (b)



the judgments for *over* in these trials seems to be effected by the absence or presence of other balls.

Movement of the target ball in the bowl in relation to static scenes with identical geometric positioning of figure in relation to ground was found to significantly effect judgements of *in*. An interaction of dynamic/versus static factor and the position of ball was found.

Ferrier states that the uses of prepositions do not have definite parameters, and that certain senses can be expressed with more than one preposition. There appear to be cases where trying to establish the presence or absence of necessary control relations results in uncertainty over whether a certain preposition is appropriate.

Ferrier's main conclusions from the study can be summarised as follows;

> (i) The functional containment relation of *in* is a perception of X and Y moving together, i.e., locational control.

(ii) The functional support of *on* is perception from the force of gravity.

(iii) The functional relation of *over* is functionally higher in the gravitational field and a lack of functional support being present (i.e., low ratings of *on*)

(iv) *In* does not appear to be transitive in functional cases, i.e., the immediate functional container appears to be the important factor.

(v) Similarity acts as a weak control for *in* when constraints are weak.

Ferrier's results, then, appear to vindicate the claim that language relates to the world in a principled way through mediation of mental models of that world. The criterion of any relation is functionality. The goal for Ferrier is to find a parsimonious account of the factors that could contribute towards a functional geometry.

We can now turn to consider a number of problems with the Ferrier study. The first set of problems relate to the task used. Firstly, the use of Lickert scales encourages subjects to make distinctions between uses of *in*, for example, that they may not make in everyday situations. For example, considering figure 6.3 (a) and (b), (b) was judged to be less *in* than (a). Under normal circumstances both uses of *in* may be considered appropriate. In fact. this problem is directly analogous to one we discussed in chapter four. Armstrong, Gleitman and Gleitman (1983) found that subjects exhibited prototype effects for well-defined categories, such as odd number. This again reflects the nature of the task, and in no way means that one represents oddness in terms of a prototype.

The problem of using Lickert scales is exacerbated in the Ferrier study with the limited choice of prepositions given to subjects to rate. Ferrier did not sufficiently cover the range of alternative prepositions which could appropriately describe each visual scene. Furthermore, the use of Lickert scales did not allow the use of verbal modification which may be used by subjects under more normal circumstances. This leads to the strong charge that the Ferrier study is invalid as subjects were forced to make distinctions (in terms of judgements) in an artificial situation, given a limited repertoire of predetermined prepositions. Furthermore, subjects were encouraged to contrast one term with another, as the rating scales for *on*, *in* and *over* were presented together for each scene.

A further problem with the Ferrier study is that, due to the limited number of scenes used, subjects could remember similar scenes as they were not sufficiently spread apart, and therefore they could presumably make distinctions as required.

There are, then, some serious problems with the Ferrier study, and therefore one must be wary with respect to drawing conclusions from the results obtained as they are probably more representative of the nature of the task than how one attributes spatial language to the spatial world under more usual circumstances. Nevertheless, the examination of how the spatial world and spatial language covary as embodied in the Ferrier study provides a foundation on which to build a more adequate methodology. We do this in experiment five, to be discussed.

### 6.6.3 Introduction

The present experiment is a video study similar to that used by Ferrier. However, the methodology of the Ferrier study is altered considerably in a significant way to avoid the flaws apparent. Specifically, the video trials were presented under the guise of a memory experiment. Subjects were instructed to try to remember the events and objects involved after blocks of ten trials. They were told that the experiment was designed to test the effects of verbal description on memory for spatial scenes. Furthermore, a sentence with a blank was presented (sometimes for the full duration of the trial, and sometimes flashed with a freeze-frame) on the screen with each trial. Subjects were asked to read the sentence and fill in the blank. To control for the memory experiment so that all subjects had the same length of description, they were instructed to keep fill-ins brief wherever possible, without loss of information. This method was designed to distract the subjects from artificial use of language (a serious flaw of the Ferrier experiment). Thus subjects were free to use whatever fill-ins they felt were most appropriate.

The study was designed to examine the claims of Garrod and Sanford (1989), discussed in chapter five, namely that;

(1) A figure is said to be *in* a ground if the ground functionally contains the figure, such that if the ground moves there is (or will be) contiguity of movement of figure with ground.

(2) A figure is said to be *on* a ground if the ground functionally supports the figure, such that if the ground moves there is (or will be) contiguity of movement of figure with ground.

Thus we examined the effects of different types of movement on the attribution of spatial language to spatial situations. The types of movement covered movement of the ground at different speeds, with the figure remaining contiguous with the ground, movement of the figure (with the ground remaining stationary), again at different speeds. Movement of figure was also varied in terms of systematicity, such that some types of movement were predictable, and other were seemingly random.

The types of figures and grounds used in the study were also varied. A possible problem with the Ferrier study not mentioned above lies in the use of ping-pong balls as figures. The present study used ping-pong ball in bowls and jugs, but also fruit in bowls and jugs. This enabled a comparison of the attribution of spatial language to situations where geometric relations and/or dynamic/static relations remain constant, where only the types of figure or ground vary.

The prepositions examined in this study, as a by-product of free use, are not restricted. However, the scenes were constructed in order to get at use of *in, on, over, under, above* and *below*.

It was predicted that;

(1) Contiguity of movement of figure with ground would affect attribution of *in* (following the Garrod and Sanford claim)

(2) There would be an effect of presence of other balls on attribution of *in* to a scene (following Ferrier).

All other comparisons are exploratory, and therefore are two-tailed.

### 6.6.4 Subjects

Subjects were forty normal-sighted native English speakers (age range 19 - 62, mean 32.375, SD 12.52) . Thirty of the subjects were male (age range 19 - 58, mean 30.5, SD 10.887), and ten of the subjects were female (age range 21 - 62, mean 38, SD 15.825). None of the subjects on questioning had any reading disorders or difficulties.

### 6.6.5 Materials

The materials consisted of video shots of combinations of bananas, oranges, apples, ping pong balls, squash balls, and a jug and bowl. Additionally several one-off trials were run involving rings, a finger, a crack and a floor. These were primarily intended as distractors for subjects so that they would not lose interest in the experiment (i.e., unusual scenes provided novelty for the memory task, and therefore kept reliability of response).

There were 322 scenes in all, each lasting five seconds (with a brief gap in between each scene). The scenes were structured into blocks of ten, with a long gap in between so that subjects could verbally recall scenes after each block of ten trials.

The order of scenes was randomised, so that subjects would not adopt strategies for responding. The large number of scenes used facilitated this. The order of presentation of scenes, and the contents of each scene are diagrammatically represented in appendix 3.

The video scenes, dynamic and static were filmed (without sound) using a Canon V-20 colour video camera. Unnatural dynamic scenes were constructed using a mixture of invisible threads, nails, and joists held (like a puppeteer) behind objects. The background to all the scenes was kept uniform in the form of a dark screen behind all objects. This facilitated clarity of the images used.

It should be stressed that all objects used were natural, ordinary, everyday objects, of a three-dimensional nature.

A tape recorder was used to record the responses given by subjects for each trial. A clip-on microphone was used for this purpose.

### 6.6.6 Procedure

Subjects were run on an individual basis. Each subject was seated in front of a video screen and video recorder and given a set of instruction which read as follows:

> You are going to take part in an experimental study designed to examine the effects of language task performance on memory for visual scenes. You will be presented with a number of scenes, each lasting five seconds. After every ten scenes you will be asked to make a simple verbal description of as many of the ten scenes as you can remember. As the experimental group, you are also required to complete a sentence (immediately after or during each scene) with whatever word(s) you feel would be most appropriate to the scene just viewed. It is important that this is done is a natural way, and conscientiously. Please also keep your sentence fill-ins short if possible, without sacrificing content.

Before proceeding, the experimenter also explained the instructions verbally to check that subjects understood the task.

The clip-on microphone was then fastened to the subject's lapel, and the volume level of the voice was checked to ensure appropriate recording quality.

Subjects were allowed a fifteen minute break half-way through the experiment

### 6.6.7 Results

For the purposes of the results, responses are grouped into three categories. These involve the preposition of interest used on its own, those involving the preposition used with verbal modification, and those involving the use of another preposition. Also, the reference objects were categorised into those cases where the ground was used as the immediate reference, and those cases where the immediate reference objects used were objects other than the ground.

For clarity of presentation, all scenes are reproduced in this section. At the end of the section, there is a concise summary of the results.

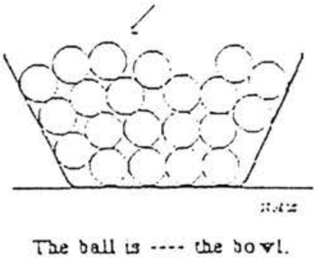
Unless otherwise reported, the statistical analyses used employed the Chi-square test (two-tailed). Chi-square values are only reported for significant results. The chi-square score required for $p<0.05$ is 3.84 (2-tailed, $df=1$), and the chi-square value required for $p<0.01$ is 6.64 (2-tailed, $df=1$).

The use of each preposition below each scene depicts the number of subjects using the relevant preposition for that scene.

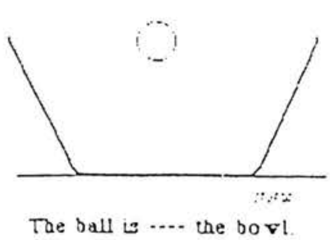
<u>Comparison of static ball/bowl scenes</u>

Contact versus noncontact of figure with bowl (via other balls), with identical geometric positioning;

Scene 150




Scene 113

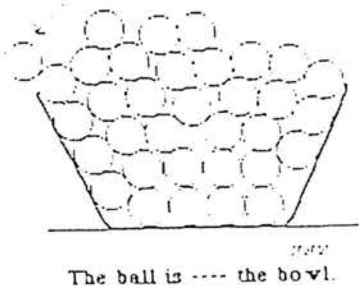



Use of *in* = 38

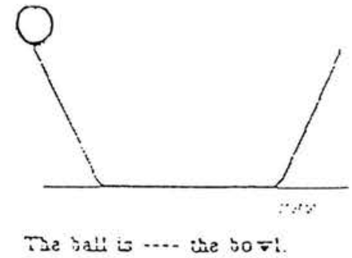
Use of *in* = 8

Chi-square = 19.56.
$p<0.01$ (Significant)

Scene 125

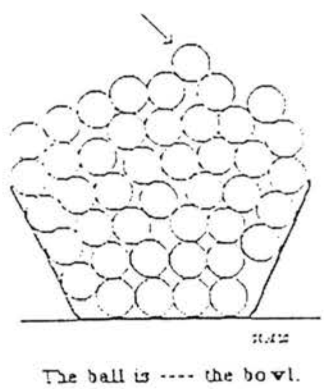



Scene 128

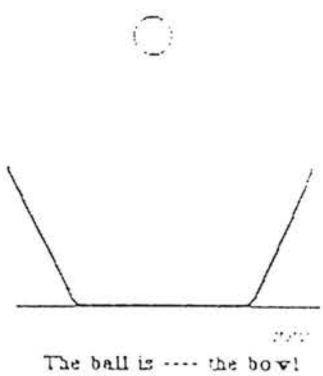



Use of *in* = 21     Use of *in* = 3     Chi-square = 13.5
$P < 0.01$ (Significant)

Scene 34



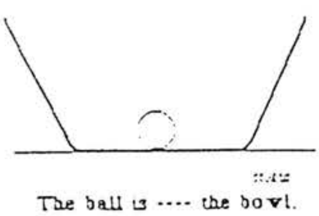

Scene 85



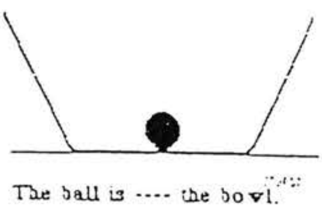

Use of *in* = 34     Use of *in* = 0     Chi-square = 34
$p < 0.01$ (Significant)

Static continuity versus discontinuity (geometric relations remaining constant):

Scene 132

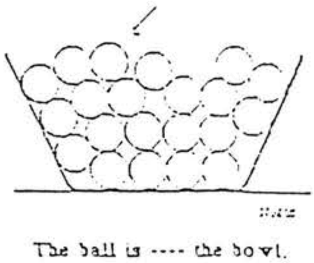



Scene 242

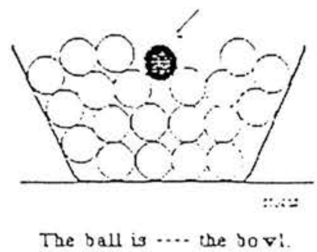



Use of *in* = 40     Use of *in* = 40     Nonsignificant

Scene 150

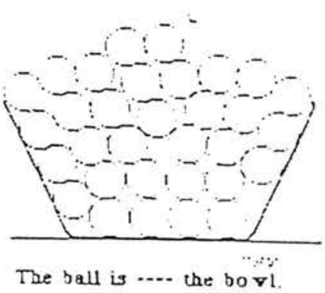



Scene 268

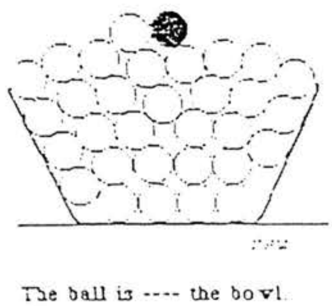



Use of *in* = 39 | Use of *in* = 39 | Nonsignificant

Scene 198

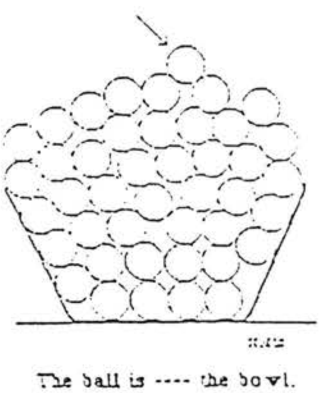



Scene 31

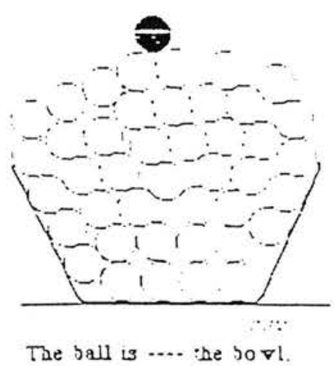



Use of *in* = 38 | Use of *in* = 37 | Nonsignificant

Scene 34

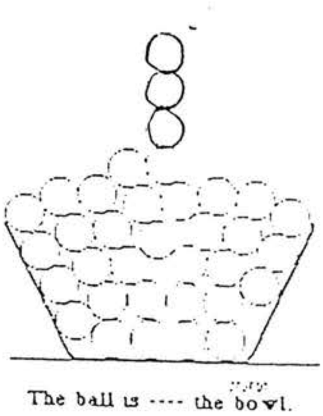



Scene 144

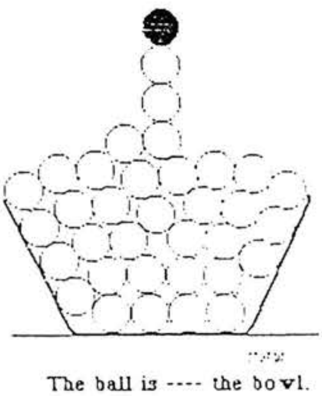



Use of *in* = 34 | Use of *in* = 32 | Nonsignificant

Scene 237




Scene 53

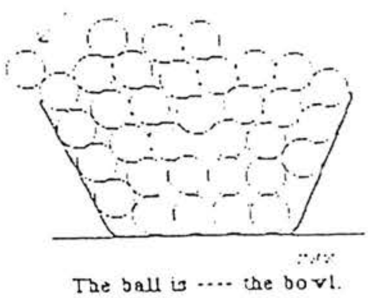



Use of *in* = 16

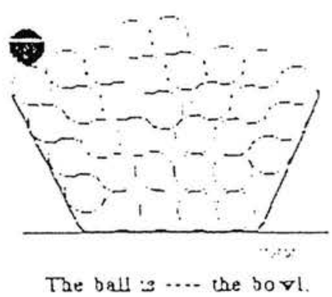
Use of *in* = 6

Chi-square = 4.55
$p<0.05$ (Significant)

Scene 125




Scene 178



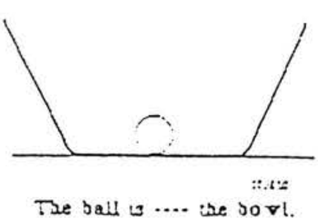

Use of *in* = 21

Use of *in* = 26

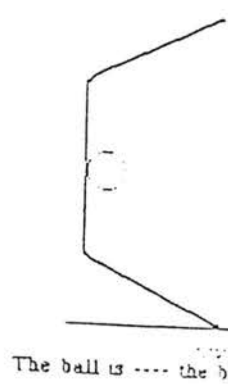
Nonsignificant

Static ball/bowl with bowl tilted:

Scene132




Scene 239

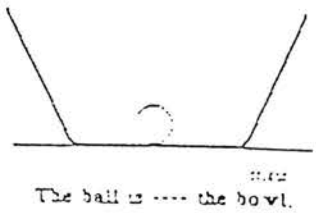



Use of *in* = 40

Use of *in* = 7

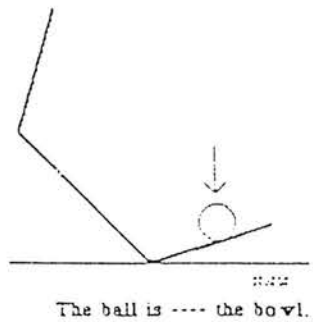
Chi-square = 23.2
$p<0.01$ (Significant)

Scene 132




Use of *in* = 40

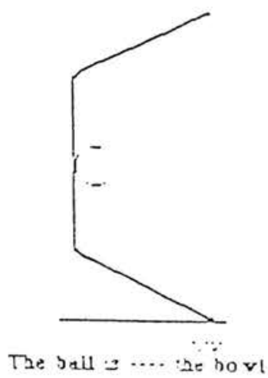
Scene 167




Use of *in* = 19

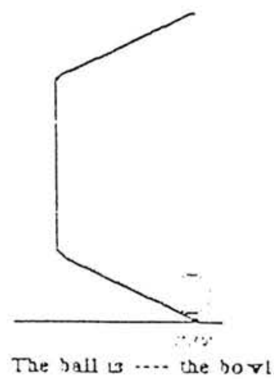
Chi-square = 7.47
$p < 0.01$ (Significant)

Scene 239




Use of *in* = 7

Scene 262

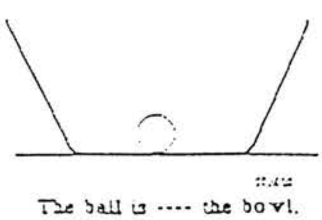



Use of *in* = 3

Nonsignificant

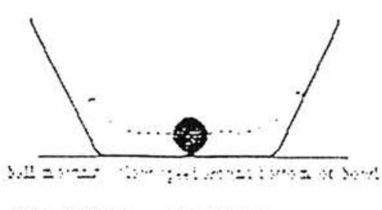
<u>Comparison of Static Versus Dynamic Continuity Ball/Bowl Scenes, With Ball Moving</u>

Scene 132




Use of *in* = 40

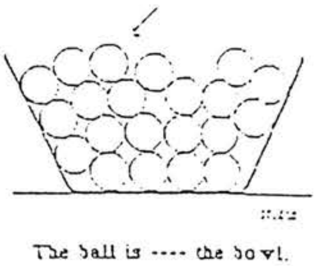
Scene 119



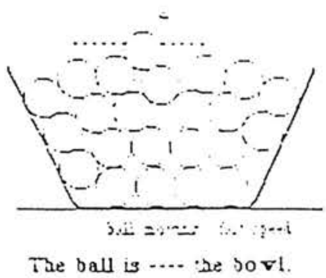

Use of *in* = 29

Nonsignificant

Scene 150




Scene 76

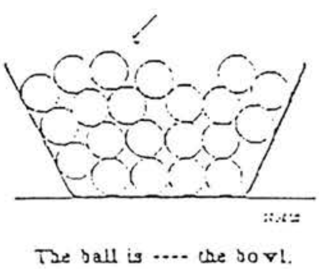



Use of *in* = 38

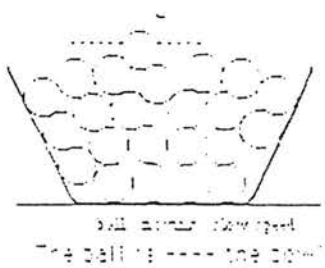
Use of *in* = 29

Nonsignificant

Scene 150




Scene 16

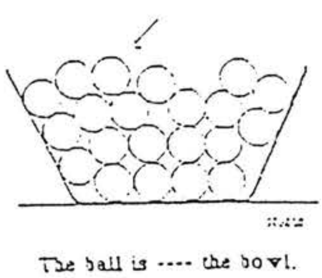


Use of *in* = 38

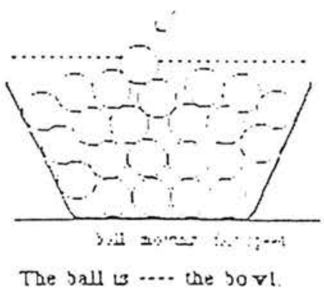
Use of *in* = 24

Nonsignificant

Scene 150




Scene 303

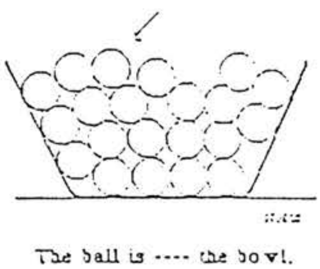



Use of *in* = 38

Use of *in* = 21

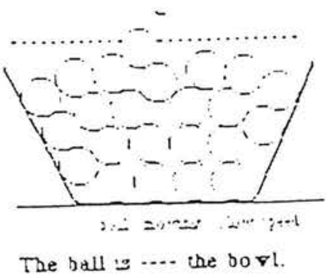
Chi-square = 4.9
$p < 0.05$ (Significant)

Scene 150



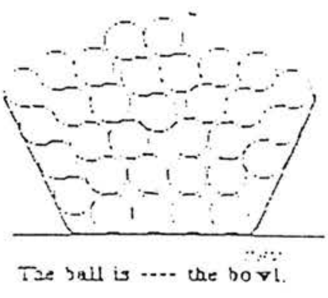

Use of *in* = 38

Scene 92



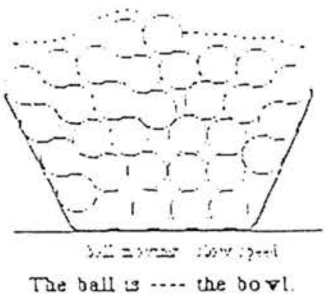

Use of *in* = 25 Nonsignificant

Scene 198



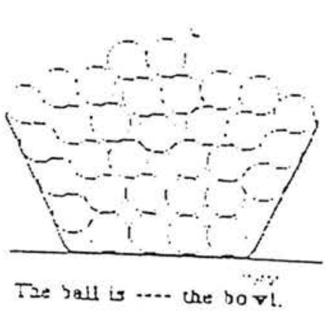

Use of *in* = 38

Scene 138



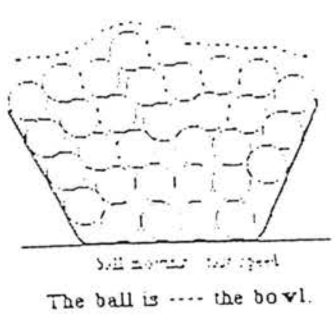

Use of *in* = 27 Nonsignificant

Scene 198



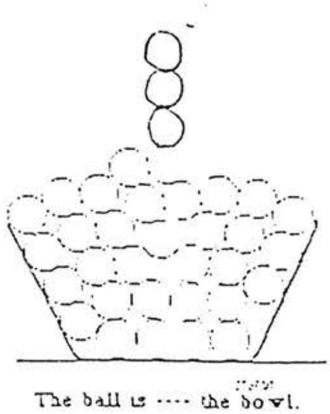

Use of *in* = 38

Scene 153



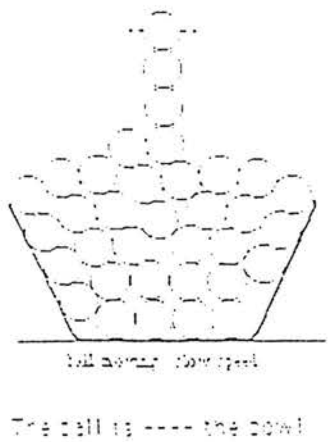

Use of *in* = 17 Chi-square = 8.01
$p<0.01$ (Significant)

Scene 237




Use of *in* = 16

Scene 6

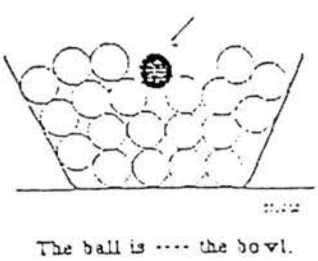


Use of *in* = 5

Chi-square = 5.76
$p<0.05$ (Significant)

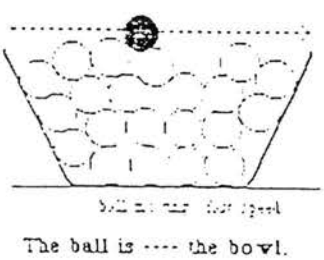
<u>Comparison of Static Versus Dynamic Discontinuity Ball/Bowl Scenes, With Ball Moving</u>

Scene 268




Use of *in* = 39

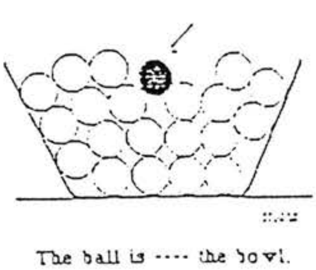
Scene 43




Use of *in* = 26

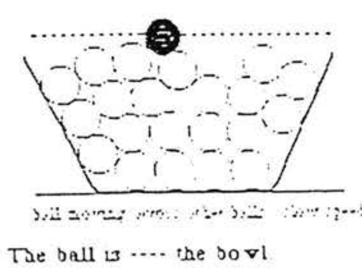
Nonsignificant

Scene 268




Use of *in* = 39

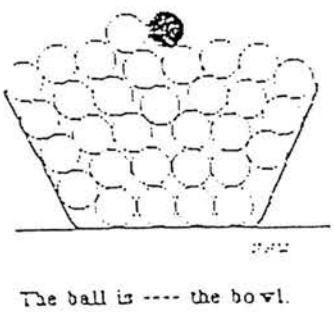
Scene 305



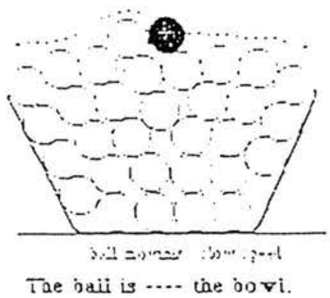

Use of *in* = 26

Nonsignificant

Scene 31



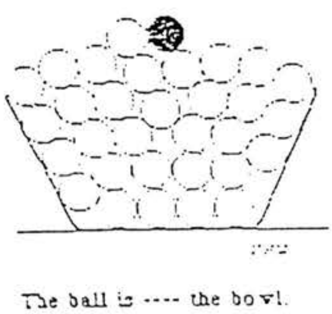

Scene 194



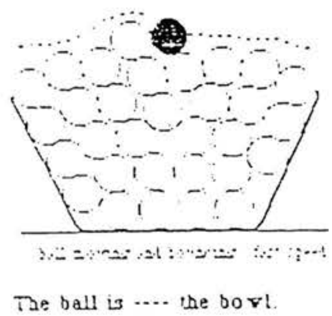

Use of *in* = 37

Use of *in* = 32 Nonsignificant

Scene 31



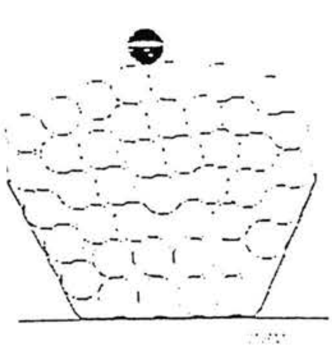

Scene 277



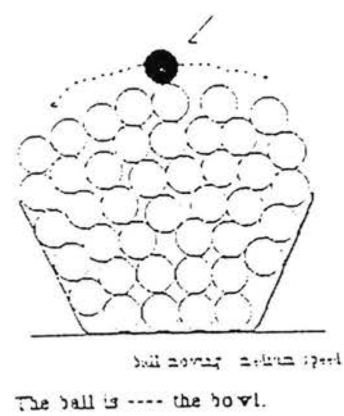

Use of *in* = 37

Use of *in* = 25 Nonsignificant

Scene 144




Scene 294

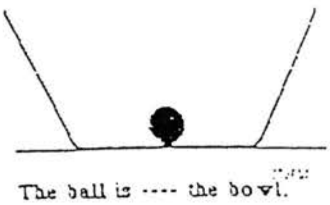


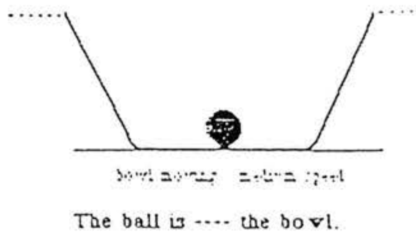

Use of *in* = 32

Use of *in* = 14 Chi-square = 7.04
$p < 0.01$ (Significant)

Comparison of Static Versus Dynamic Continuity Ball/Bowl Scenes, With Bowl Moving

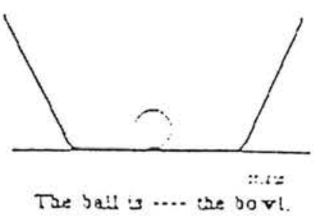
Scene 242 | Scene 241

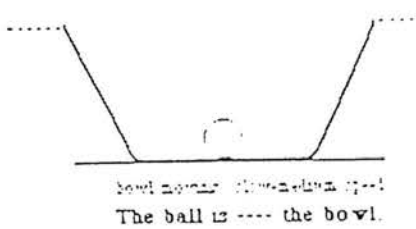



Use of *in* = 40 | Use of *in* = 40 | Nonsignificant

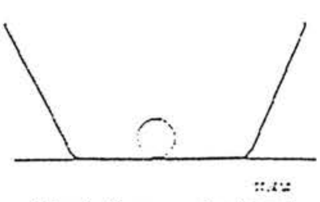
Scene 132 | Scene 91

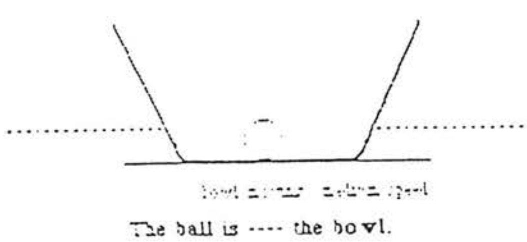



Use of *in* = 40 | Use of *in* = 40 | Nonsignificant

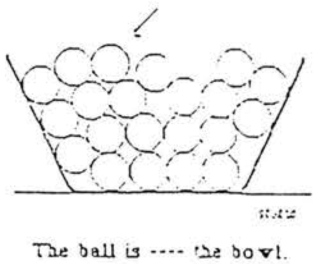
Scene 132 | Scene 180



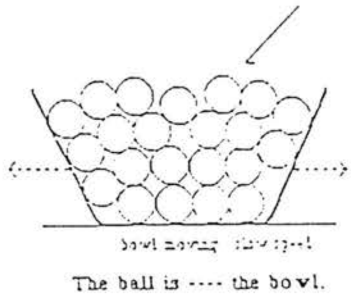

Use of *in* = 40 | Use of *in* = 40 | Nonsignificant

Scene 150



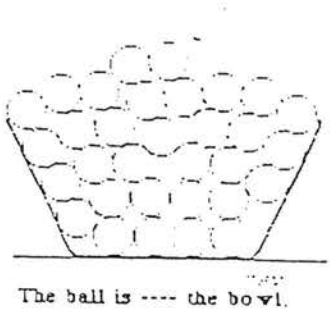

Use of *in* = 40

Scene 71



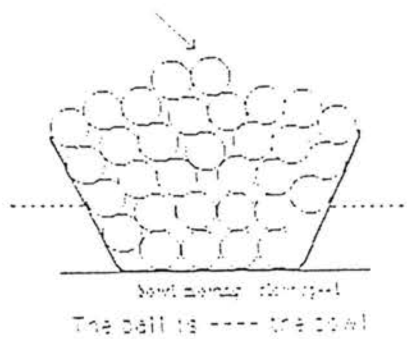

Use of *in* = 40 Nonsignificant

Scene 198



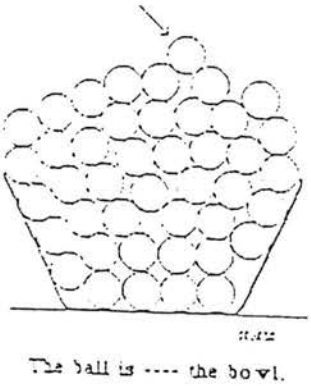

Use of *in* = 38

Scene 19



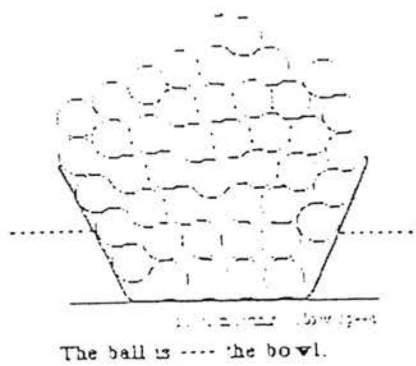
Use of *in* = 40 Nonsignificant

Scene 34



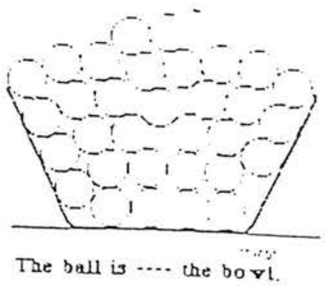

Use of *in* = 34

Scene 302

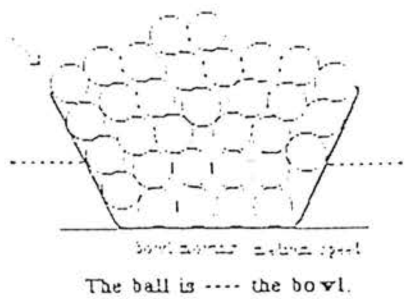



Use of *in* = 39 Nonsignificant

Scene 198



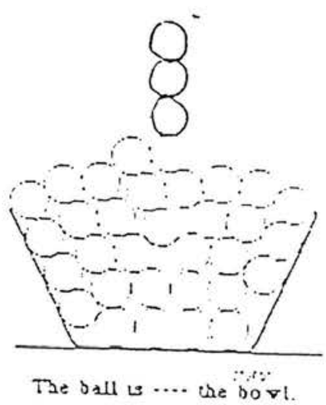

Scene 159



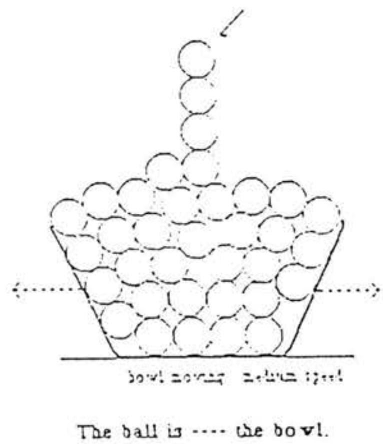

Use of *in* = 38

Use of *in* = 40 Nonsignificant

Scene 237



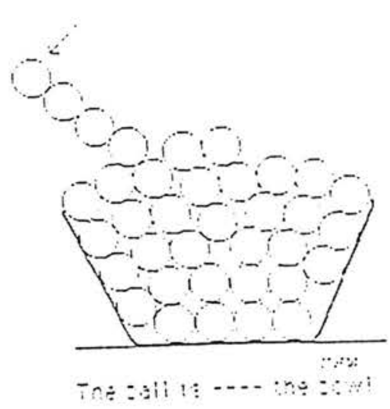

Scene 285



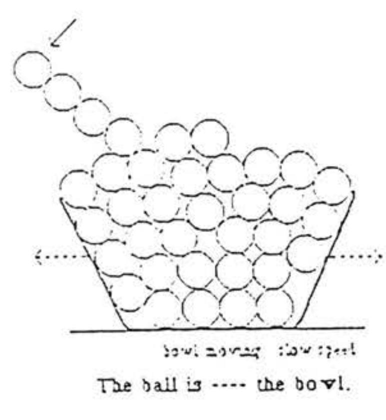

Use of *in* = 16

Use of *in* = 31 Chi-square = 4.79
$p<0.05$ (Significant)

Scene 23



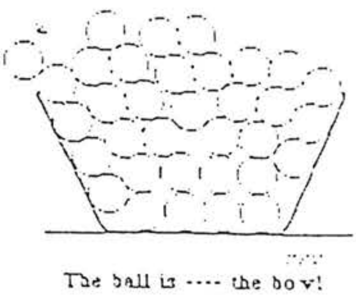

Scene 65

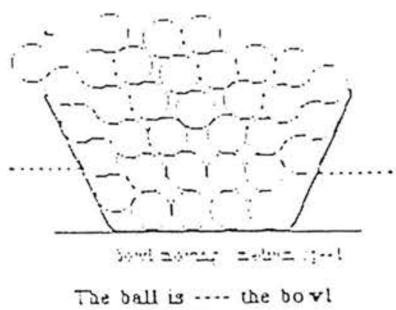



Use of *in* = 11

Use of *in* = 30 Chi-square = 8.8
$p<0.01$ (Significant)

Scene 125 Scene 273

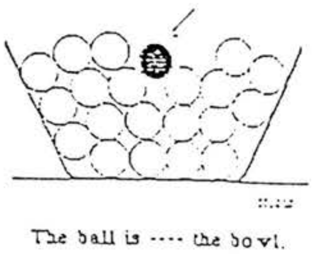


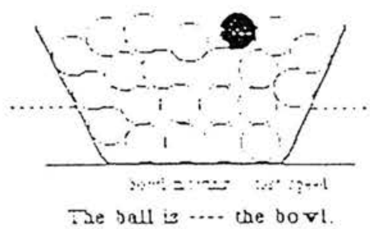




Use of *in* = 21 Use of *in* = 37 Chi-square = 4.4
$p < 0.05$ (Significant)

<u>Comparison of Static Versus Dynamic Discontinuity Ball/Bowl Scenes, With Bowl Moving</u>

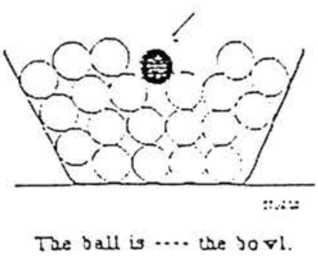
Scene 268 Scene 154

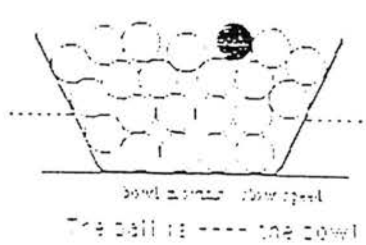



Use of *in* = 39 Use of *in* = 40 Nonsignificant

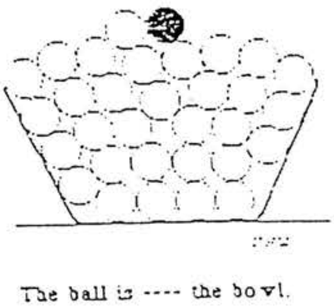
Scene 268 Scene 15



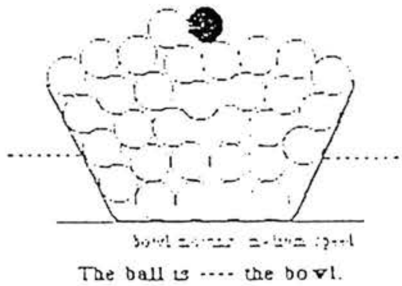




Use of *in* = 38 Use of *in* = 40 Nonsignificant

Scene 31



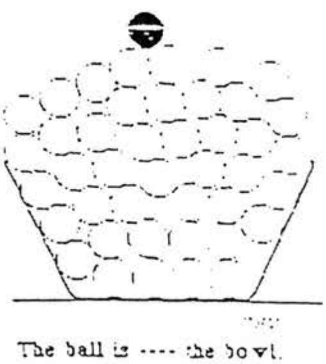

Scene 203



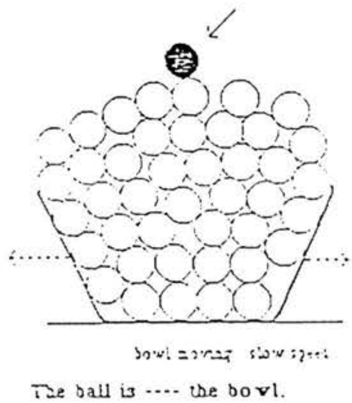

Use of *in* = 37

Use of *in* = 40 Nonsignificant

Scene 144



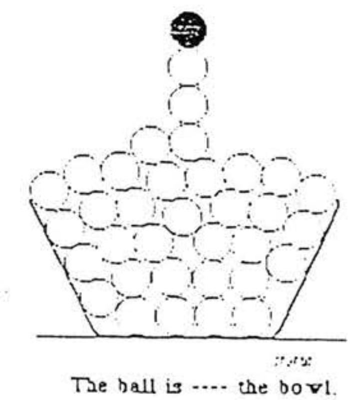

Scene 33



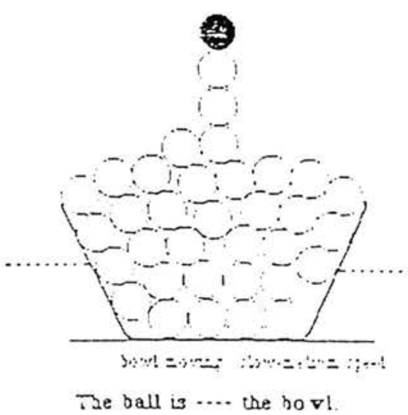

Use of *in* = 32

Use of *in* = 39 Nonsignificant

Scene 53




Scene 121

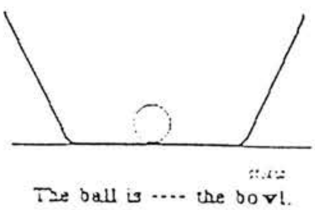



Use of *in* = 6

Use of *in* = 32 Chi-square = 17.79
$p<0.01$ (Significant)

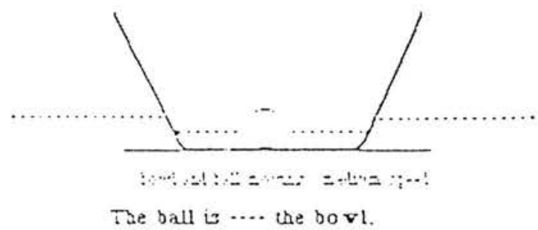
Miscellaneous Ball/Bowl Comparisons

Scene 132



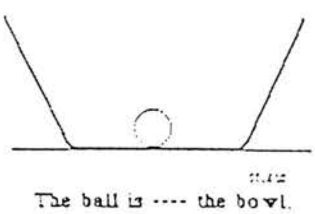

Use of *in* = 40

Scene 169



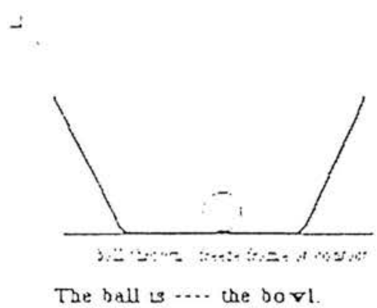

Use of *in* = 40 Nonsignificant

Scene 132




Use of *in* = 40

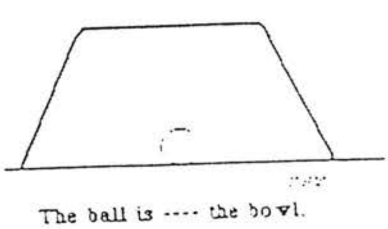
Scene 69




Use of *in* = 40 Nonsignificant

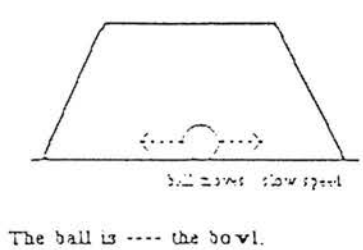
Inverted Bowl Ball Scenes With Static/Dynamic Comparisons (Ball Moving):

Scene 45



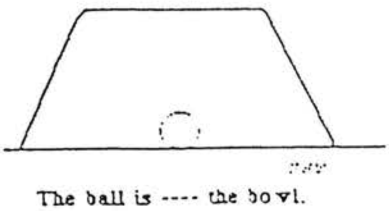

Use of *under* = 40

Scene 1

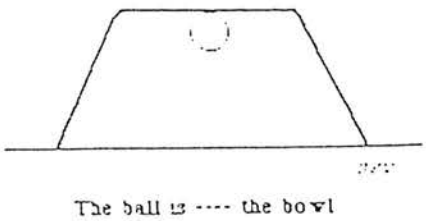



Use of *under* = 40 Nonsignificant

Scene 45




Scene 251

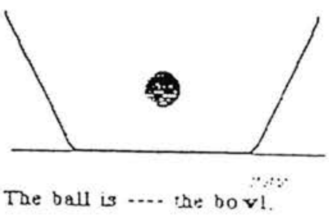



Use of *under* = 40

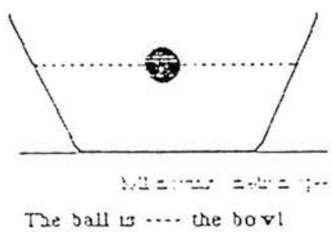
Use of *under* = 21 Chi-square = 5.9
$p < 0.05$ (Significant)

Ball/Bowl Static Versus Dynamic (No Other Balls Present):

Scene 115



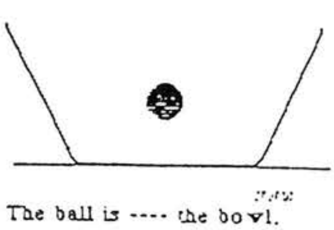

Scene 155



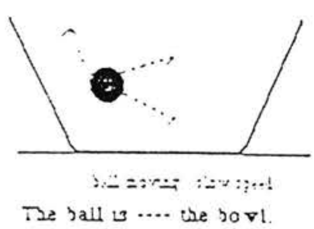

Use of *in* = 29
Use of *over* = 10

Use of *in* = 28
Use of *over* = 10 Nonsignificant

Scene 115




Scene 200



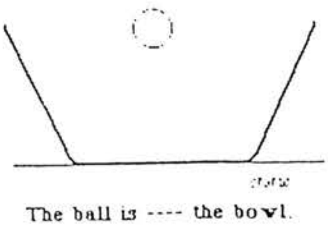

Use of *in* = 29

Use of *over* = 10

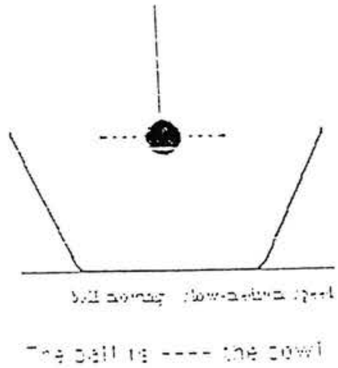
Use of *in* = 5 Chi-square = 16.9
$p < 0.01$ (Significant)

Use of *over* = 3 Nonsignificant

Scene 113



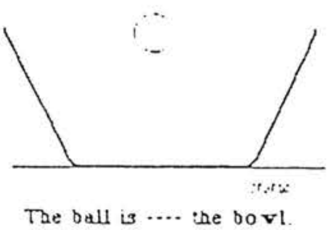

Scene 22



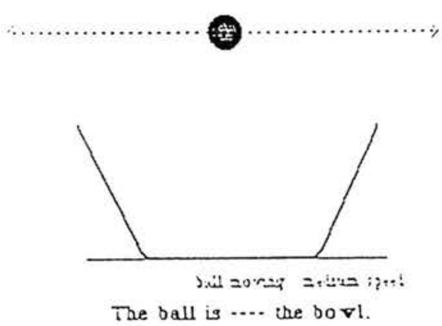
Use of *over* = 21

Use of *over* = 32 Nonsignificant

Scene 113




Scene 146

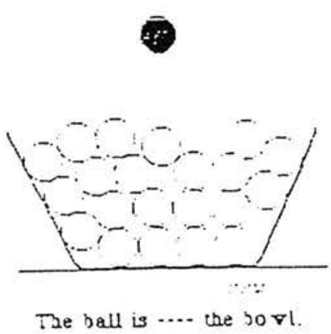



Use of *over* = 21

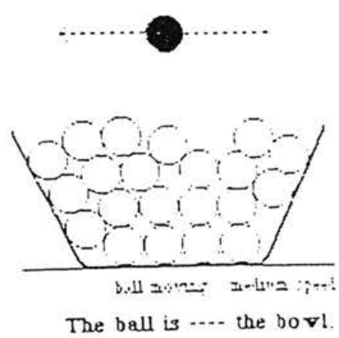
Use of *over* = 31 Nonsignificant

Ball/Bowl Static Versus Dynamic Comparisons With Discontinuity (Other Balls Present):

Scene 56



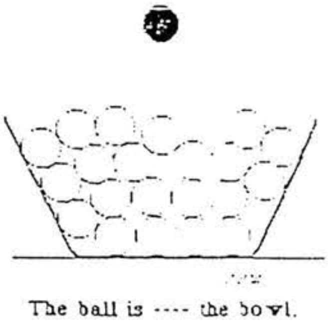

Scene 80




Use of *over* = 27

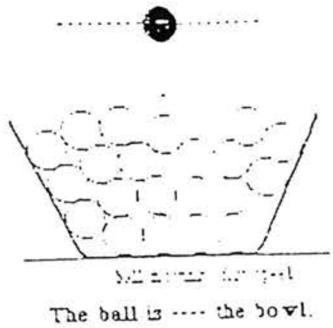
Use of *over* = 38 Nonsignificant

Scene 56



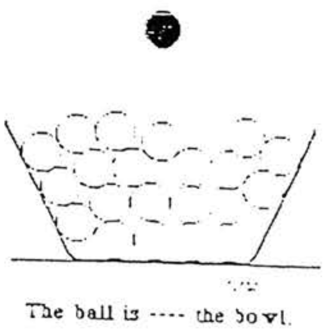

Use of *over* = 27

Scene 46



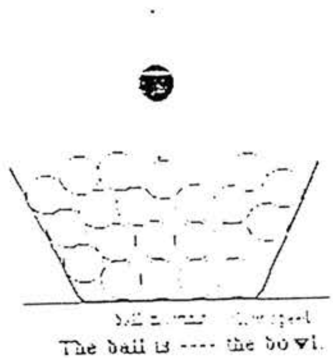

Use of *over* = 37 Nonsignificant

Scene 56



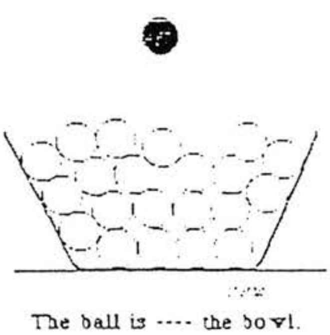

Use of *over* = 27

Scene 312



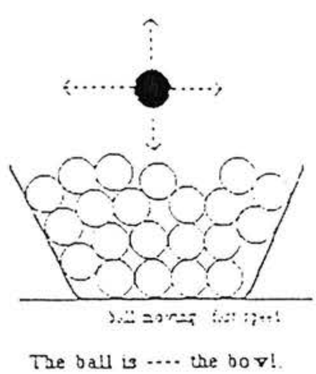

Use of *over* = 40 Nonsignificant

Scene 56



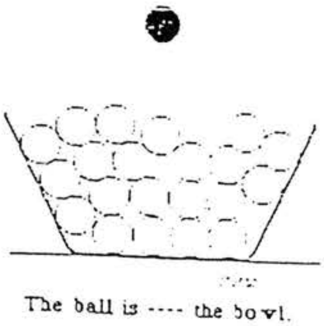

Use of *over* = 27

Scene 27



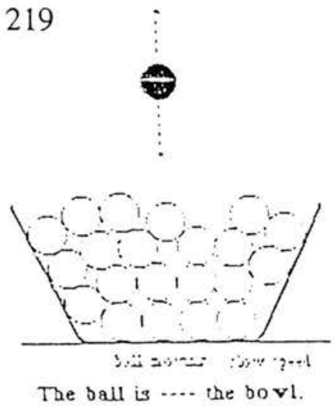

Use of *over* = 29 Nonsignificant

Scene 56



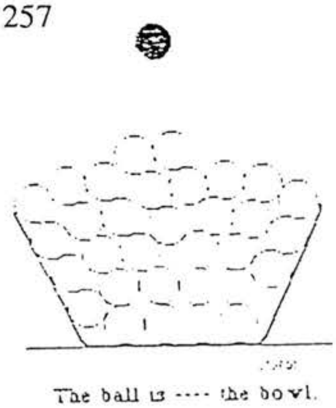

Use of *over* = 27

Scene 219



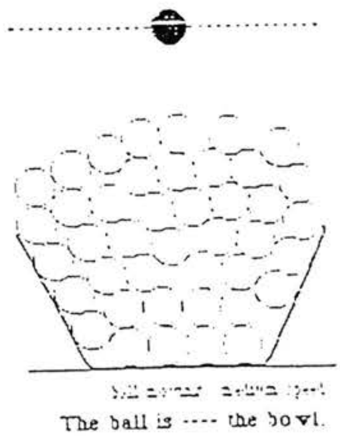

Use of *over* = 38 Nonsignificant

Scene 257



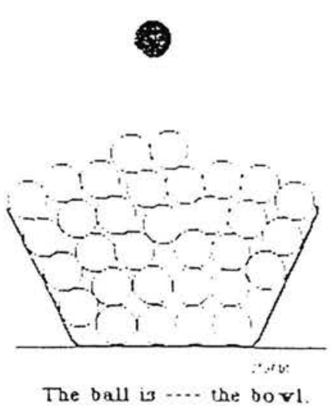

Use of *over* = 31

Scene 82



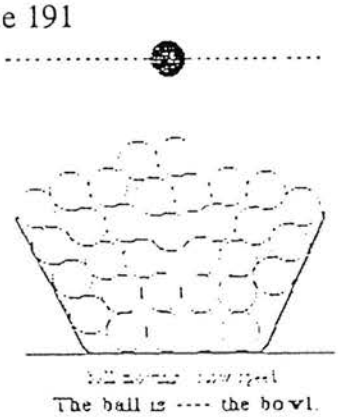

Use of *over* = 37 Nonsignificant

Scene 257



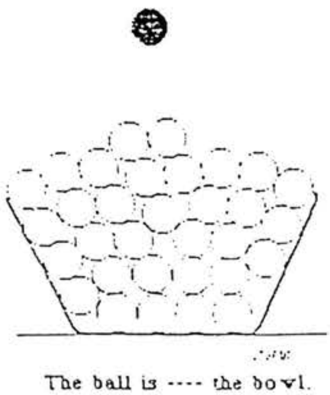

Use of *over* = 31

Scene 191



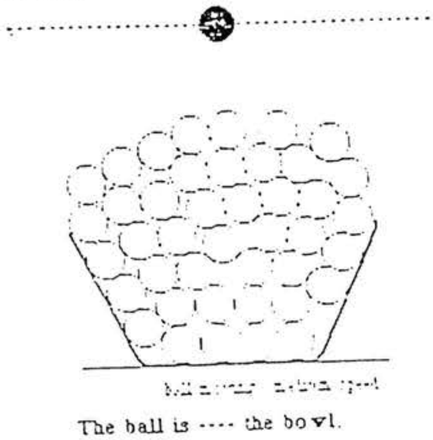

Use of *over* = 37 Nonsignificant

Scene 257



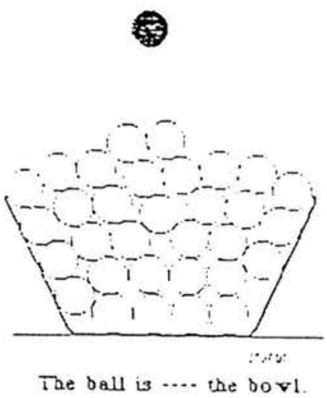

Use of *over* = 31

Scene 129



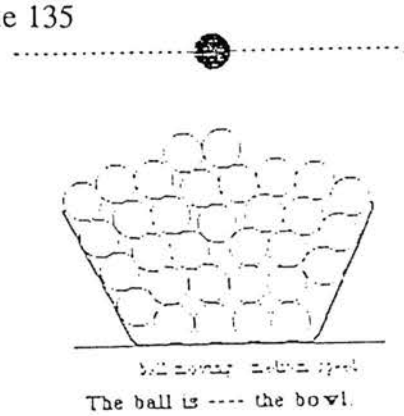

Use of *over* = 35 Nonsignificant

Scene 257




Use of *over* = 31

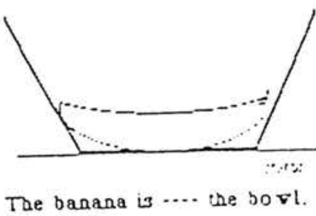
Scene 135




Use of *over* = 38 Nonsignificant

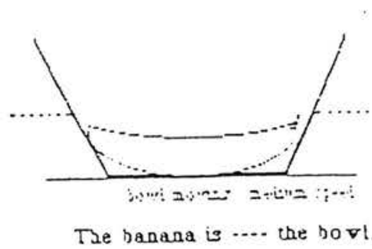
<u>Banana/Bowl Continuity Static Versus Dynamic, With Bowl Moving</u>

Scene 105



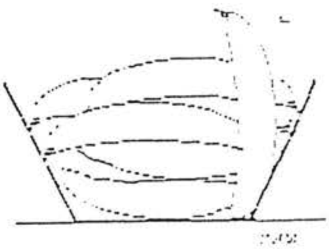

Use of *in* = 40

Scene 48




Use of *in* = 40 Nonsignificant

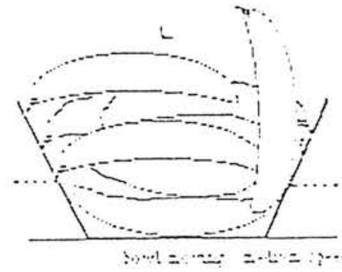
Scene 120



The banana is ---- the bowl.

Use of *in* = 40

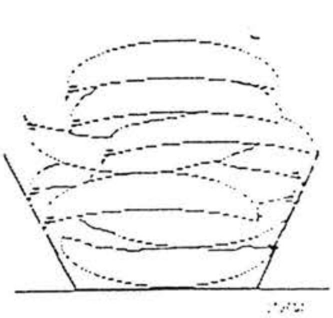
Scene 193



The banana is ---- the bowl.

Use of *in* = 40 Nonsignificant

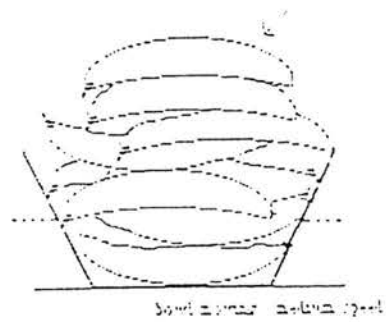
Scene 32



The banana is ---- the bowl.

Use of *in* = 37

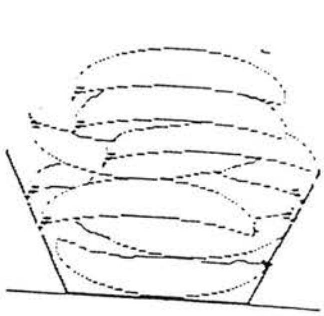
Scene 226



The banana is ---- the bowl.

Use of *in* = 40 Nonsignificant

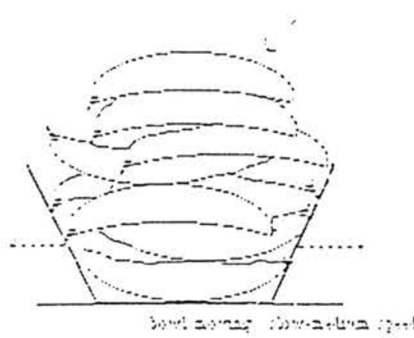
Scene 32



The banana is ---- the bowl.

Use of *in* = 37

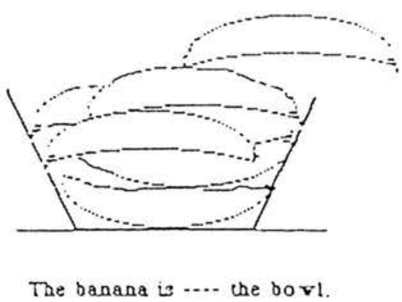
Scene 77



The banana is ---- the bowl.

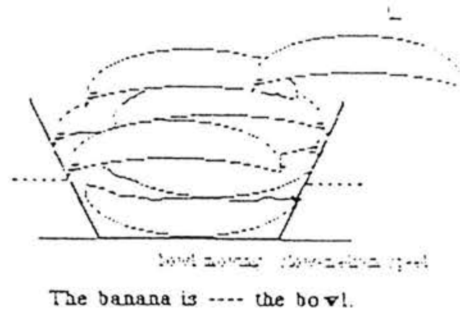
Use of *in* = 40 Nonsignificant

Scene 35




Use of *in* = 13

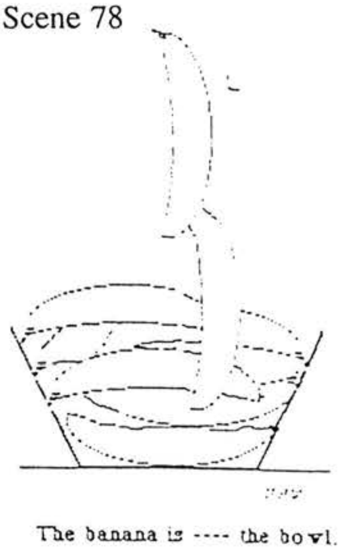
Scene 84




Use of *in* = 29

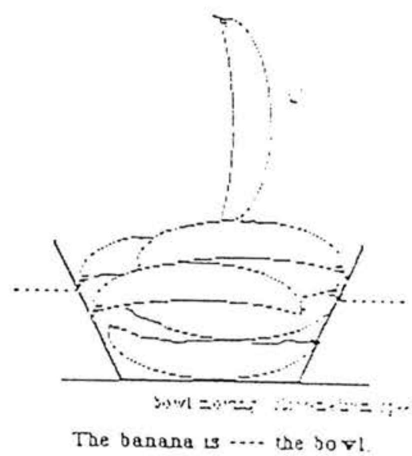
Chi-square = 6.1
$p < 0.05$ (Significant)

Scene 78




Use of *in* = 2

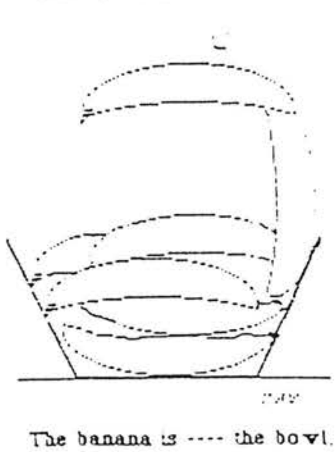
Scene 55




Use of *in* = 24

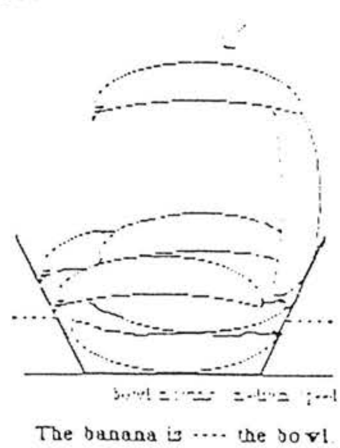
Chi-square = 18.6
$p < 0.01$ (Significant)

Scene 160




Use of *in* = 4

Scene 171

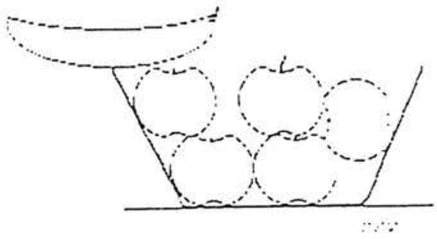



Use of *in* = 21

Chi-square = 11.56
$p < 0.01$ (Significant)

Banana/Bowl Dynamic Versus Static Comparisons With Discontinuity:

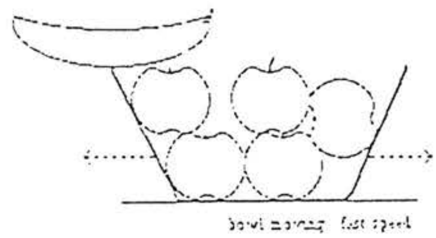
Scene 142



The banana is ---- the bowl.

Use of *in* = 13

Scene 293

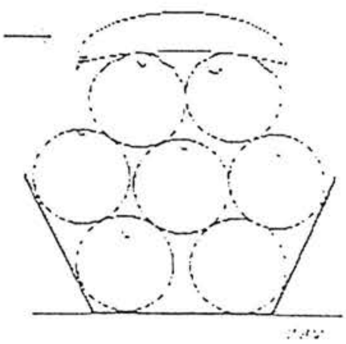


The banana is ---- the bowl.

Use of *in* = 34

Chi-square = 9.3
$p < 0.01$ (Significant)

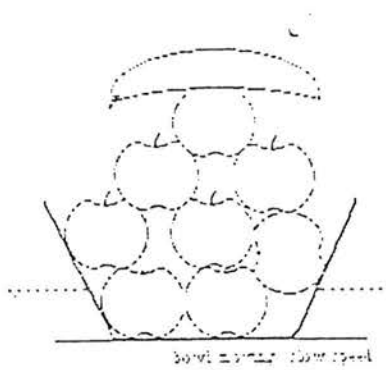
Scene 133



The banana is ---- the bowl

Use of *in* = 37

Scene 68

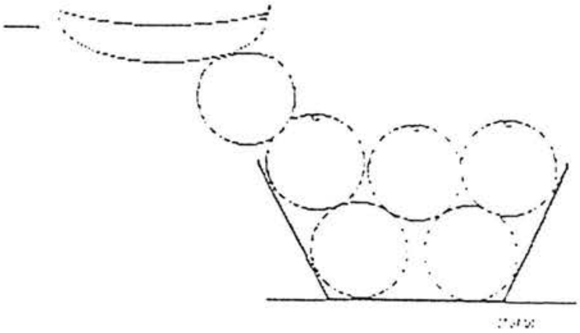


The banana is ---- the bowl.

Use of *in* = 40

Nonsignificant

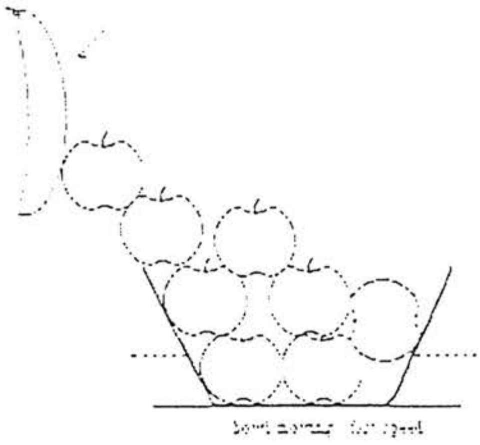
Scene 143



The banana is ---- the bowl.

Use of *in* = 8

Scene 24



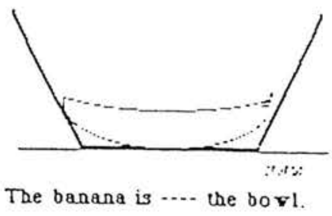
The banana is ---- the bowl.

Use of *in* = 31

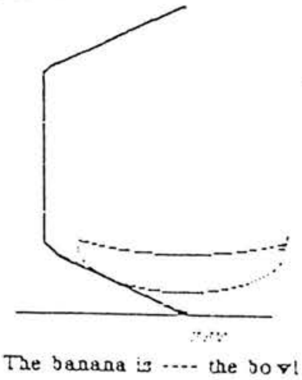
Chi-square = 13.6
$p < 0.01$ (Significant)

Banana/Bowl With Bowl Tilted:

Scene 105




Scene 74

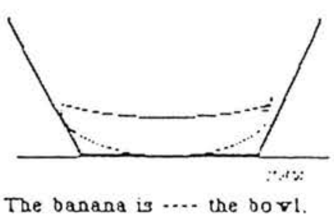



Use of *in* = 40

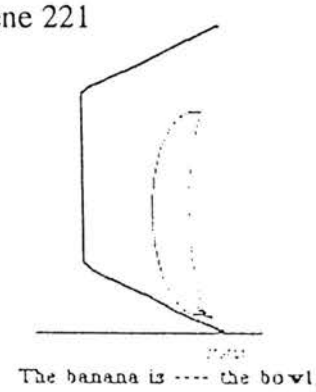
Use of *in* = 7

Chi-square = 23
$p < 0.01$ (Significant)

Scene 105




Scene 221



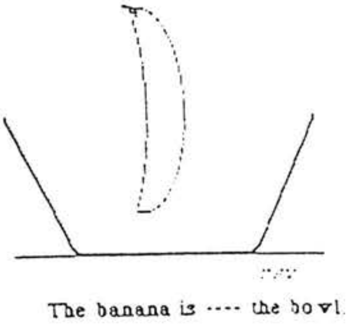

Use of *in* = 40

Use of *in* = 9

Chi-square = 19.6
$p < 0.01$ (Significant)

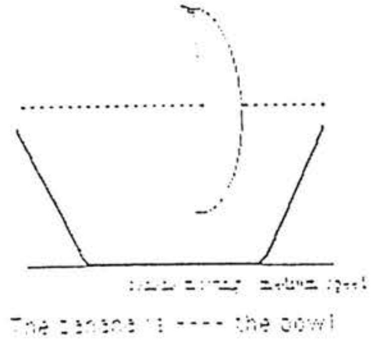
Banana/Bowl Static Dynamic Comparisons With Banana Moving (Continuity):

Scene 207




Use of *over* = 21
Use of *in* = 17

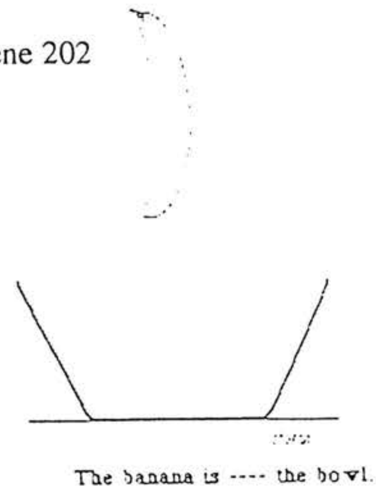
Scene 25



Use of *over* = 25
Use of *in* = 11

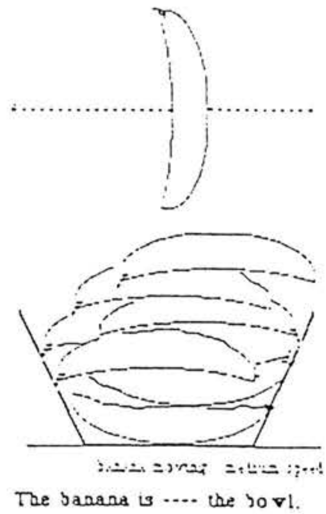
Nonsignificant

Scene 202



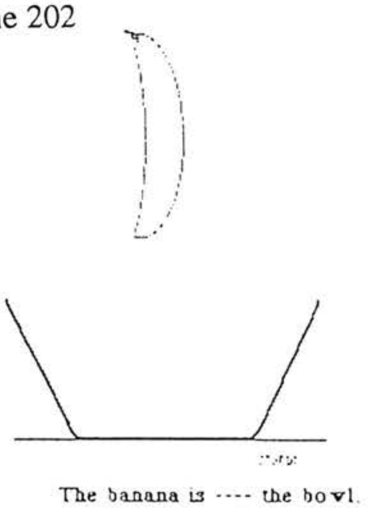

Use of *over* = 25

Scene 166



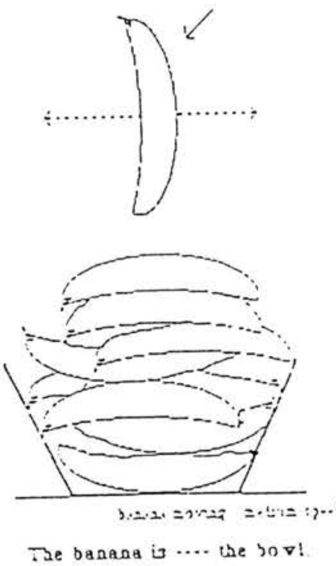

Use of *over* = 29 Nonsignificant

Scene 202



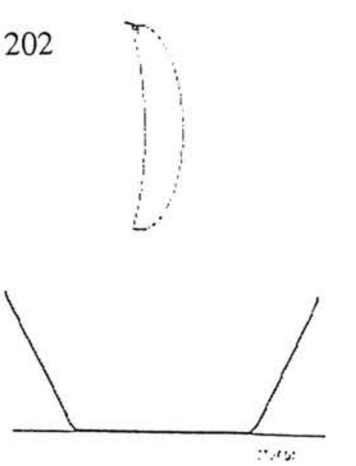

Use of *over* = 25

Scene 173



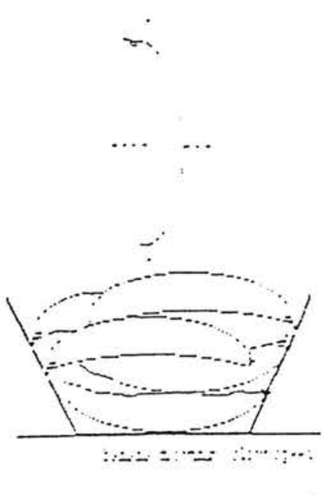

Use of *over* = 31 Nonsignificant

Scene 202




Use of *over* = 25

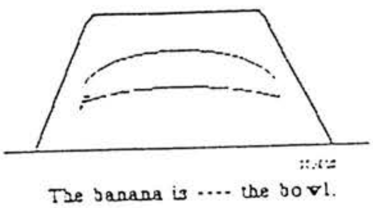
Scene 102



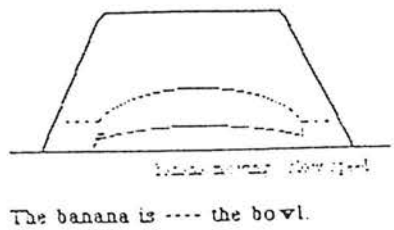

Use of *over* = 29 Nonsignificant

Banana/Bowl Dynamic Versus Static With Bowl Inverted:

Scene 94




Scene 157

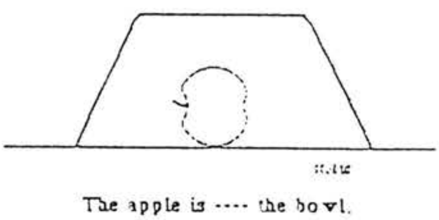



Use of *under* = 33

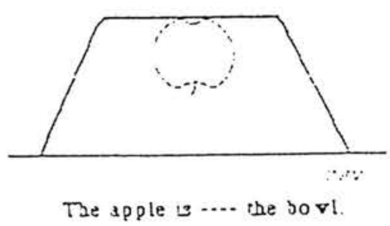
Use of *under* = 40 Nonsignificant

Apple/Bowl With Bowl Inverted:

Scene 174



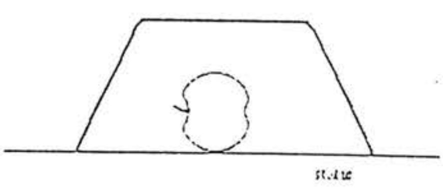

Scene 254



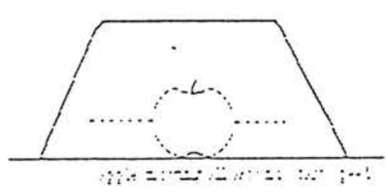

Use of *under* = 40

Use of *under* = 29 Nonsignificant

Scene 174




Scene 162

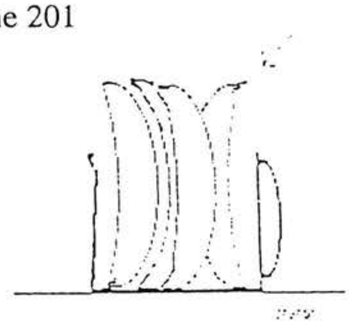



Use of *under* = 40

Use of *under* = 36 Nonsignificant

Jug Versus Bowl Comparisons:

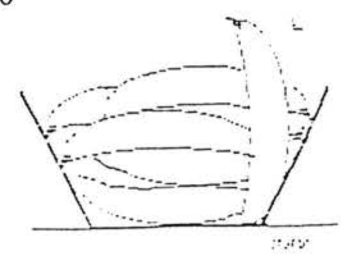
Scene 201



The banana is ---- the jug.

Use of *in* = 40

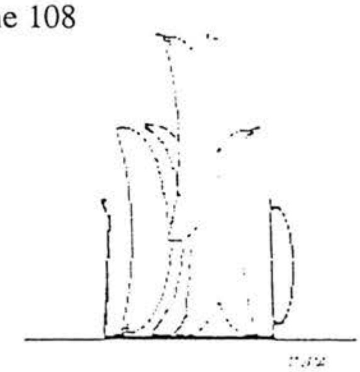
Scene 120



The banana is ---- the bowl.

Use of *in* = 40 Nonsignificant

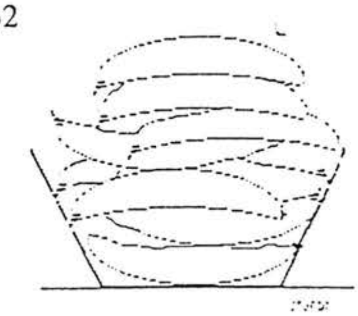
Scene 108



The banana is ---- the jug.

Use of *in* = 20

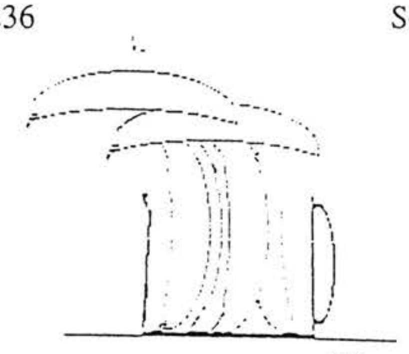
Scene 32



The banana is ---- the bowl.

Use of *in* = 37 Chi-square = 5.07
$p < 0.05$ (Significant)

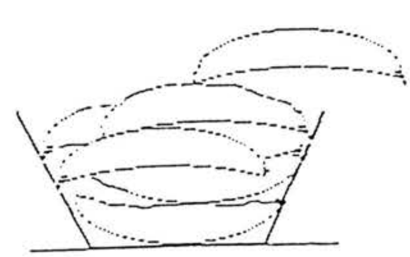
Scene 236



The banana is ---- the jug.

Use of *in* = 7

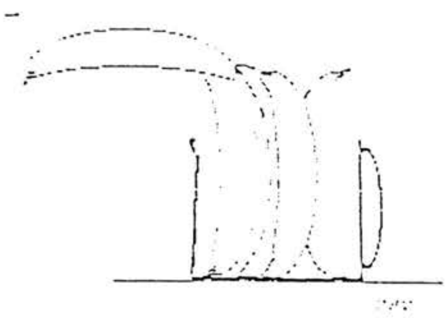
Scene 35



The banana is ---- the bowl.

Use of *in* = 13 Nonsignificant

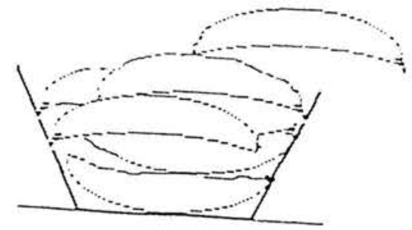
Scene 292



The banana is ---- the jug.

Use of *in*= 4

Scene 35

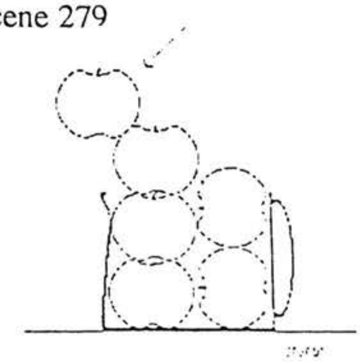


The banana is ---- the bowl.

Use of *in*= 13

Chi-square = 4.76
$p<0.05$ (Significant)

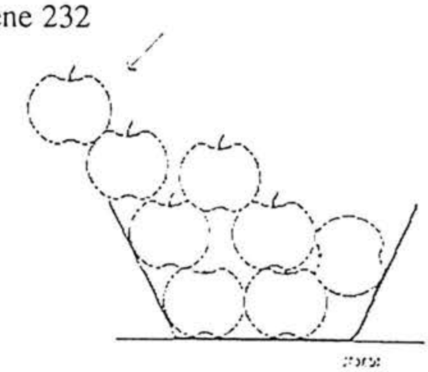
Scene 279



The apple is ---- the jug.

Use of *in*= 11

Scene 232

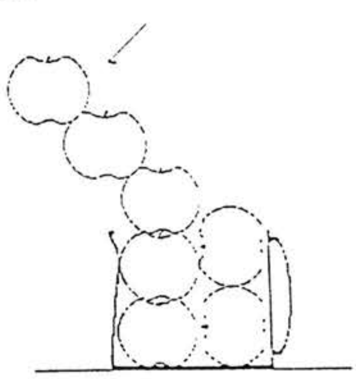


The apple is ---- the bowl.

Use of *in*= 15

Nonsignificant

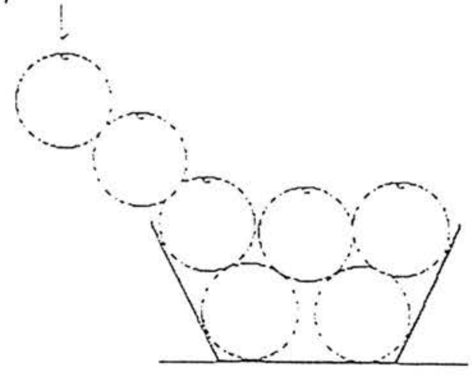
Scene 269



The apple is ---- the jug.

Use of *in*= 3

Scene 247

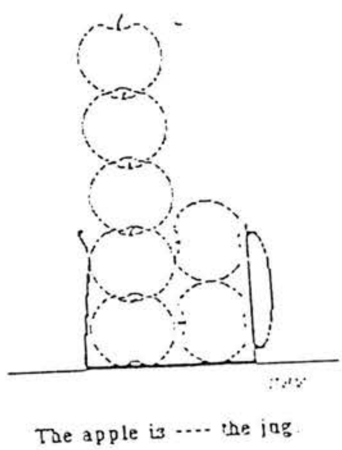


The orange is ---- the bowl.

Use of *in*= 11

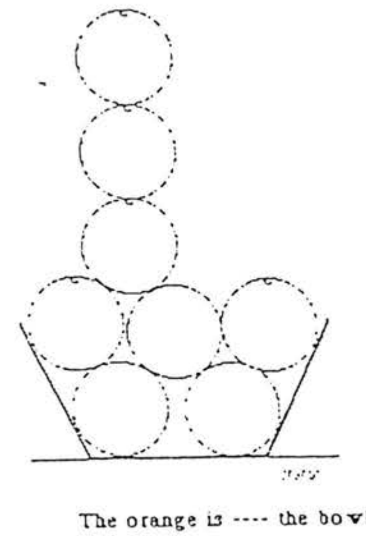
Chi-square = 4.57
$p<0.05$ (Significant)

Scene 215




Use of *in* = 4

Scene 227




Use of *in* = 9 Nonsignificant

### 6.6.8 Summary of Main Results

First of all, comparing static scenes, where geometric relations remain constant, it was found that contact of the figure via other objects (continuity preserved or otherwise) affected the use of *in*. Thus the use of *in* is not governed by geometric position alone. Non-continuity produced a significant reduction in the use of *in* when the pile was high, or when the figure was placed in an unnatural situation, as compared with continuity conditions. This was only true of static scenes. No differences in use of *in* were found with low piles, even in the non-continuity conditions. Movement of the figure was found to reduce the use of *in*, although not significantly in every case. Contiguity of movement of figure with ground was found to significantly increase the use of *in*. This was particularly true when the pile was high, or when the figure was placed unnaturally. Tilting the container (away from canonical orientation) has the effect of reducing the use of *in*.

Use of *over* was found to increase when the figure was swinging like a pendulum above the container. The length of swing had no influence on this effect. Movement of figure had no effect on the use of *under* when the container was inverted.

Finally, comparing static scenes involving the jug and bowl, the ground was found to have a significant effect on the use of *in*. With unnatural piles, *in* was used significantly more with the bowl as ground as compared with the jug as ground.

Turning to reference objects, when the pile was high or unnatural, there was a significant increase in the use of other objects as reference objects, rather than immediate reference to the ground. Contiguity of movement of figure and ground removed this effect.

Verbal modification did not systematically vary with any changes in conditions. However, it was observed that some subjects used verbal modification consistently, and others largely stuck to one-word fill-ins.

### 6.6.9 Discussion

The cover of a memory experiment, it can be argued, has yielded use of language akin to that used in everyday situations. In contrast to the Ferrier experiment, subjects were not asked to make decisions about appropriate use of language which may be artificial in nature. Subjects, on debriefing, commented that they found the task simple, and that they did not expend conscious effort filling in the sentences paired with each scene. Therefore the results can be relied upon as a useful barometer of language use.

The results in the main provide clear evidence that factors other than geometric relations influence language use. In particular, contiguity of movement of figure with ground was found to produce a robust effect on use of *in,* as did contact of figure with other objects. This supports the functional relations analysis. If it can be demonstrated that a container is fulfilling its function, then use of *in,* it was predicted, should increase, and it did. Furthermore, movement of the figure was found to reduce the use of *in,* which is the converse of this, and therefore lends further support to the analysis.

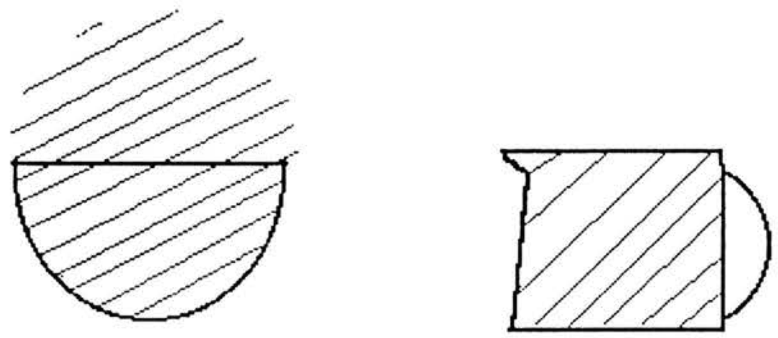
The presence of contact of the figure via other objects is clearly an important factor. As we saw in chapter four, Herskovits (1986) accounts for this effect with the pragmatic principle of *tolerance.* A more parsimoniouis explanation is forthcoming if we consider that a container is still controlling the location of the figure via contact with other objects, and therefore the figure does not have to be interior to the container.

Non-continuity was observed to only have an effect in static situations. It appears that contiguity of movement of figure with ground overrides the discontinuity criteria. One way to interpret this is to argue that, in absence of clear evidence that the ground is fulfilling its function, one is influenced by other factors, one of which is discontinuity. This finding is contrary to that of Ferrier, and is suggestive that the continuity effects yielded by Ferrier are a by-product of an unnatural experimental task situation.

The results also provide evidence for the importance of the specific function of the ground. Comparing the jug to the bowl, in unnatural situations the jug has a negative effect on the use of *in.* This could be explained in terms of what the container usually contains. Jugs are associated with the containment of liquids, whereas bowls more usually contain solids, such as fruit. Perhaps the presence of fruit in the jug therefore can be viewed as removed from its proper function, leading to the weakening of the evidence in static cases.

Another more plausible explanation for this finding, again relating to specific function, in that containers can be said to have a sphere of functional influence, such that they can control different regions of space dependent on function. This view is schematised in figure 6.6. However, one would expect that movement of the jug would lead to a significant increase in the use of *in*, and to an irradication of the jug/bowl difference that appeared comparing static scenes.

Figure 6.6 Spheres of Functional Infuence Associated With Jugs and Bowls



The use of *over* is significantly increased when the figure is swinging above the container. This result can be interpreted in two ways. Firstly, it can be argued that *over* involves the notion of a path, and that the swinging motion of the figure natural increases use of *over* as it directly demonstrates the existence of a path. Secondly, it can be argued that *over* involves a functional component, such as functional aboveness, and that the movement of the figure about a gravitational axis hightlights the interaction with the ground, such that the ground is controlling the position of the figure via the central axis. At this time, the first explanation seems most parsimonious. However, in chapter eight, we will consider the issue of whether one should ascribe a functional component to *over* at some length.

# Chapter 7

## Evidence from First Language Acquisition

### 7.1 Introduction

In this chapter we provide evidence from the language acquisition literature which supports the experimental evidence of the last chapter. We demonstrate that the pattern of acquisition of prepositions is perfectly consistent with the functional component of lexical entries thus far posited. Furthermore, the importance of the nature of the objects in the interpretation of an expression appears to be something the child is acutely aware of early on.

### 7.2 Why Appeal to First Acquisition Literature ?

Developmental perspectives are interesting in themselves, but are not simply useful for their own sake. They also sometimes may be the only reasonable way of answering nondevelopmental questions. For example, we can consider Gould's (1983) discussion of whether a zebra is a white animal with black stripes or a black one with white stripes. As Gould points out, there are few more perennial questions; and certainly a great many who have asked that question have not been the least bit interested in how zebras develop. They simply want to know what sort of thing the adult is. Yet the clearest way to tell is to consider how stripes develop from embryological stages. When this developmental perspective is adopted, in conjunction with some data about anomalous adult zebras, it becomes clear what they really are. Gould also discusses how developmental considerations allow us to see "the difference between superficial appearance and knowledge of underlying causes" (p. 372) when applied to the puzzle of why a cross between a horse and a zebra usually has more stripes than a zebra. Superficial comparisons would predict a smaller number; but an understanding of how stripes are related to embryological development suggests strong reasons for the increase.

Wallace, Klahr and Bluff (1987) also present a compelling argument maintaining the importance of a developmental perspective with respects to providing an adequate psychological theory in any domain. The emphasis is on the perspective of conceptual understanding and word meaning from the point of view of existence on a continuum. They argue that one should adopt a process-oriented account of word meaning and conceptual understanding such that one can only define a concept in relation to how it has developed. Thus acquisition literature provides an essential route into this problem domain.

## 7.3 The Evidence: Review of First Acquisition Literature

Much research has been conducted on the acquisition of words in many different classes, and generally on what has been referred to as 'the mapping problem' (Clark, 1973). What one wishes to know is what information the child brings to the language learning situation. In other words, Clark (1977) asked the question of what the child knows a priori about the spatial relations between the objects around him.

Clark argues that the young child knows that some objects have flat supporting surfaces while others act as containers. Bower (1974) noted that containers, in fact, appear to exercise a special fascination over the very young child. The child also knows something about normal orientation - which way up a chair goes, and so on. He also knows, or is rapidly finding out at about 12 months, that one can place some objects on top of larger ones, but not the reverse. Size also plays an important role for containers too. For example, small objects will fit into large objects, but not the reverse. Based on this evidence, Clark (1977) suggested that surfaces and containers should play some part in the child's acquisition of words for different spatial relations. The knowledge that the child has a priori is about objects, and how they interact with each other. The nature of the objects themselves appears to constrain how they are talked about, and this, it will be demonstrated, is in terms of functional relations.

Clark (1977) presents evidence that the first prepositions that children use spontaneously to denote relations in space are *in* and *on*. These appear in children's speech between 2;0 and 2;6, and generally seem to be used correctly. Clark (1973) looked at how soon children appeared to understand these two prepositions, together with *under,* in a series of comprehension tasks. Each child had to follow instructions such as;

"Put A in/on/under B."

Children over 3;0 made very few errors, but from 1;6 to 2;11 the children exhibited systematic errors. First of all, even the youngest children appeared to get *in* right. *On*, though, was often treated as if it meant *in,* and *under* was sometimes treated as if it meant *in* and sometimes as if it meant *on*. The critical factor in accounting for these patterns of errors was whether B was a container or whether it simply had a flat supporting surface on it and no container-like space. Whenever B was a container, the child placed the other object, A, *inside* (and thus always got *in* "right" automatically). When B was not a container, the child placed A *on top of* the supporting surface. Clark (1977) categorised these strategies as two ordered rules :

(1) If B is a container, A is inside it.

(2) If B has a horizontal surface, A is on it.

The two rules accounted for 92% of the errors made by the youngest children (1;6-1;11) and for 91% of the errors in the next age group up (2;0-2;5). The next oldest group (2;6-2;11) made fewer than 10% errors overall, but the rules still accounted for 71% of them. Instead of considering only responses that were initially scored as errors, however, it could be argued that Rule 1 ought to account for all the *in* instructions and for half the *on* and *under* instructions (that is, wherever B was a container) among the younger children. Rule 2 should account for the other half of the *on* and *under* instructions (that is, wherever B has a flat surface). Overall the two rules accounted for 89% of the data from the youngest children, while "correct" responses accounted for only 53% of these data.

Further evidence that the children were really using general rules much like (1) and (2) came from a second experiment with the two youngest groups of children where each child was given a copying task (Clark, 1977). The experimenter first placed one object in a spatial relation to another, either inside, on top, or about an inch away. The child was given an identical pair of objects and simply told "Do what I did." As predicted, wherever the experimenter's configuration conformed to the rule identified in the first experiment, the child managed it, and wherever the configuration did not conform, the child simply applied the rules and came up with predictable errors. Since there was no mention of the words *in, on* and *under* in this task, it is clear that the "correct" responses from the earlier comprehension task do not necessarily reflect any semantic knowledge. Instead they reflect the nonlinguistic or conceptual preferences the young child has for putting objects inside containers, or, failing that option, putting them on a supporting surface.

Clark (1977) also observed that the children in the copying task seemed to have an awareness of orientation of objects. A child of 1;6 or 2;0 clearly knows that glasses have their openings up. The children frequently righted the glass to its canonical orientation whenever the experimenter changed the orientation of the glass. Once the glass is righted, the child can simply apply rule 1 as before. Clark found that a few 2.5 year olds provided further evidence of knowing the normal spatial relations when they objected to putting something *under* a crib: the reason was that one sleeps in a crib. However, they knew by that age what *under* meant and would carry out the instructions appropriately.

The work of Wilcox and Palermo (1974/5) provides some additional evidence with *in* and *on* that youngest children have a preference for putting objects inside containers whenever possible, and otherwise putting them *on* some surface. They found the same pattern of errors as Clark (1973) . Hence, with *in* and *on* there is evidence that the child's a priori conceptual preferences play a critical role in his learning to map words onto specific spatial relations (Clark, 1973).

Clark (1977) extended her earlier work to the acquisition of other spatial relations, namely the word pairs *up - down, at the top - at the bottom, over - under* and *above - below.* Using the same children as were used of Clark (1973), the task involved the instructions :

(i) Put A at the top/bottom of/above/below B.
(ii) Make A go up/down/over/under B.

Clark (1977) found a steady increase in the number of correct responses with age. The easiest of the pairs, overall, was *up - down*, and the relative order of acquisition was *up - down,* then *top - bottom,* then *over - under,* and lastly *above - below.* This mirrors the order found in Clark (1972).

There is a lot of more recent evidence that children typically learn words encoding locative concepts such as *in, on* and *under* before they learn words for locative concepts such as *between, back* and *front.* In a series of crosslinguistic studies, Johnson and Slobin (1979) found this to be the case. Indeed, their work has been replicated in an experimental study of English by Durkin (1981), as well as observational studies of Hebrew (Dromi, 1979) and the Romance languages (Clark, 1991).

Johnson and Slobin (1979), following Clark (1972), argue that the acquisition order of these two groups of words is predicted by the relative cognitive complexity of the concepts involved. Additionally, some variation of order (mostly within the groups) may result from the linguistic complexity of the means available for expressing a particular concept in a particular language. For instance, all other things being equal, a word will be learned later if it is morphologically complex (composed of more than one adult morpheme), or if it is homonymous (has more than one meaning in the adult language).

Grimm (1975) and Vorster (1984) extended the range of prepositions examined to uses other than simply spatial ones. Grimm (1975), in a study of the spontaneous productions of 137 German preschoolers and first-graders, found that spatial prepositions were learned first, and that some of these found expression as temporal prepositions and some as 'purely grammatical' prepositions (e.g., the dative marker zu). Vorster (1984), studying six Afrikaans-learning 3-year olds, corroborates the results of Grimm. Spatial prepositions again were learned first, and *to* as a directional preposition, followed by temporal prepositions (or temporal uses of spatial prepositions and others indicating relations such as the instrumental and the dative.

Tomasello (1987) points to the problems in the explanation of the above acquisition data. He particularly cites the problems with explanations which appeal to cognitive factors, e.g., the abstract nature of the conceptual relations specified by the grammatical prepositions. As Tomasello states (1987, p. 87);

> "It is not obvious that for the child sweeping with a broom or giving something to someone involves more complex or abstract concepts than placing an object on a table or in a cup."

This example illustrates the difficulties involved when one tries to compare concepts across diverse semantic categories.

Tomasello sets out to resolve some of the problems with a detailed case study of one child's early use of English prepositions during her second year of life. This case study attempts to investigate not only acquisition order, but also other acquisition patterns involving omissions, misuses, and the like. Four levels of use were distinguished;

OMISSION; relational word not expressed, but the relation is implicit in the utterance and its non-linguistic context, e.g., Bug monkey-bars.

HOLOPHRASE; only the relational word is expressed, e.g., off, up, etc.

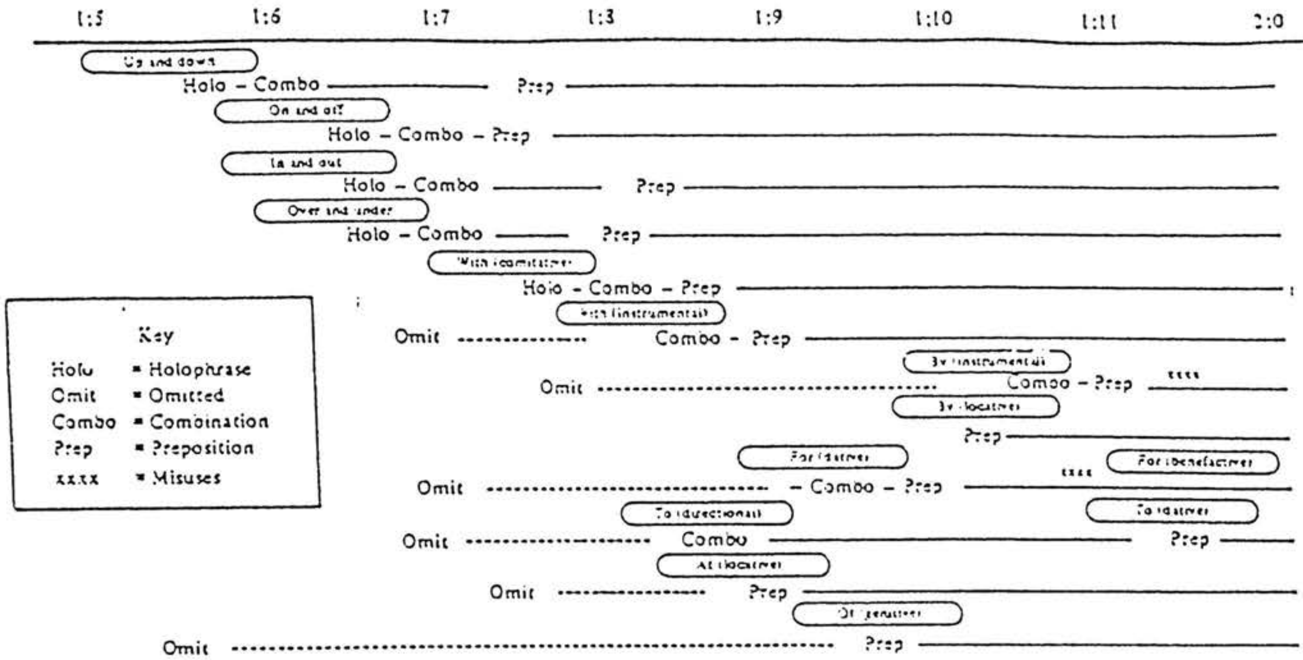
COMBINATION; the relational word and one of the related items are expressed, e.g., Bug on/On monkey-bars.

PREPOSITION; the relational word and both of the related items are expressed, e.g., Bug on monkey-bars.

The results of Tomasello's detailed study supports the existing evidence that spatial prepositions are indeed learned first. The order of acquisition presented by Tomasello is depicted in figure 7.1.

What we can pick up on from this data is that spatial oppositions such as *above-below* are actually learned later than oppositions like *over-under*. This case, in particular is

Figure 7.1




interesting as over has many more different types of usage than above. If one considers that a simple stative use of *over* is one use, then one can argue that the meaning of *above* is a subset of the meaning of *over*. This seems to fly in the face of acquisition data. It may seem then, that the pattern of acquisition cannot simply reflect notions of complexity. Maybe we can appeal to the idea that *over* is simply used more frequently in mother-infant interactions than *above*. This, however, is not the case (Tomasello, 1987), and even if it was it can't explain the error rates apparent with early use of above.

The explanation we wish to pursue here is that prepositions involving functional relations are those that are learned first. This goes hand-in-hand with the notion that infants learn functional relations early on. The learning of how objects can interact with each other is key. Hence, when the infant is faced with a relation which is more abstract and cut off form the objects, there is more difficulty experienced. For example, in the case of *above*, one object being *above* another object is apparent irrespective of the nature of the objects. With the case of *over*, by contrast, the understanding is dependent on the nature of the objects and how they interact with each other. What happens is that the young infant learns first about the properties of objects and how they interact with each other. When presented with a spatial relation, they assume that this refers to how the objects are most likely to interact, which is the attribution of a functional relation to the situation. This explanation accounts for the error findings in the studies discussed above.

The utilitarian nature of children's definitions additionally presents support for this analysis. Krauss (1952) cites that children frequently give definitions of object in terms of function, e.g., "a tree is to climb," a table is to sit at," etc. Related to this point, Harrison (1972) has argued that children learn referents and uses together. For instance, a child learns to use the word table, in situations which are functional, such as "The table is where we eat dinner, "Daddy works at his table." Thus they learn which verbs - "eat," "work" - "table" is used with, and such information is dependent on functions that the object serves.

### 7.4 Direct Evidence: Stevens and Coventry

#### 7.4.1 Introduction

Stevens and Coventry (in preparation) have directly tested the claim that prepositions involving functional relations are learned first. In fact, the study by Stevens and Coventry is in part a replication of the adult experimental (video) study we presented in the previous chapter (experiment five). The study adopted both production sand comprehension measures. The production study adopted a modification of the basic 'puppet-theatre' protocol used by Johnston (1984) to elicit production of the prepositions *behind* and *in front of,* since this method proved highly successful. Two puppets were used, one as the protagonist who would communicated with the subject and one as an agent of change, like a 'Naughty Teddy' (McGarrigle & Donaldson, 1978) who could alter the situation without the child assuming that the change of the situation was an important factor to which the experimenter was expecting the child to respond.

Thirty scenes were selected from the adult video experiment described and discussed above (section 6.6). The situations were used to produce use of either *in* or *on,* depending on the functional elements of the situation. It was therefore decided to use a group of children around age 3;0 as the youngest age group, since this is the age when children appear to have mastered linguistic use of these prepositions (Clark, 1973). Another set of situations examined were used to produce use of *over* and *above,* again depending on the functional elements in the scenes. Children of age 3;0 have not yet mastered these prepositions according to the literature reviewed above, and it was hoped that they might overextend other prepositions for use in these situations. The other two age groups were children around 4;0 and around 5;0; the oldest children should have mastered use of *over* and *above*, and the situations investigated whether use of these prepositions could also be explained by functional relations.

The factors that were examined for the *in/on* paradigm were: spatial position of target object, contiguity of movement of target with container and continuity of target object with other objects present in the container.

It was hypothesised for the *in/on* paradigm that;

(i) Spatial position to target object within the reference container would affect preposition used; the more the target was contained within, the more *in* would be used.

(ii) Contiguity of movement of target object with container would affect the preposition used; the greater the contiguity of movement, the more *in* would be used.

(iii) Continuity of target object with other objects in the container would affect preposition used in static scenes and scenes of non-contiguous movement; the more the continuity, the more *in* would be used. However, in scenes with contiguity of movement between figure and ground, continuity was predicted to have no significant effect.

(iv) There would be no interaction of these factors with the age of the subjects.

(v) The spatial position of the figure would affect the ground reference object used, whether the container or other container fruit. Contiguity of movement and continuity would have no significant effect on the ground reference object; if they did, it would show that any significant change in preposition use might be as a result of contiguity and continuity increasing the perceptual salience of one or other ground reference objects, and a preposition then chosen to fit that reference object, rather than notions of functional control changing the appropriate preposition even with the same reference object.

(vi) Other features of the container used would affect the prepositions used; the greater the amount of horizontal surface available as part of the container, the more *on* would be used.

The factors that were examined for the *over/above* paradigm were spatial position of target object and degree of movement of target object.

It was hypothesised for the *over/above* paradigm that;

(vii) If the target object was stationary, then *above* would be used more, whereas if the target was moving, then *over* would be used more.

(viii) The youngest children, not having acquired *over* and *above*, would use *on* in the former case above, and *in* in the latter case.

The comprehension study was divided into two parts. The first was based on Clark's (1973) object-placement task for five prepositions: *in, on, over, under, above.*

It was hypothesised that:

(ix) There would be an increase in mean score with age.

(x) Mistakes across age groups would reflect the order acquisition found in previous studies (reviewed above): *in, on, under, over/above.* It was hypothesised that *over* would precede *above*, since it involves function relations.

(xi) Errors made would be attributed to the children working within the non-linguistic schema of Clark (1973); thus they would place the target *in* the container when in canonical position, and place it *on* the container in inverted (non-canonical) position.

The second half of the comprehension study was itself divided into two parts; the first investigated when an object moving down into a container would be deemed to be *in*. Two responses were thought possible; level at the rim, or on the base. Both are acceptable within the functional relations theoretical perspective, but since the rim position occurs first before the base position in the movement of the fruit downwards, the hypothesis would predict children who understand in in terms of functional control would choose the rim position predominantly, whereas children using the non-linguistic schema of Clark (1973) would choose the base position.

The second part of the comprehension study was designed to investigate which of the senses of *over* is most apt by asking the subject where the target object first becomes over the reference when moving on a path. If the functional control sense is most apt, the object will be *over* when it moves into the limits defined by the sides of the reference container; if the *above-across* sense is most apt, it will be *over* when it moves past those limits.

The results of the Stevens and Coventry study largely confirm the hypothesis. Here we discuss the results in sections.

### 7.4.2 Production Experiment Results

#### *In/On*

Increased contiguity of movement was reflected in greater uses of *in* as the preposition to describe the relation of figure to ground objects. This factor was found to interact with the spatial position of the figure object in relation to the ground object. Obviously the more the figure object is inside the ground object, the more *in* is used.

The prediction that there would be no effect of the age of the subjects on the effect of contiguity of movement on the preposition chosen was confirmed. The youngest subjects however were still older than the age at which previous studies have suggested that the use of *in* and *on* begins to emerge.

The spatial position of the figure object was found to affect the choice of reference ground object, container or other fruit. This is an indirect effect of the fact that the higher the figure object, the greater the number of other fruit on which it was resting; this increased perceptual salience of the fruit will obviously result in greater use as the referenced ground object.

An interaction was found between the spatial position of the figure object and the effect of contiguity of movement of figure and ground on the preposition chosen; the effect of contiguity increasing use of *in* was greatest the more the figure object was within the ground bowl.

The hypotheses predicted that there would be differing effects of continuity of figure object with other objects in the ground bowl in the three movement conditions on prepositions chosen. No significant effect of continuity was found in the contiguity of movement condition. No significant continuity effects however were also found in the static and non-contiguity of movement conditions. It could be argued that continuity is not at all a salient factor for children of this age. Alternatively, as the figure apple and the other oranges in the non-continuity condition were functionally similar in being fruit, although they are perceptually dissimilar, the non-continuity resulting might not have been great enough to cause a significant effect on notion of functional control and preposition choice. Further experiments using non-continuity condition objects both functionally and perceptually dissimilar is necessary to decide between the two possibilities.

There was no effect of contiguity of movement on the reference ground object chosen confirming the prediction of the hypothesis.

When the notion of functional control in a scene was lessened , the notion of support seemed to replace it, with greater rise in use of *on* being observed. rather than use of prepositions with less notion of functional support according to Garrod and Sanford (1989), such as *on top of.*

***Over/Above***

Most of the subjects were unable to give a response containing a preposition; it is difficult to discern whether this is because they have not yet acquired productive use of these prepositions, or because other factors in the situation acquired more salience, such as the string on which the figure apple hung, and its swinging movement in the dynamic scenes which were commented on by the subjects in most of the responses containing no preposition.

The latter argument was strengthened by the observation that increased movement in the scene led to increased responses containing no preposition. It is however possible that another factor had an effect. In the static scene where the apple hung over the brick, there was increases use of *on top of*, which decreased when movement was present; thus the children may have used *on top of* where they believed it appropriate in the static scene, and given no response in the dynamic scenes because they believed it inappropriate.

The hypothesis predicted that children would overextend productions of already acquired prepositions like *in* and *on* into scenes where other prepositions would be more accurate. This was demonstrated by the effect of age on prepositions chosen.

### 7.4.3 Comprehension Experiment Results

The prediction of the hypothesis was confirmed that mean score would increase with age and that the pattern of mistakes across the groups would reflect the order of acquisition in, on, under, over/above observed in most cross-cultural studies (e.g., Johnston and Slobin, 1979). The significant increase in mean score with age was that between the 3;3 and 4;4 mean age groups, and reflected the acquisition of comprehension of *over* and *above* by the latter group, and also by the 5;3 mean age group. it was not possible to show that acquisition of *over* preceded that of *above*, as predicted.

However these two older groups of subjects seemed unable to produce these prepositions in the puppet-theatre situations. Possibly comprehension of spatial prepositions precedes production; the alternative hypothesis which is more likely is that the production experiment protocol was more difficult for the children to focus on preposition required to describe a scene, because of the presence of the string and the swinging movement.

The prediction that errors would fall under the non-linguistic rules schema of Clark (1973) was also confirmed. Thus when confronted with a canonical container, subjects would place the figure object in the container, whereas with an inverted non-canonical container, subjects would place the figure object on the container.

These errors show that the child is constructing a mental model which does not reference the preposition in the linguistic instruction. The functional model to which the child is responds is one that is constructed from the most likely relation between the figure and the ground objects, that may have been encountered during the child's own play with objects; that the child responds is because of the social demands of the experimental situation.

The trend in *in* responses seen in the second comprehension experiment suggests a subsumption of the model derived from the non-linguistic rules schema of Clark (1973) by that from functional control sometime in the third year.

The *over* responses produced in comprehension experiment one follow a developmental trend; the youngest group mostly either give no response, or placed the figure *in* or *on* the ground object in accordance with the non-linguistic rules of Clark (1973), although some subjects could place the figure *above* the ground or pass the figure over the ground; the middle group all gave a response, though the proportional pattern of responses across the non-linguistic passed and above groups remained the same; the eldest group also gave responses, but responses in the passed group increased significantly.

A significant proportion of the youngest group were able to give a response in this comprehension experiment, whilst virtually none were able to do so in the over paradigm of the production experiment. Thus possibly comprehension of these prepositions precedes production; however it was shown that in the production experiment there were certain methodological problems and it would be unwise therefore to draw conclusions about the relation of comprehension to production in these experiments.

The eldest group showed a significant increase in use of passed response, where focus is given to the endpoint of the path across the ground container. In comprehension experiment two, a similar change in uses os senses of over can be seen. The youngest group predominantly are unable to respond in the experiment as to when the figure object becomes over the ground object; those responses given are when the figure is over the centre of the container. The middle group however show a vast increase in the centre response. The eldest group show a different pattern, where the passed response increases significantly, as dores the outset response. These latter responses both possibly are accounted for by the above-across sense of Brugman (1981, 1988), Lakoff 1987) and Brugman and Lakoff (1988).

The sense of *over* that would be predicted by functional control is where the figure object is controlled by the ground, but is spatially separated from it; this would be reflected by the above response in experiment one and the centre response in experiment two. This sense does seem to be the one that emerges earliest developmentally. However, other senses of over do exist, and these seem to be occur predominantly after theyhave emerged. The above-across sense of Brugman is one that can be seen to emerge in these groups of subjects. *Over* would therefore be polysemous as Lakoff (1987) predicted, the the functional control sense may be that sense which is central member to which others are linked by image-transformations, as it emerges earliest.

### 7.5 Conclusions: Summary of First Acquisition Literature

We have presented above a review of the first acquisition of spatial prepositions. What we have argued is that existing first aquisition literature can be reinterpreted in light of previous chapters where we have argued, and presented experimental evidence in support of the argument, that functional relations are more central to the meaning of spatial prepositions (some, not all) than geometric relations. When the literature is viewed from this perspective, we have compelling support from the acquisition data. The picture that emerges is that the infant is initially concerned with properties of objects in terms of the functions that objects have, and how objects interact with each other. Thus, the youngest children in Clark's (1972, 1977) studies always acted in accordance with the functions of the ground object concerned; if the ground was a container, the figure was automatically put inside the ground; if the ground was not a container, but had a supporting surface, then the figure was placed on top of the ground.

Furthermore, the order of acquisition supports the hypothesis that the prepositions which are learned first are those involving functional relations, rather than those involving purely geometric relations. The most convincing evidence for this is that *above* and *below* are learned later than *over* and *under*. This result cannot be explained in terms of frequency of use, or complexity as *over* and *under* are more complex. The most straightforward explanation is that *over* does involve a functional component, where as *above* does not.

The Stevens and Coventry study provides the clearest evidence for the importance of functional relations, with a study that demonstrates a great deal of continuity between adult and child attribution of prepositions to situations. There appears to be a valuable parallel to be drawn between the adult and child data.

## Chapter 8

## Minimal Specification in Action: A Conceptual Analysis

### 8.1 Introduction

In this chapter we wish to demonstrate that a minimally specified account of the semantics of spatial prepositions can work. Furthermore, from the point of view of linguistic theory it makes more sense. We begin the chapter with a reanalysis of the use types of Herskovits (1986), demonstrating that they can be usefully reclassified within a minimally specified framework by extending the pragmatic principles which already play a central role in her analysis.

We then develop minimally specified lexical entries[1] incorporating the evidence accrued in the last chapter involving primary use of functional relations, This framework is developed within a semantic field.

### 8.2 Herskovitsian Use Types Reclassified

#### 8.2.1 The Case of *In*

Let us begin with *in*. We can start with the meaning postulated by Garrod and Sanford. This is;

*In*: Inclusion of a geometric construct in a 1, 2 or 3-D functionally controlling space.

We have examined in chapter five what this actually means, and have suggested some improvements, but at this time this version will suffice. What we wish to argue here is that one lexical entry only is necessary to derive the use types, which do not have to be lexicalised in our account. What we can do, is to take the pragmatic principles outlined by Herskovits, and apply them to the lexical entry above. In this way, separate lexicalisation of use types is not necessary.

We can begin with an example given by Herskovits. The expression;

the nails in the box

[1] See also Schlesinger (1979, 1989) for a similar argument made for instrumental case.

according to Herskovits (p, 87) corresponds to two different use types, one that implies containment, the other embedding. The distinction between containment and embedding, Herskovits argues, is supported by the use of conjunctions such as :

*There is plutonium and a crack in the vase.
*There are nails and a hammer in the box.

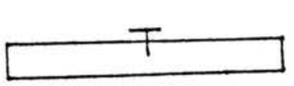
As we have seen earlier in the thesis, tests for ambiguity are ill-founded (see sections 1.4.2 and 6.2). Indeed, we have provided (section 6.2) an explanation as to why conjunctions, such as above do not appear to be felicitous.

Let us pursue the case of nails, in this case, *the nail in the board.* Herskovits (p. 111) appeals to the knowledge of the normal properties of and interaction with the objects to draw pragmatic inferences which further determine the normal situation type, but do not stem from the matching use type. As she states;

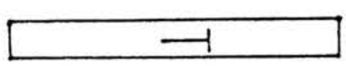
> "Having selected *gap/object 'embedded' in physical object* as the relevant use type, we can be more specific than simply asserting that the nail is embedded in the board; we know that the nail will typically be as in figure [8.1] (a) as opposed to figure (b) below. What we know about the use of nails, about the properties of wood, and how a nail is inserted into it, make situations like (b) very unlikely. And since a normal situation type is restricted to normal interactions of the objects related, it is restricted to the interpretation corresponding to figure (a) below."

Figure 8.1

(a)



(b)



This description of decoding brings into focus basic reasoning abilities which one must assume underlie language processing. These are listed by Herskovits as checking consistency, selecting a best match, and drawing inferences. However, if one is appealing to this type of information, then surely this should be utilised early on. In the case of *the nails in the board* there are two possible interpretations of the expression. It does not follow that if there are two interpretations of the expression (which there are), that the two different interpretations have to match two different lexical representations for the preposition. Acknowledging that there *are* two different uses for the expression simply has to be accounted for. From our knowledge of nails and boards we know that nails have a strong tendency to be embedded in surfaces. Indeed that is the main function of nails; to hold objects together. This will be, naturally one of the most important pieces of information we have stored in memory about nails; their function. If we then turn to the object of the expression, *the board,* it becomes clear that the function of a nail will be the strongest factor leading to the interpretation of the whole expression. However, the knowledge about how nails are normally in surfaces leads to the interpretation in (a). The point is that the interpretation relates heavily to the function of nails. The function implies that the nail is through the board. Hence, the introduction of the importance of 'function' enables the interpretation (a) to be reached rather than (b) (although (b) is a possible interpretation given a suitable context).

According to Herskovits's account there are two different interpretations of a single use type in the case of *the nail in the board.* We have given an explanation as to how an interpretation is realised. However, if there are two different interpretations of a single use type, there must be a case for the lexicalisation of these different interpretations if Herskovits is to remain consistent. Herskovits does not do this, which leaves the question of why she decides not to lexicalise at this level, when she decides to lexicalise use types, which are at a similar level. Let us pursue this point.

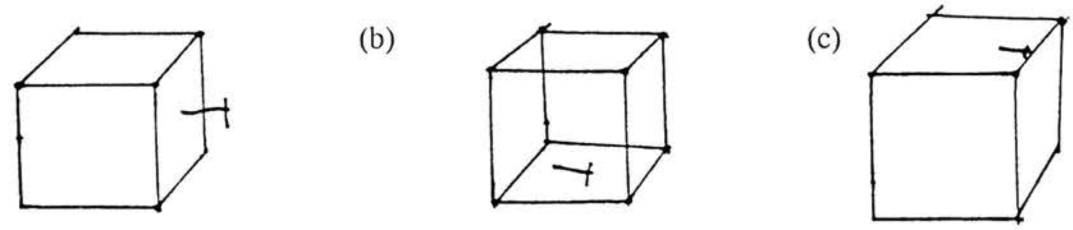
To continue with our theme of nails, let us examine the contrast between ;

The nails are in the board.
The nails are in the box.

With the first sentence we have two possible interpretations of the use type *gap/object 'embedded' in physical object.* These are (a) and (b) above. With the second sentence we similarly have many interpretations of the use type *gap/object 'embedded in physical object.* However, with the second sentence we also have the possibility of the the use of another use type, namely, *spatial entity in container.* We can have all the interpretations of the second sentence depicted in figure 8.2.

Figure 8.2

(a) (b) (c)



One can ask the question of whether there is a difference between the situations depicted above. Certainly, it is true that (c) is a less viable interpretation of the sentence than (a) or (b). In some way we wish to capture this fact. Herskovits does this when talking about the realisation of a use type as discussed above with recourse to general world knowledge. However, we wish to point out that the same information required at this point can also be used to come up with the interpretation given in (a), a different use type, without requiring the lexicalisation of a different use type.

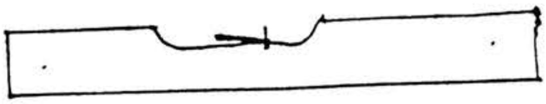
The main difference between the two sentences above is in the ground of the expression. We have already discussed the information germane to nails which will lead to more probable interpretations. In the case of the figure of the first sentence, there is considerable empathy between the figure and ground from our knowledge of nails and boards. If we cross-match information that may be present in the lexical entries for the nouns involved, we easily come to the reading already intimated. The lexical entries for the nouns may look something like the following;

*Nail:* Used to hold things together. Normally in flat surfaces. Information about shape. Representation of hammering action.

*Board:* Flat surface. Supporting function. Part of larger surface. Normally made of wood.

The information above suggests that the most likely candidates for the preposition will be *in, on* and *through* based on the knowledge we have in the entries above. The reading of *in* which will be realised will be the use type as suggested. There is nothing in the lexical entry for board to suggest the reading of *spatial entity in container.* A board is not normally conceived of as being a container. If we consider the case in Figure 8.3 below, there is a strong tendency to say that the nail is *on* the board rather than the nail is in the board. From our conceptualisation of a board apparent in the

Figure 8.3



lexical entry for board, there is no information suggesting that a board can be a container with respects to a nail in the way that a box can. However, if we substitute *woodworm* for *nail* the story is quite different. Woodworm can be viewed as being contained in a board. This is not the *gap/object 'embedded' in physical object* use type as Herskovits's analysis would suggest; the woodworm can move freely in the wood, although their position is still being controlled by the movement of the board.

What is becoming apparent is that we must examine both nouns in the expression before an interpretation is possible. Turning to the expression, *the nails in the box,* two interpretations of this expression are equally plausible. This becomes clear when we consider what the lexical entry for box many look like;

*Box:* Has the function of containing other objects (normally smaller than the box).

Yet again, a functional component greatly influences the interpretation of the expression. As the function of a box is to contain other objects, the use type, *spatial entity in container* is a plausible candidate for the interpretation of the expression. Indeed, because of knowledge we have about the function of nails and boxes we require a context with which to decide on the interpretation appropriate in a particular situation. In other words, given the sentence in the null context, the use type interpretations of *gap/object 'embedded' in physical object* and *spatial entity in container* are both equally plausible interpretations. These interpretations are derived from the lexical entry above applied to the nouns in the expression, and the conceptual information therein is crosschecked.

Let us now substitute the object of the above expression for another object. We can try the noun, *doll.* In the lexical entry for this we will have something like the following;

*Doll*: Toy, often made of plastic or cloth, with human features.

There is no information in this entry about the function of dolls that is relevant to the relation, *in*. If dolls have a function, it is to be played with. Thus, with the expression, *the doll is in the box* the function of the box leads to the interpretation of the expression such that the doll is situated interior to the box.

The picture being painted here rests very much on the lexical entry for the preposition involving the notion of function. This is essential for the interpretation of the expression. The introduction of 'functional relations' into the analysis, and into the representation for the lexical entry for *in*, alleviates the need for separate lexicalisation of the use types for *in* proposed by Herskovits (1986). As the pragmatic principles and world knowledge required by Herskovits in her analysis have to be used to get to the situation type, there is no reason why these principles cannot be used only earlier. The rationale for this is that the knowledge is being used already, so here is no need for separate lexicalisation of the use types.

We also wish to drop the use types on the grounds of our now familiar objections to full specification. In this case, it is always possible to further split the use types into yet more use types. If one wished to carve up the geometric world, then the level of analysis adopted is arbitrary.

### 8.1.2 The Case of *At*

Turning to *at*, we propose that there are two different senses for *at* which need to be lexicalised. These are;

*At1:* (Static) for a point to coincide with another

*At2:* (Dynamic) for an object to functionally interact with another object

The differences in sense reflect the distinction between an abstract detached pieces geometric meaning and a functional meaning involving interaction between the objects concerned. This distinction is supported by the results of experiments two and three reported in chapter five. The experiments followed the method of sense delineation suggested by Herskovits herself; namely that a spatial preposition will correspond to two different senses if there is some distinction important to a language user. The results provided evidence in terms of switching of preposition when *AT1* and *At2* were both possible candidates for sentence completions in two sentences paired with complex pictures. Thus, the distinction between *At1* and *At1* is supported using criteria Herskovits accepts.

Adopting two senses for *at,* one can easily reclassify the use types given by Herskovits for *at* as falling under *At1* or *At2.* These are schematised in figure 8.4.

Some of the use types are listed under both senses as they can be used in both ways depending on the objects involved in the expressions. For example, taking the case of *Julie is at the post-office,* both senses are appropriate under different conditions. *At1* is appropriate if Julie is walking down the street, and the speaker is referring to Julie's position at that particular moment in time in relation to a path. This is the abstract, detached pieces geometric usage. On the other hand, if one was to say that *Julie is at the post-office* in response to an enquiry such as "where's Julie?", then the *At2* sense is appropriate. This sense means much more than simply specifying Julie's whereabouts. Additionally, the sense implies that Julie is interacting with the post-office in a functionally appropriate way. In this case, she may be buying stamps or withdrawing some family credit.

Figure 8.4

*At1 extensions*

Spatial entity at location
Spatial entity at generic place
Spatial entity at landmark in highlighted medium
Physical object on line and indexically defined crosspath
Physical object at a distance from point, line or plane

*At2 extensions*

Person at institution
Person using artifact
Spatial entity at location

One can however contrast ;

Julie is at the post-office.
*Julie is at the bedroom/corridor.

The difference here is perfectly consistent with a minimally specified account. The use of *at* is not appropriate in the second sentence above as the objects are not associated directly enough with a functional relation. A bedroom is conceived of a place which contains a bed. However, a shop, place of work, etc, are directly associated with functional relations. A bedroom and corridor are however primarily conceived of as containing spaces, hence the morpheme 'room'. Nevertheless, one can conceive of a situation where one can be *at* the bedroom. If Julie was a carpenter working on my bedroom, then I may usefully say that *Julie is at the bedroom* using *At2*[1] .

Herskovits points to a remote/close-up viewpoint distinction contrasting *at* with *on* and *in* with respects to the "spatial entity at location" use type. These contrasts can be readily explained with recourse to our two senses for *at*. Let us take up Herskovits's pair comparisons (p. 132);

> Jonas is at/in the store.
> June is at/in the supermarket.
> Lou is at/on the beach.
> Jimmy is at/next to the pool.
> Sue is at/by the lake.

Herskovits argues that *at* is associated with a remote point of view, whereas *in* is associated with a close-up point of view. Herskovits explains five conditions which separate out the two expressions in each case. Let us explain these within our alternative framework. The five observations (p. 132-133) are:

(1) *At* will be required if speaker and addressee are close to each other and far from the supermarket. What counts as "far" is difficult to make precise. The ordinary Euclidian metric does not apply. For instance, space in a city is organised by salient boundaries: of buildings, yards, streets, etc. The applicable metric has more to do with how many of these boundaries are crossed than with straight Euclidian distance. Thus, if I am across the street from the supermarket, I am more likely to use *at* than I am in the parking lot, although the actual distance may be the same.

(2) *In* will be required if speaker and addressee are close to each other in the supermarket.

(3) *At* will be preferred if the speaker's knowledge of June's position is not based on direct perception: conversely, *in* will be preferred if the speaker can see June, or more generally has direct perceptual evidence of her presence in the supermarket.

[1] Of course, one can say *Julie is at the bedroom* using *At1* applied to Julie walking past a series of doors, one of which is the bedroom door.

(4) *In* will be required if the speaker needs to contrast the interior with the exterior, for instance when the addressee expects June to be just outside the supermarket.

(5) There is a tolerance for sentences with at not to be rigorously true at the time of speaking. Thus I could well say June is at the supermarket, not knowing, and not caring, whether she has already arrived there. No such laxity is allowed with June is in the supermarket.

Distance from the supermarket is relevant in that information about what someone is doing at a moment in time is most relevant when it is less obvious. In the case of (1), a question such as "where is June?" requires as informative an answer as possible. The use of *at* is therefore appropriate as it not only describes a location, but an activity too. This is reflected in a similar answer to the question, "she's away shopping". The fact that June is contained in the building is normally of much less interest to the inquirer. However, if the speakers are nearer the supermarket, *in* may be a more appropriate response as containment is of more relevance in that situation. If the speakers are near the supermarket, they are more likely to know that June is on a shopping trip as they must know her if they are conversing about her. They therefore already have knowledge about her actions, i.e., that she is shopping. In this situation, *at* may still be used for emphasis. Even if one was in the supermarket car park (of course leading to the implication that those parked in the car park may indeed be shopping; yet again the speakers know June, and therefore have more knowledge about her actions). June may be well known for her spendaholic tendencies, in which case, *June is at the supermarket* may be used to emphasise her shopping tendencies.

It should be mentioned that the use of *in* in this case can also lead to the implication that June is shopping. However, the purpose of June's trip is much more obvious with the use of *at* as *At2* directly incorporates this component in the lexical entry. It can be argued that the mention of the noun *supermarket* itself leads to the implication, and not the preposition *in* in this case. The notion of containment, however, will strongly suggest shopping as the person will have been there for a significant period of time.

If both conversants are in the supermarket, *in* will be required as it is obvious that the referent is shopping as the conversants are too. Containment will then be the most relevant preposition to use. The question "Where is June?" will almost certainly refer to the whether or not June has changed location or not. The use of *at* in this situation doesn't work as June could still be at the supermarket if she was pushing her shopping trolley outside the supermarket. The car park can be conceived of as part of the shopping excursion in a similar way, and hence being *in* the car park is still interaction with the supermarket.

(3) naturally follows from what has already been said. If one can see June, then one will know that she is shopping/interacting with the supermarket in a functional way. Containment is then the appropriate relation therefore to use.

Yet again, (4) has already been explained by the fact that *at* could have June pushing the shopping trolley outside the supermarket building. *In* specifies the contrast of interior with exterior, i.e., a change of state.

To finish this example, (5) naturally follows as June could be pushing the trolley outside the supermarket. The functional relation suggests the whole functional interaction with supermarket, and this doesn't all have to be contained within the supermarket.

Turning to the "person using artifact" use type, Herskovits argues that the normal use condition could not be inferred pragmatically; tems which fall within this use type are not simply special cases of " spatial entity at location". For example, with *Maggie is at her desk*, one could claim that, if Maggie was very close to her desk but cleaning the floor, the sentence was not false but uncooperative: the speaker should know that the addressee will infer that Maggie is using her desk. Herskovits makes the point that such a pragmatic inference should be "cancellable" (following Grice, 1974): if the sentence by itself risks misleading, but its conventional meaning admits the possibility that Maggie is not using the desk, the speaker need only warn the addressee, but means of an added but clause for instance:

*?Maggie is at her desk, but she is cleaning the floor.

This sentence seems contradictory. Herskovits provides other examples indicating that functional interaction is a key factor is separating this use type from the others. However, Herskovits does not recognise the importance of functional relations with respects to any of the other use types. For example, to return to *Julie is at the post office,* we can see that the same problems with cancelling a supposed pragmatic inference apply here;

*?Julie is at the post office, but she is hailing a taxi.

We have already discussed the role of functional relations with "spatial entity at location". Let us focus on the "person at institution" use type. This use type, according to Herskovits, is related to the "spatial entity at location" use type. This is clearest, Herskovits suggests, when one compares:

My son is at the University
My son studies at the University.

The verb in the second sentence denotes the activity performed at the institution. Hence, one can in fact construct parallel expressions synonymous with the ones falling clearly into the use type "spatial entity at location".

This interpretation is hardly surprising as we see the above expressions as relating to *At2*. When one says *My son is at the university,* the assumption is that he works there. The addition of a verb adds specificity to this. He could be a student there, a lecturer, or a cleaner or secretary. The normal interpretation is that the son is a student. The addition of the verb makes it clearer what type of functional interaction takes place there in this case. Furthermore, one can use *At2* without the use of the determiner;
*My son is at university*

but this is not true with At1;

**My son is at junction.*

Thus the reduction of use types to two senses for *at* appears to deal with case accountability adequately, as well as being supported by the behaviour of language users empirically.

### 8.1.3 The Case of *On*

Our analysis of *on* follows the same pattern as for that of *in*. We can follow Garrod and Sanford in recognising the lexical entry as;

*On:* For a geometric construct X to be contiguous with a line or surface Y. If Y is the surface of an object Oy, and X is the space occupied by another object Ox, for Oy to support Ox.

Again, this lexical entry can be used to derive the use types dependent on information pertinent to the function of the figure and ground in the expression. For example, Herskovits proposes that there is a use type for *on* which is *Physical object transported by a large vehicle*. For example, one can say *the children on the bus*. This is compatible with the lexical entry postulated above. The children are being functionally supported by the bus; the bus is providing the function of a (moving) supporting surface to change the location of the passengers. A container also can provide this function. Herskovits (1986) notes that one cannot say **the children on the* *car*. This is because a car is viewed as a container, thus still functionally controlling the location of the children. However, one is more likely to lose one's balance travelling on a bus as compared with a car. Thus the analogy of a table is more appropriate for a bus as compared with a car.

The pragmatics detailed by Herskovits affecting the use of *on* again can be extended to avoid lexicalisation of the use types, much as has been done for *in* above. We therefore will move on to consider our analysis.

### 8.2 *In, On, At, Over, Under, Above, Below:* The Final Analyses

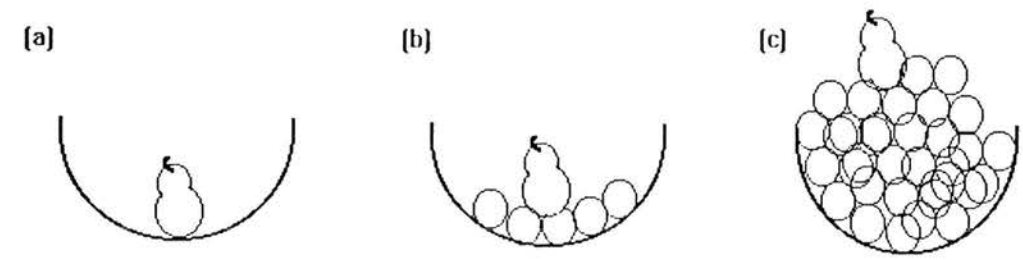
Spatial prepositions may be divided into two classes; those involving a functional component and those involving no functional component. Functional relations are primary in our analysis, reflected in the fact that spatial prepositions involving a functional component are learned before those that don't. *In, on, over* and *under* do involve such a component, whereas *above* and *below* do not. Initial evidence for this comes by way of the fact that figure/ground variations with *in, on, over* and *under* lead to different geometric positionings of figure in relation to ground. With *above* and *below,* by contrast, variations in figure and ground have no significant effects on the spatial relations depicted. Thus *above* and *below* can be regarded as being abstract geometric relations, whereas the other terms are not purely geometric in nature (that is, they are not purely *spatial* relations). We can summarise the lexical entries simply as follows;

*In:* Functional containment.
*On:* Functional support
*Over:* Functional aboveness
*Under:* Functional belowness

What is important is the interpretation of the term *functional* here. We will begin with *in,* which developmentally emerges before the others to be considered.

For *in* to be used appropriately a container must be fulfilling its function. The criteria used to govern this depends on the container. Thus, in experiment five in chapter five it was found that the specific type of container does influence use of *in* when the pile of objects is extremely high in static situations, but that contiguity of movement of figure with ground significantly increases use of *in* and overrides information about the height of the pile, and non-continuity information. The function of a container is to control the location of objects designed for it to contain. It is sensible then, that the interpretation of an expression involving *in* will therefore be dependent on knowledge associated with the container, and information relating to its purpose. If a container can be shown to be fulfilling its function, then *in* can be deemed to be appropriate. In this analysis constraint on location is primary, and the geometry of situations is a by-product of the container fulfilling its function. This approach avoids recourse to the use of Herskovits's (1986) principle of tolerance. Within this framework, all the situations in figure 8.5 are plausible candidates for use of *in*. In (c) *in* is appropriate as the bowl is constraining the location of the balls which in turn are constraining the location of the pear. Thus the bowl is functionally containing the pear via other objects.

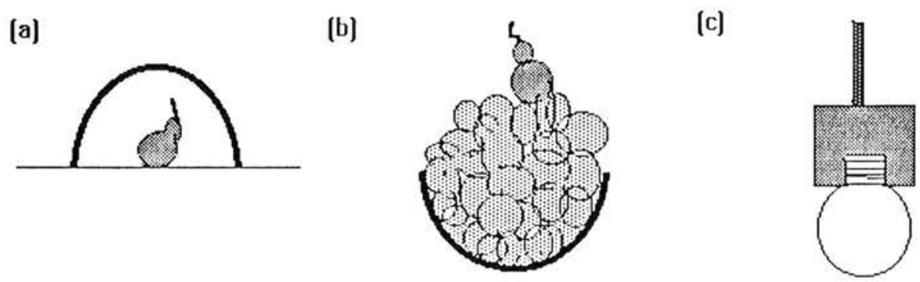
Figure 8.5




In experiment five, chapter five, it was demonstrated that contiguity of movement enables one to use *in* where it would clearly not be a primary candidate with the same scene used statically. Again, a purely geometric framework fails to capture this finding.

The importance of specific function of objects provides us with an explanation for some of the problems of case accountability cited throughtout the thesis. We can compare the appropriateness of the use of *in* in the scenes shown in figure 8.6.

Figure 8.6



In (a) *in* is not appropriate; it is at best misleading. Although it can be argued that if the bowl was moved in (a) that the pear would move with it, the bowl is not fulfilling its function in the way in which it was designed. Containers need to be in canonical orientation if they have no lid for them to successfully contain objects. Thus, object specific information about function is important. Notice that if a container has a lid, then it can be inverted and use of *in* is still appropriate.

In (c) the orientation of the socket goes against gravity. The function of a socket is to contain a lightbulb. In this case canonical orientation has no effect as the lightbulb is screwed into the socket.

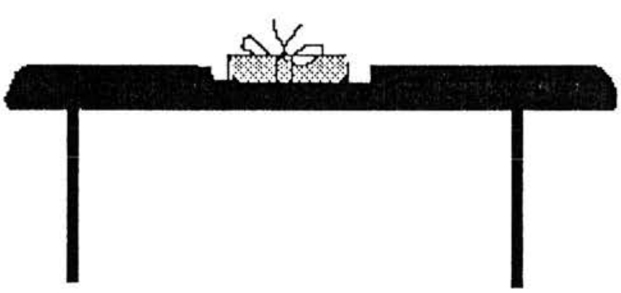
Turning to the issue of how the language and the spatial world covary, we can begin with the encoding problem. Use of *in* is predicted more by contiguity of movement of figure with ground than geometric positioning. In static scenes, other information aside from geometric positioning effects the use of *in*. It would appear that we need to make reference to mental models to explain the change in criteria used dependent on whether the scenes are static or dynamic. Use of *in* is not dependent on a single definition (as in classical accounts) being met or not, but is dependent on the mental model constructed in relation to the spatial situation. Experiment four (in chapter five) provided evidence for this. By mental model, we mean a temporary structure in working memory which serves as a surrogate representation between language and the spatial world.

With respects to case accountability, the importance of functional relations (how objects interact with each other) becomes central. The actual geometric position of figure in relation to ground is predicted most by the specific functional containment properties of the ground, rather than a construct such as interior. The fact that interior holds in many situations is part-and-parcel of functional containment.

Having examined how use of *in* and the world covary, one can arrive at a lexical entry for *in*. The entry we offer is that of *functional containment*. This is a minimal representation, and requires several operations to be performed to get at the interpretation of an utterance. It is only after relevant functional properties of the figure and ground have been accessed can the interpretation take place. This is in turn affected by other information apparent, such as contiguity of movement of figure with ground, etc. The important point here is that it is interaction between objects which is important, and in particular interaction relating to what objects are for. Not only are criteria relevant in relation to whether the ground is fulfilling its function, but the function of the figure is also paramount. A *nail*, for example, has a specific function, which relates to its containment properties. Thus a nail is not normally *in* objects in the same way that a ball is, for example. This explains the ambiguity is cases such as *the nail is in the box* without recourse to the postulation of two different senses for *in*.

*On* is treated in a similar way to *in*. This time it is functional support which is of relevance. For example, in the case of figure 8.7, *in* is not appropriate for use as the table has a strong functional support characteristic. We can see that the relationship between prepositions relates to the functions of objects. Thus we can explain the cases previously unaccounted for in chapter five, involving transitivity. One can say in figure 8.8 (a) that *the book is on the table* (the dictionary), and in (c) that *the lid is on the table*, but one cannot say in (b) that *the lid is on the table*. The explanation for this can found with recourse to the functional properties of the objects involved. In (b)

Figure 8.7



the jar and lid have a strong functional interaction relation in that jars are sealed with lids, and the function of a lid is to seal a jar. Thus the primary interaction in (b) involving the lid is that involving the jar. In (a) and (c), although the book and lid are being supported by the brick and books respectively, the functional properties of the table as a supporting surface are primary. Thus cases of transitivity can be explained in terms of object specific functional support.

We concur with Bennett (1990) on the choice of the superiority for the central sense of *over*. We wish to add to this a function component, where the lexical entry for *over* is functional aboveness. This entry, at the very least, can allow for a reduction in the number of senses of *over* that are recognised in the Brugman and Lakoff account. Again, functional properties relating to the function of the figure and ground can account for geometric relations. In the case of *the tablecloth over the table*, the specific function of the tablecloth is enough to indicate that contact is present without postulating a different sense for *over*. This case is marked in that the use of *on* (functional support) highlights the function of the table, and thus leads to a different interpretation. Thus, *over* in terms of functional aboveness is flexible with respects to the functional properties of figure and ground. *Over,* therefore, has a wide application, reflected in the Brugman and Lakoff recognition of many senses.

## Chapter 9

## Conclusions

There are several salient points which have been made during the course of the thesis. To conclude, we wish to reiterate these main points. The points made fall into two areas. Firstly, we have suggested a methodology with which to deal with lexical semantics. In particular, it has been argued that a close link between linguistic theory and processing is heuristic to semantic analysis. Moreover, we have developed a set of methods which can aid the delineation of senses. Two principles can be outlined ;

(1) For an analysis to merit two different senses of a word, the occurrences have to have a difference which is psychologically motivated in addition to the linguistic criteria which have been extensively discussed.

(2) Any theory proposing a set of senses for a word should test the distinctions made empirically so that the theory has psychological validity.

All researchers in the area of prepositions have talked about psychological validity without pursing it to any degree. Their analyses are flawed accordingly. Distinctions made in a theory of language should ultimately represent distinctions made by the users of language. One cannot study language independent of the users of that language as it is the users we rely on the establish whether communication is successful or not.

Secondly, we have suggested indirectly that lexical semantics it at a crossroads. The "skeleton in the cupboard of cognitive science", to quote Herskovits, at the end of this thesis, has almost certainly risen from the dead to haunt cognitive science. In particular, we arrive at a major problem with semantic analyses, as is standardly practised. This is, at least from a processing point of view, that it is necessary to have information about both nouns in an expression (and here we are only dealing with the verb, 'be') in order to come up with an interpretation of the expression. What is more, the information has to be crosschecked before a semantic interpretation can take place. Furthermore, from the semantic point of view, the information that is relevant in the lexical entry for each nominal (which will be represented conceptually in a variety of ways), can only be determined during the crosschecking unless there is prior information available.

The position adopted also has ramification for semantics in general. The main point here is that the meaning of a word in context is dependent on the co-occurrence relations that that word has with other words in context. This means that it is difficult to get an idea about the lexical entry for a word because it is difficult to separate out the word from the end result of the crosschecking process.

**General Conclusions**

We have shown that *in* can be appropriately used if the container is shown to be fullfilling its function. Functional containment is to successfully contain objects associated with individual containers. This may mean that a container can only contain specific objects/figures as associated with a particular function. The question to be asked is the one of how one can assess whether or not a container is fullfilling its function. Two criteria have been examined in the thesis;

(1) If the container, as already suggested, contains the figure associated with it. For example, if the geometric position remains the same, the object most associated with the function of the container will be associated with 'in' more than an object which does not have such an association with the cointainer. However, containers do share common properties, i.e., by virtue of their physical dimensions, they are bound to have common functions. Thus the effects of ground-function specificity may only hold in cases where this 'common function' appears to be in doubt.

(2) If it can be demonstrated that a container is fullfilling its function as a container. Thus, if it controls the location of the figure over time, as this is its function; to constrain the location of the objects it contains. A container which does not fullfil this function is not a container. Thus it can be predicted that, if the figure is shown to remain in the same position in relation to the container over time, then the function of the container will be vindicated, and thus the relation 'in' is appropriate.

In situations where there is not enough information available to assess whether the container is fullfilling its function, then other information may be used to assess this. One way would be to use various discriminability criteria, such as continuity/discontinuity effects.

Thus coordination phenomena, such as zeugma, may be explained with reference to inference-chaining, as opposed to the semantic content of the preposition, etc.

The content for the lexical entry for 'in' will be much as Garrod and Sanford describe; that of functional containment. However, this will not be, as Herskovits

(1986) suggests, and as Garrod and Sanford assume, an 'ideal' meaning with use types lexicalised. There is no need for this. Nor, as Lakoff (1987) mentions, do we require a prototypical representation for 'in' with other senses represented polysemously in a radial lexicon. Instead, 'in' has a minimal representation 'functional containment' which operates inference procedures for a more specific realisation of the spatial relations involved. The key to this lies in the use of the word 'functional', which necessitates the accessing of functionally relevant information to do with figure and ground, and importantly how they may interact with each other.

'On' may be treated the same way. That is, there is a minimal specification for its lexical entry, namely 'functional support', and the specific spatial relations this denotes on each occassion is dependent on the functional properties of the figure and ground. However, not all prepositions are quite as clear cut. 'At', we have argued, is a different case in that there are maybe two senses of 'at'. We found evidence for this with experiement one. Other prepositions may not be quite as simple. 'Over' for instance has been examined in some detail. Although there is an important functional component with 'over', there is suggestion that Lakoff (1987) may be correct in his arguments for full specification.

Other prepositions, such as 'above' do not have a functional component, and indeed appear to be learned later. Such relations are abstract geometric relations, and do perhaps call for the types of geometric analyses suggested by Crangle and Suppes (1989). However, conceptually some prepositions which do not require a direct functional component in the lexical entry still have different realisations ('situation types') associated with the objects involved. 'Near' for example involves distances between objects dependent on the objects. It also requires that the objects are roughly the same size. Nevertheless, there is a crucial difference with 'near' and 'in'. 'In' involves control relations, constraints on location, control of position over time. 'Near' by contrast is a static relation, a 'detached pieces' relation which does not involve inference about how objects causally interact with each other over time. To put it another way, 'in' requires the force dynamics of Talmy (1988), and 'near' does not.

Once again, it has been argued (chapter 7) that functional relation prepositions are learned first, and abstract geometric relations are learned later. This seems to be the case. The young child learns spatial relations through interaction with the objects. Initially this leads the child to directly associate words with the functions of objects. It is later that the child learns words associated with more abstract (geometric) relations which are less (if at all) reliant on functional information.

One final point relates to experientialism. It should be noted that the analysis presented is perfectly compatible with Lakoff's (1987) account of experientialism. The mistake that Lakoff and other cognitive linguists have made is to start from spatial relations and work to other domains. In the realm of spatial language, it is action governed interaction between objects which is primary to the use of spatial terms.

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## Appendix 1

## Visual scenes used in Experiment 2

Appendix 1

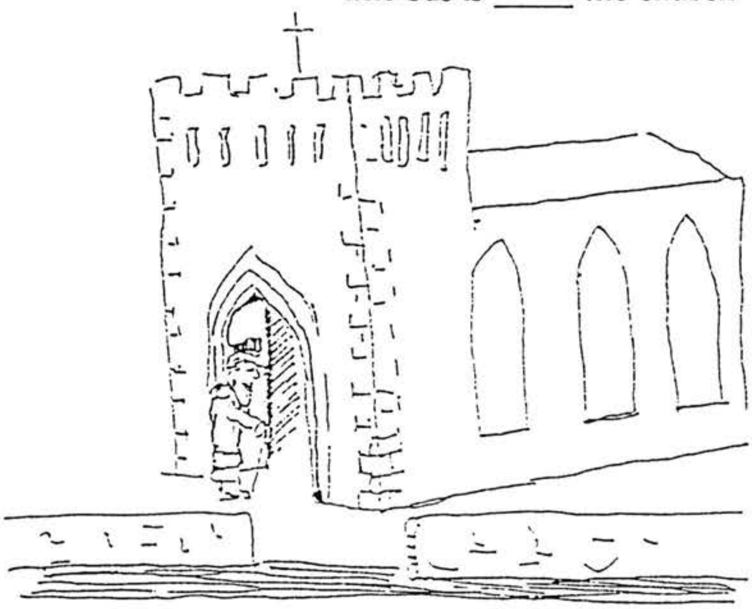
Visual scenes used in Experiment 2

*At* scenes

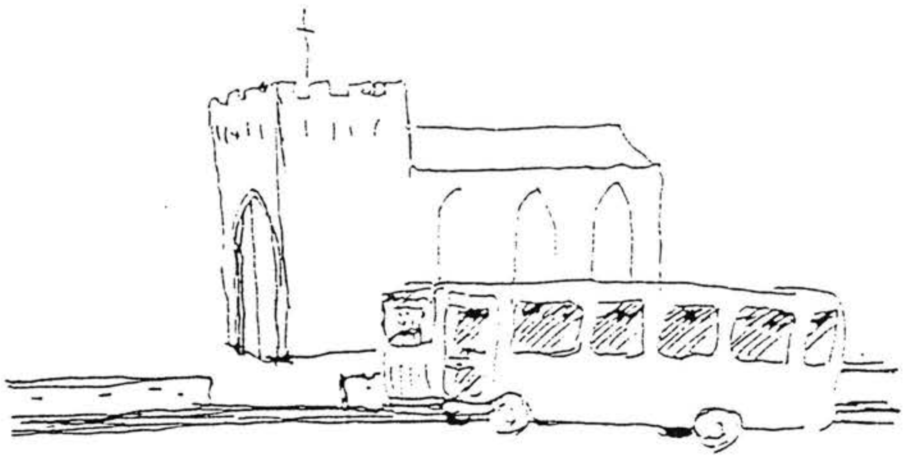
(1) Sentences used ; The old lady is _____ the church

The bus is _____ the church

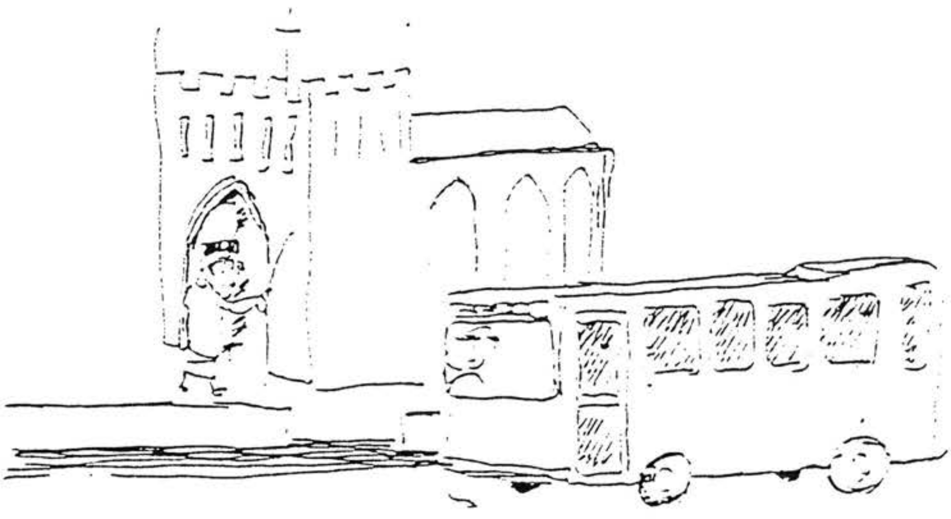
(a)



(b)



(c)



Appendix 1

Visual scenes used in Experiment 2

*At* scenes

(2) Sentences used ; The man _____ the piano

The cat is _____ the piano

(a)

(b)

(c)

Appendix 1

Visual scenes used in Experiment 2

*At* scenes

(3) Sentences used ; The man _____ the desk

The light is _____ the desk

(a)

(b)

(c)

Appendix 1

Visual scenes used in Experiment 2

*At* scenes

(4) Sentences used ; The woman is _____ the typewriter

The fly is _____ the typewriter

(a)

(b)

(c)

Appendix 1

Visual scenes used in Experiment 2

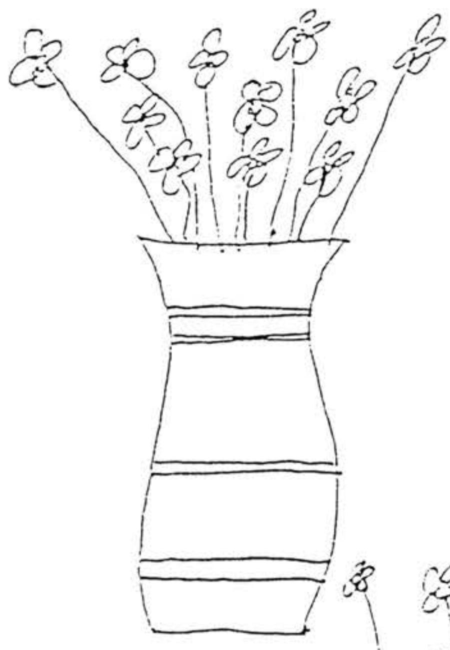
*In* scenes

(1) Sentences used ; The crack is _____ the vase

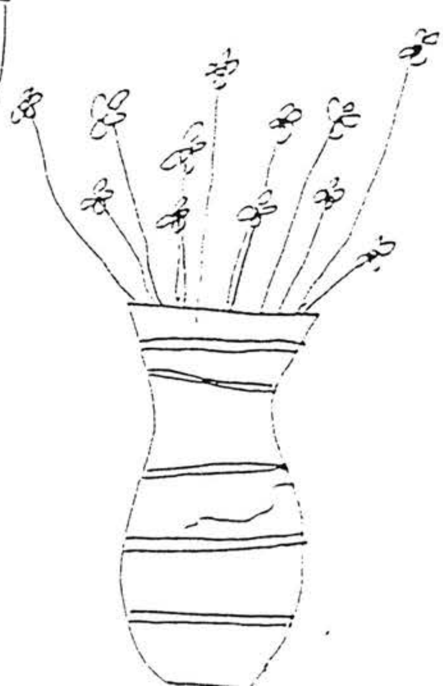
The flowers are _____ the vase

(a)

(b)



(c)



Appendix 1

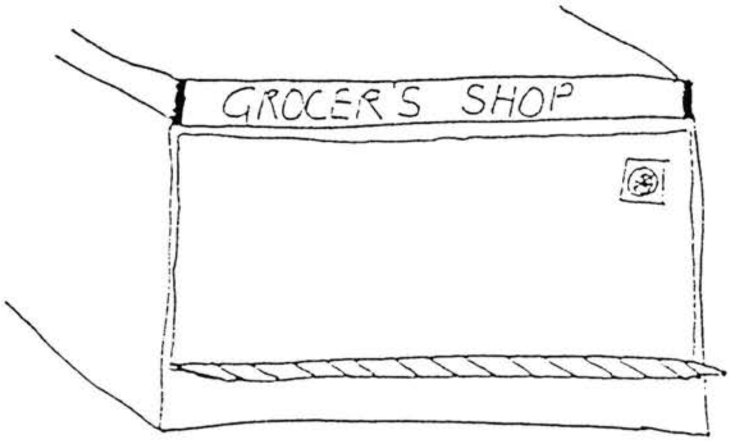
Visual scenes used in Experiment 2

*In* scenes

(2) Sentences used ; The ventilator is _____ the window

The golliwog is _____ the window

(a)




(b)


(c)

Appendix 1

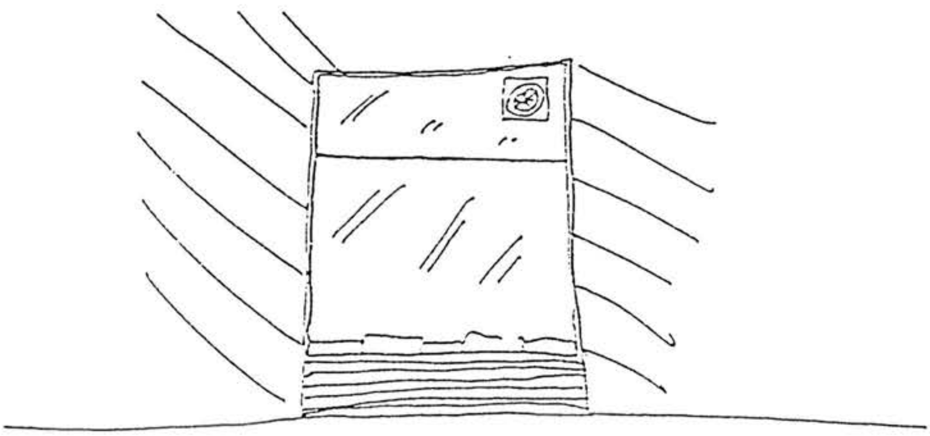
Visual scenes used in Experiment 2

*In* scenes

(3) Sentences used ; The ventilator is _____ the window

The cat is _____ the window

(a)



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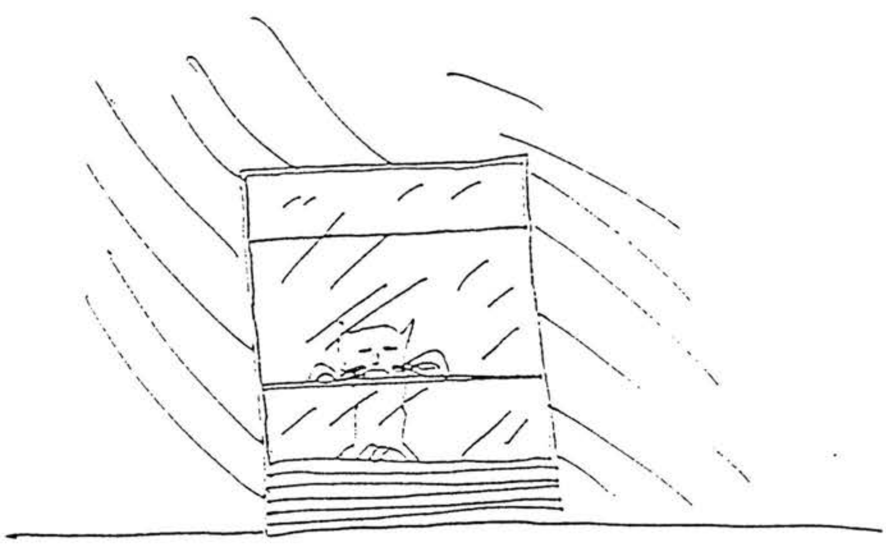
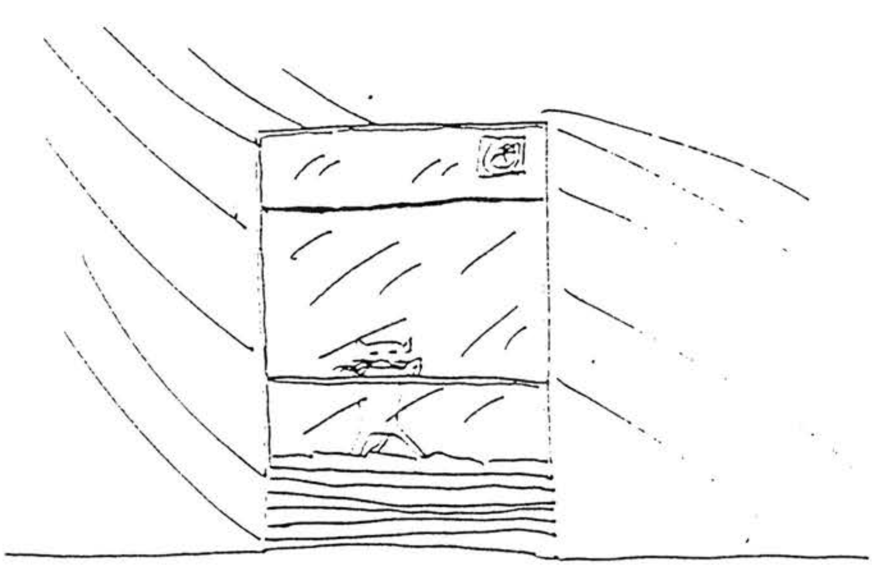


(c)



Appendix 1

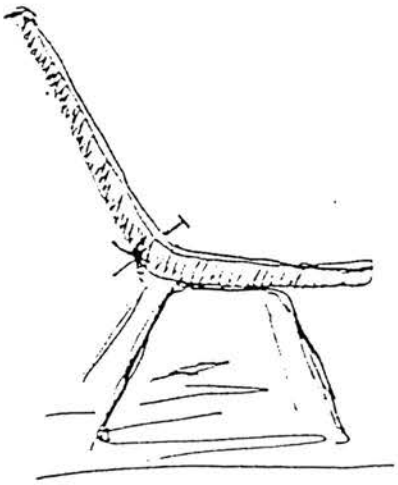
Visual scenes used in Experiment 2

*In* scenes

(4) Sentences used ; The nail is _____ the chair

The man is _____ the chair

(a)



(b)

(c)

Appendix 1

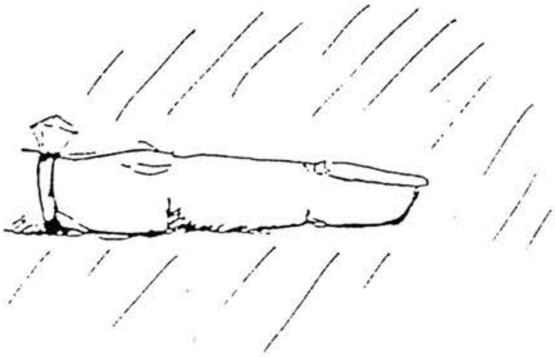
Visual scenes used in Experiment 2

*On* scenes

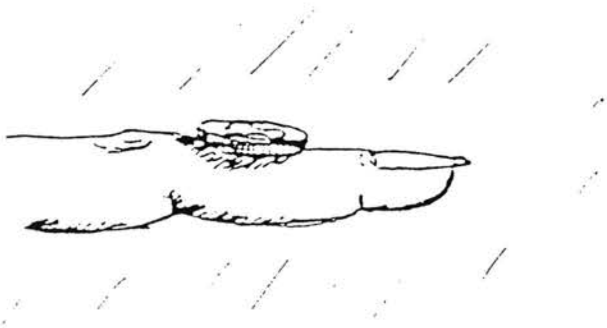
(1) Sentences used ; The ring is _____ the finger

The coin is _____ the finger

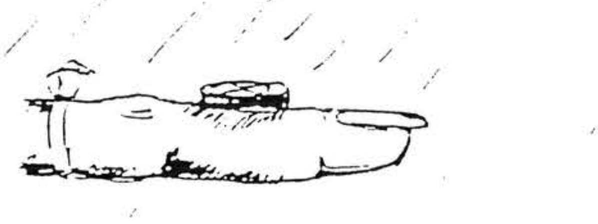
(a)



(b)



(c)



Appendix 1

Visual scenes used in Experiment 2

*On* scenes

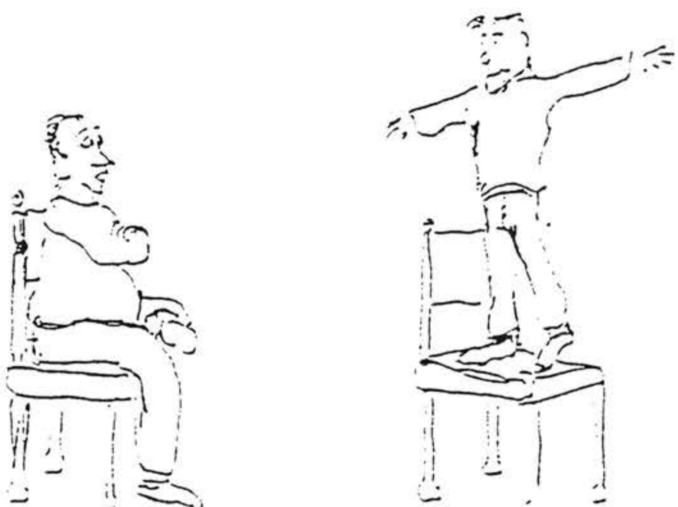
(2) Sentences used ;  The man is _____ the chair

The man is _____ the chair

(a)

(b)

(c)



Appendix 1

Visual scenes used in Experiment 2

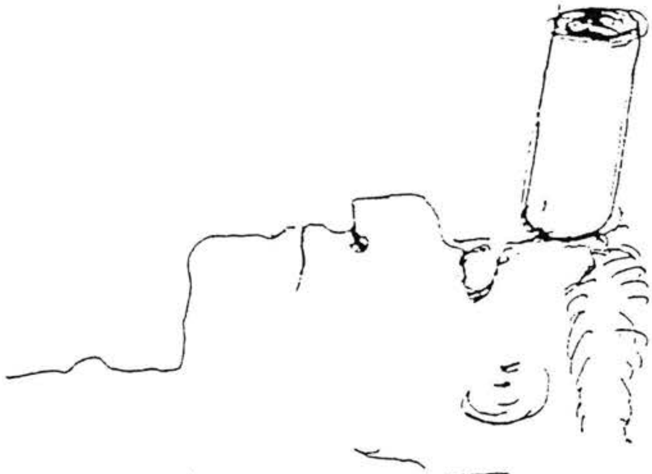
*On* scenes

(3) Sentences used ; The lines are _____ the forehead

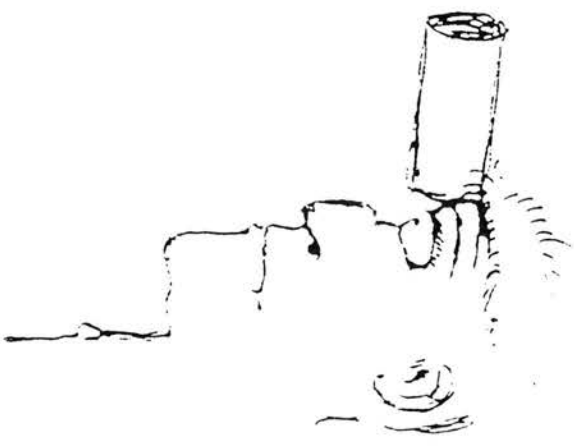
The tube is _____ the forehead

(a)

(b)



(c)



Appendix 1

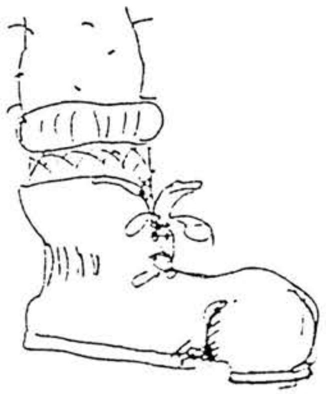
Visual scenes used in Experiment 2

*On* scenes

(4) Sentences used ; The shoe is _____ the foot

The ball is _____ the foot

(a)



(b)

(c)

Appendix 1

Visual scenes used in Experiment 2

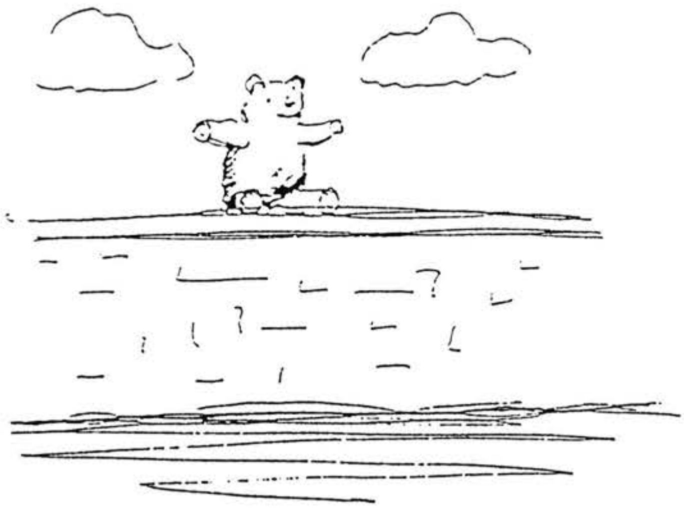
*On* scenes

(5) Sentences used ; The crack is _____ the wall

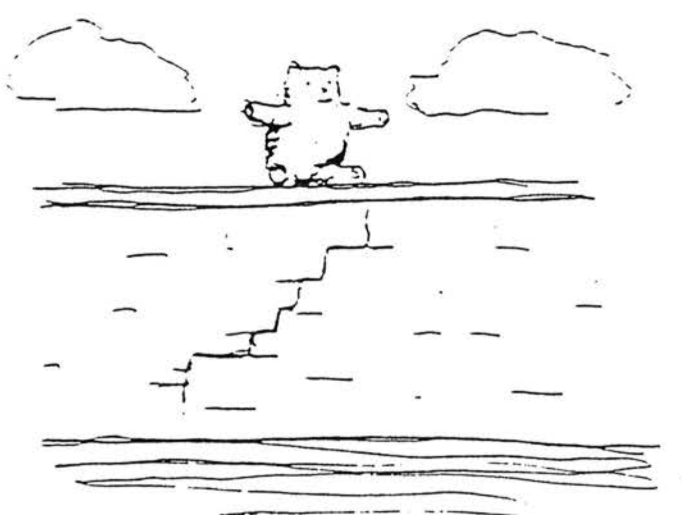
The teddy bear is _____ the wall

(a)

(b)



(c)



# Appendix 2

## Order of Presentation of Scenes Used in Experiment 2

## Appendix 2

**Order of presentation of scenes used in Experiment 2**

### Questionnaire A

(1) At/1a
(2) In/1b
(3) On/1c
(4) On/3a
(5) In/2a
(6) At/3c
(7) On/2a
(8) At/4a
(9) In/4c
(10) At/1b
(11) On/3b
(12) At/2c
(13) In/2b
(14) On/2b
(15) In/3c
(16) At/4b
(17) On/5c
(18) In/1a
(19) On/4c

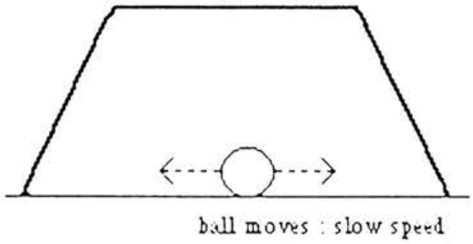
### Questionnaire B

(1) In/4b
(2) At/3b
(3) On/5b
(4) In/3b
(5) At/4c
(6) On/4b
(7) In/4a
(8) On/3c
(9) At/2b
(10) On/1b
(11) In/2c
(12) On/5a
(13) At/2a
(14) In/1c
(15) At/1c
(16) On/4a
(17) At/3a
(18) On/2c
(19) In/3a
(20) On/1a

# Appendix 3

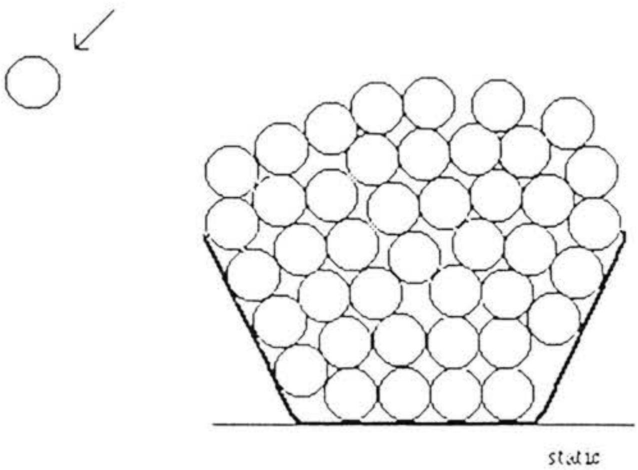
## Order of Presentation of Scenes Used in Experiment 5

scene 001



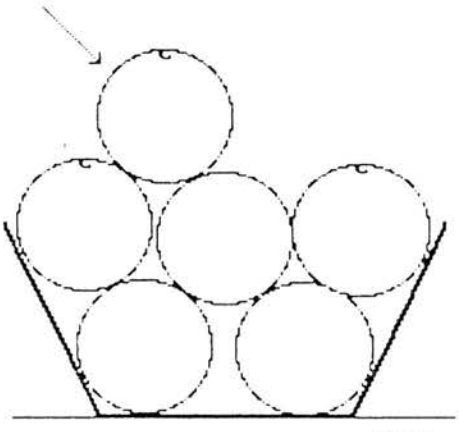

**The ball is ---- the bowl.**

scene 002



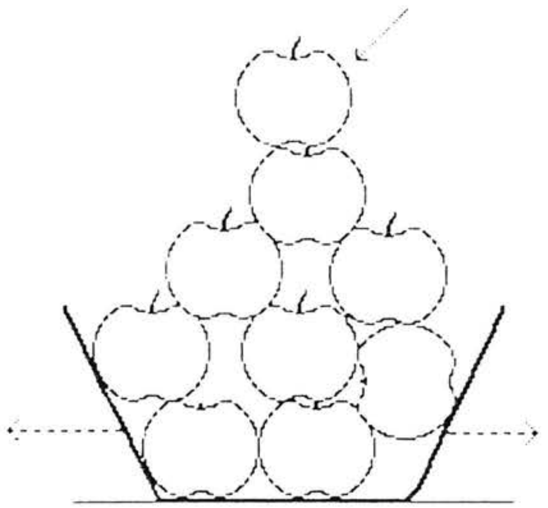

**The ball is ---- the bowl.**

scene 3



The orange is ---- the bowl

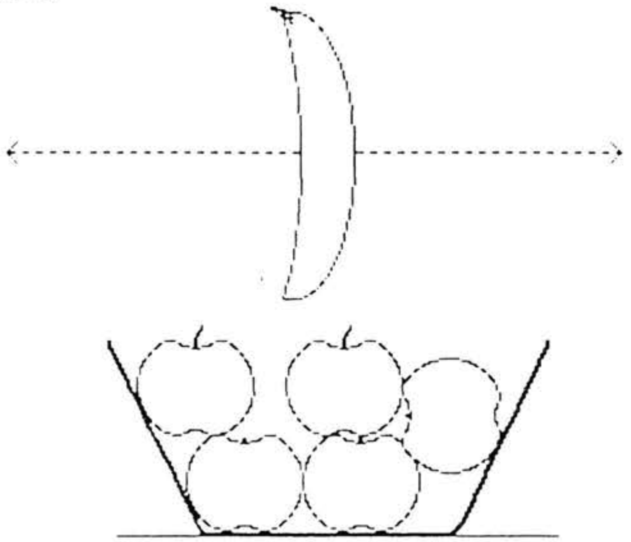
scene 4



bowl moving medium speed

**The apple is ---- the bowl.**

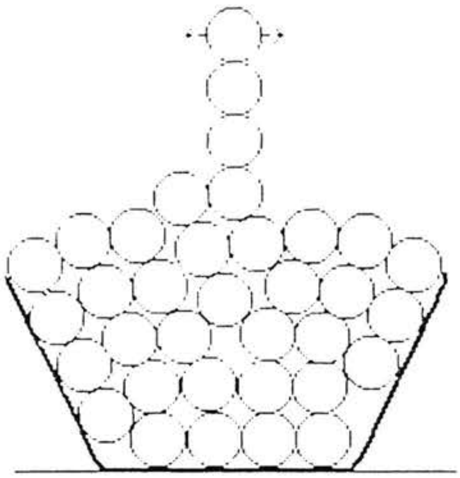
scene 5



banana moving : medium speed

**The banana is ---- the bowl.**

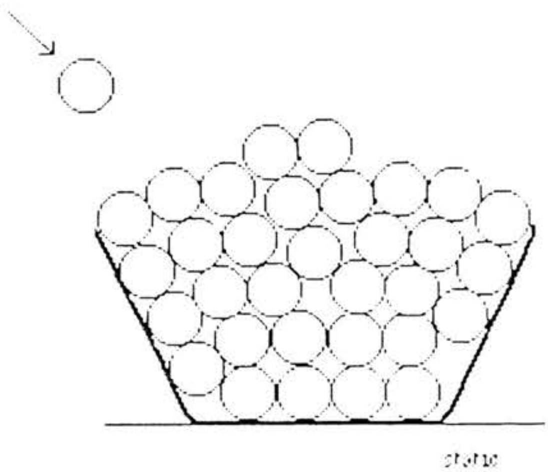
scene 6



ball moving : slow speed

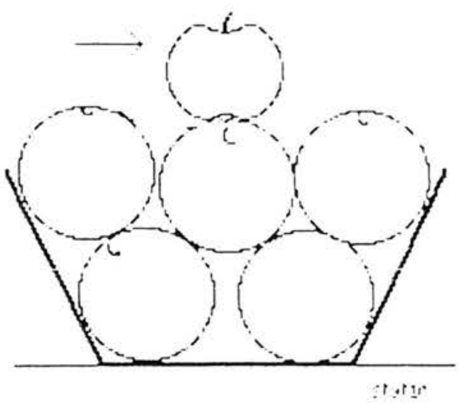
The ball is ---- the bowl

scene 7



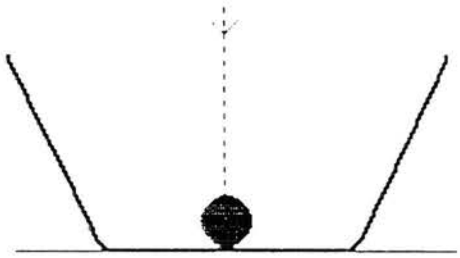
The ball is ---- the bowl

scene 8



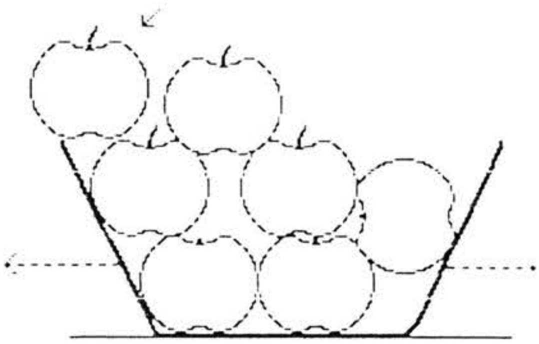
**The apple is ---- the bowl.**

scene 9



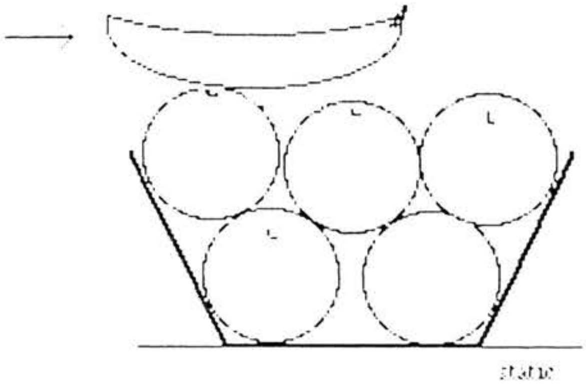

The ball is ---- the bowl

scene 10



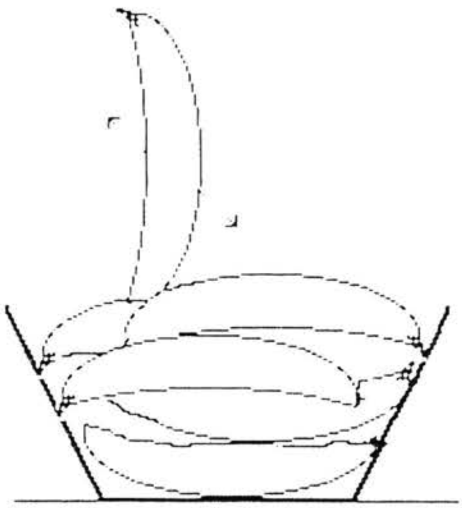

**The apple is ---- the bowl.**

scene 11




**The banana is ---- the bowl.**

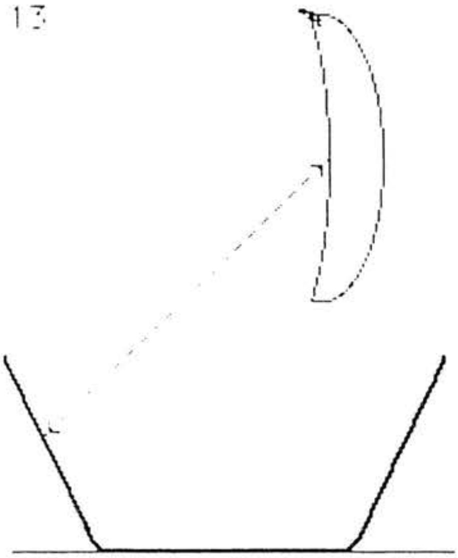
scene 12



banana moving : slow-medium speed

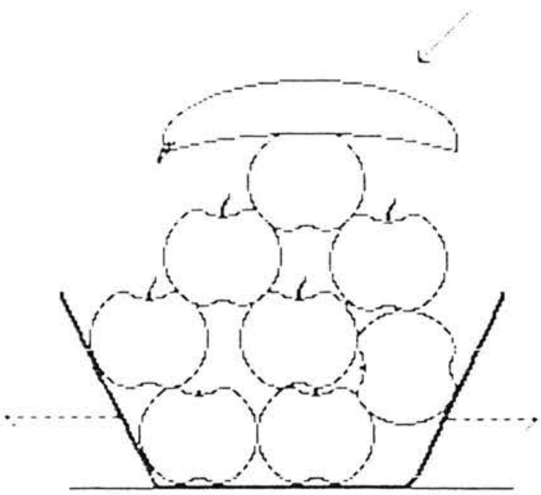
**The banana is ---- the bowl.**

scene 13



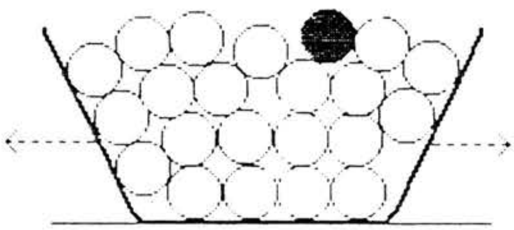

The banana is ---- the bowl

scene 14




**The banana is ---- the bowl.**

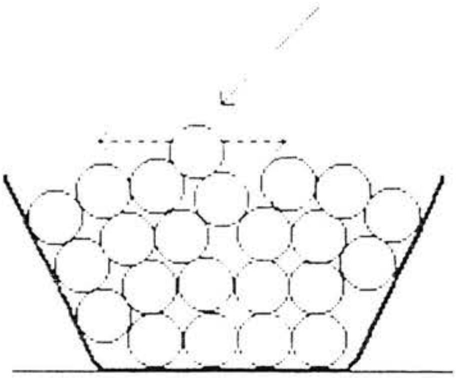
scene 15



bowl moving slow speed

The ball is ---- the bowl

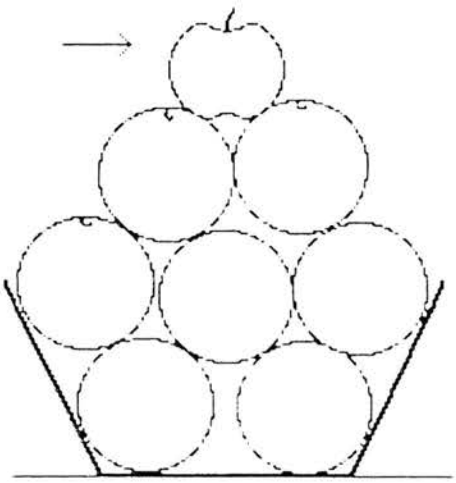
scene 16



ball moving slow speed

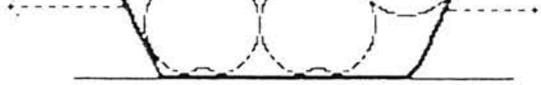
The ball is ---- the bowl

scene 17



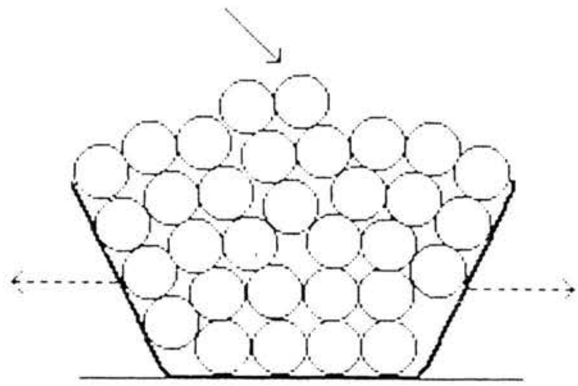
The apple is ---- the bowl

scene 18



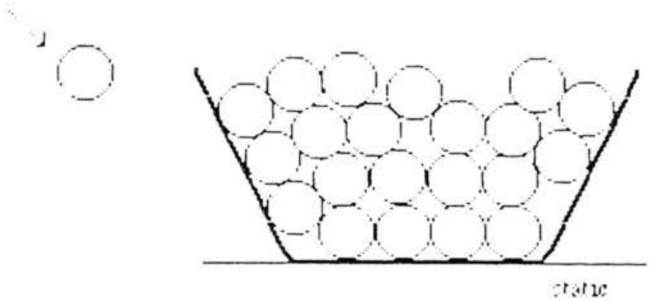

**The apple is ---- the bowl.**

scene 19



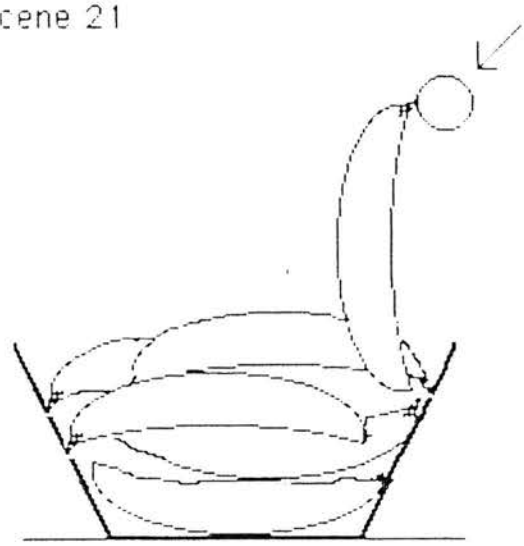

The ball is ---- the bowl.

scene 20



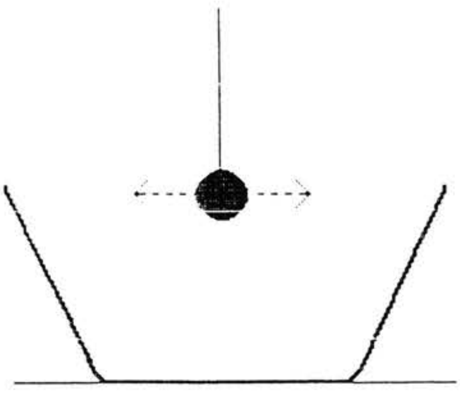

The ball is ---- the bowl.

scene 21



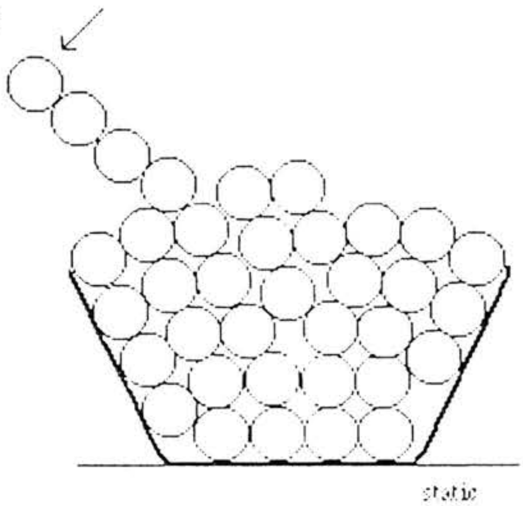

**The ball is ---- the bowl.**

scene 22



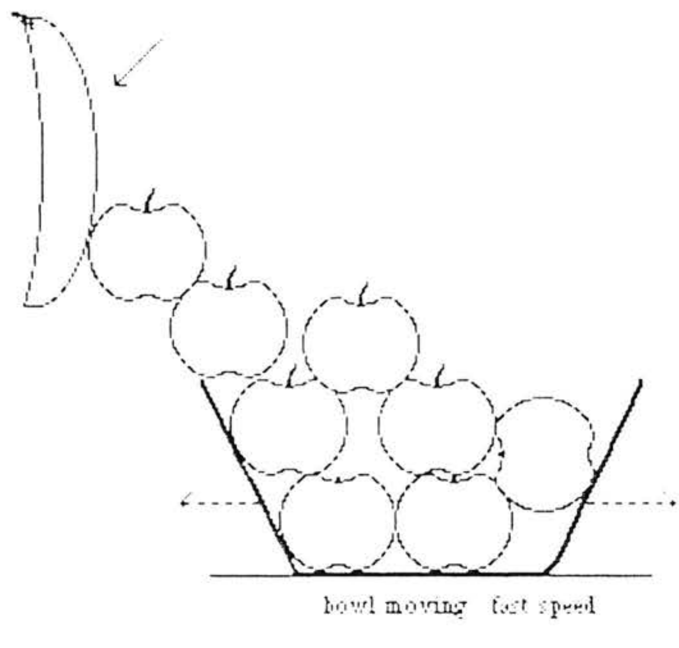

The ball is ---- the bowl.

scene 23



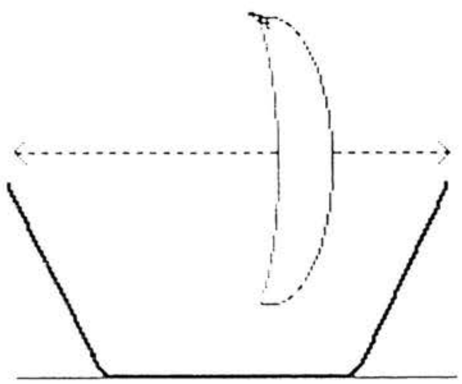

The ball is ---- the bowl

scene 24



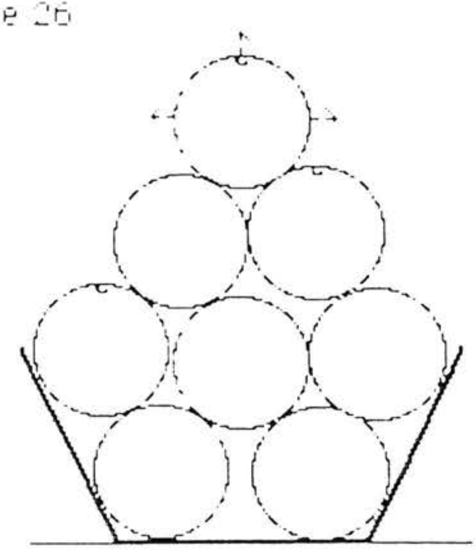

**The banana is ---- the bowl.**

scene 25



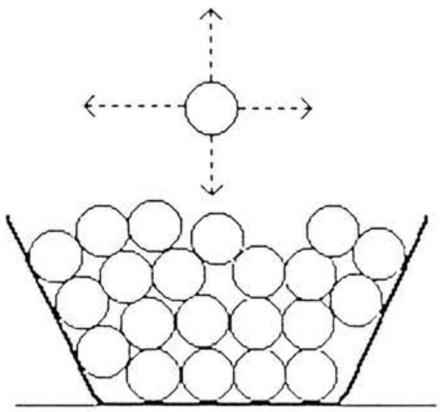

The banana is ---- the bowl.

scene 26




The orange is ---- the bowl.

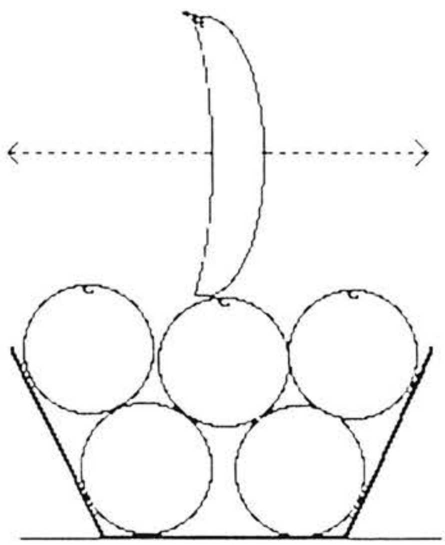
scene 027



ball moving fast speed

**The ball is ---- the bowl.**

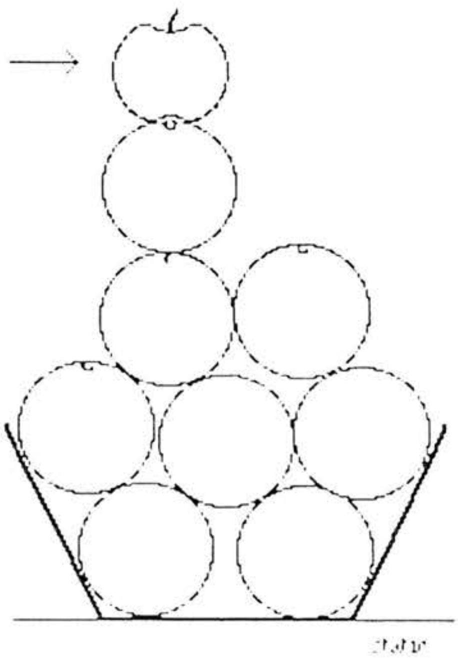
scene 028



banana moving : fast speed ( contact with oranges )

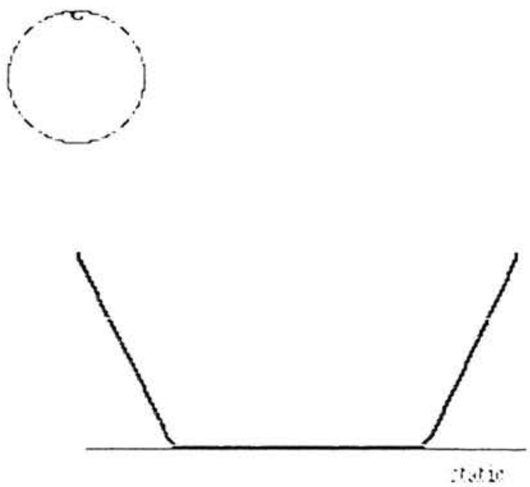
**The banana is ---- the bowl.**

scene 29



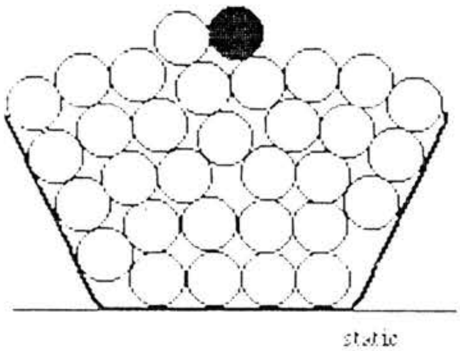
**The apple is ---- the bowl.**

scene 30



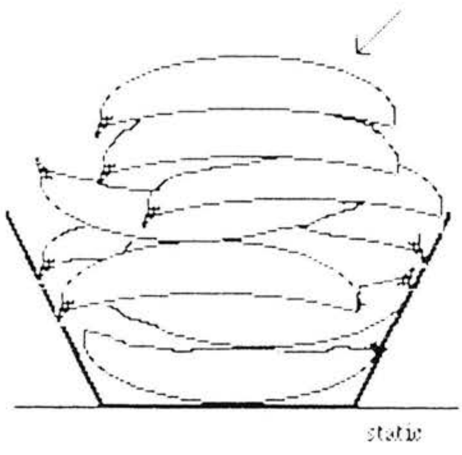
The orange is ---- the bowl

scene 31



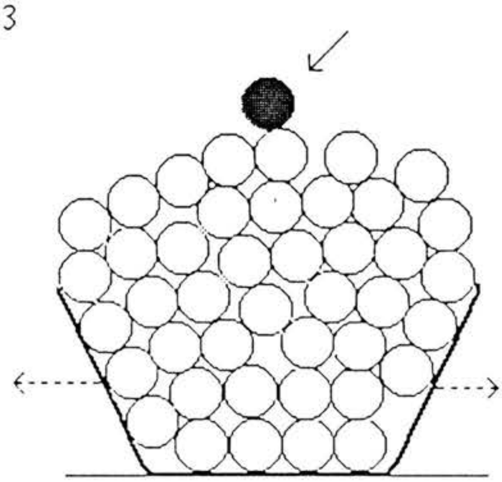

The ball is ---- the bowl.

scene 32




The banana is ---- the bowl.

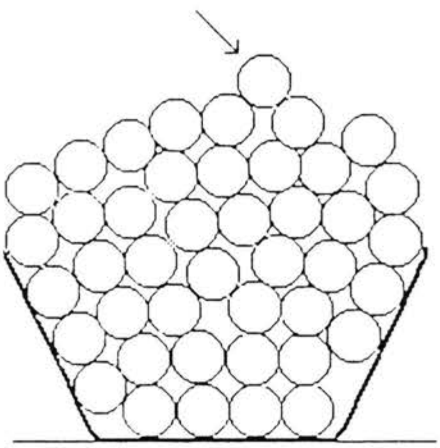
scene 033



bowl moving . slow speed

**The ball is ---- the bowl.**

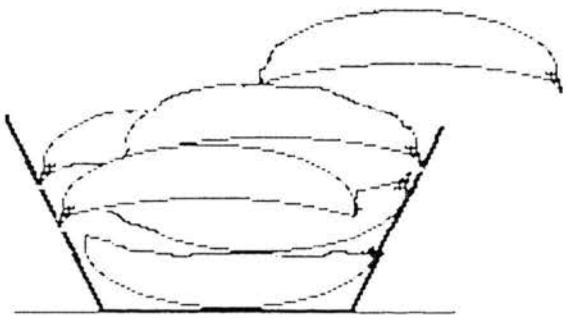
scene 034



static

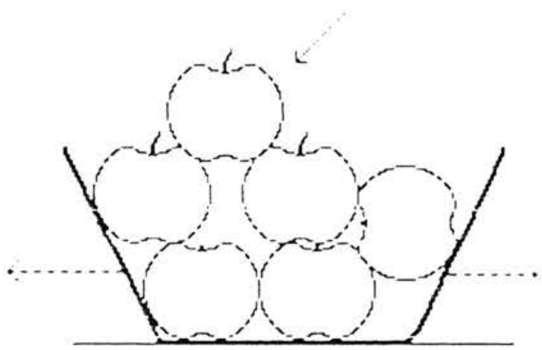
**The ball is ---- the bowl.**

scene 35



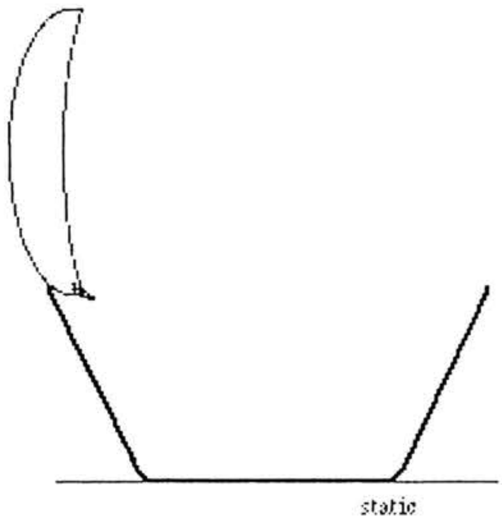
**The banana is ---- the bowl.**

scene 36



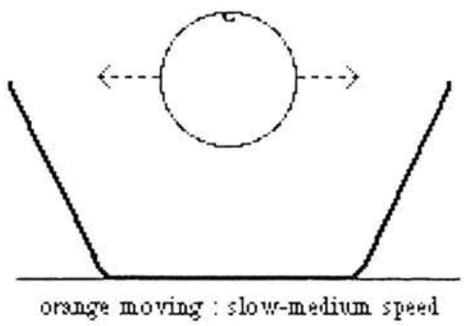

**The apple is ---- the bowl.**

scene 37



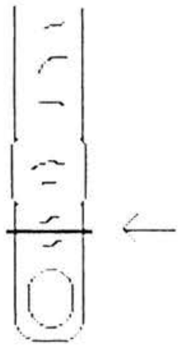

**The banana is ---- the bowl.**

scene 38




**The orange is ---- the bowl.**

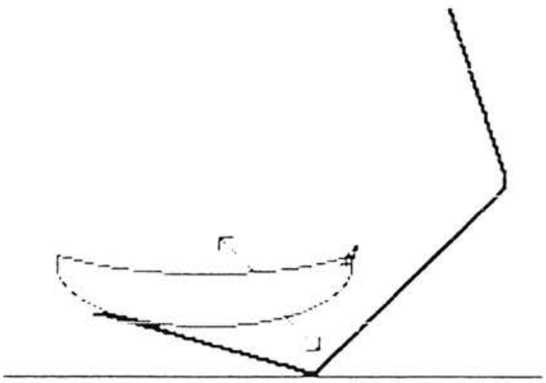
scene 39



static

**The ring is ---- the finger.**

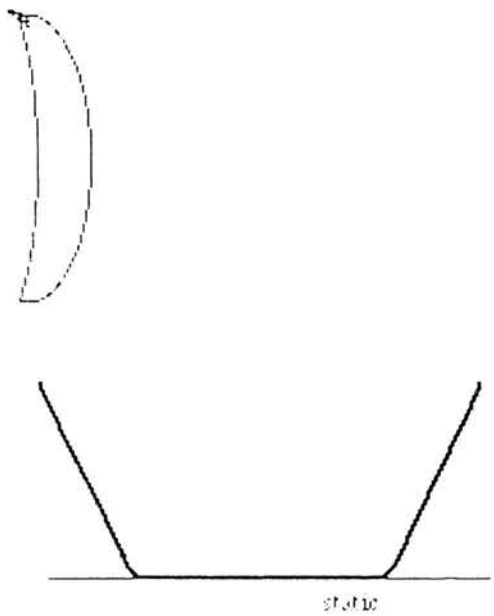
scene 40



banana moving slow speed

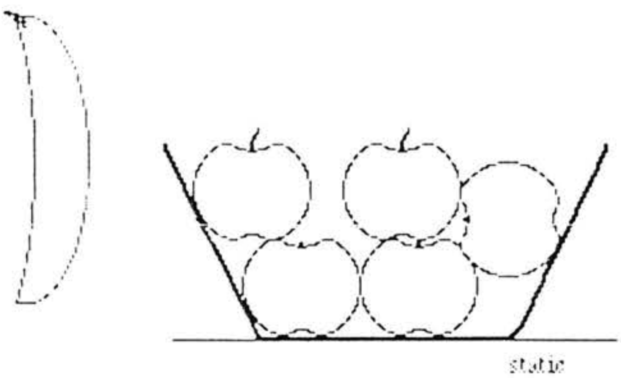
**The banana is ---- the bowl.**

scene 41



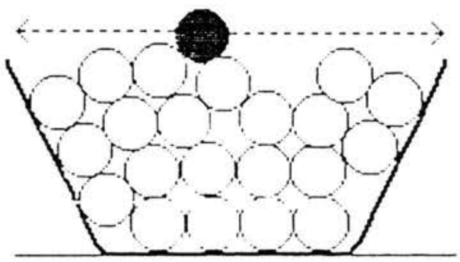

The banana is ---- the bowl.

scene 42



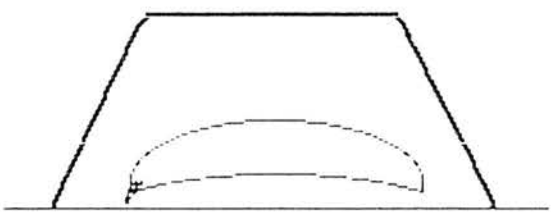

The banana is ---- the bowl.

scene 43



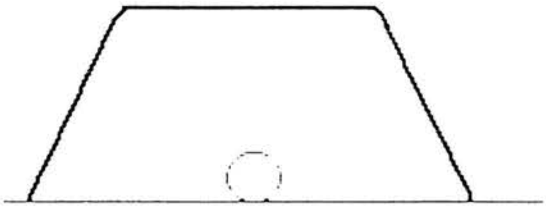

**The ball is ---- the bowl.**

scene 44



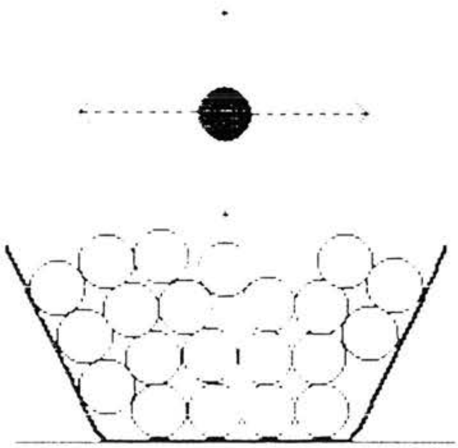

**The banana is ---- the bowl.**

scene 45



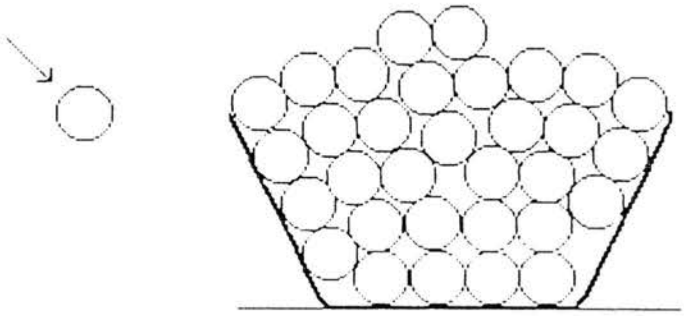

**The ball is ---- the bowl.**

scene 46



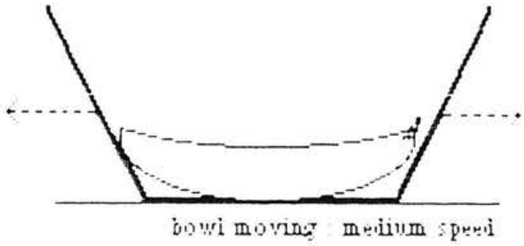
**The ball is ---- the bowl.**

scene 47



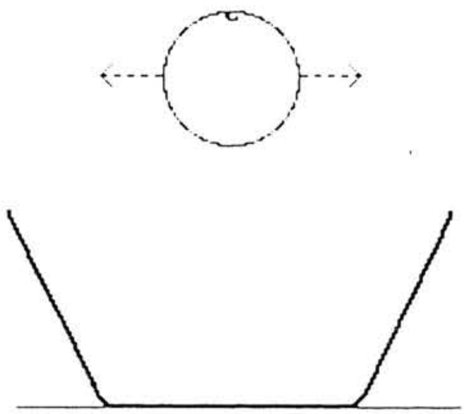

The ball is ---- the bowl.

scene 48




**The banana is ---- the bowl.**

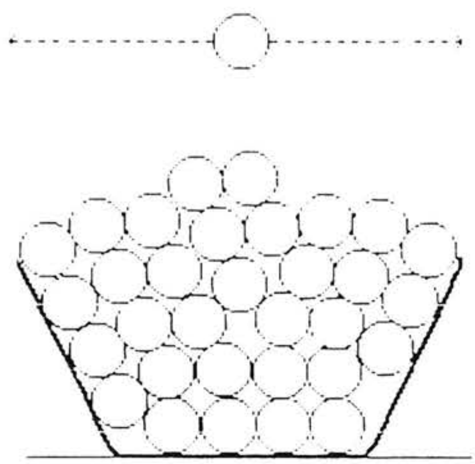
scene 49



orange moving slow-medium speed

**The orange is ---- the bowl.**

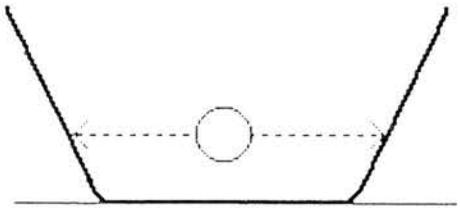
scene 50



ball moving medium speed

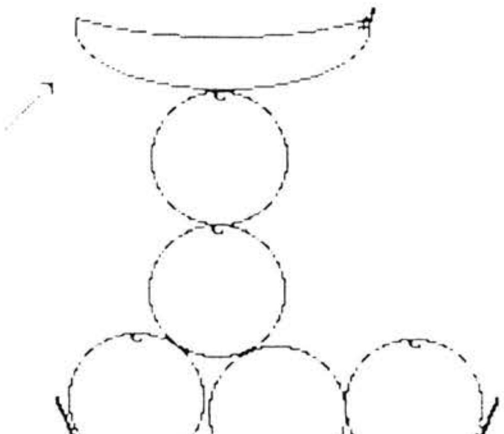
The ball is ---- the bowl.

scene 51



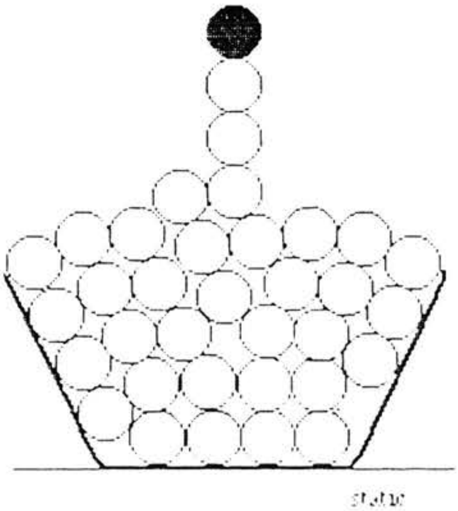

**The ball is ---- the bowl.**

scene 52



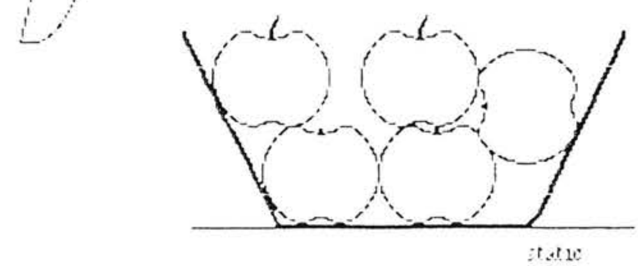

The banana is ---- the bowl

scene 53



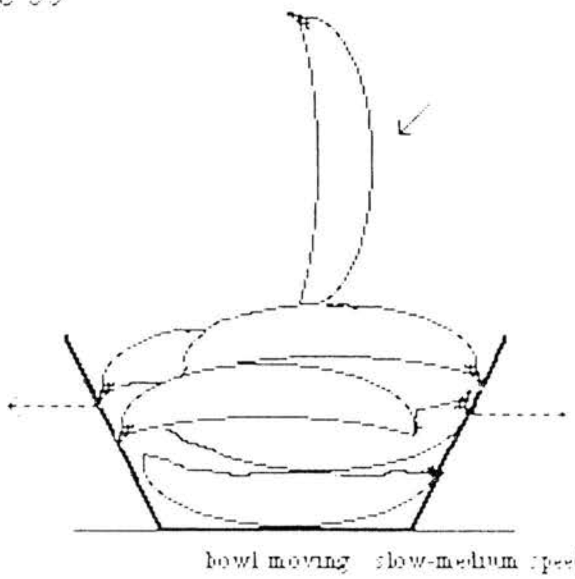

The ball is ---- the bowl.

scene 54



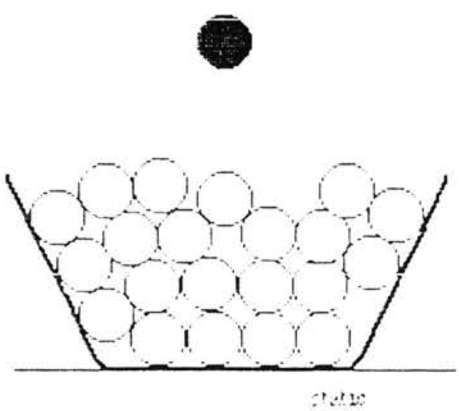

The banana is ---- the bowl.

scene 55



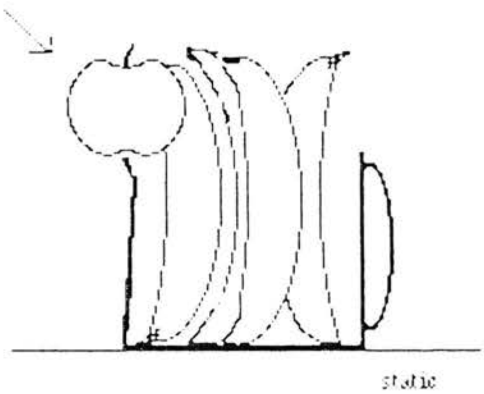

**The banana is ---- the bowl.**

scene 56



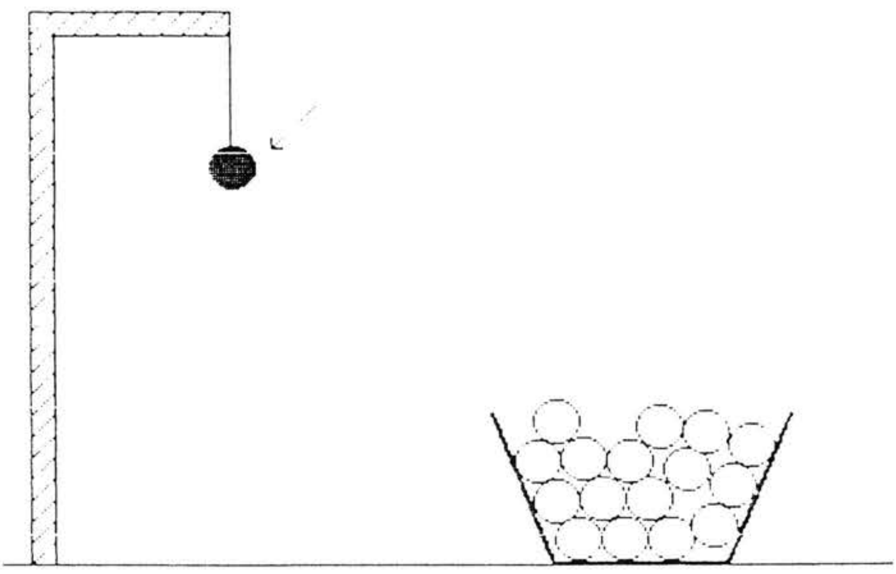
**The ball is ---- the bowl.**

scene 57



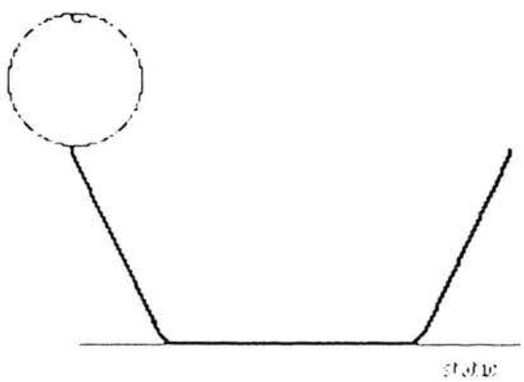

**The apple is ---- the jug.**

scene 58



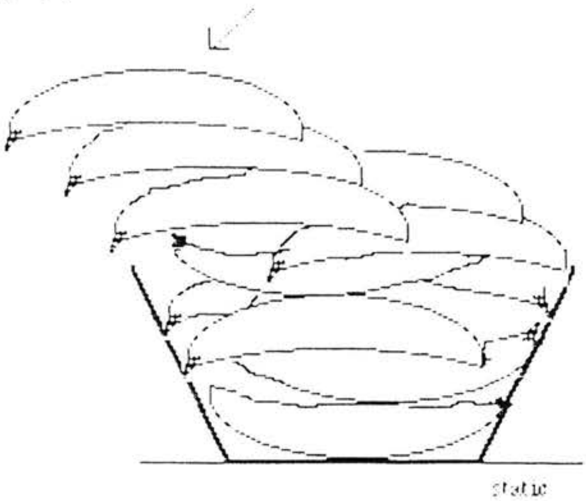

**The ball is ---- the bowl.**

scene 59



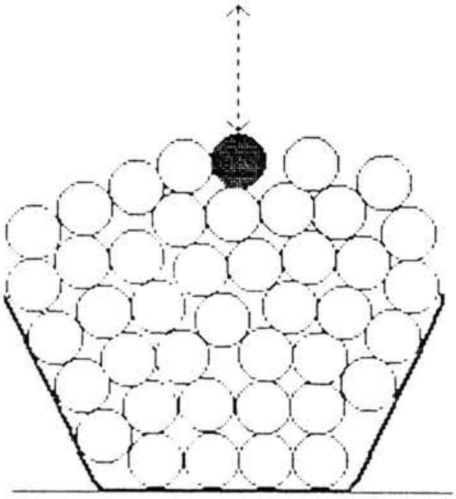

The orange is ---- the bowl.

scene 60




The banana is ---- the bowl.

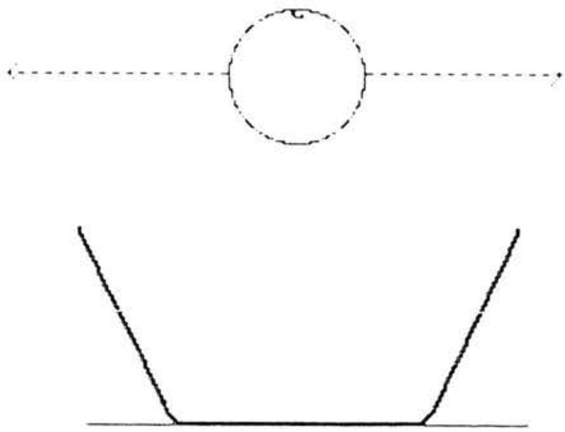
scene 61



ball moving : slow-medium speed

The ball is ---- the bowl.

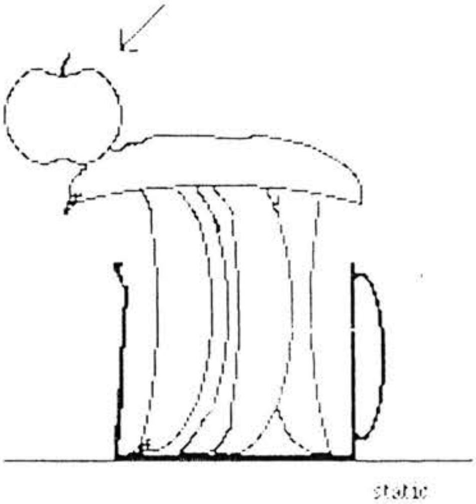
scene 62



orange moving : medium-fast speed

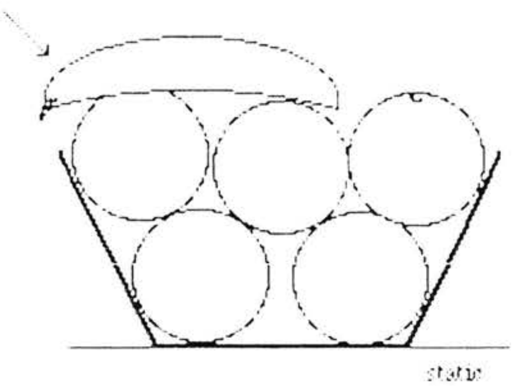
The orange is ---- the bowl.

scene 63



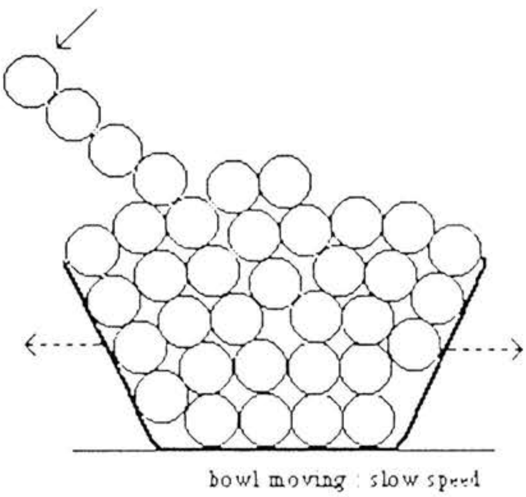

The apple is ---- the jug.

scene 64



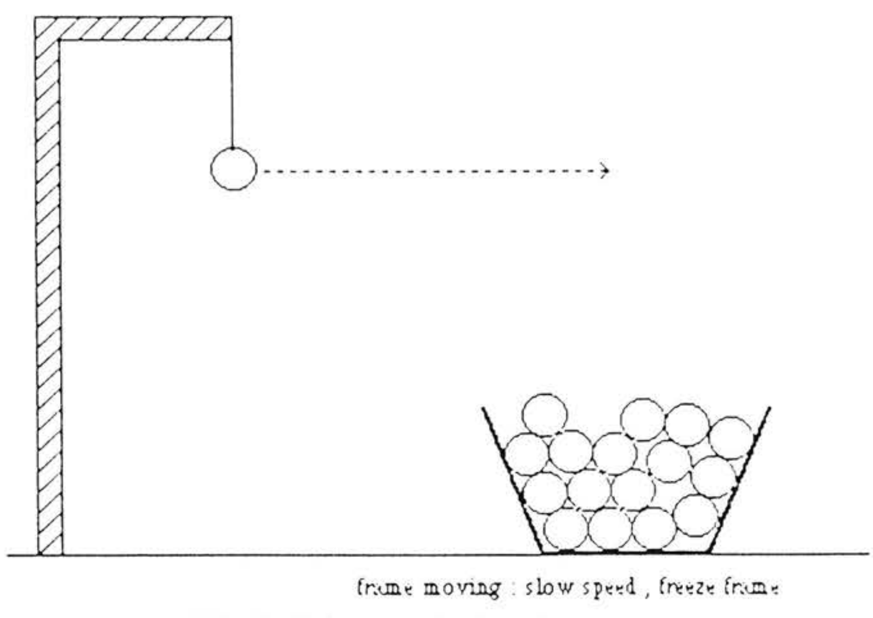

The banana is ---- the bowl.

scene 065



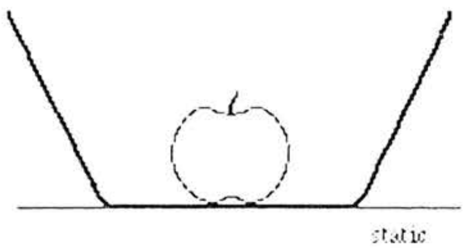

**The ball is ---- the bowl.**

scene 066



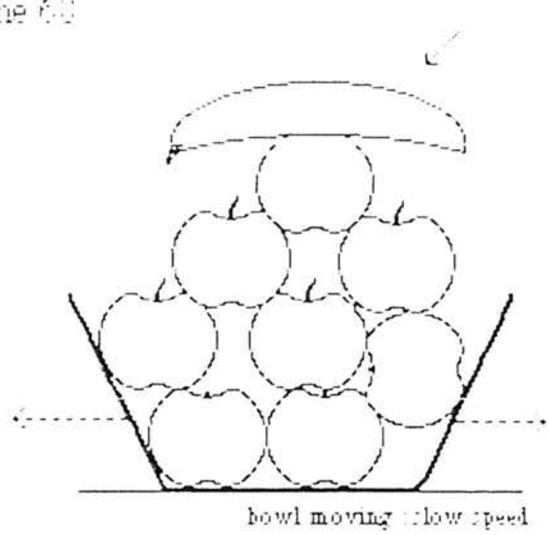

**The ball is ---- the bowl.**

scene 67



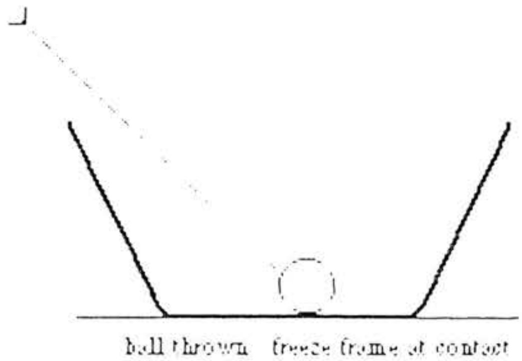

**The apple is ---- the bowl.**

scene 68



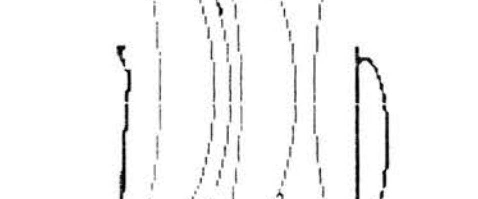

**The banana is ---- the bowl.**

scene 69



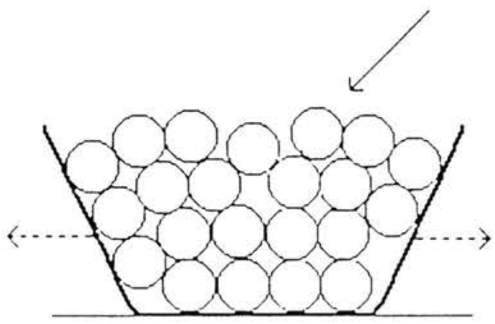

**The ball is ---- the bowl.**

scene 70



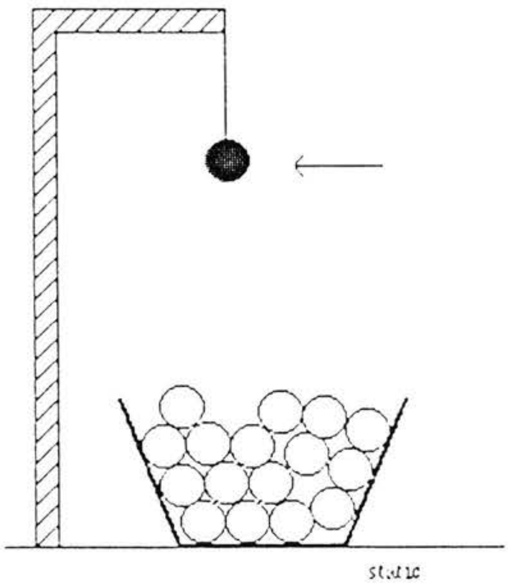

**The apple is ---- the jug.**

scene 071



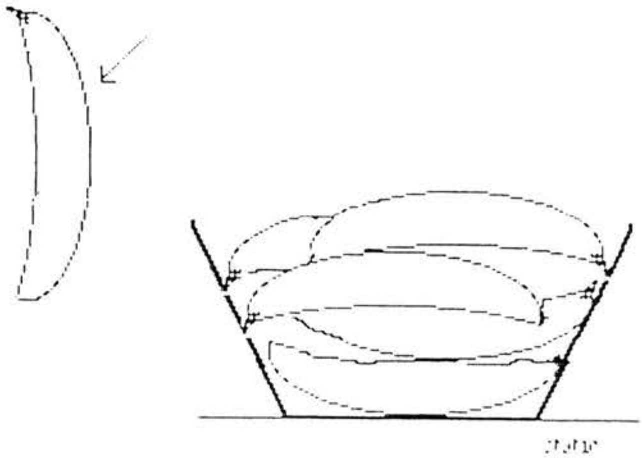

The ball is ---- the bowl.

scene 072



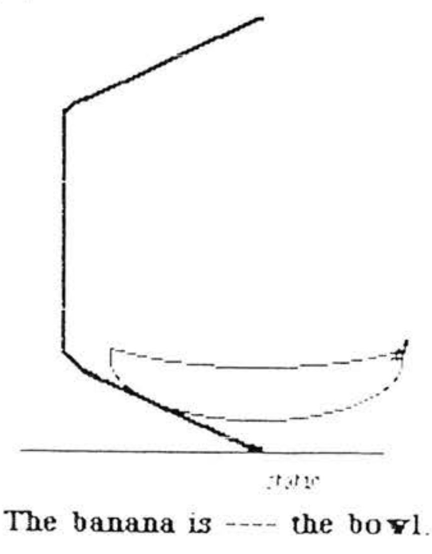

The bowl is ---- the ball.

scene 73



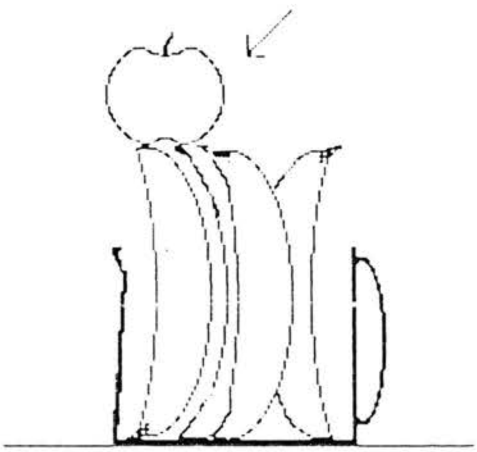

The banana is ---- the bowl.

scene 74



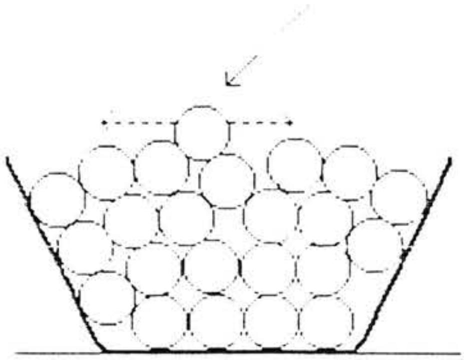

The banana is ---- the bowl.

scene 75



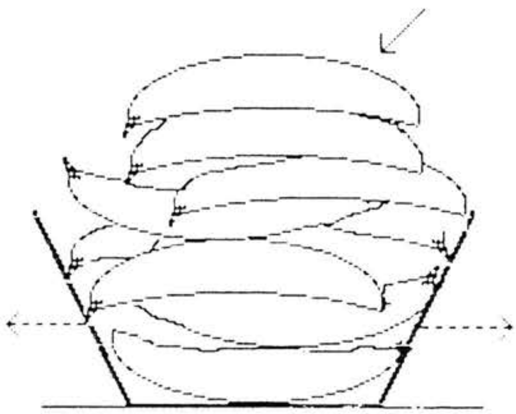

The apple is ---- the jug.

scene 76



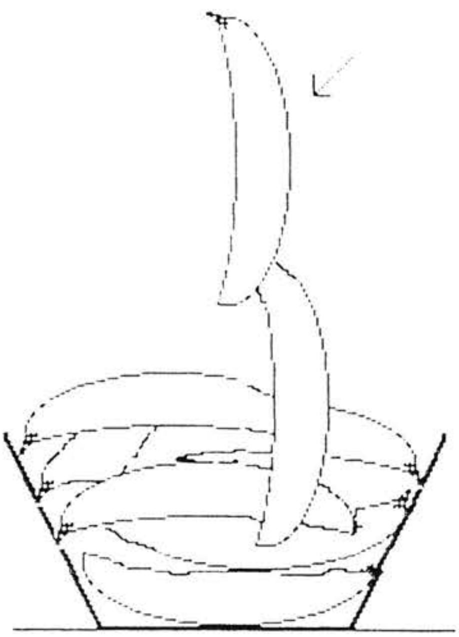

The ball is ---- the bowl.

scene 77



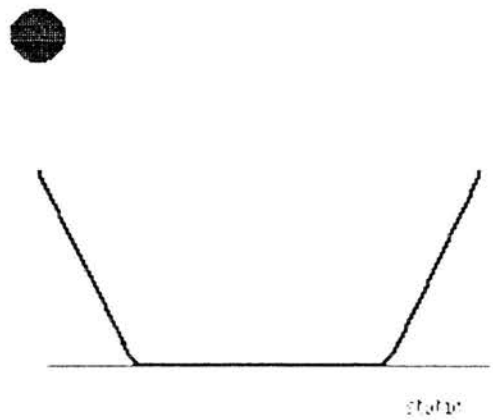

**The banana is ---- the bowl.**

scene 78



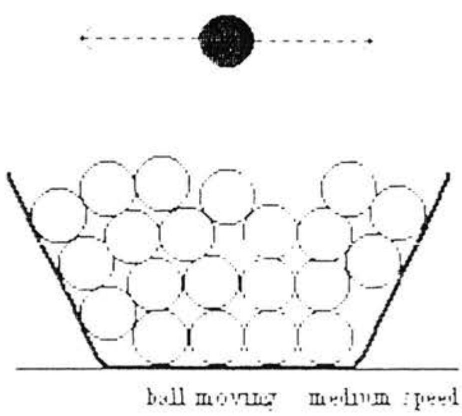

**The banana is ---- the bowl.**

scene 79



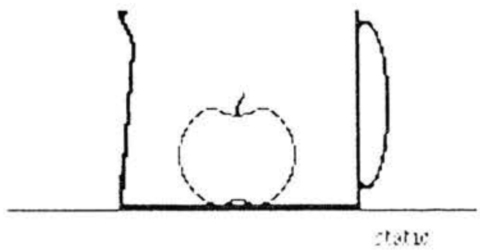

The ball is ---- the bowl.

scene 80



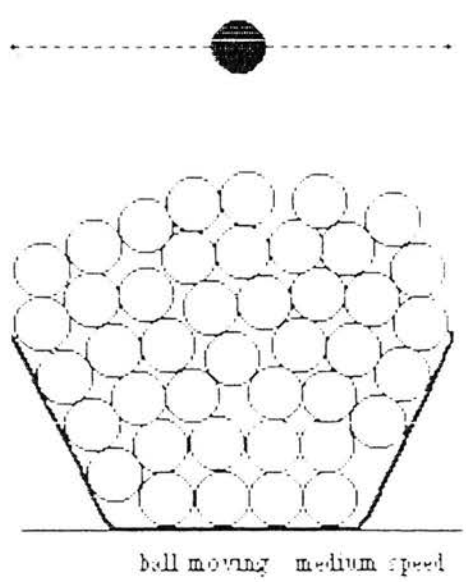

The ball is ---- the bowl.

scene 81



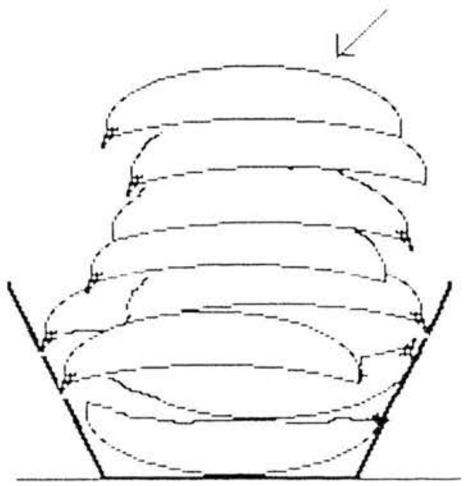

The apple is ---- the jug.

scene 82




The ball is ---- the bowl.

scene 83

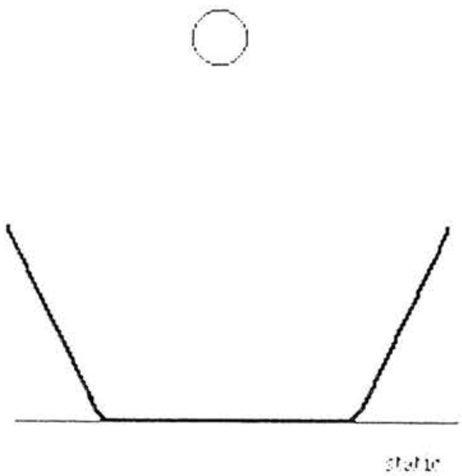



**The banana is ---- the bowl.**

scene 84

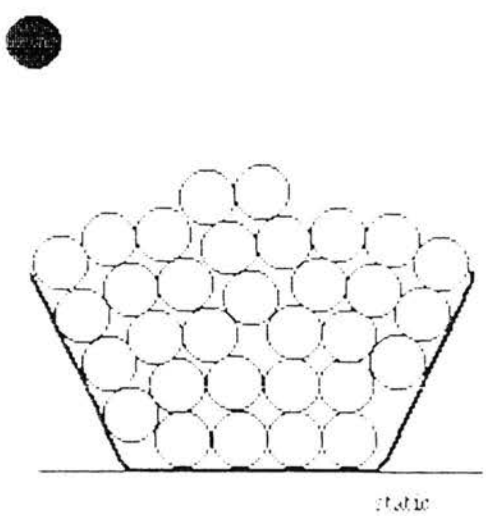

**The banana is ---- the bowl.**

scene 85



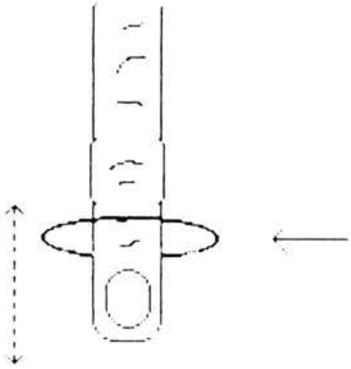

The ball is ---- the bowl.

scene 86




The ball is ---- the bowl.

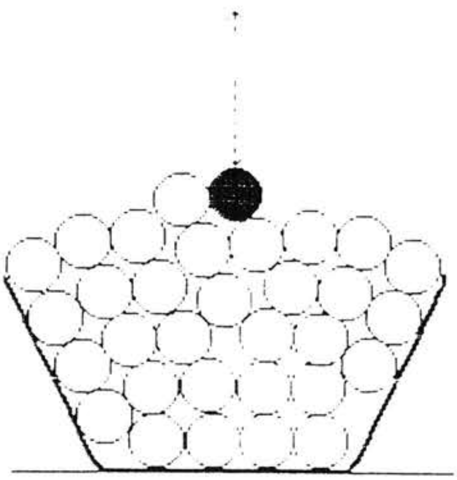
scene 87



ring moving : medium speed ( on and off finger )

**The ring is ---- the finger.**

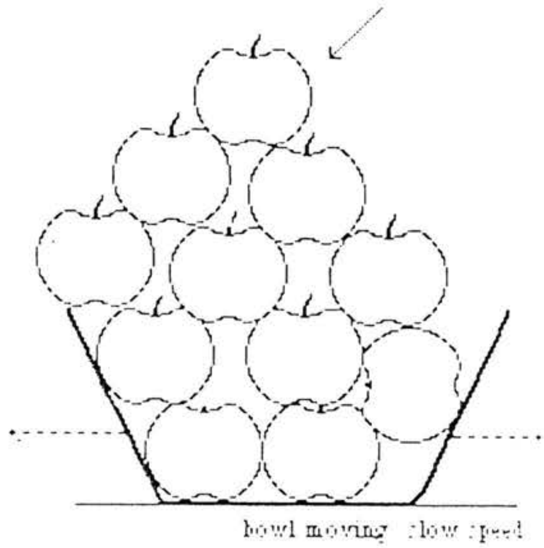
scene 88



ball moving : slow speed, freeze frame

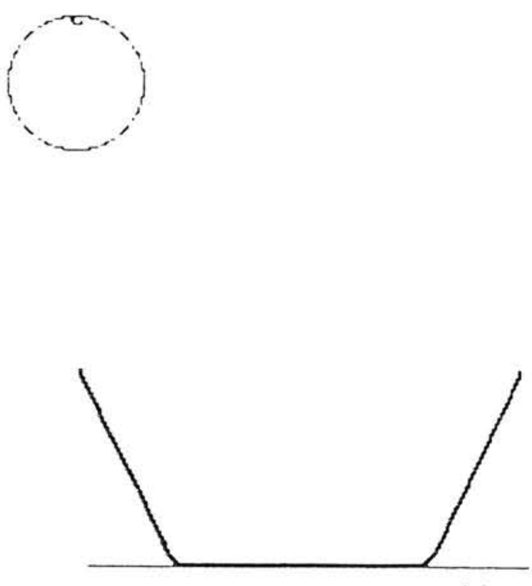
**The ball is ---- the bowl.**

scene 89



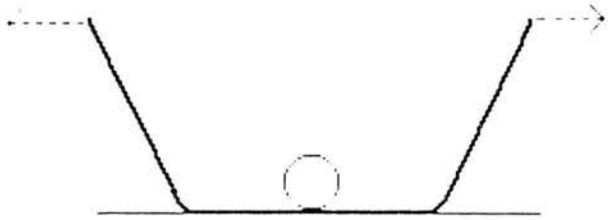

The apple is ---- the bowl.

scene 90



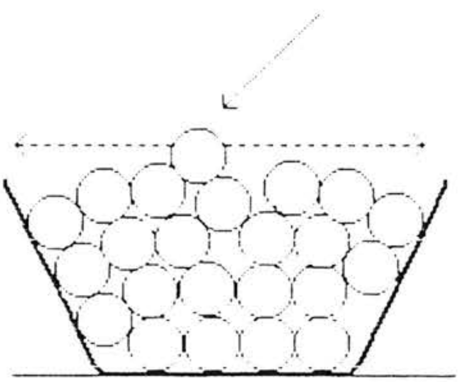
The orange is ---- the bowl.

scene 91



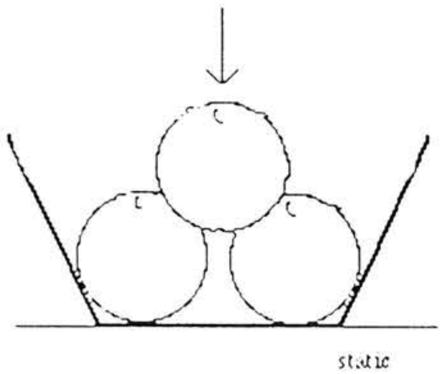

**The ball is ---- the bowl.**

scene 92



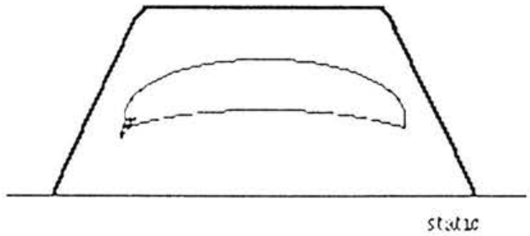

**The ball is ---- the bowl.**

scene 093



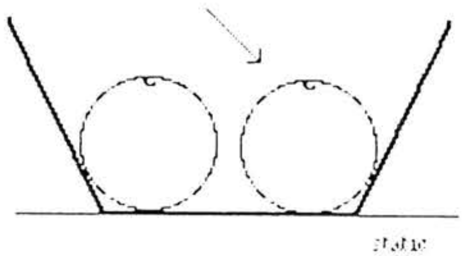

The orange is ---- the bowl.

scene 094



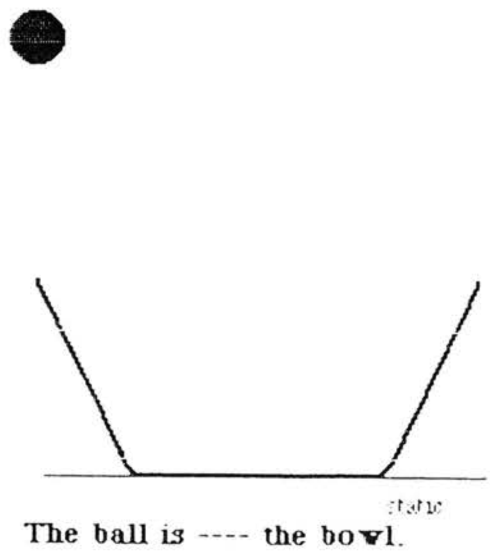

The banana is ---- the bowl.

scene 95



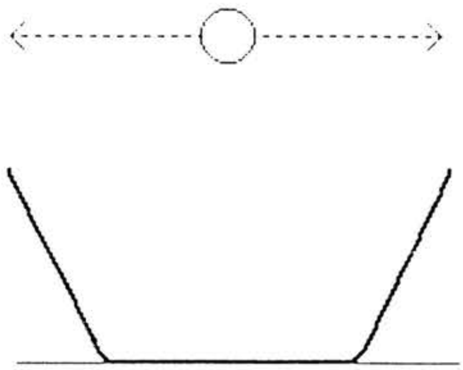

The orange is ---- the bowl.

scene 96



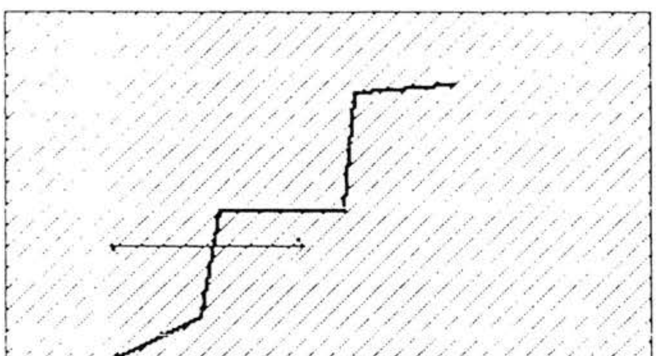

The ball is ---- the bowl.

scene 97



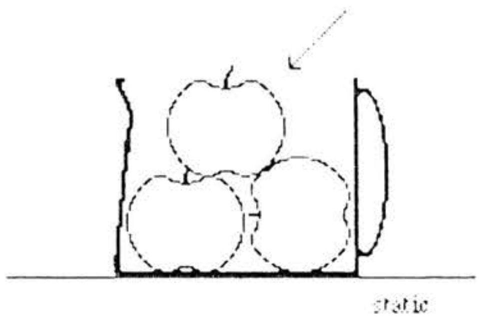

**The ball is ---- the bowl.**

scene 98



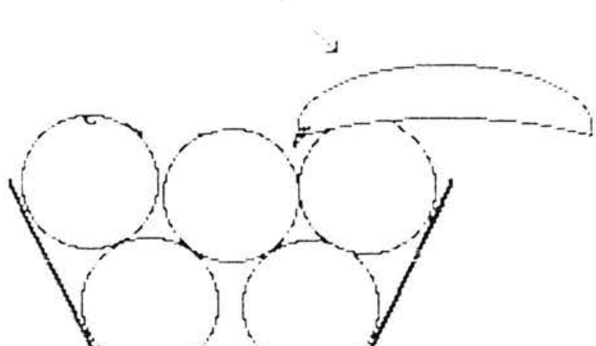

**The crack is ---- the floor.**

scene 99



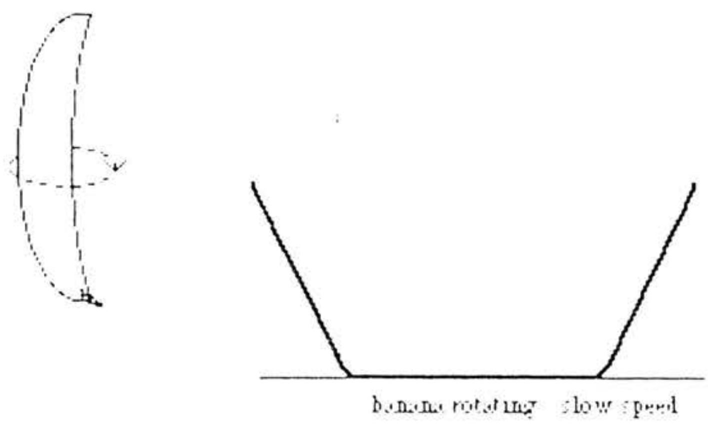

The apple is ---- the jug.

scene 100



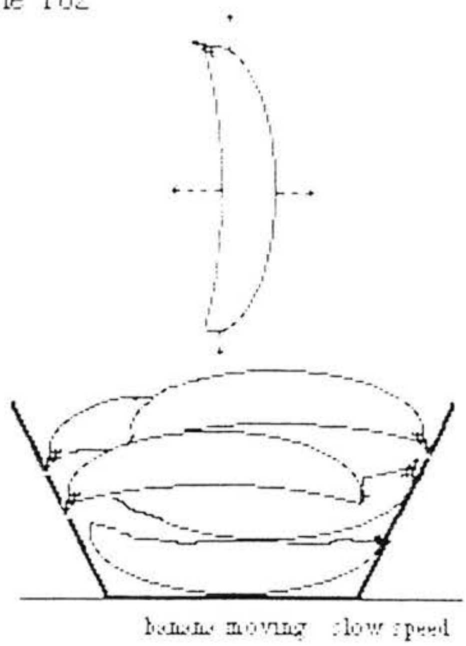

The banana is ---- the bowl.

scene 101



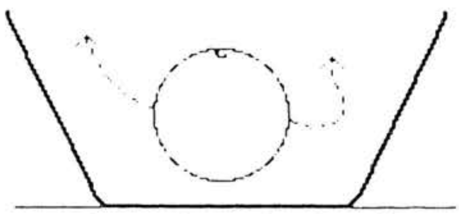

**The banana is ---- the bowl.**

scene 102




**The banana is ---- the bowl.**

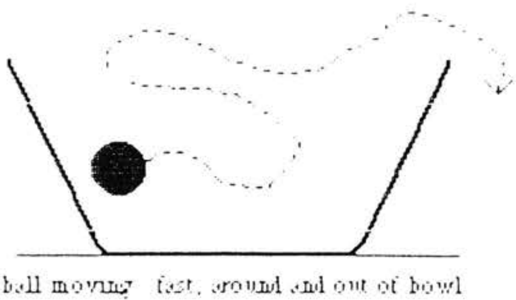
scene 103



orange moving, not hitting bowl - medium speed

**The orange is ---- the bowl.**

scene 104



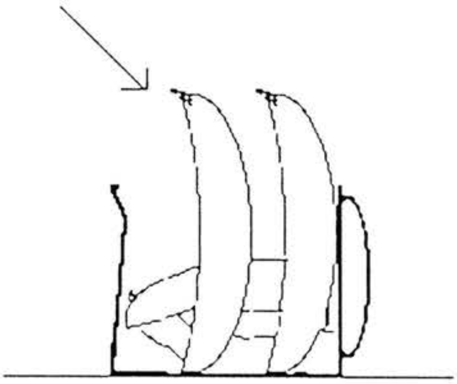
ball moving - fast, around and out of bowl

**The ball is ---- the bowl.**

scene 105

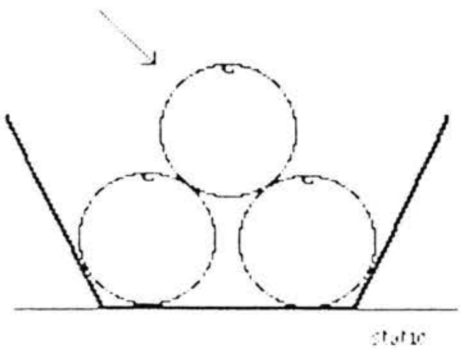
The banana is ---- the bowl.

scene 106



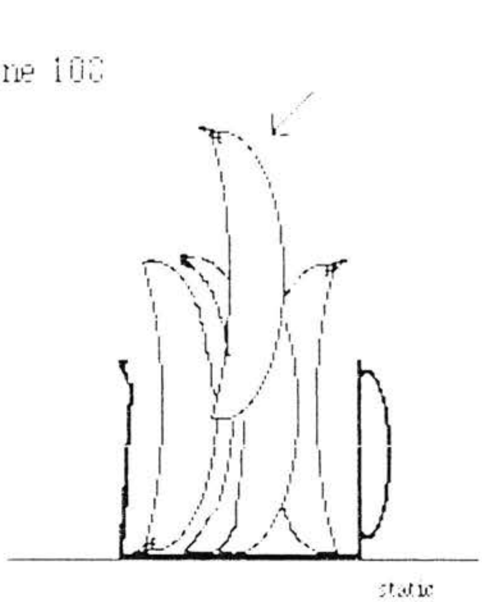

The banana is ---- the jug.

scene 107



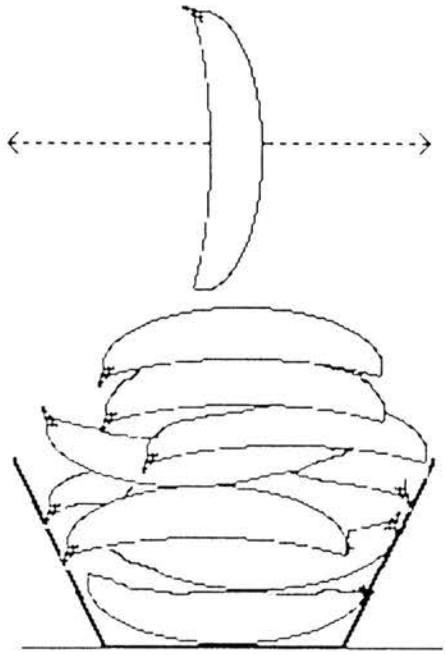

The orange is ---- the bowl.

scene 108




The banana is ---- the jug.

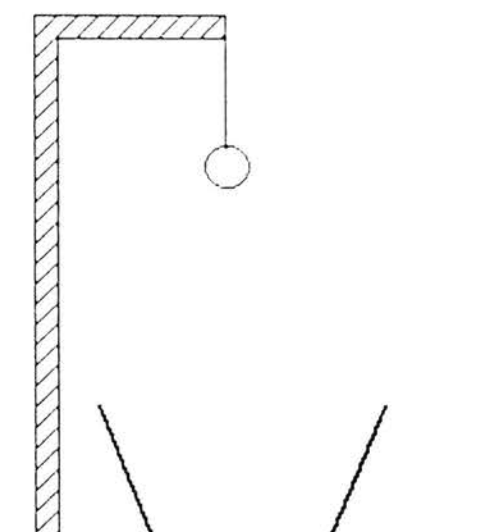
scene 109



banana moving : fast speed

**The banana is ---- the bowl.**

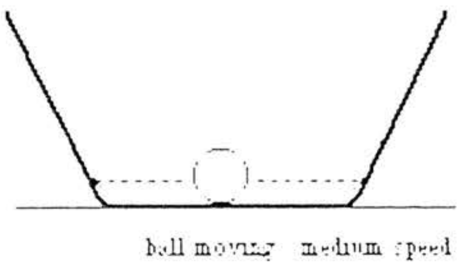
scene 110



static; ball rocking slightly

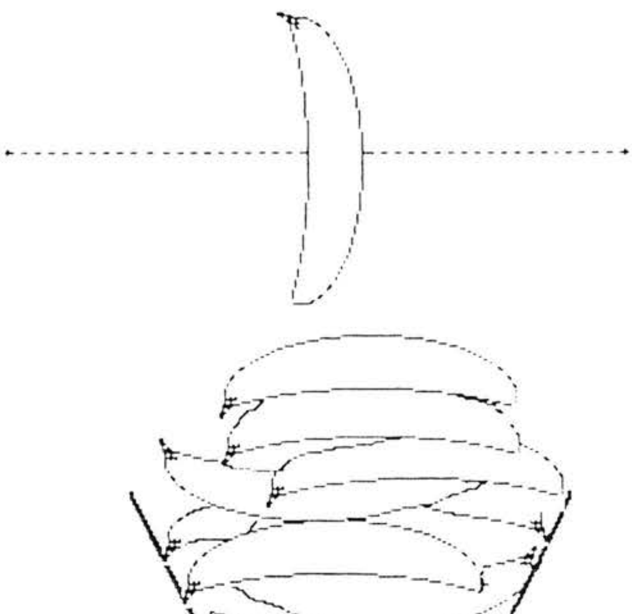
**The ball is ---- the bowl.**

scene 111



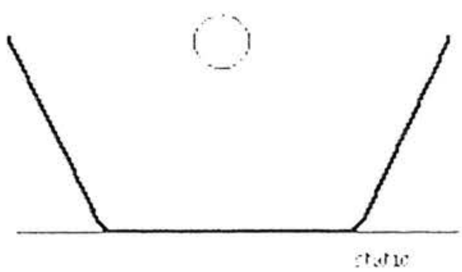

**The ball is ---- the bowl.**

scene 112



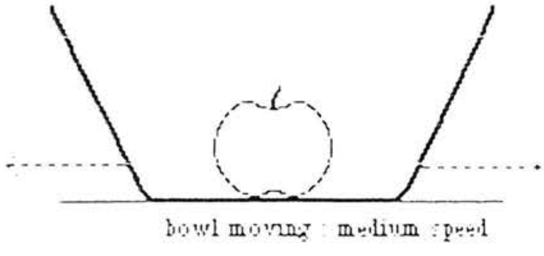

**The banana is ---- the bowl.**

scene 113



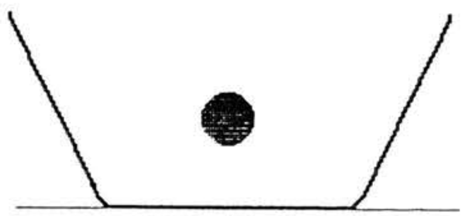

The ball is ---- the bowl.

scene 114




The apple is ---- the bowl.

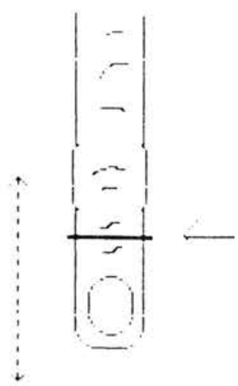
scene 115



static

The ball is ---- the bowl.

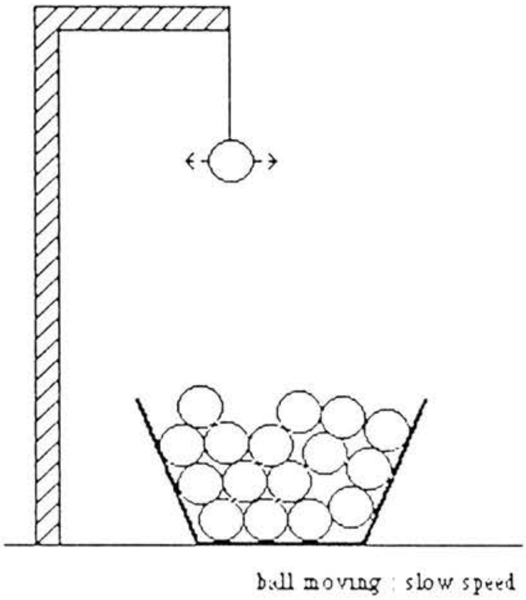
scene 116



ring moving medium speed ( on and off finger )

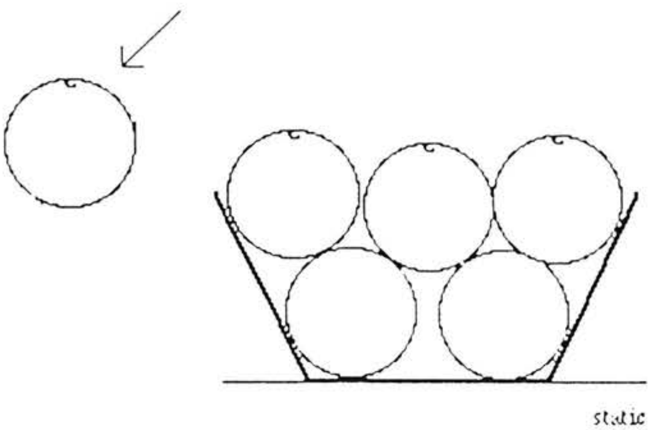
The ring is ---- the finger.

scene 117



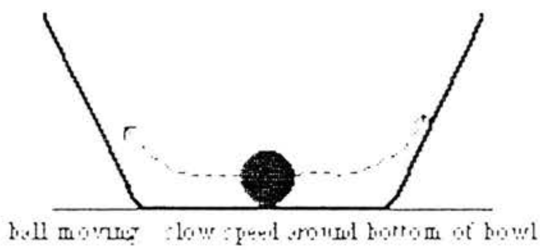

The ball is ---- the bowl.

scene 118



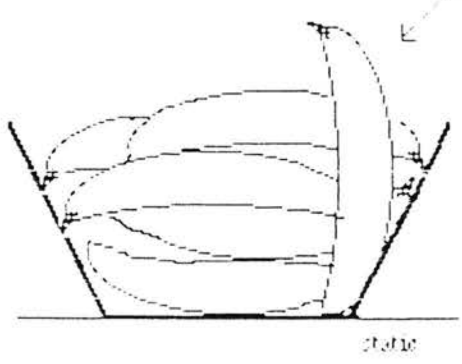

The orange is ---- the bowl.

scene 119



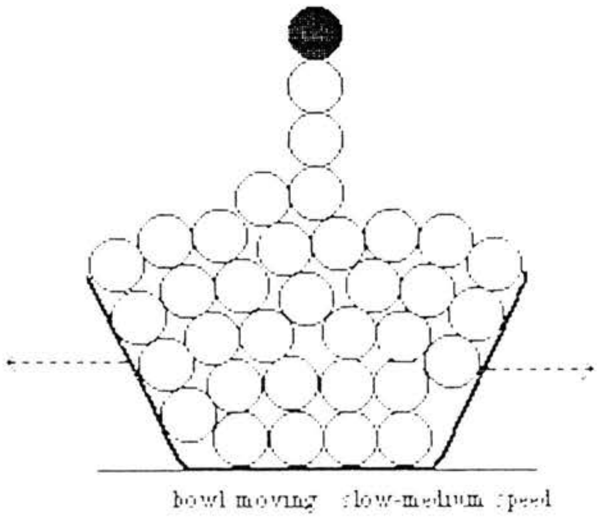

**The ball is --- the bowl.**

scene 120



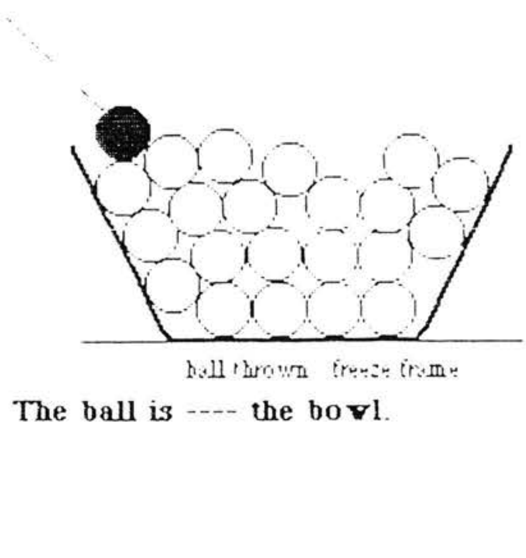

**The banana is ---- the bowl.**

scene 121



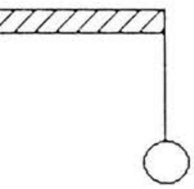

**The ball is ---- the bowl.**

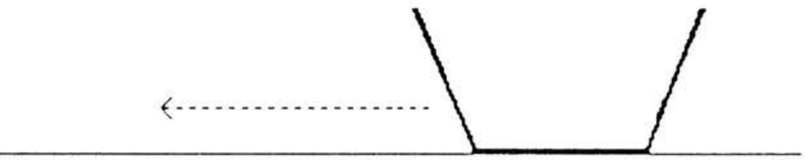
scene 122




**The ball is ---- the bowl.**

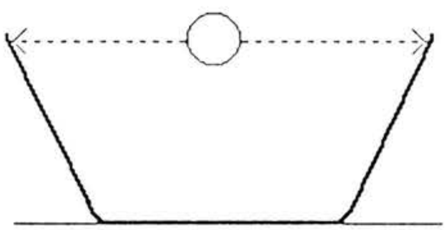
e 123



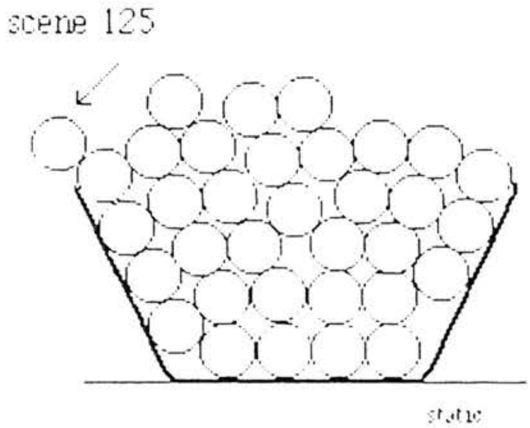



The ball is ---- the bowl.

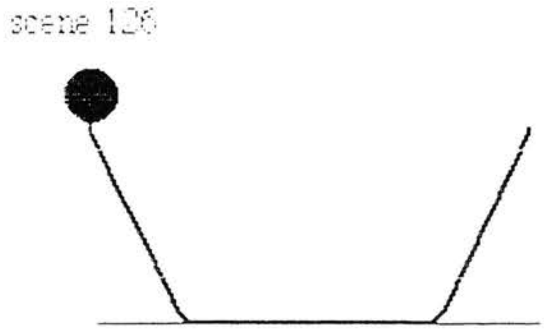
scene 124




The ball is ---- the bowl.

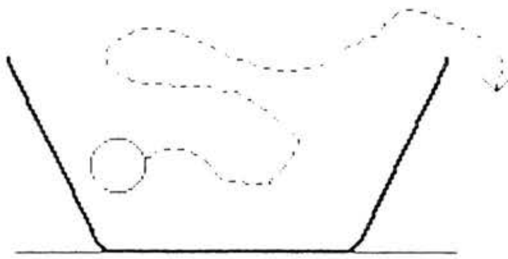



The ball is ---- the bowl.




The ball is ---- the bowl.

scene 127



ball moving fast, around and out of bowl

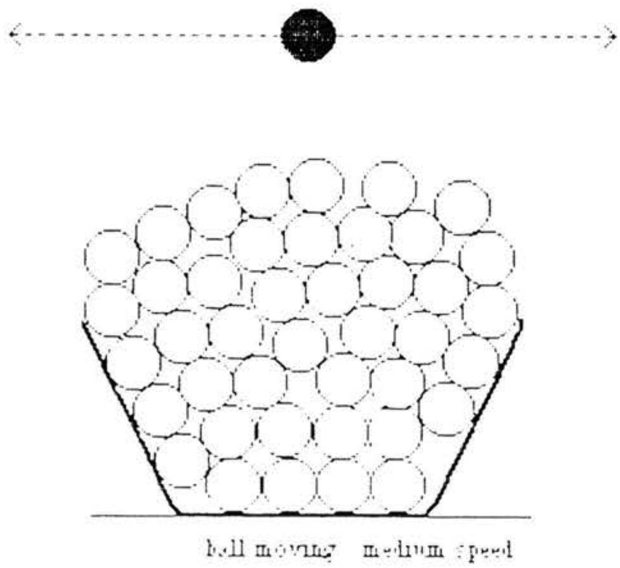
**The ball is ---- the bowl.**

scene 128

static

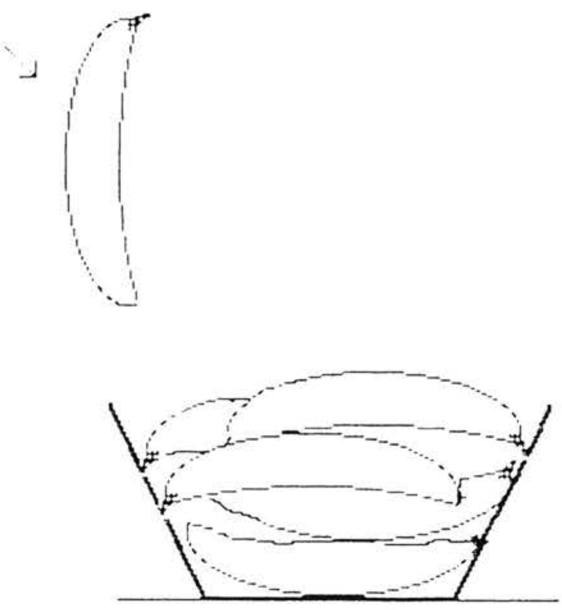
**The ball is ---- the bowl.**

scene 129



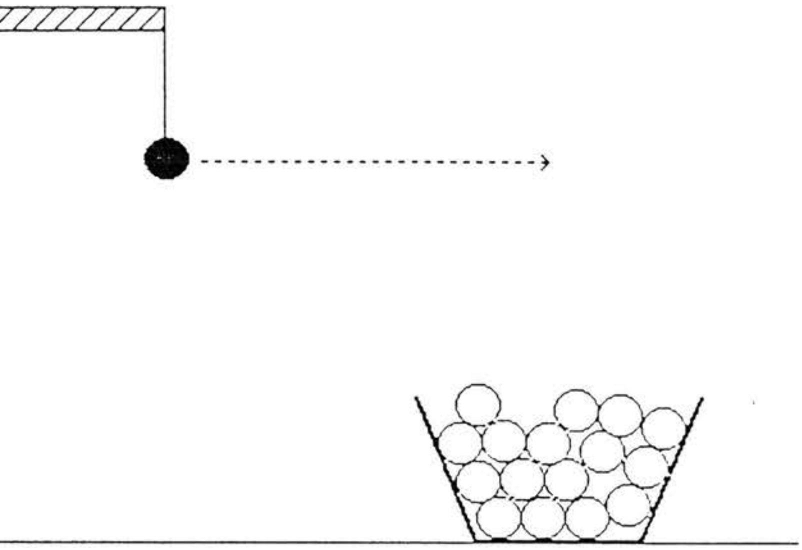

**The ball is ---- the bowl.**

scene 130




**The banana is ---- the bowl.**

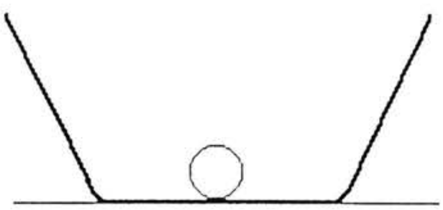
131



frame moving : slow speed

**The ball is ---- the bo▼l.**

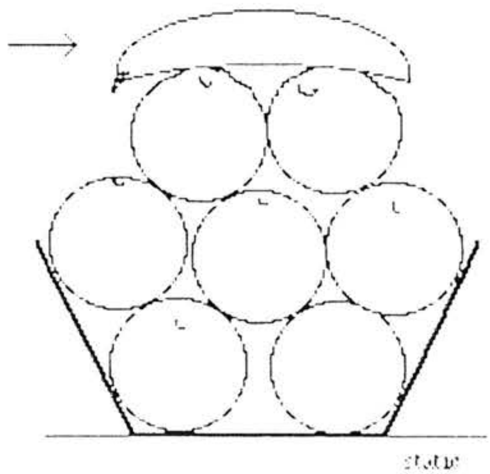
scene 132



static

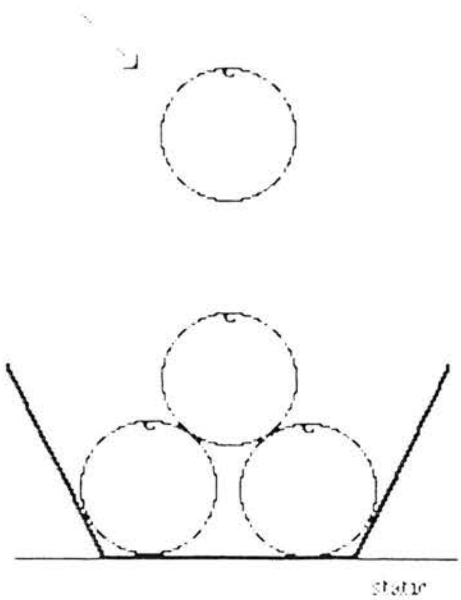
**The ball is ---- the bo▼l.**

scene 133



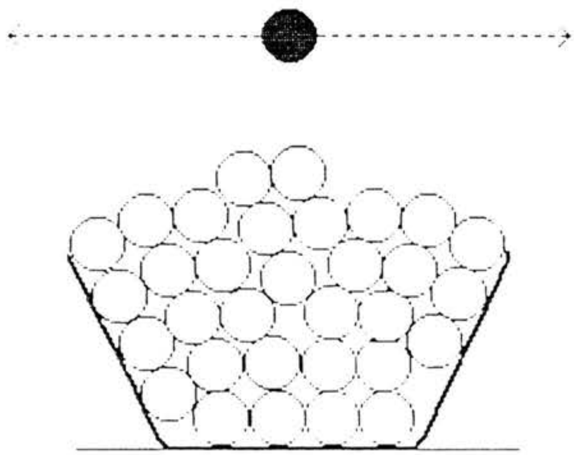

**The banana is ---- the bowl.**

scene 134




**The orange is ---- the bowl.**

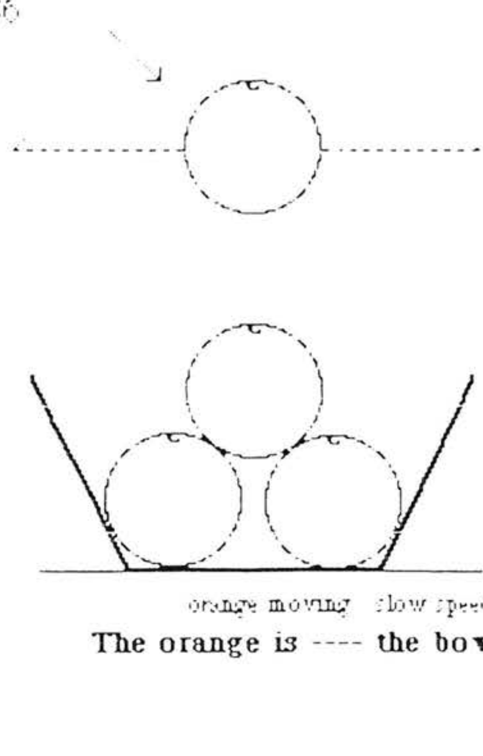
scene 135



ball moving medium speed

**The ball is ---- the bowl.**

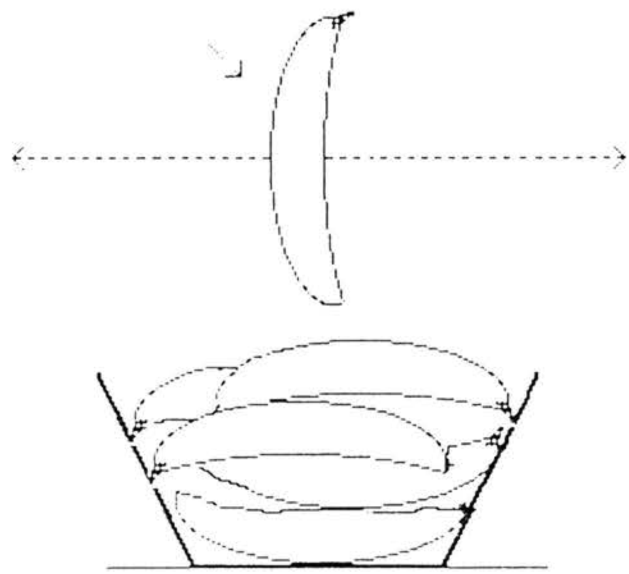
scene 136



orange moving slow speed

**The orange is ---- the bowl.**

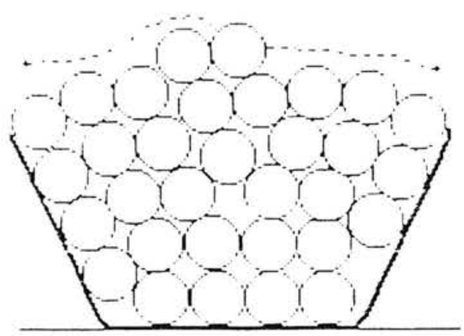
scene 137



banana moving : medium speed

**The banana is ---- the bowl.**

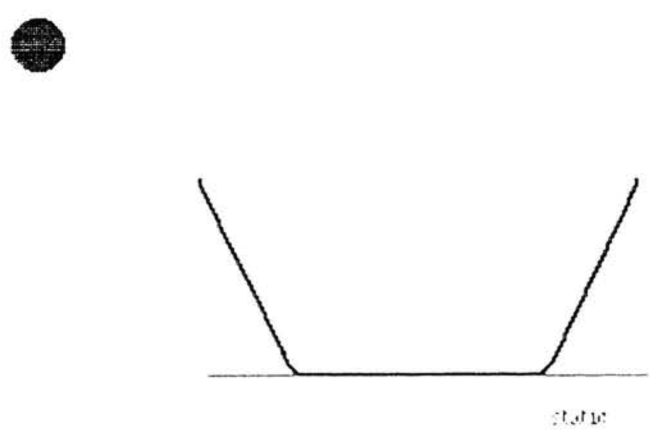
scene 138



ball moving : slow speed

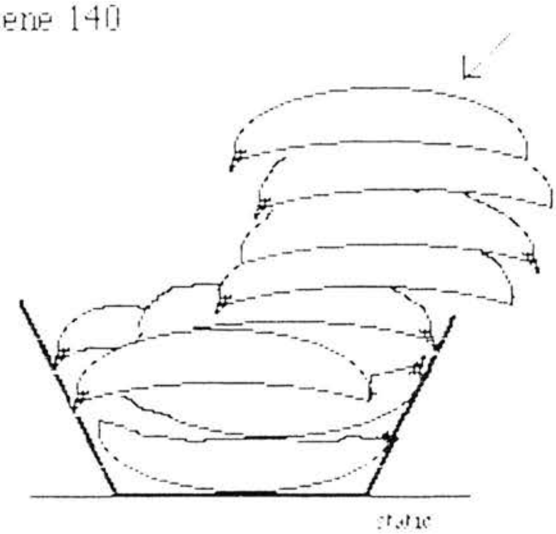
**The ball is ---- the bowl.**

scene 139



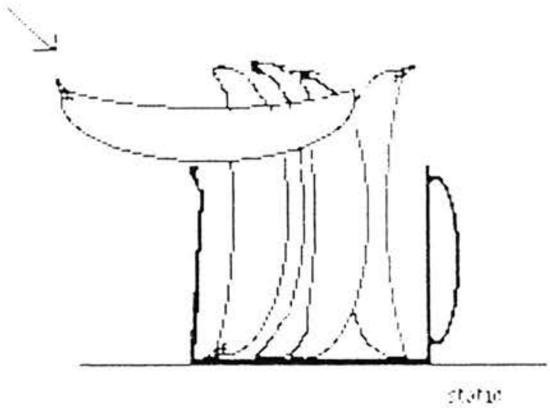

The ball is ---- the bowl.

scene 140



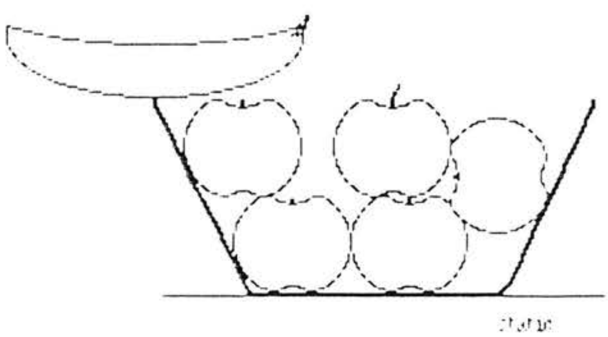

The banana is ---- the bowl.

scene 141



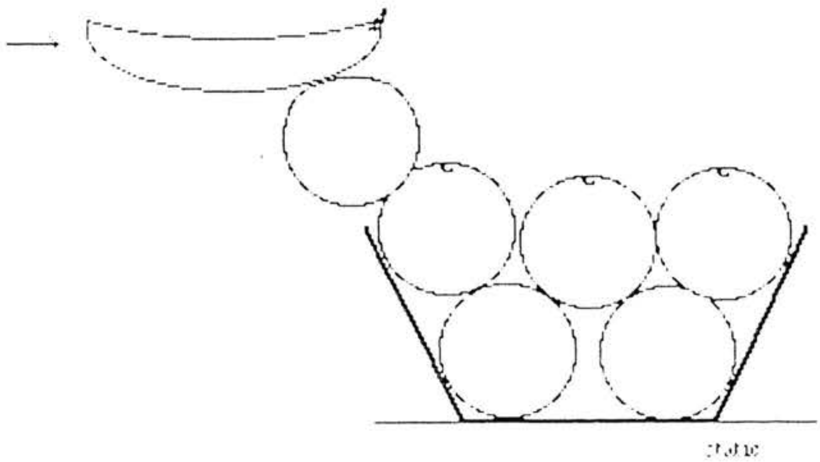

The banana is ---- the jug.

scene 142



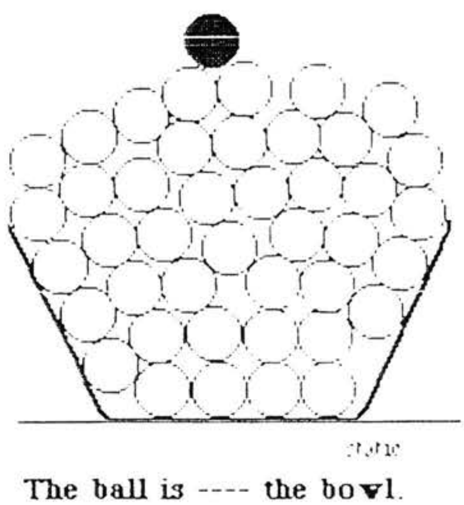

The banana is ---- the bowl.

scene 143



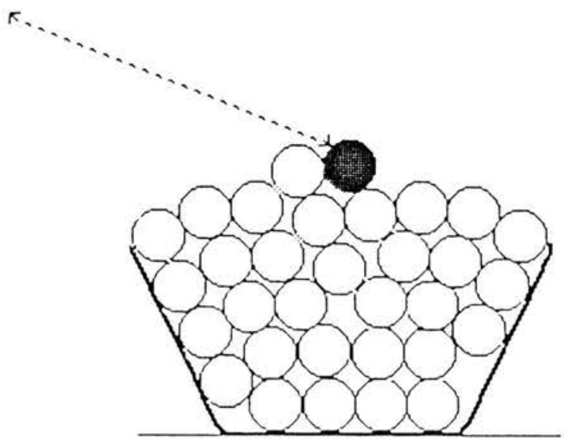
The banana is ---- the bowl.

scene 144



The ball is ---- the bowl.

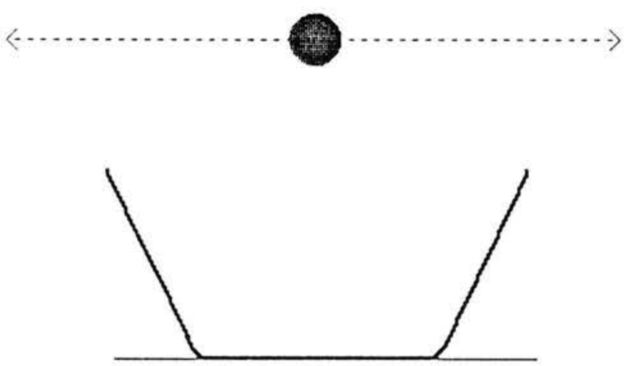
scene 145



ball moving  medium speed

**The ball is ---- the bowl.**

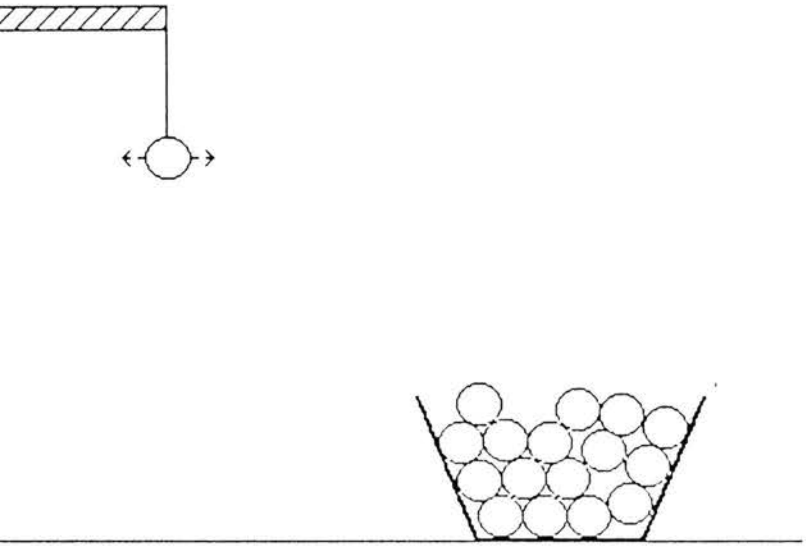
scene 146



ball moving : medium speed

**The ball is ---- the bowl.**

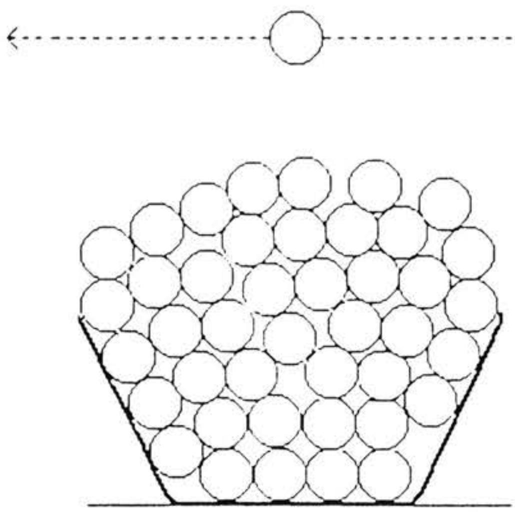
e 147



ball moving slow speed

**The ball is ---- the bowl.**

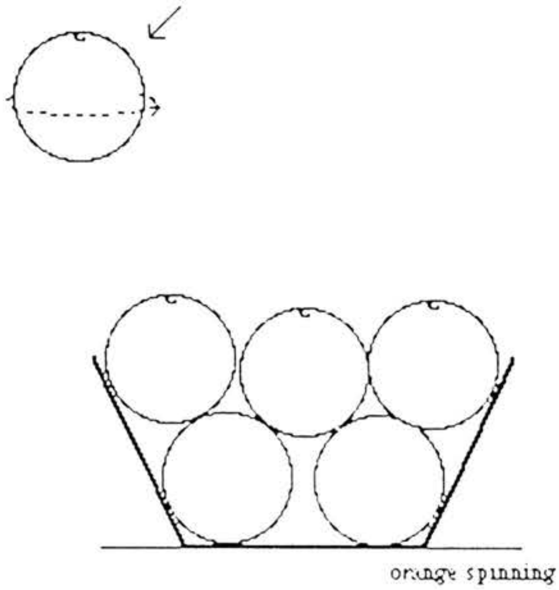
e 148



ball moving : medium speed

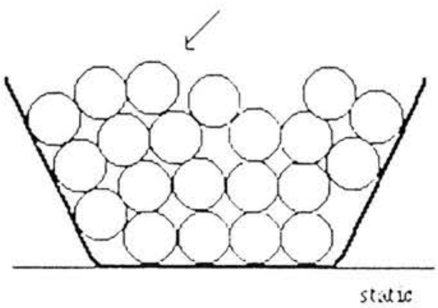
**The ball is ---- the bowl.**

scene 149



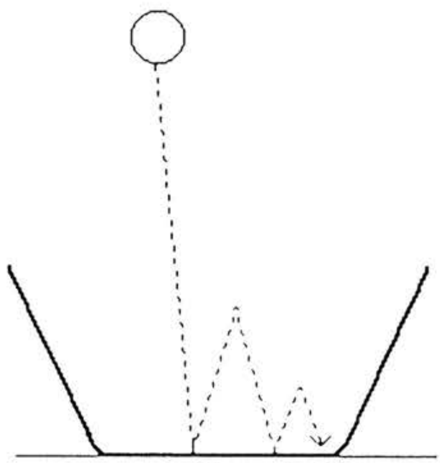

The orange is ---- the bowl.

scene 150




The ball is ---- the bowl.

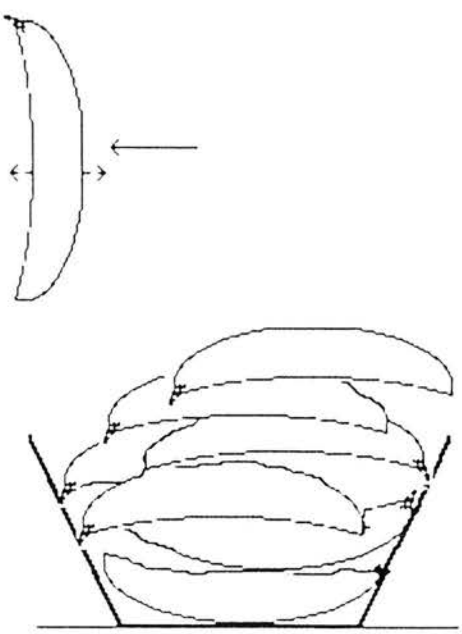
scene 151



ball dropped and bounces in bowl.

**The ball is ---- the bowl.**

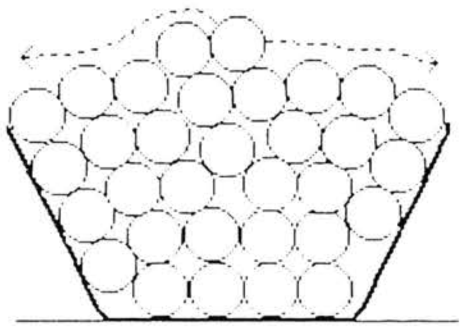
scene 152



banana swinging, slow speed

**The banana is ---- the bowl.**

scene 153



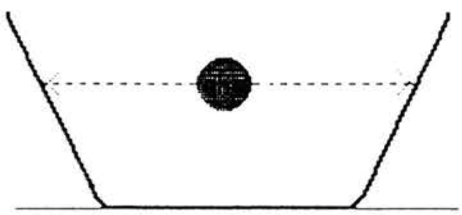

**The ball is ---- the bowl.**

scene 154



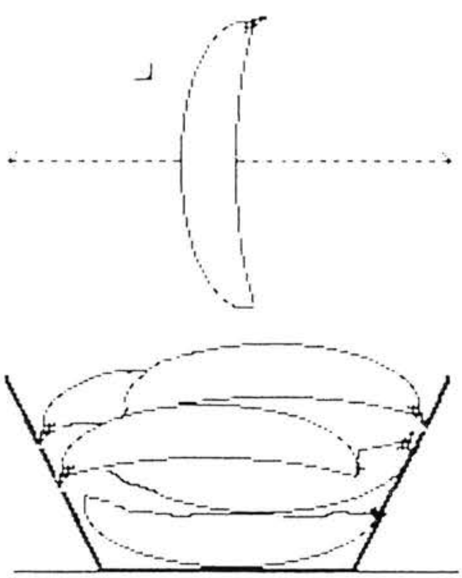

**The ball is ---- the bowl.**

scene 155



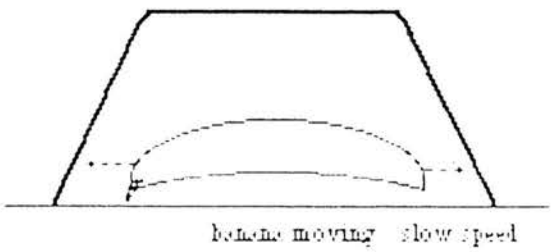

**The ball is ---- the bowl.**

scene 156



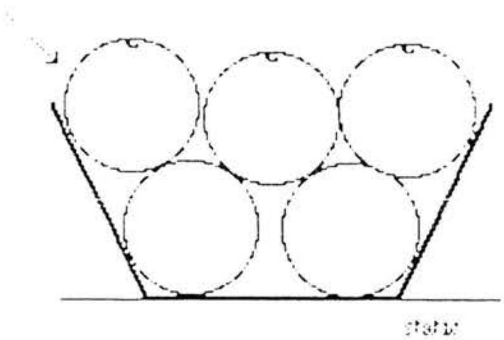

**The banana is ---- the bowl.**

scene 157



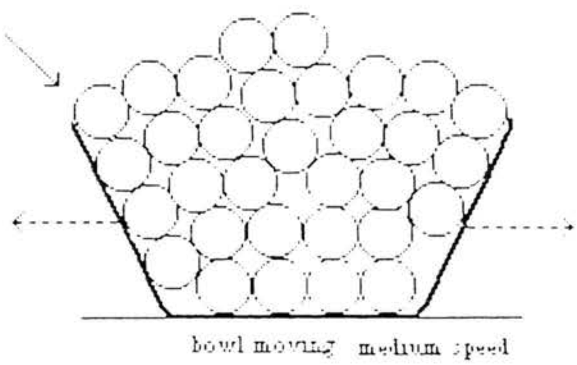

The banana is ---- the bowl.

scene 158



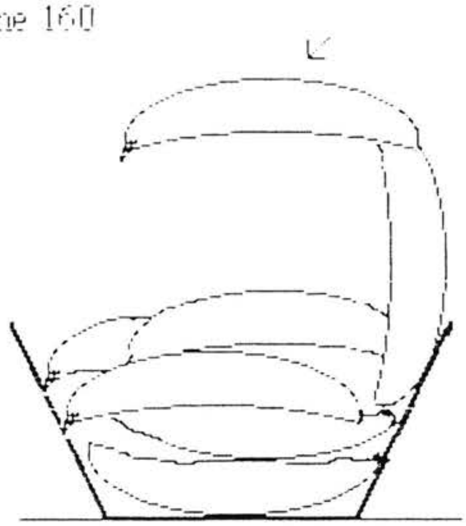

The orange is ---- the bowl.

scene 159

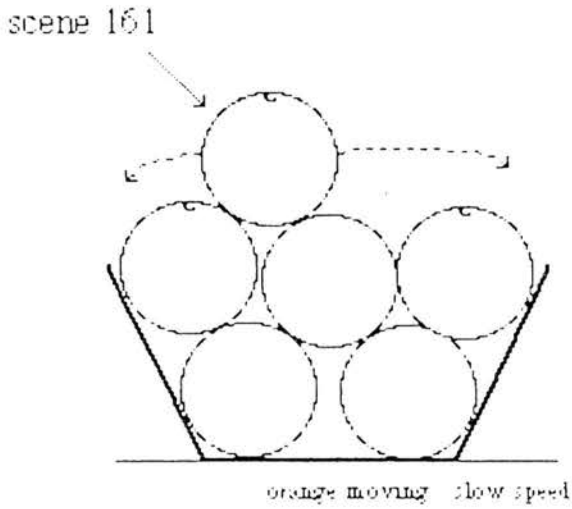



**The ball is ---- the bowl.**

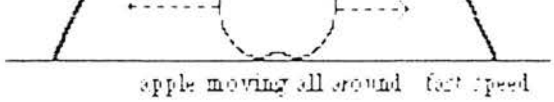
scene 160




**The banana is ---- the bowl.**

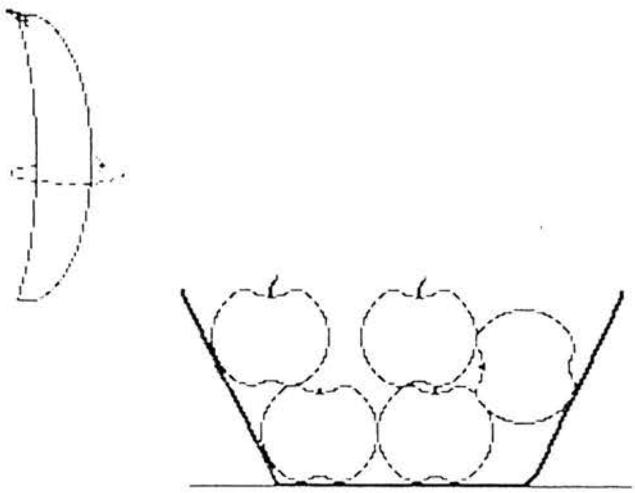



The orange is ---- the bowl.




The apple is ---- the bowl.

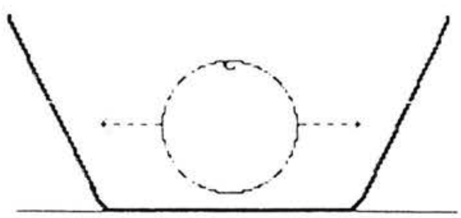
scene 163



banana rotating slow speed

**The banana is ---- the bowl.**

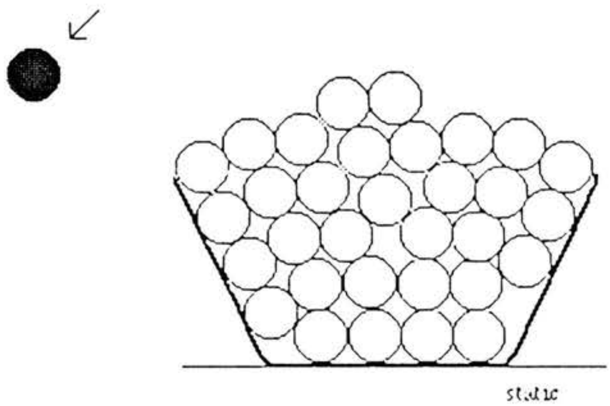
scene 164



orange moving slow-medium speed

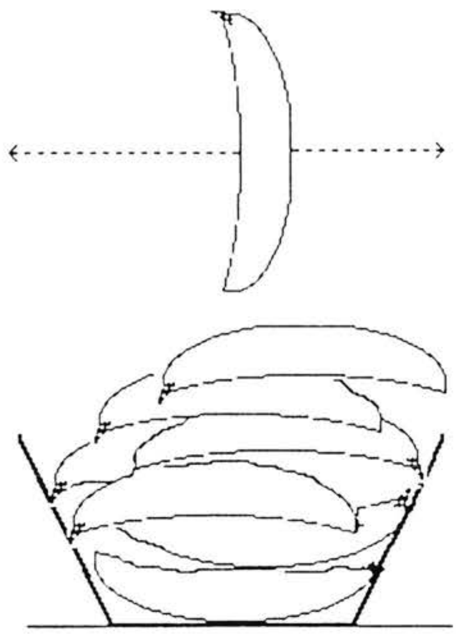
**The orange is ---- the bowl.**

scene 165



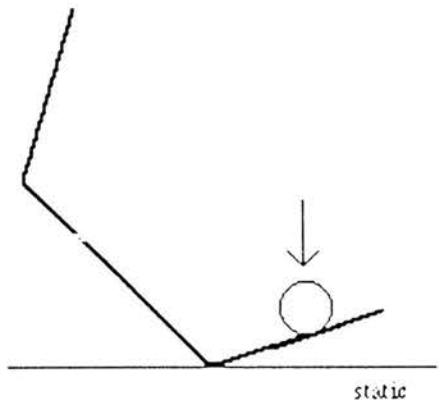

The ball is ---- the bowl.

scene 166



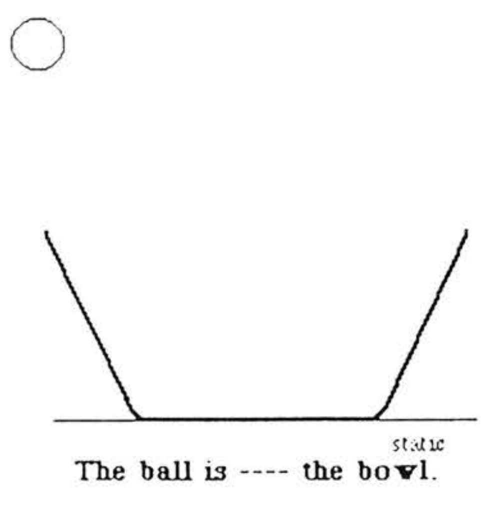

The banana is ---- the bowl.

scene 167



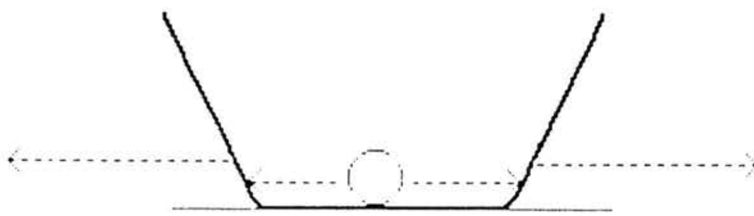

The ball is ---- the bowl.

scene 168



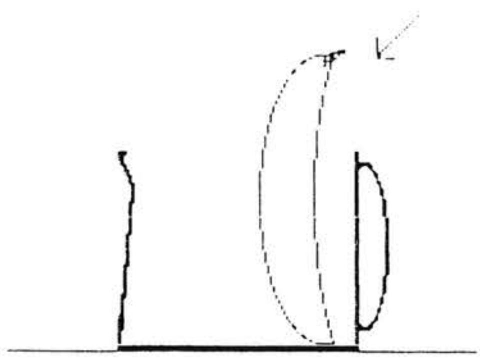

The ball is ---- the bowl.

scene 169



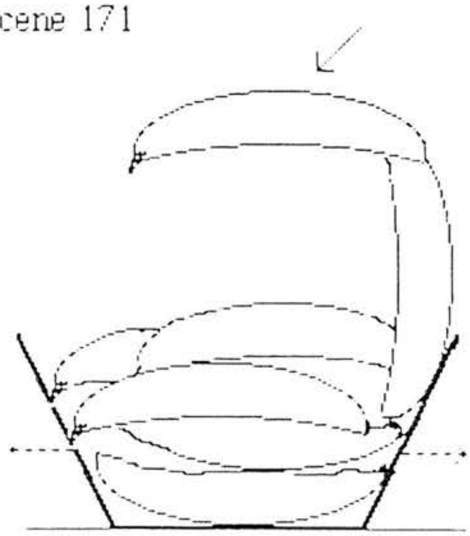

**The ball is ---- the bowl.**

scene 170



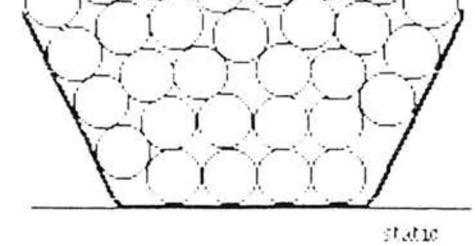

**The banana is ---- the jug.**

scene 171



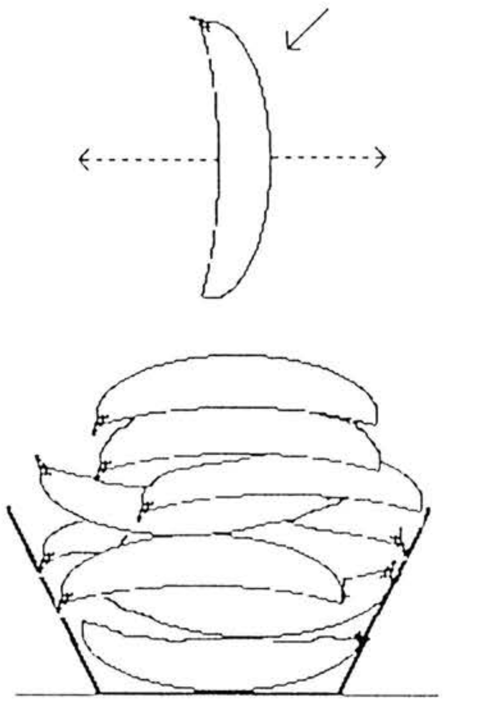

**The banana is ---- the bowl.**

scene 172




**The ball is ---- the bowl.**

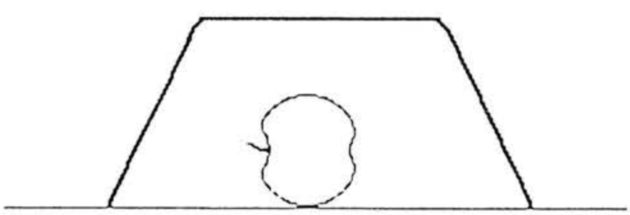
scene 173



banana moving : medium speed

**The banana is ---- the bowl.**

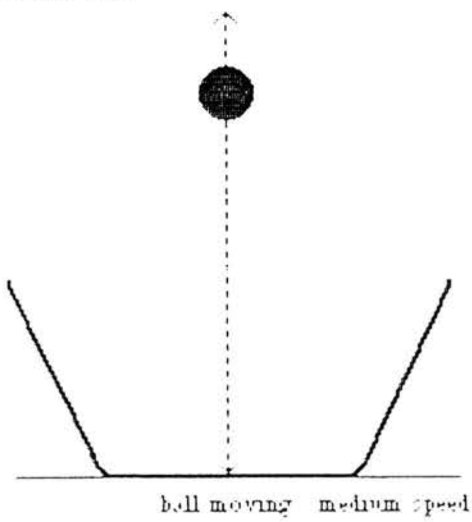
scene 174



static

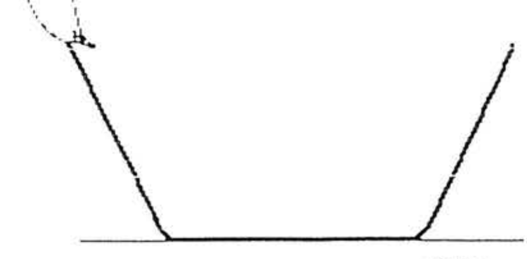
**The apple is ---- the bowl.**

scene 175



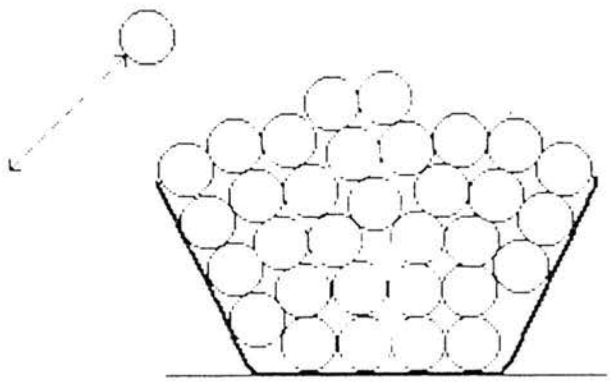

The ball is ---- the bowl.

scene 176




The banana is ---- the bowl.

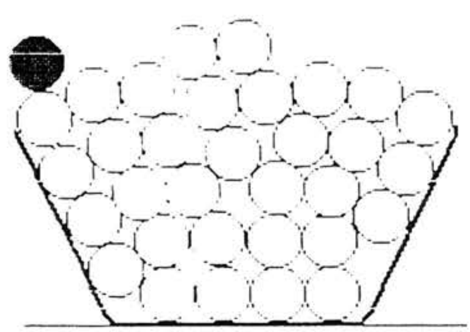
scene 177



ball moving medium speed

**The ball is ---- the bowl.**

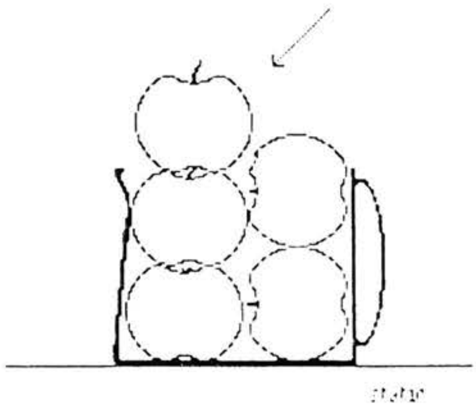
scene 178



static

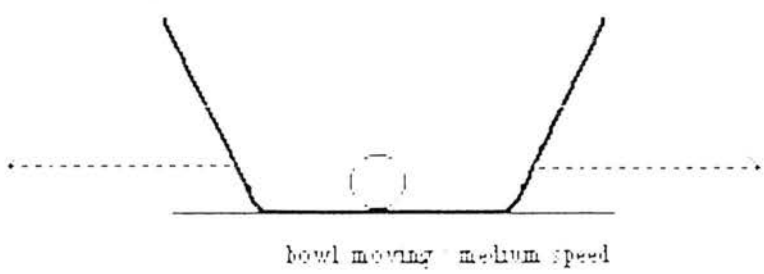
**The ball is ---- the bowl.**

scene 179



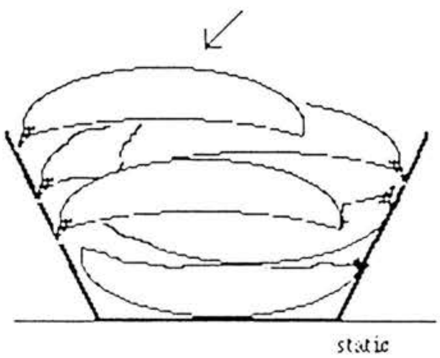

**The apple is ---- the jug.**

scene 180



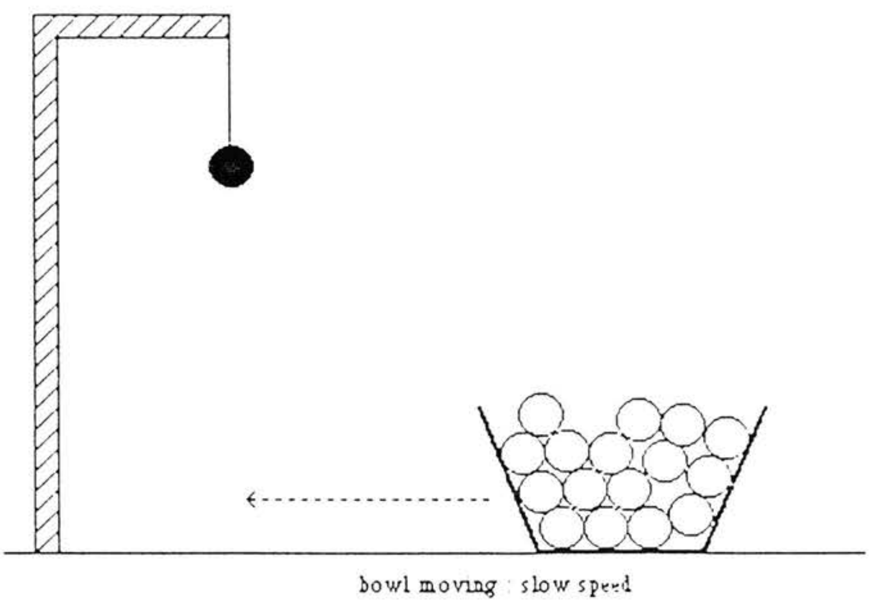

**The ball is ---- the bowl.**

scene 181



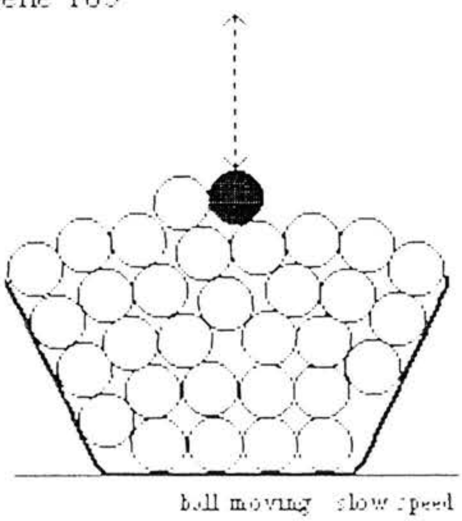

The banana is ---- the bowl.

scene 182



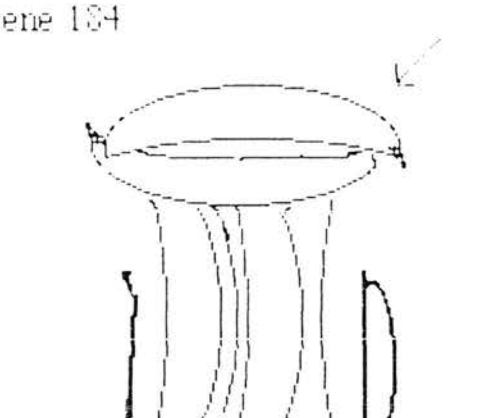

The ball is ---- the bowl.

scene 183



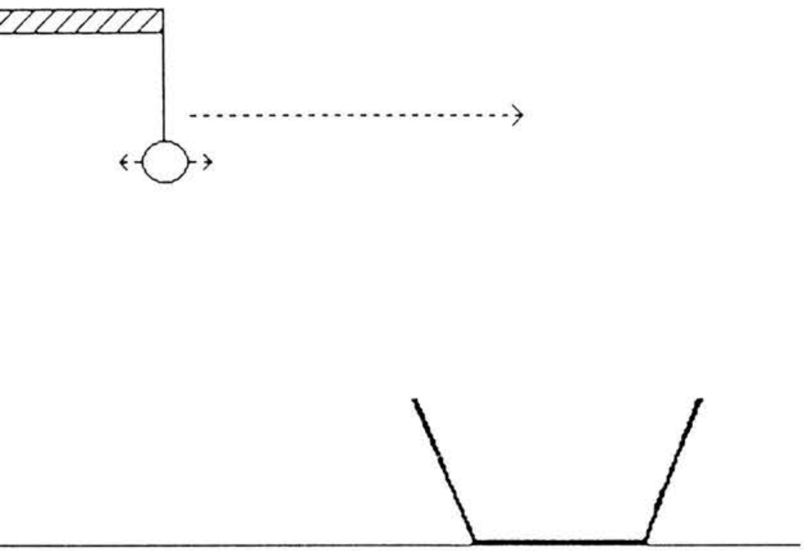

**The ball is ---- the bowl.**

scene 184




**The banana is ---- the jug.**

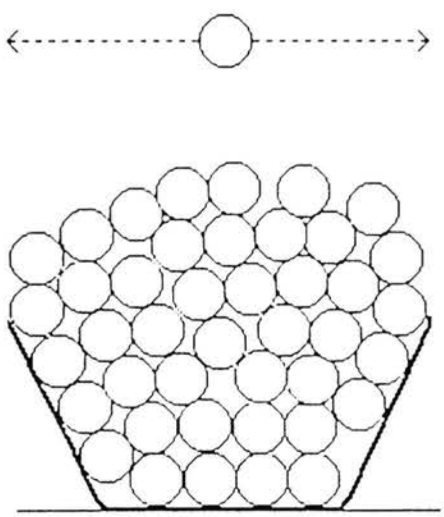
ne 185



ball swinging; frame moving: medium speed

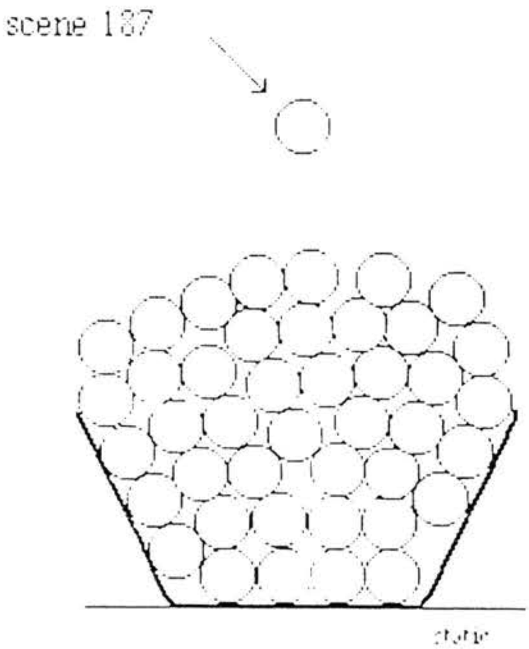
**The ball is ---- the bowl.**

ne 186

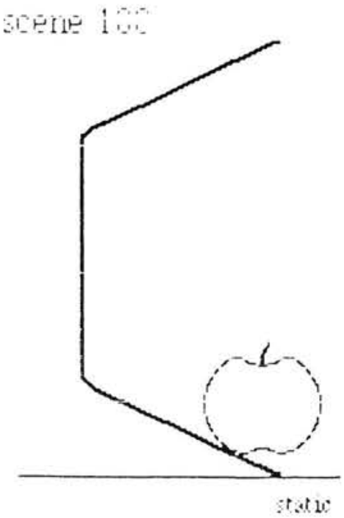


ball moving : medium speed

**The ball is ---- the bowl.**

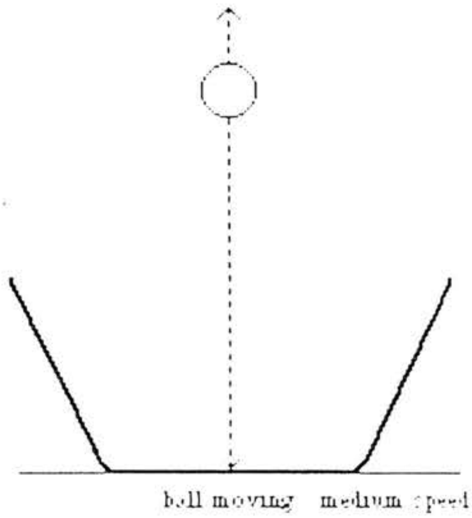



The ball is ---- the bowl.



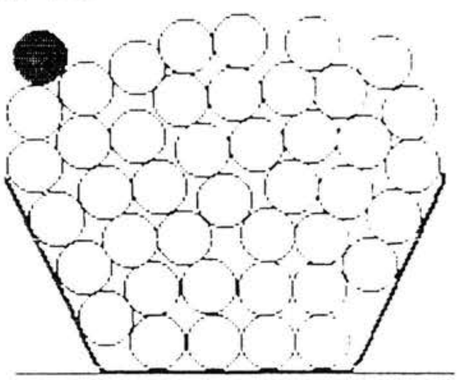

The apple is --- the bowl.

scene 189



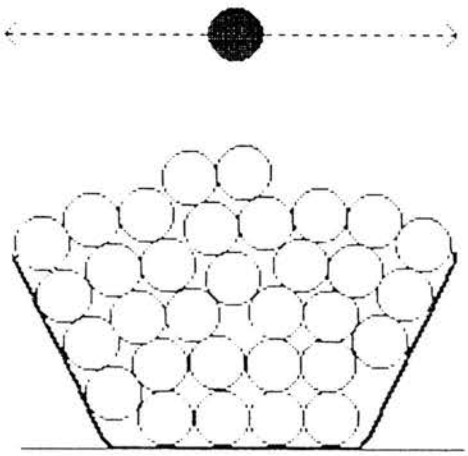

**The ball is ---- the bowl.**

scene 190



**The ball is ---- the bowl.**

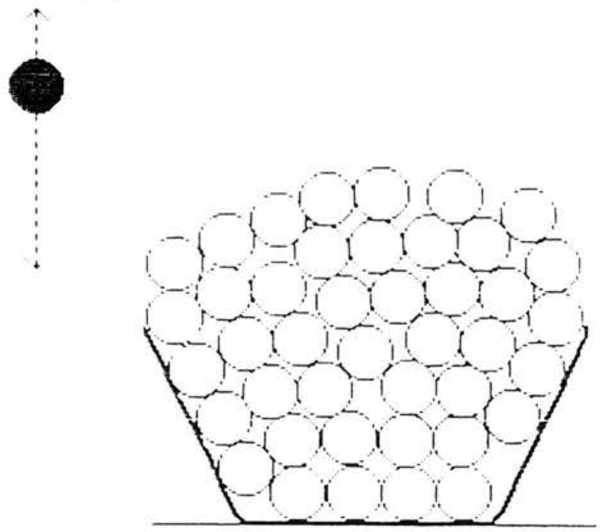
scene 191



ball moving : slow speed

**The ball is ---- the bowl.**

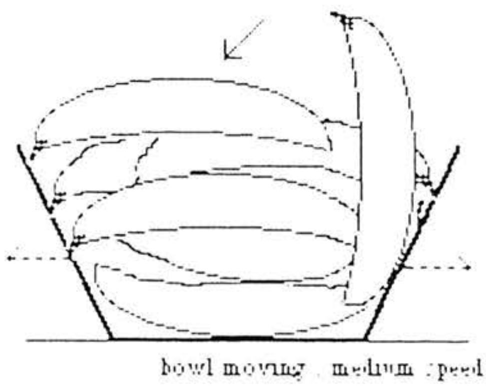
scene 192



ball moving : slow speed

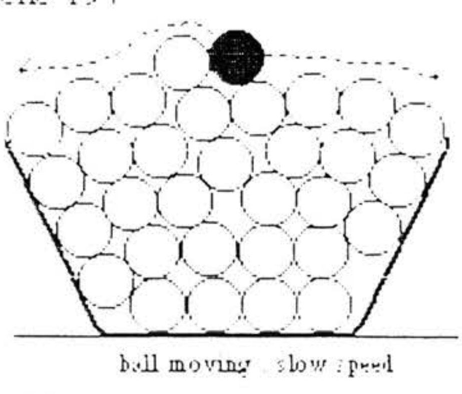
**The ball is ---- the bowl.**

scene 193



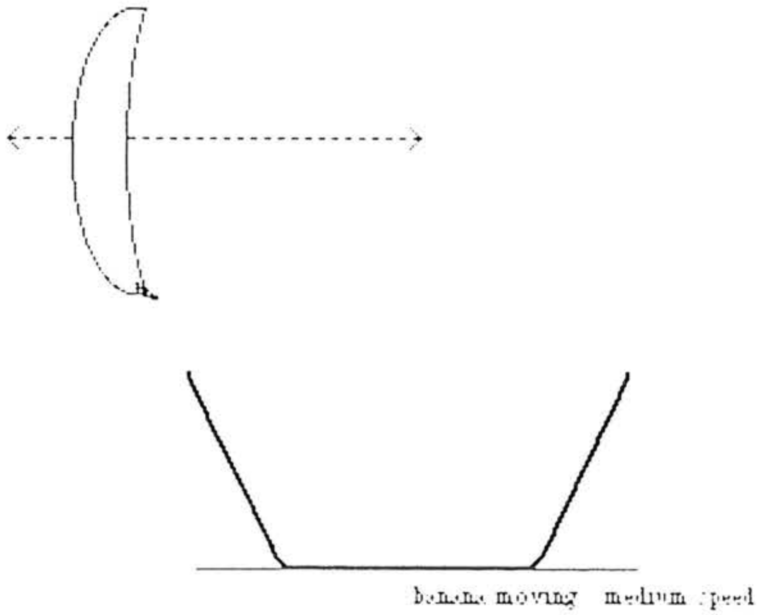

**The banana is ---- the bowl.**

scene 194



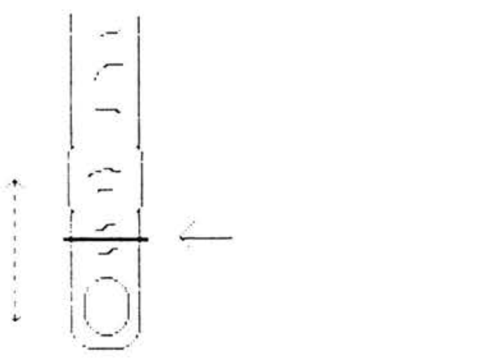

**The ball is ---- the bowl.**

scene 195



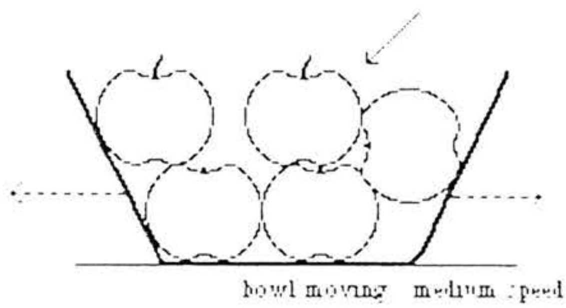

**The banana is ---- the bowl.**

scene 196



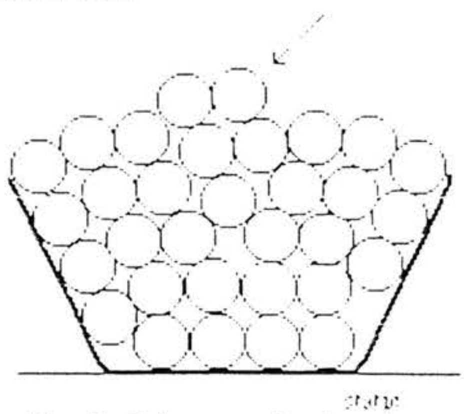

**The ring is ---- the finger.**

scene 197



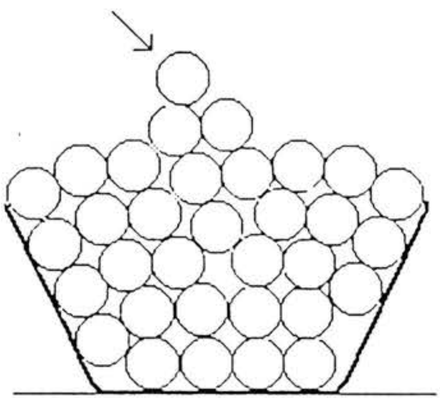

**The apple is ---- the bowl.**

scene 198



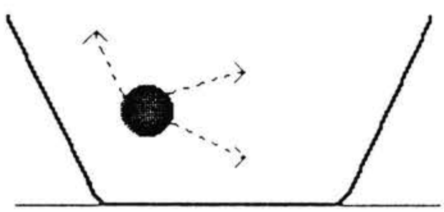

**The ball is ---- the bowl.**

scene 199



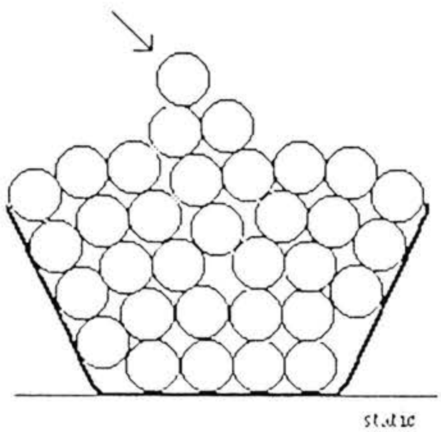

The ball is ---- the bowl.

scene 200



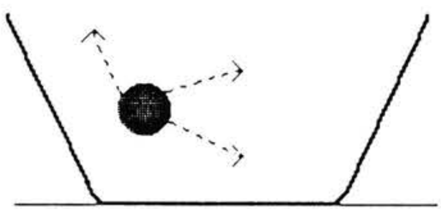

The ball is ---- the bowl.

scene 199



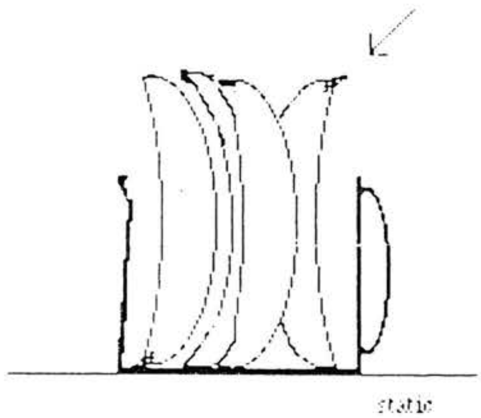

The ball is ---- the bowl.

scene 200



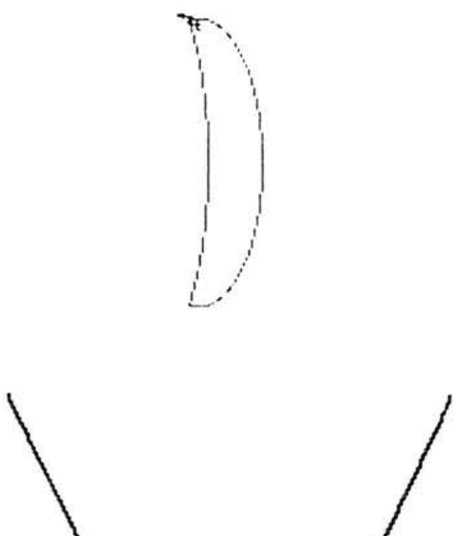

The ball is ---- the bowl.

scene 201



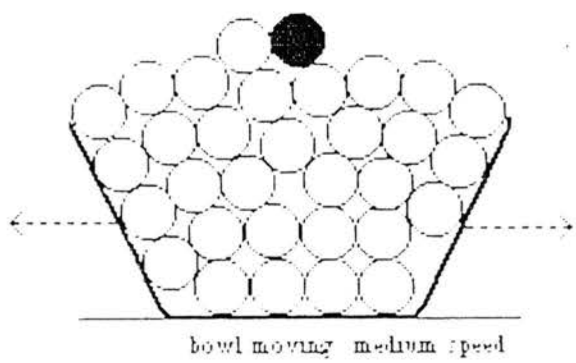

The banana is ---- the jug.

scene 202



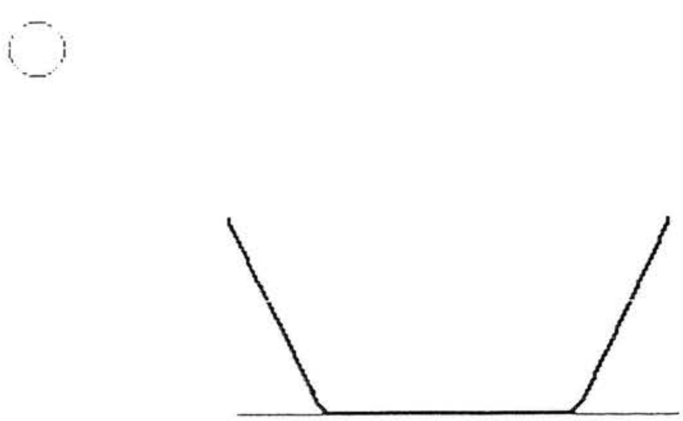

The banana is ---- the bowl.

scene 203



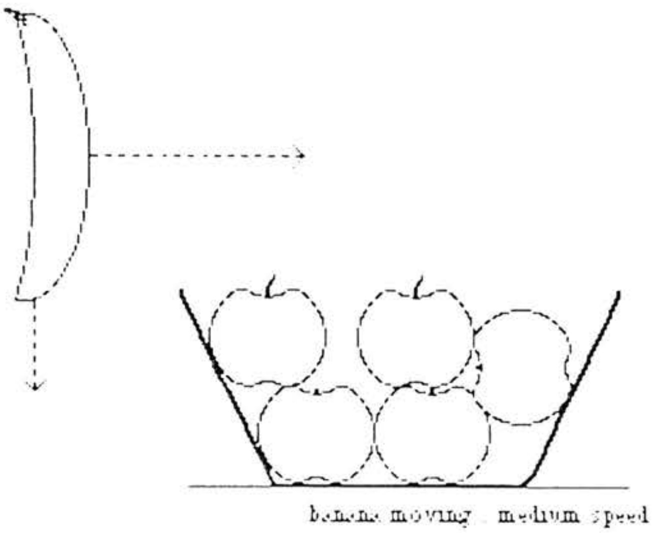

**The ball is ---- the bowl.**

scene 204



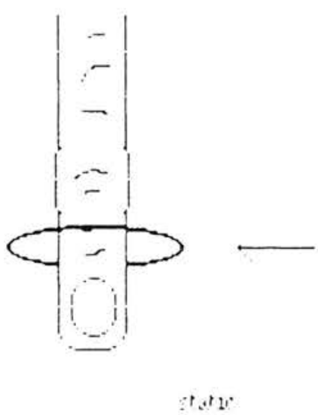

**The ball is ---- the bowl.**

scene 205



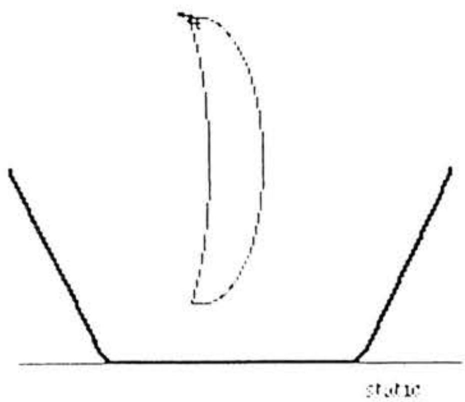

The banana is ---- the bowl.

scene 206



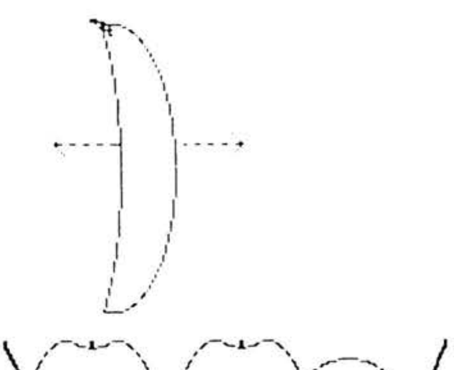

The ring is ---- the finger.

scene 207



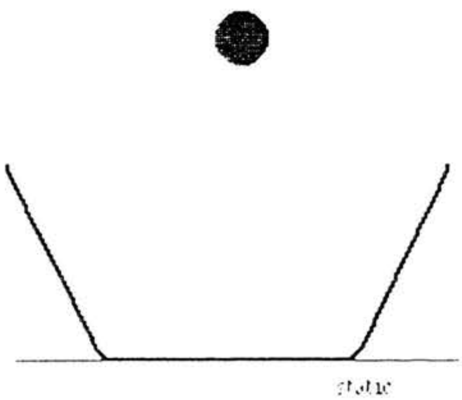

**The banana is ---- the bowl.**

scene 208



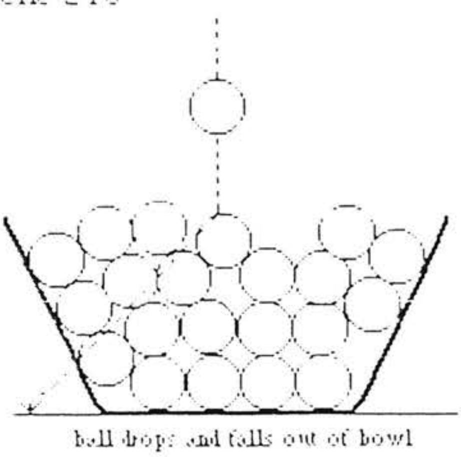

**The banana is ---- the bowl.**

scene 209



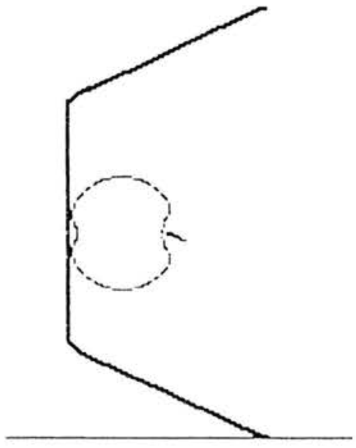

The ball is ---- the bowl.

scene 210



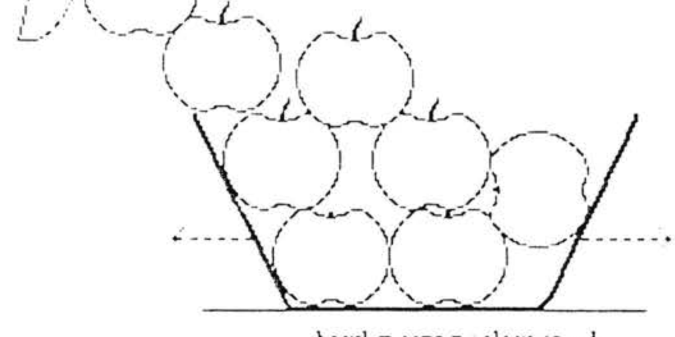

The ball is ---- the bowl.

scene 211



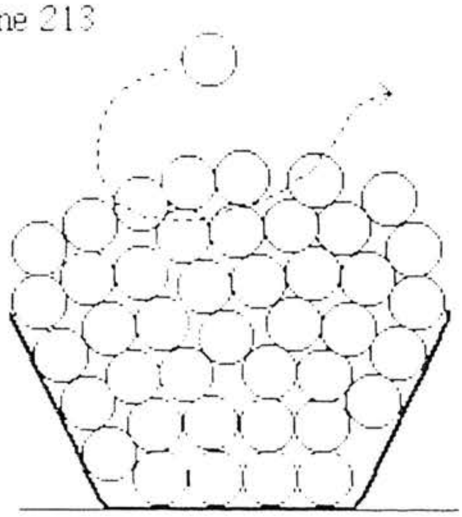

The apple is ---- the bowl.

scene 212




The banana is ---- the bowl.

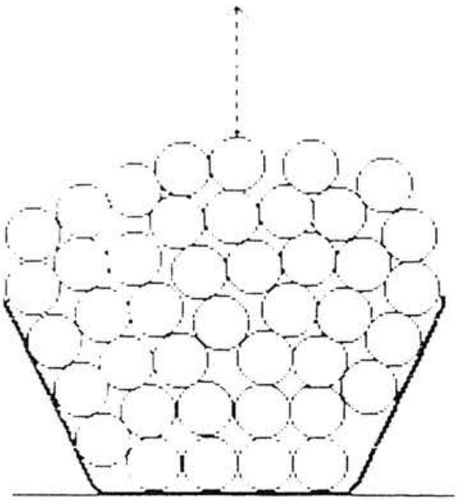
scene 213



ball moving around : slow speed

**The ball is ---- the bowl.**

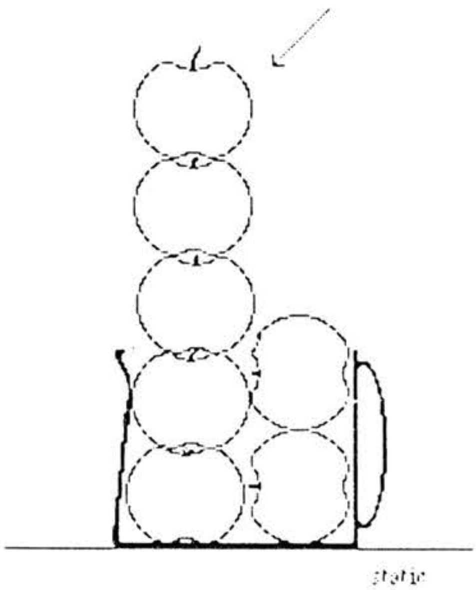
scene 214



ball moving : slow-medium speed

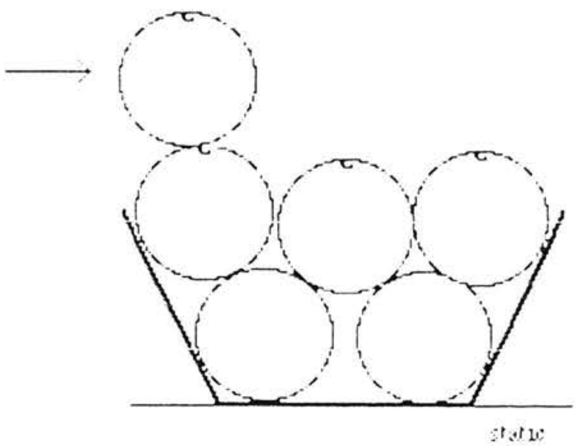
**The ball is ---- the bowl.**

scene 215



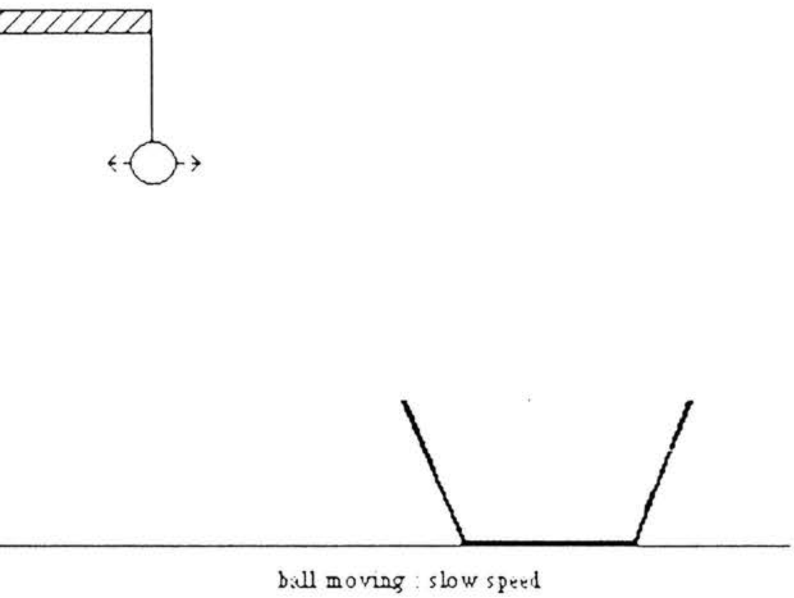

The apple is ---- the jug.

scene 216



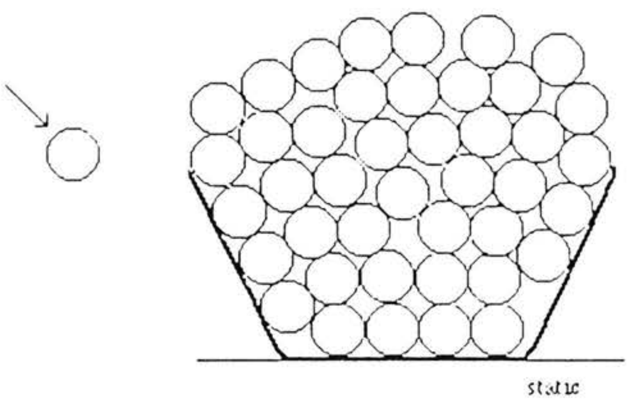

The orange is ---- the bowl.

e 217



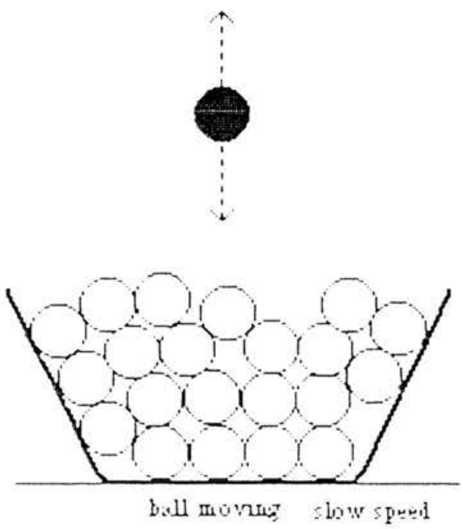

The ball is ---- the bowl.

ne 218




The ball is ---- the bowl.

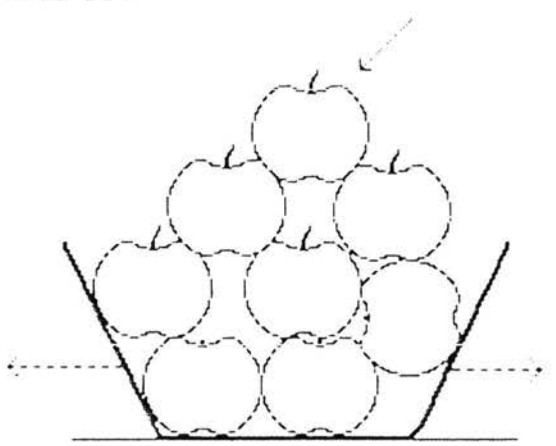
scene 219





**The ball is ---- the bowl.**

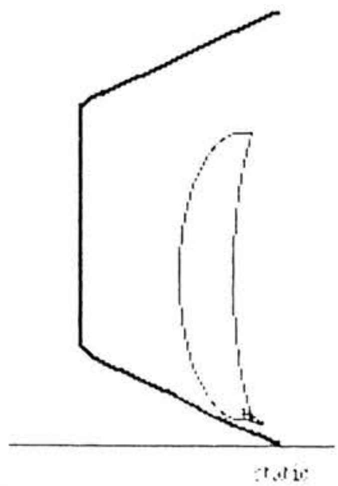
scene 220





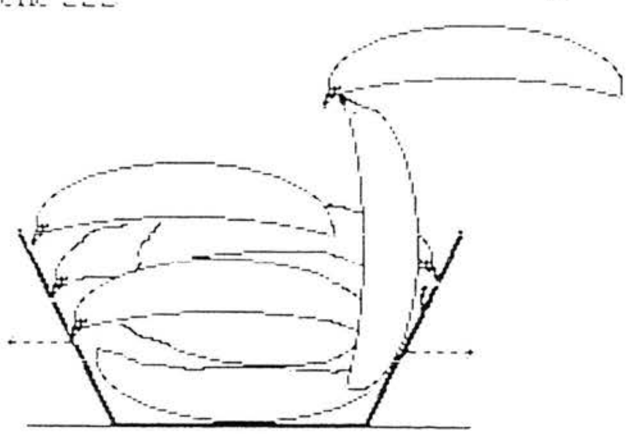
**The apple is ---- the bowl.**

scene 221



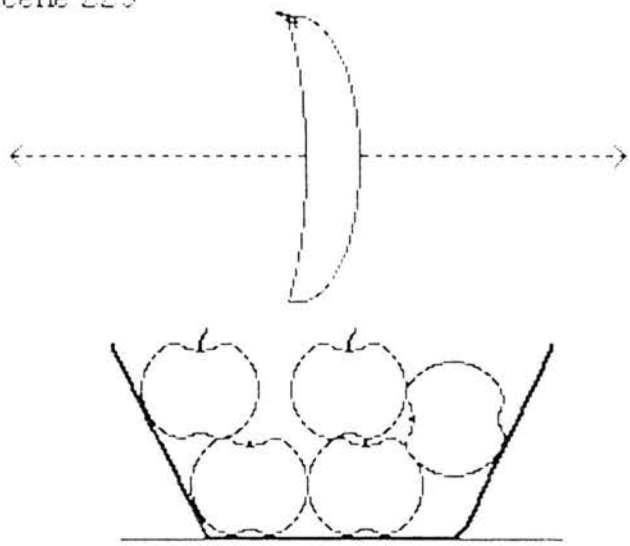

The banana is ---- the bowl.

scene 222




The banana is ---- the bowl.

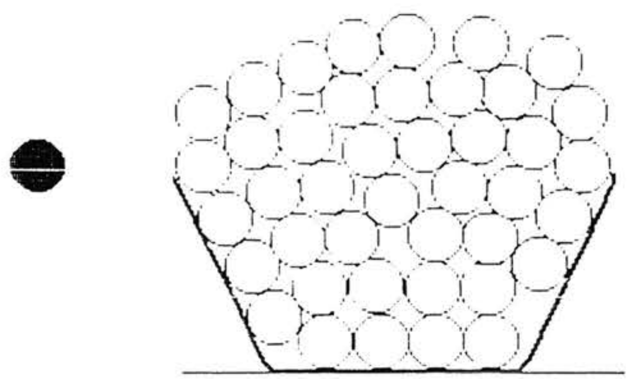
scene 223



banana moving , medium speed , freeze frame

**The banana is ---- the bowl.**

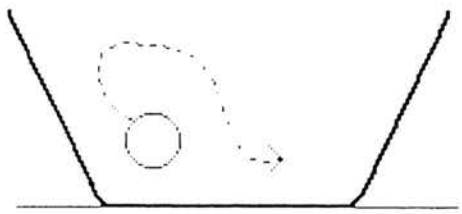
scene 224



static

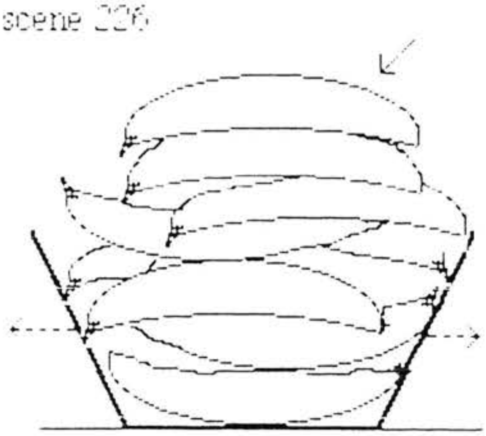
**The ball is ---- the bowl.**

scene 225

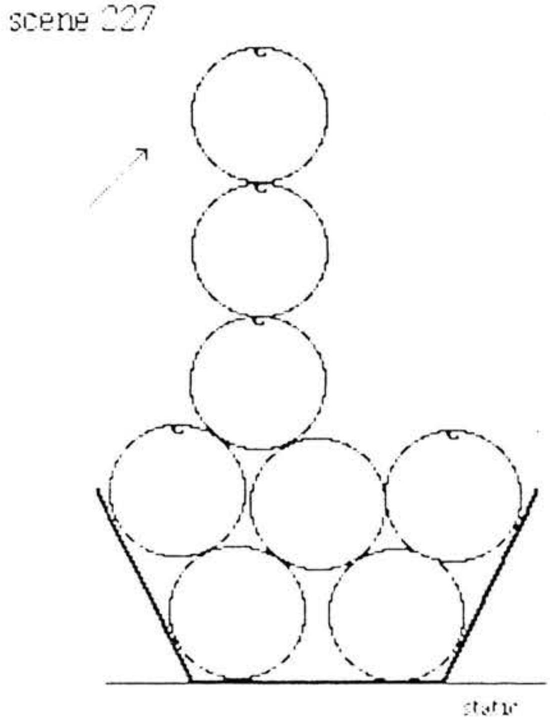



The ball is ---- the bowl.

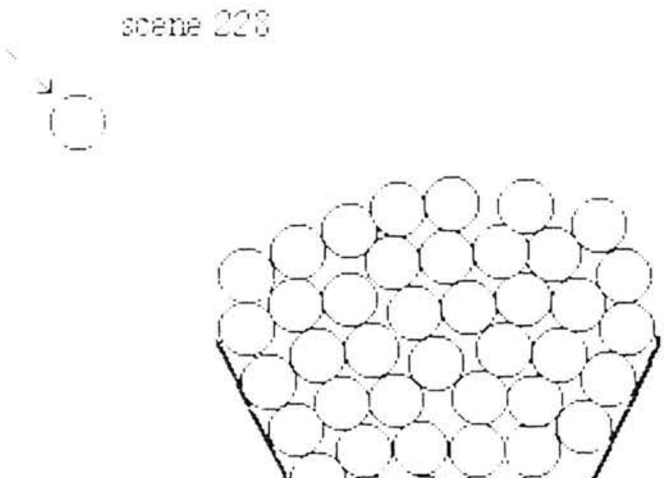
scene 226




The banana is ---- the bowl.

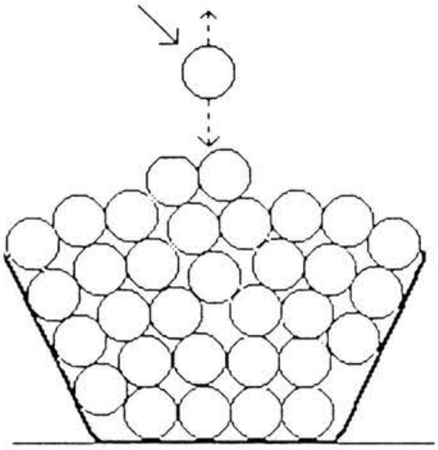



The orange is ---- the bowl.




The ball is ---- the bowl.

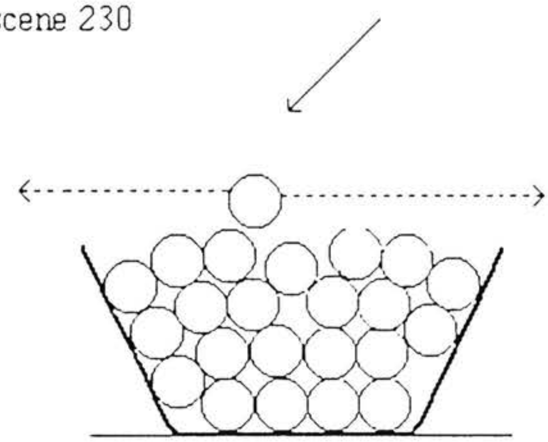
scene 229



ball moving : medium speed

**The ball is ---- the bowl.**

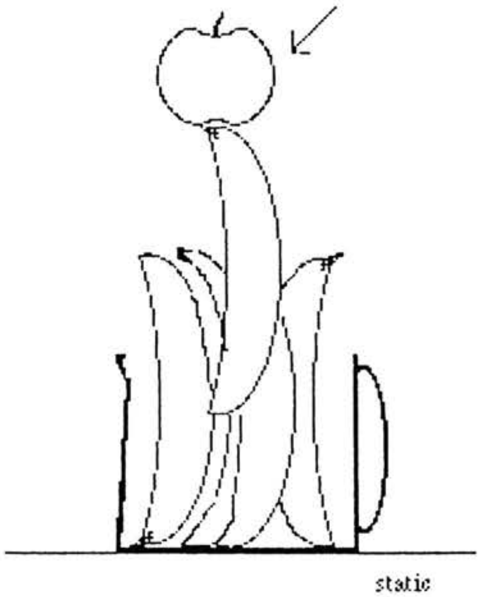
scene 230



ball moving : fast speed

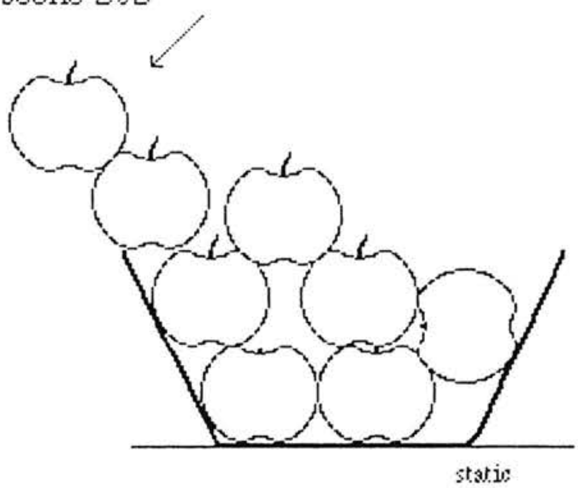
**The ball is ---- the bowl.**

scene 231



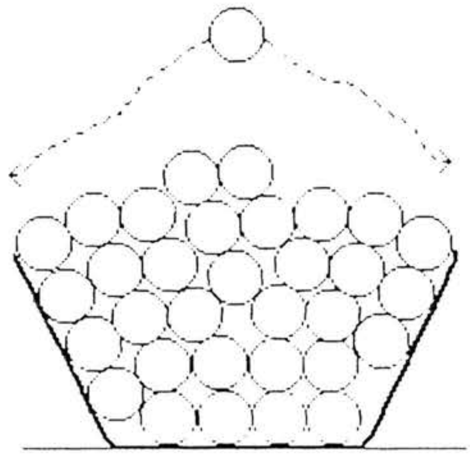

**The apple is ---- the jug.**

scene 232




**The apple is ---- the bowl.**

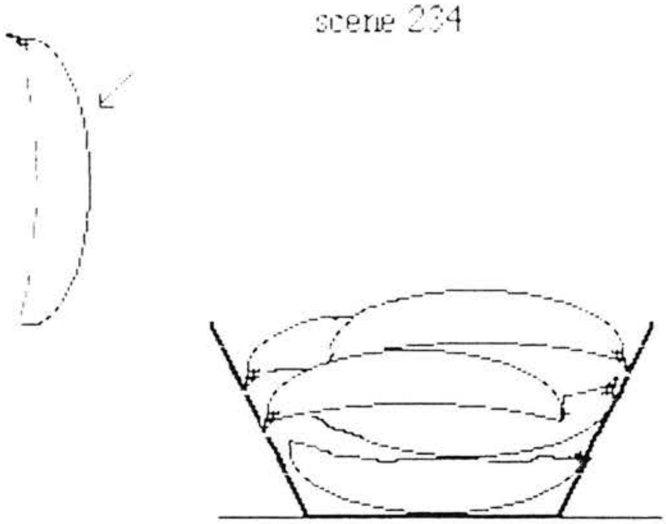
scene 233



ball moving medium speed

**The ball is ---- the bowl.**

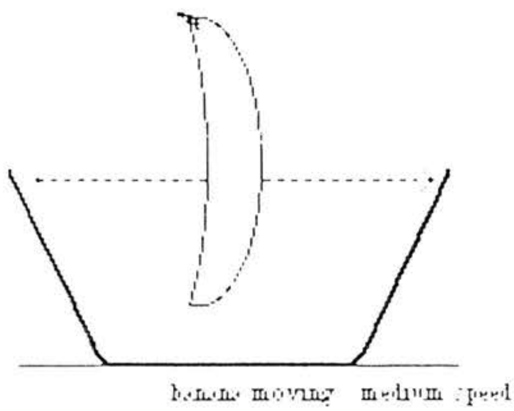
scene 234



static

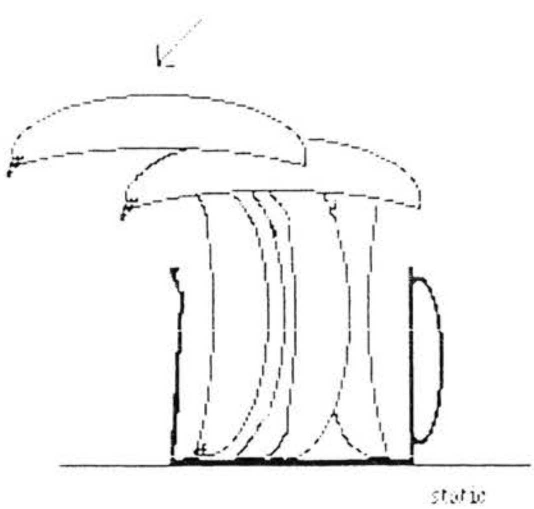
**The banana is ---- the bowl.**

scene 235



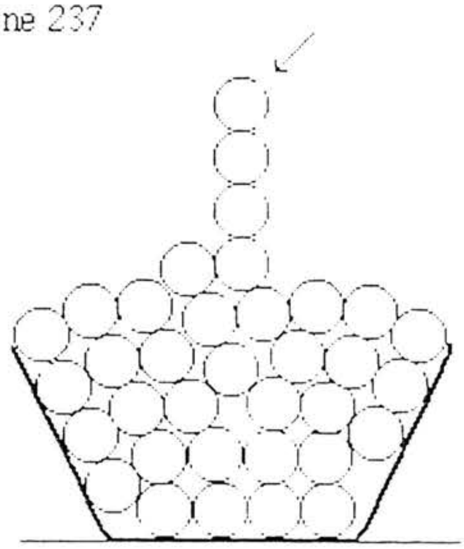

The banana is ---- the bowl.

scene 236




The banana is ---- the jug.

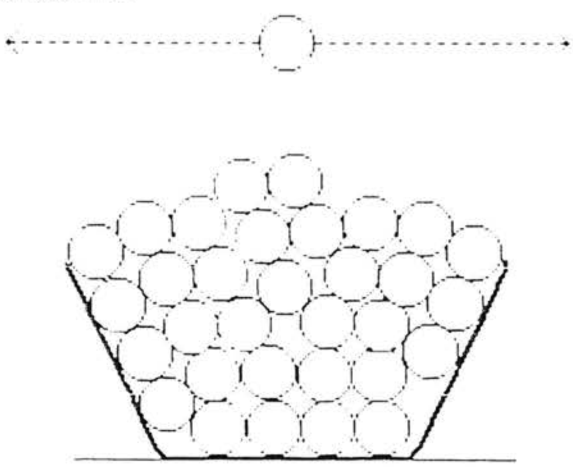
scene 237



static

**The ball is ---- the bowl.**

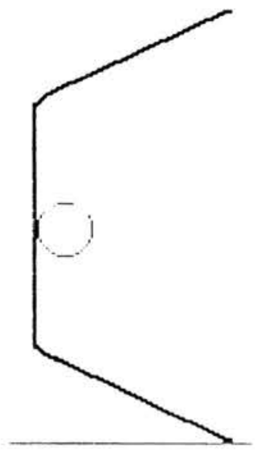
scene 238



ball moving : medium speed

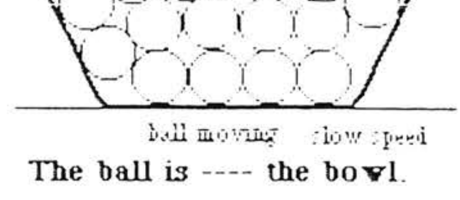
**The ball is ---- the bowl.**

scene 239



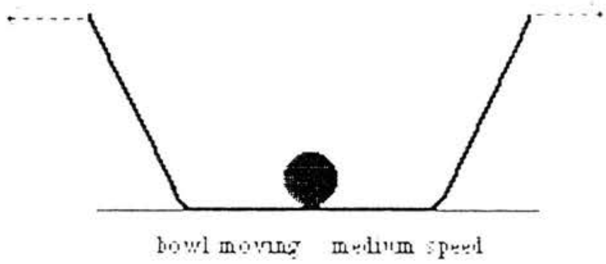
**The ball is ---- the bowl.**

scene 240



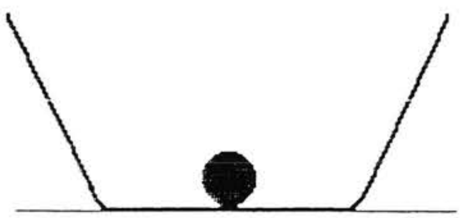

**The ball is ---- the bowl.**

scene 241




**The ball is ---- the bowl.**

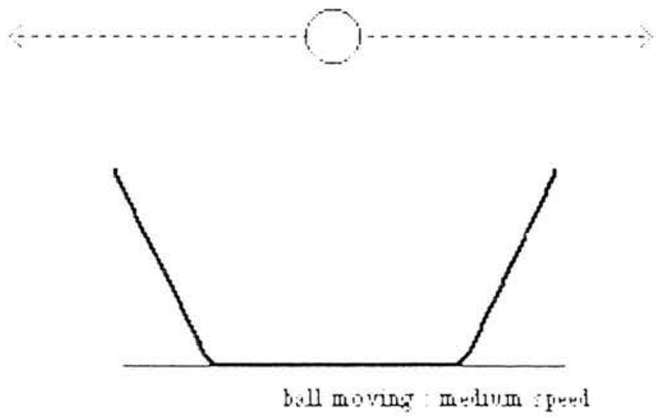
scene 242



static

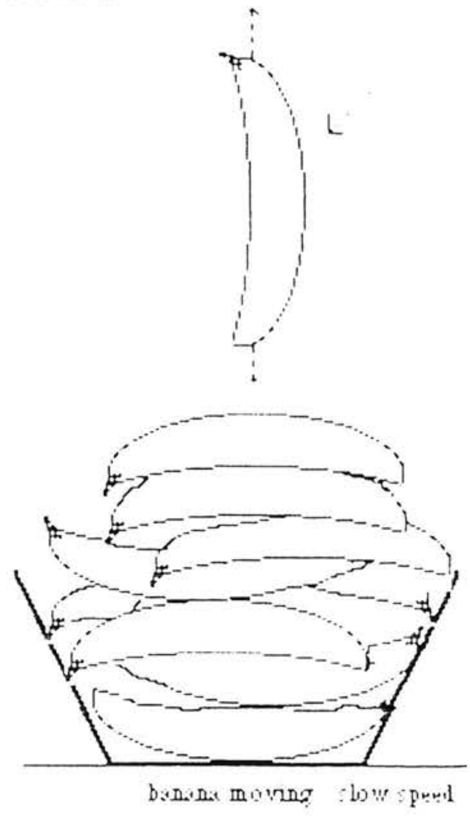
**The ball is ---- the bowl.**

scene 243



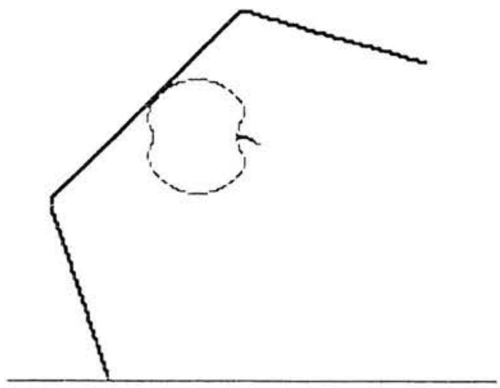

**The ball is ---- the bowl.**

scene 244




**The banana is ---- the bowl.**

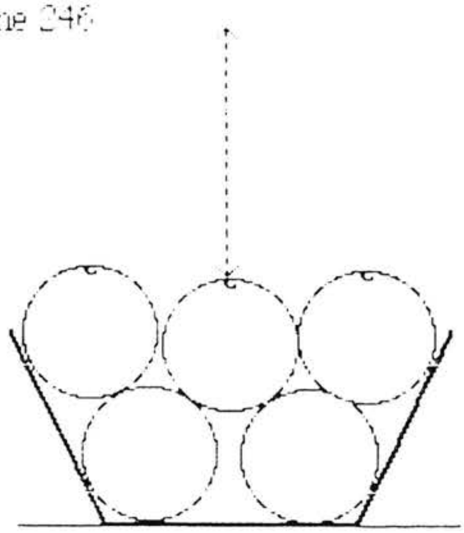
scene 245



static

**The apple is ---- the bowl.**

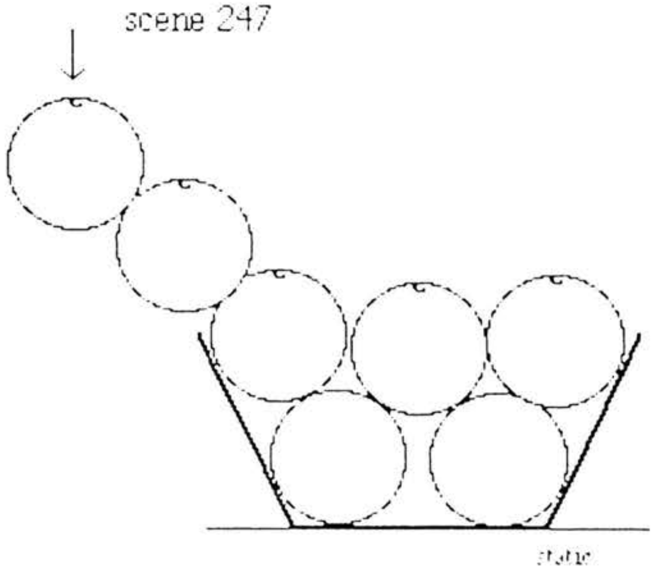
scene 246



orange moving fast speed, freeze frame

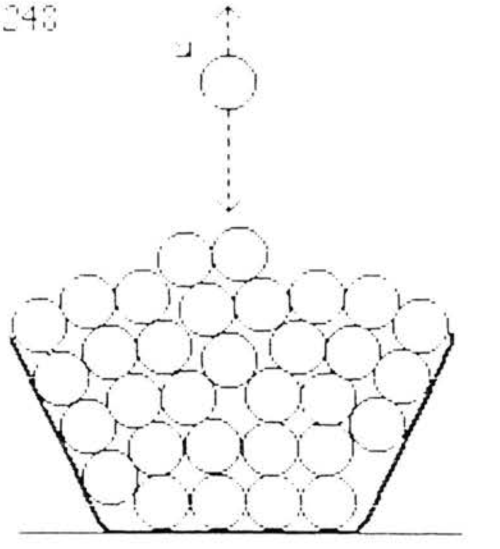
**The orange is ---- the bowl.**

scene 247



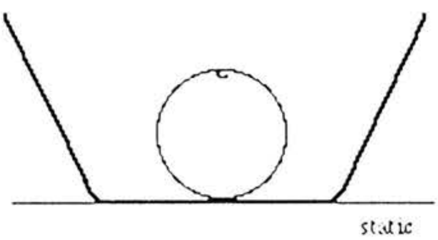

The orange is ---- the bowl.

scene 248



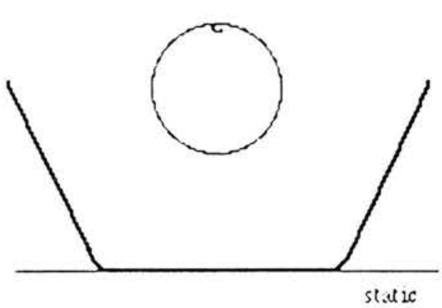

The ball is ---- the bowl.

scene 249



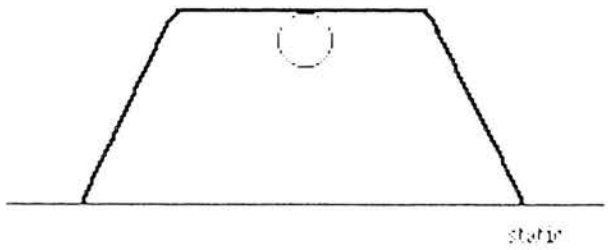

The orange is ---- the bowl.

scene 250



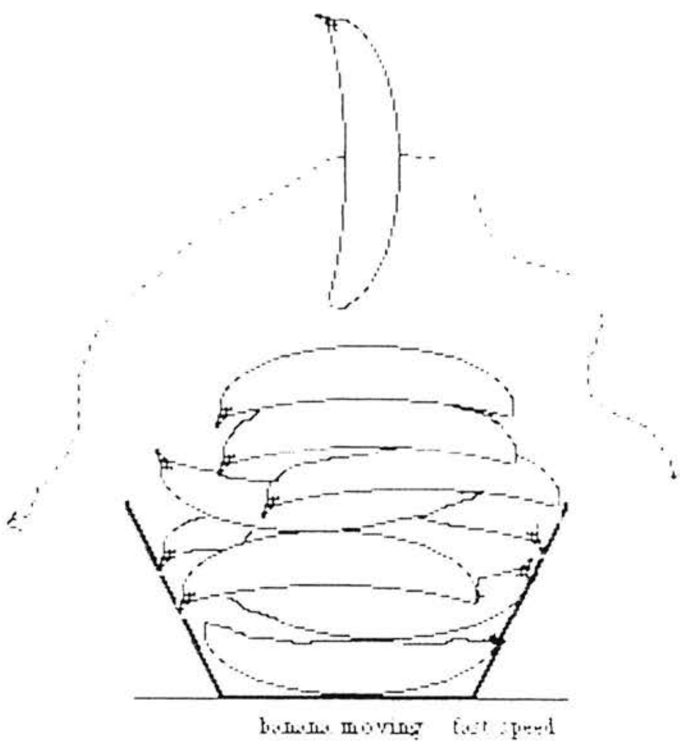

The orange is ---- the bowl.

scene 251



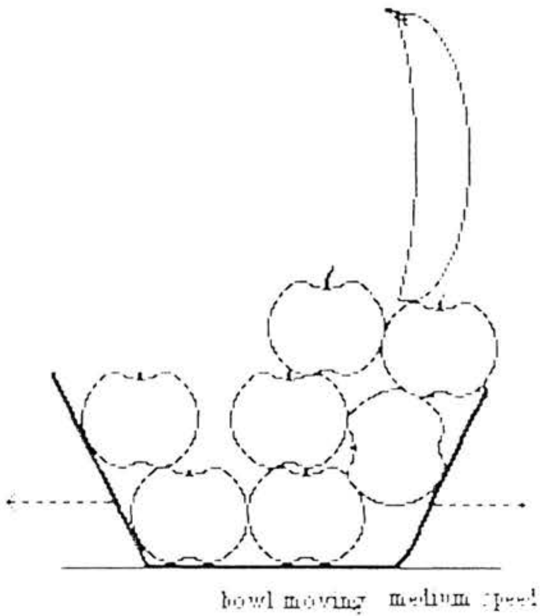

**The ball is ---- the bowl**

scene 252



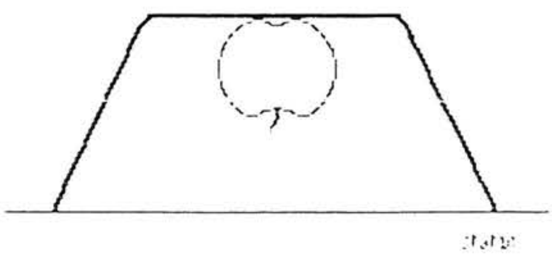

**The banana is ---- the bowl.**

scene 253



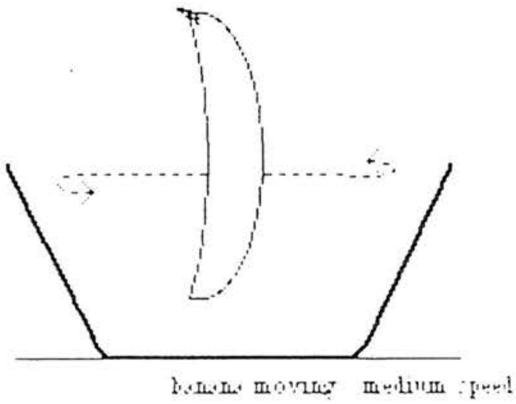

**The banana is ---- the bowl.**

scene 254



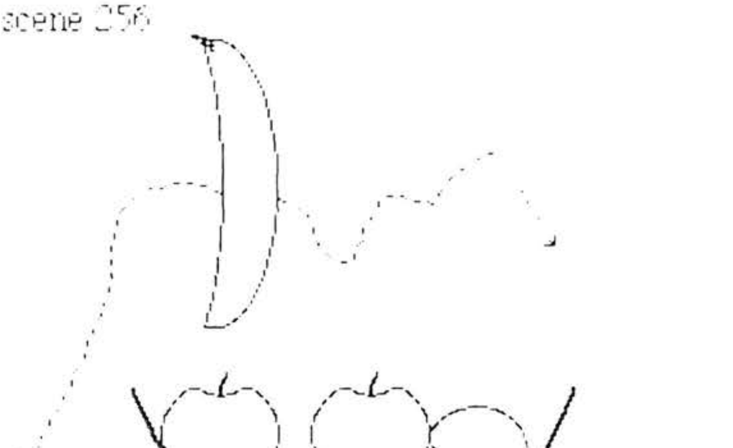
**The apple is ---- the bowl.**

scene 255



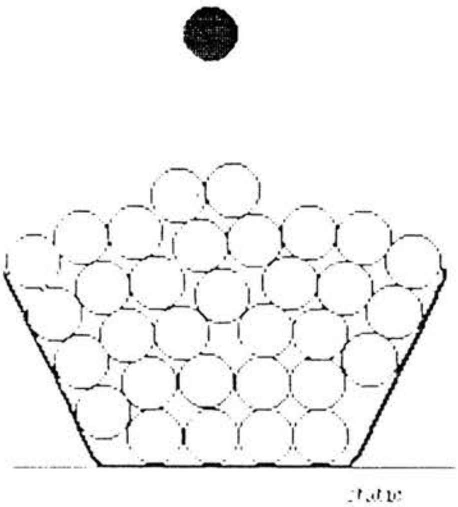

**The banana is ---- the bowl.**

scene 256



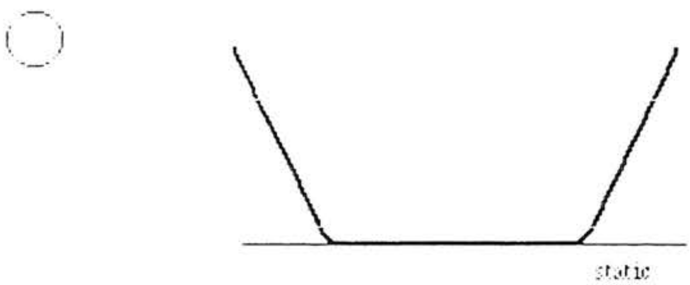

**The banana is ---- the bowl.**

scene 257



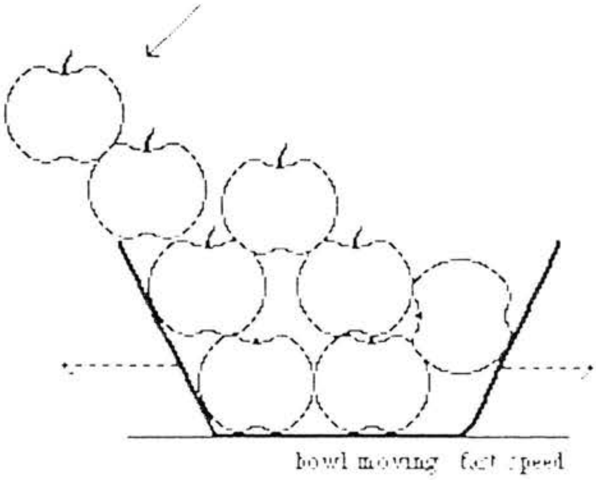

The ball is ---- the bowl.

scene 251



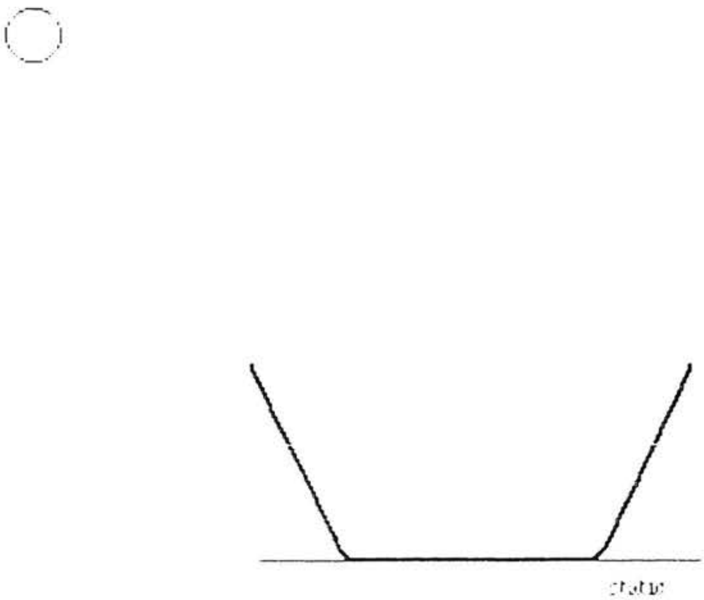

The ball is ---- the bowl.

scene 259



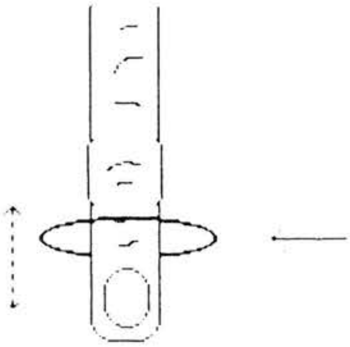

**The apple is ---- the bowl.**

scene 260




**The ball is ---- the bowl.**

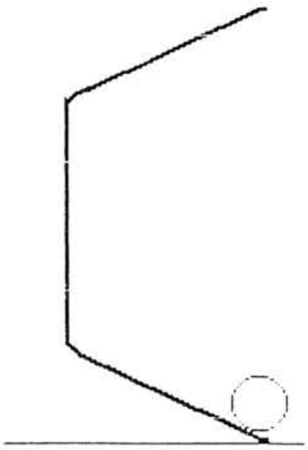
scene 261



ring moving (medium speed) (on finger)

**The ring is ---- the finger.**

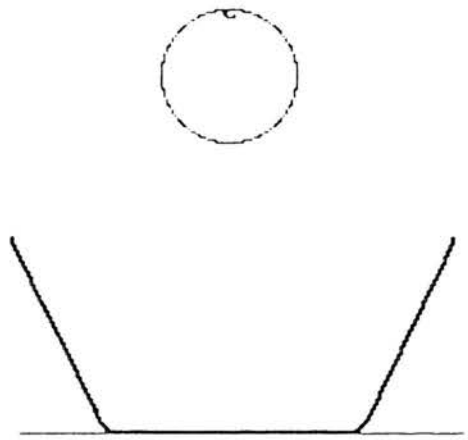
scene 262



static

**The ball is ---- the bowl.**

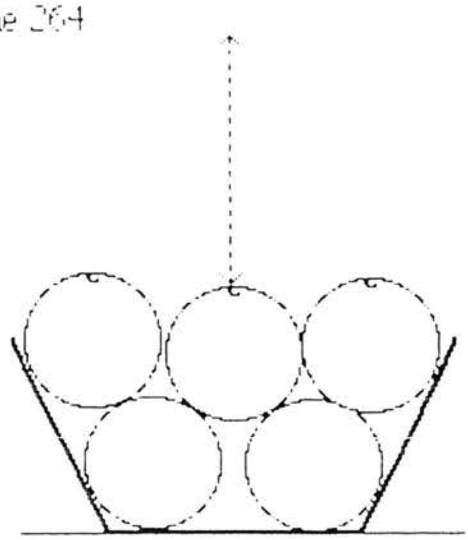
scene 263



static

The orange is ---- the bowl.

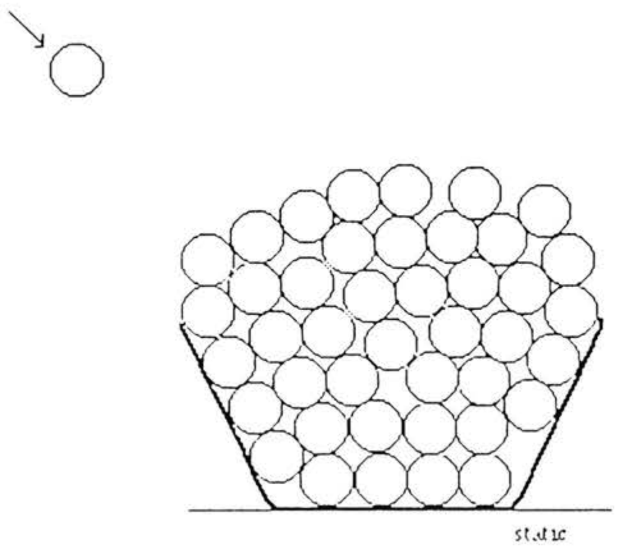
scene 264



orange moving : slow speed , freeze frame

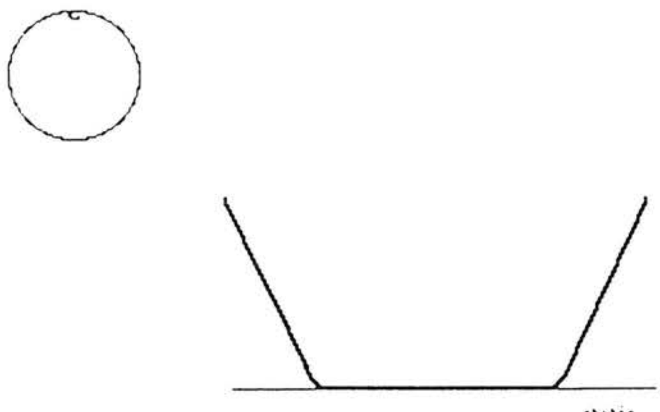
The orange is ---- the bowl.

scene 265




**The ball is ---- the bowl.**

scene 267

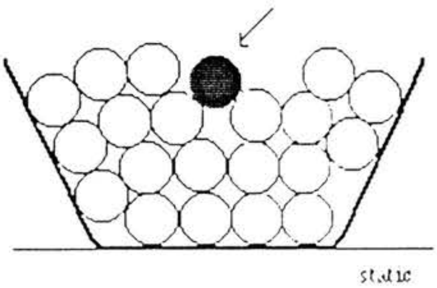



**The orange is ---- the bowl.**

scene 266

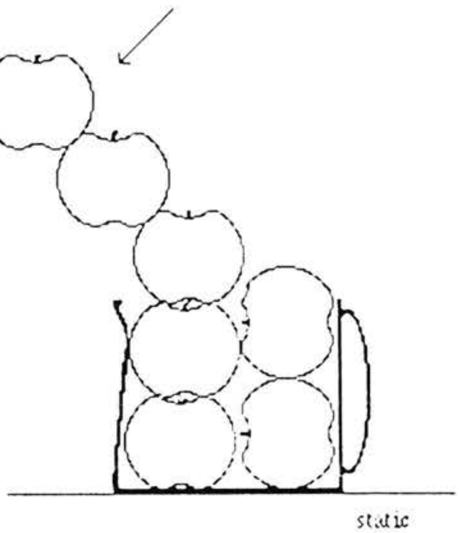
The orange is ---- the jug.

scene 268



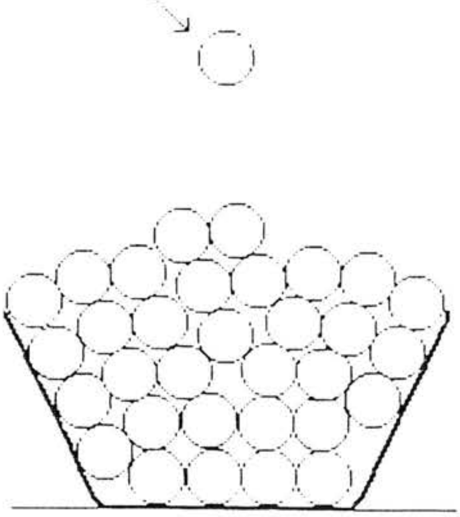

The ball is ---- the bowl.

scene 269




The apple is ---- the jug.

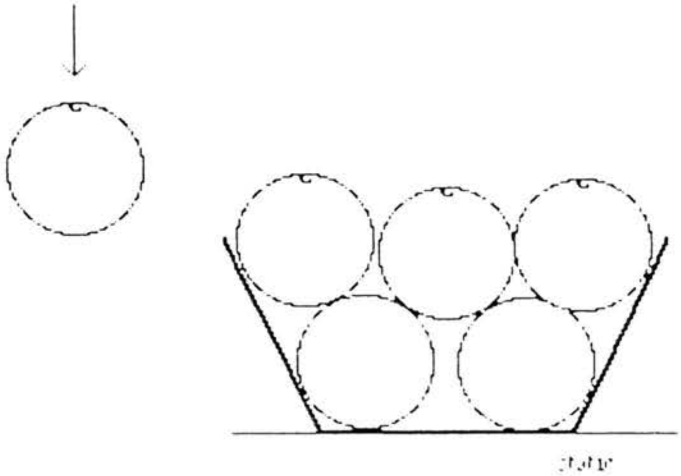
scene 270



The ball is ---- the bowl.

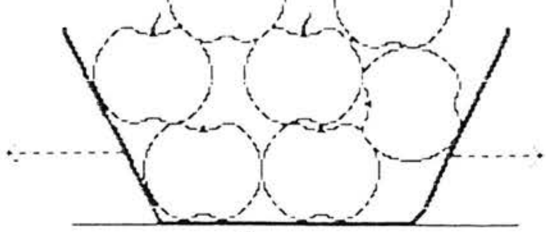
static

scene 271



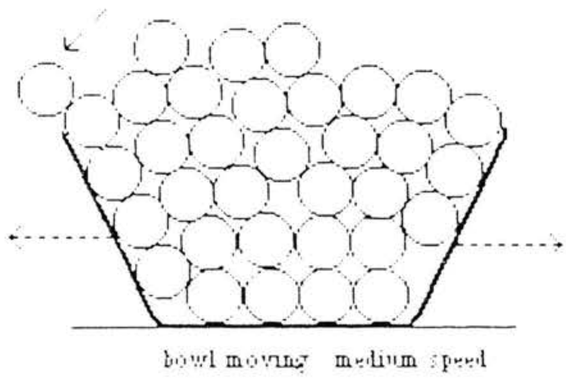
**The orange is ---- the bowl.**

scene 272



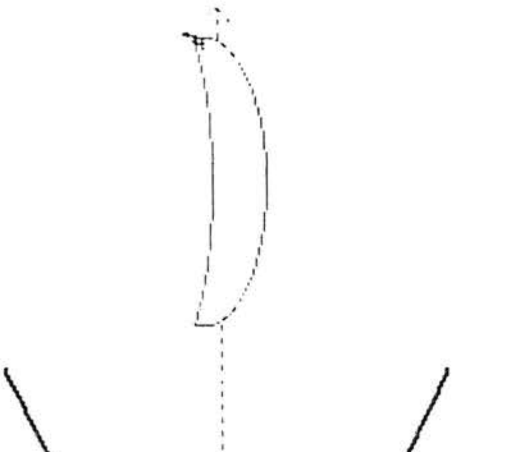

**The apple is ---- the bowl.**

scene 273



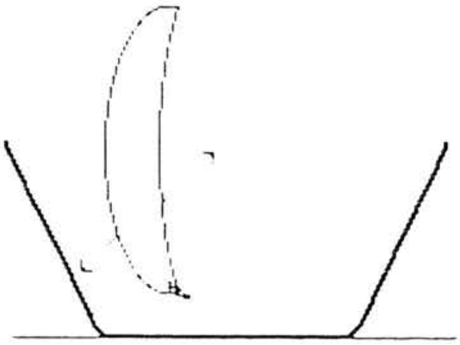

The ball is ---- the bowl.

scene 274




The banana is ---- the bowl.

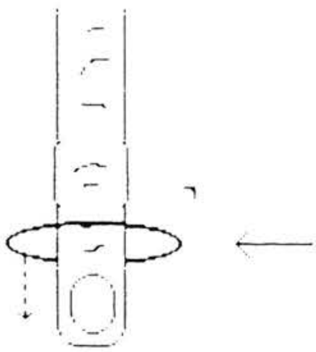
scene 275



banana moving slow speed

**The banana is ---- the bowl.**

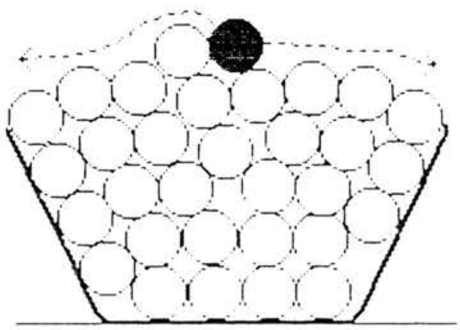
scene 276



ring moving medium speed ( on and around finger )

**The ring is ---- the finger.**

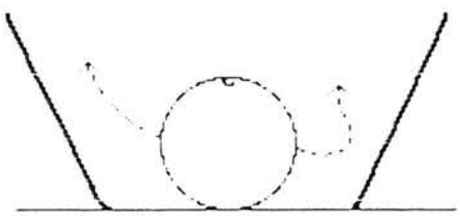
scene 277



ball moving and bouncing   fast speed

The ball is ---- the bowl.

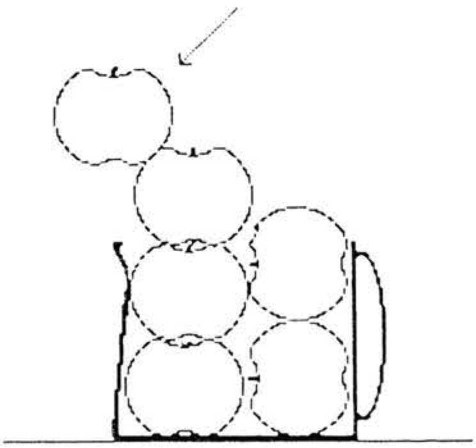
scene 278



orange moving   medium speed

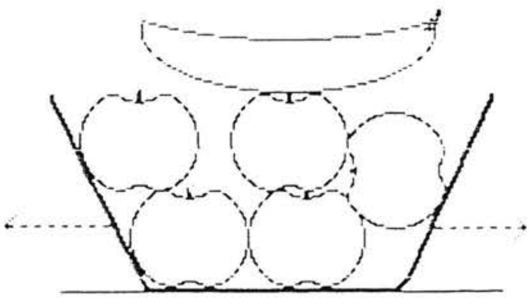
The orange is ---- the bowl.

scene 279



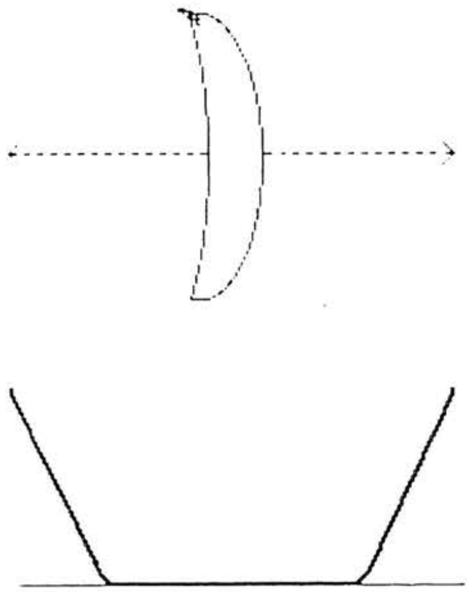
The apple is ---- the jug.

scene 280




The banana is ---- the bowl.

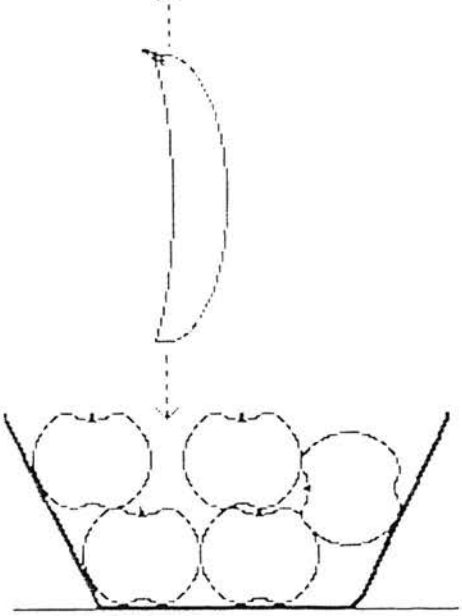
scene 281



banana moving medium speed

**The banana is ---- the bowl.**

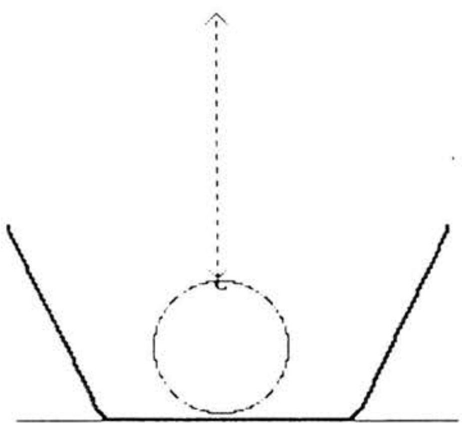
scene 282



banana moving slow speed

**The banana is ---- the bowl.**

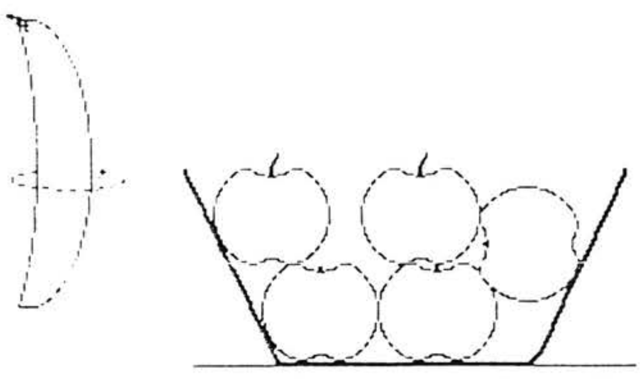
scene 283



orange moving medium speed

The orange is ---- the bowl.

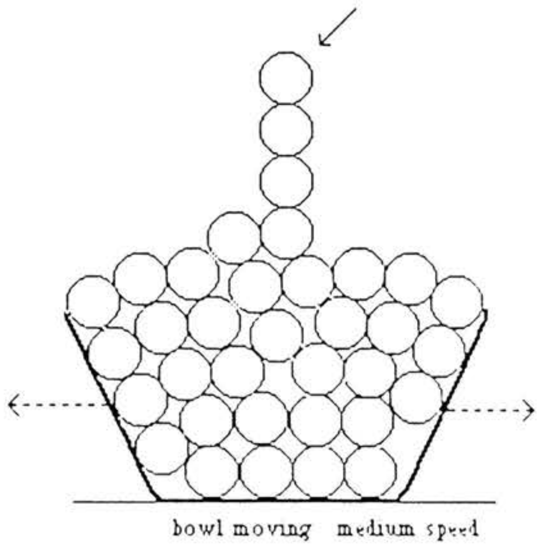
scene 284



banana rotating slow speed

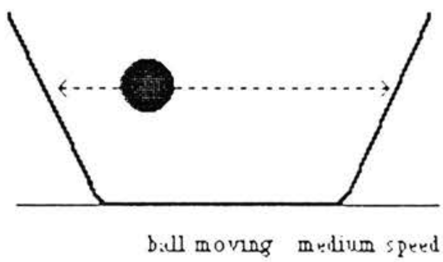
The banana is ---- the bowl.

scene 285




**The ball is ---- the bowl.**

scene 286

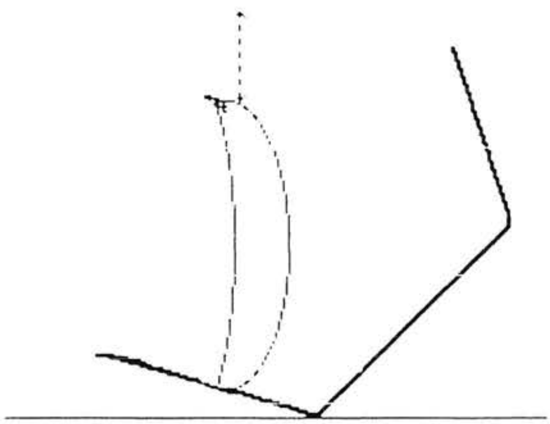



**The ball is ---- the bowl.**

scene 287

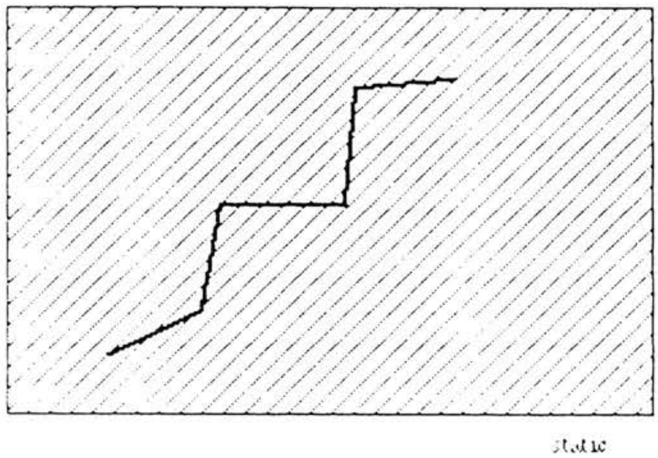

The ball is ---- the bowl.

scene 288



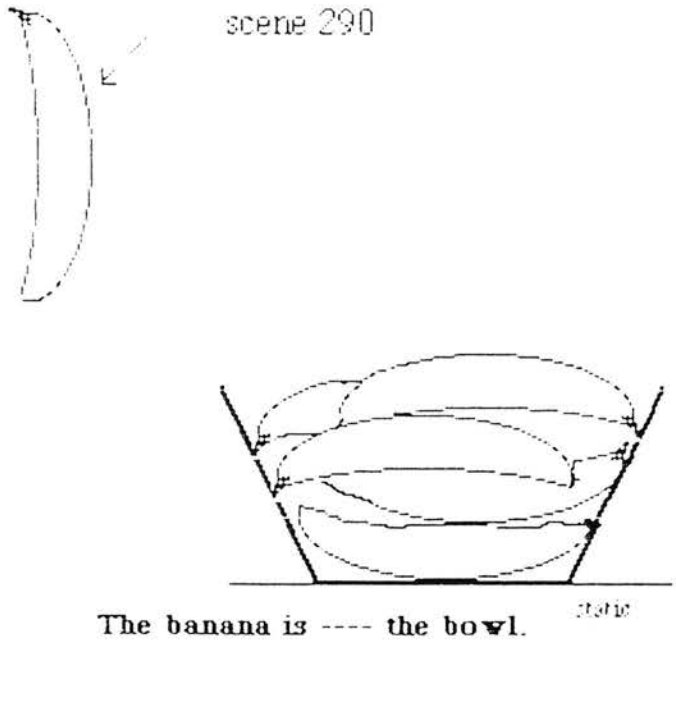

The banana is ---- the bowl.

scene 289



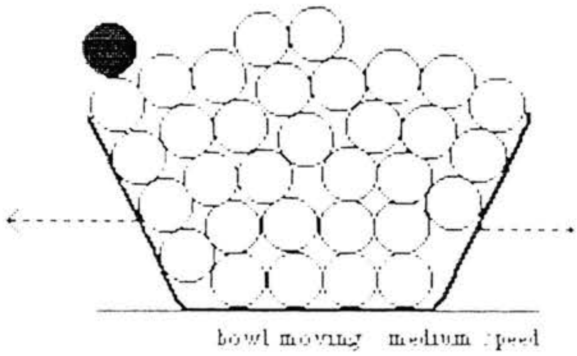

The crack is ---- the floor.

scene 290



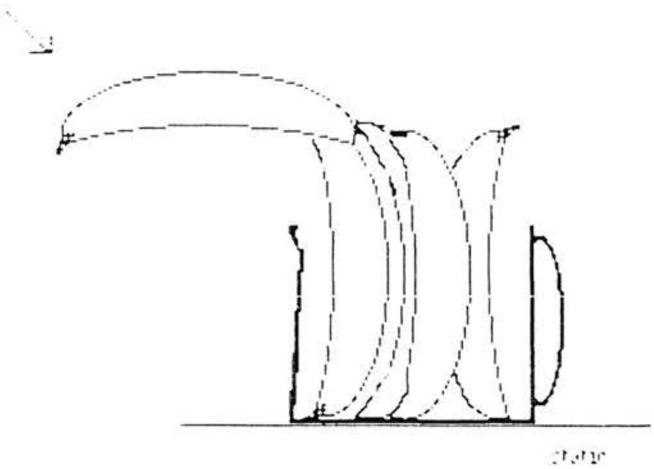

The banana is ---- the bowl.

scene 291



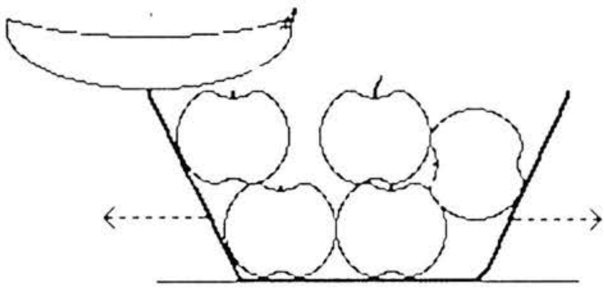

The ball is ---- the bowl.

scene 292



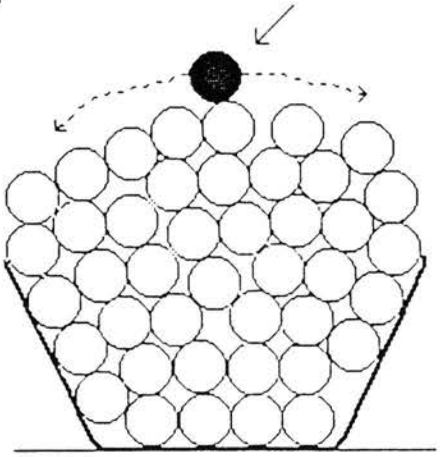

The banana is ---- the jug.

scene 293



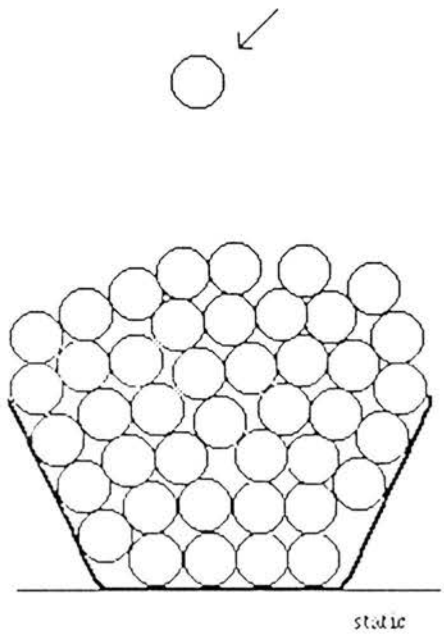

**The banana is ---- the bowl.**

scene 294



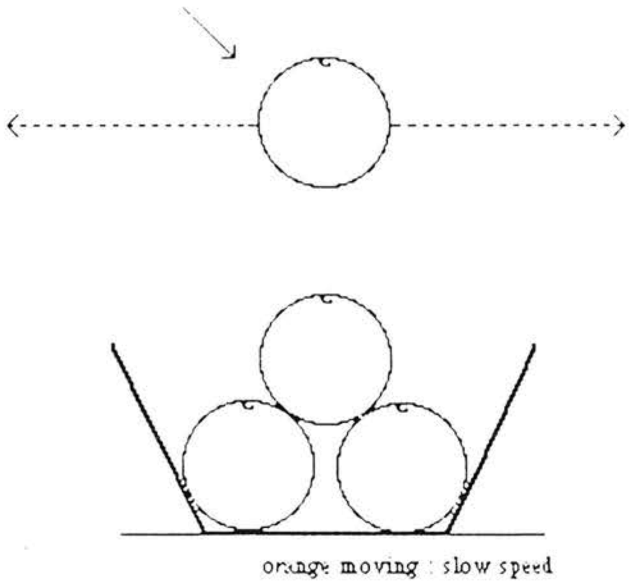

**The ball is ---- the bowl.**

scene 295



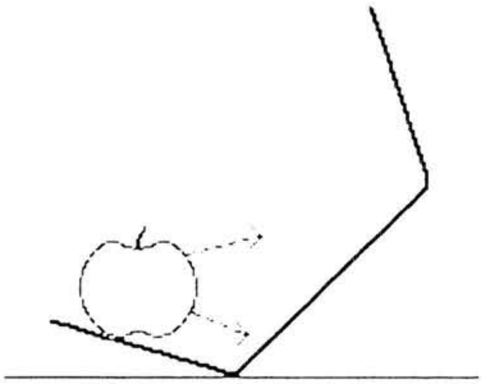

The ball is ---- the bowl.

scene 296



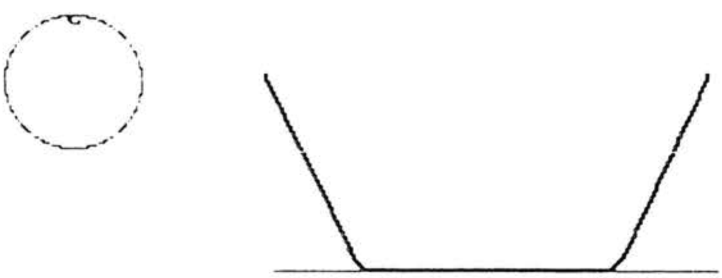

The orange is ---- the bowl.

scene 297



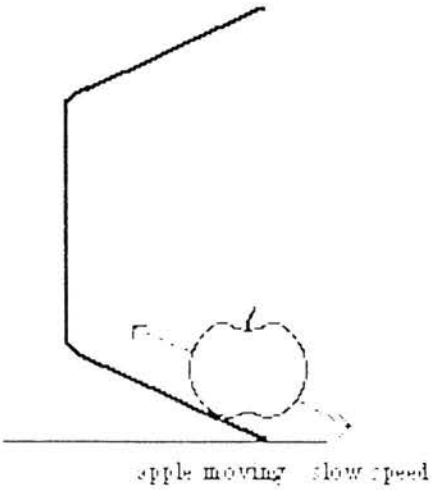

The apple is ---- the bowl.

scene 298



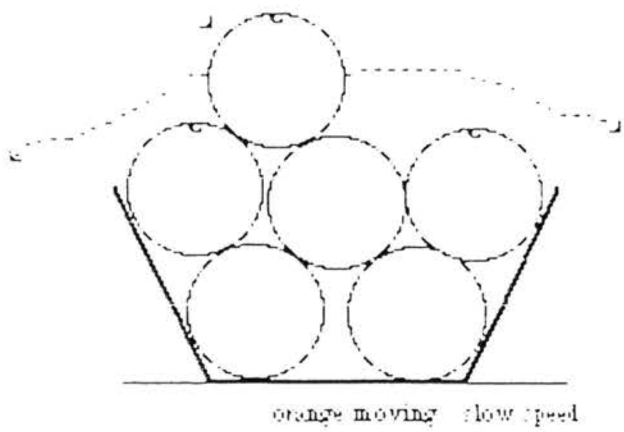

The orange is ---- the bowl.

scene 299



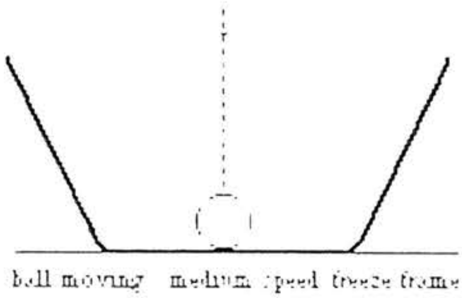

**The apple is ---- the bowl.**

scene 300



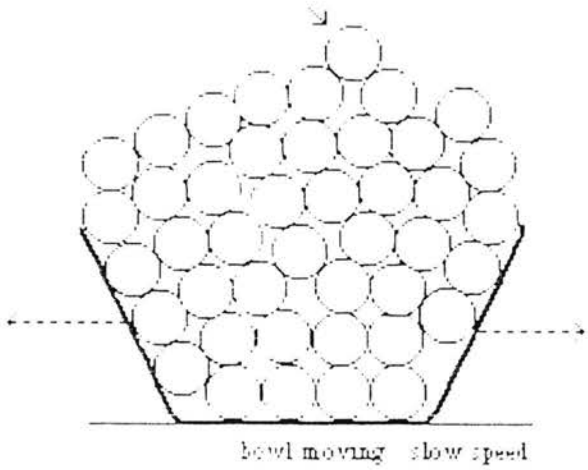

**The orange is ---- the bowl.**

scene 301



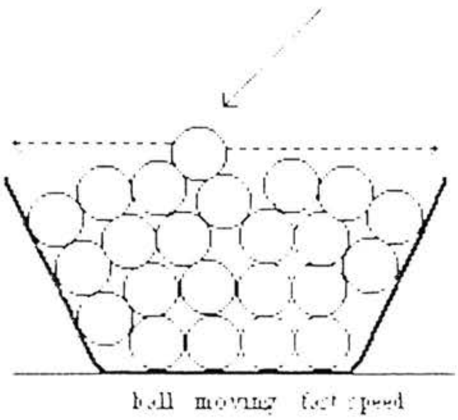

**The ball is ---- the bowl.**

scene 302



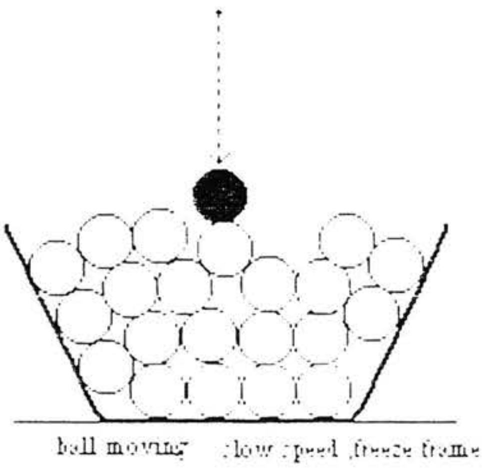

**The ball is ---- the bowl.**

scene 303



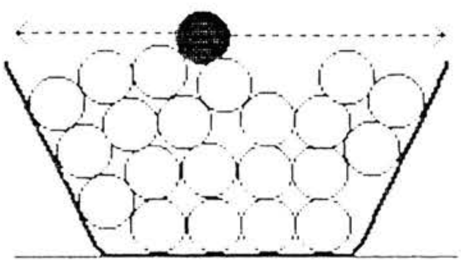

The ball is ---- the bowl.

scene 304




The ball is ---- the bowl.

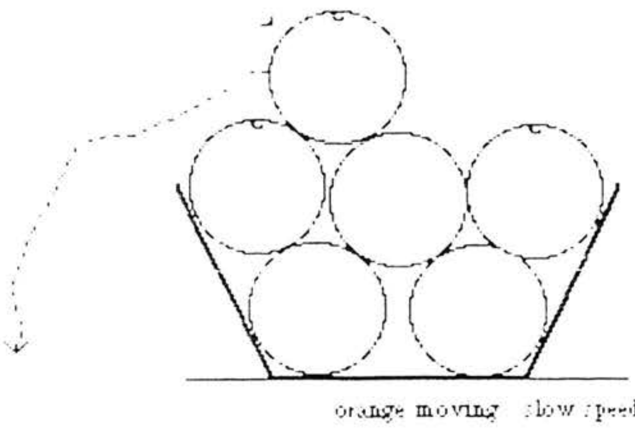
scene 305



ball moving across other balls slow speed

**The ball is ---- the bowl.**

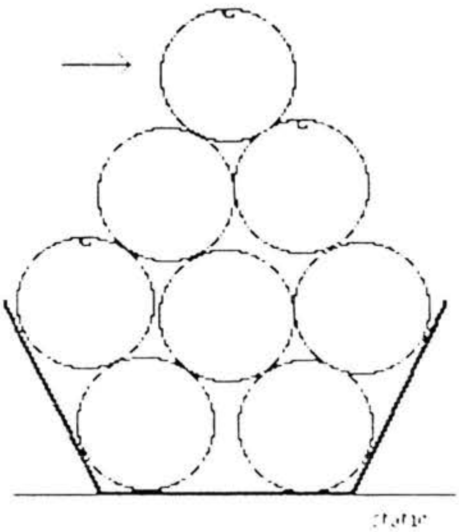
scene 306



orange moving slow speed

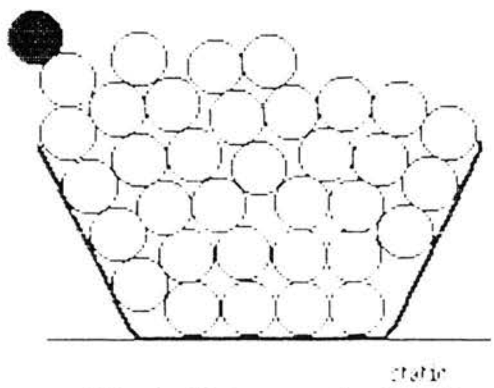
**The orange is ---- the bowl.**

scene 307



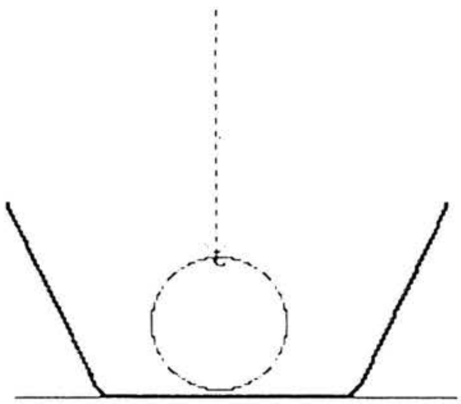
The orange is ---- the bowl.

scene 308



The ball is ---- the bowl.

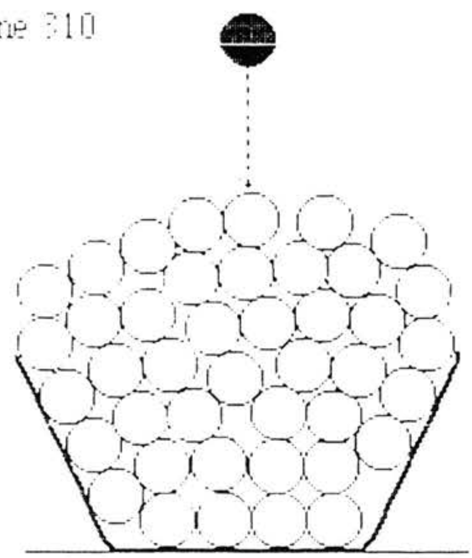
scene 309



orange moving medium speed, freeze frame

**The orange is ---- the bowl.**

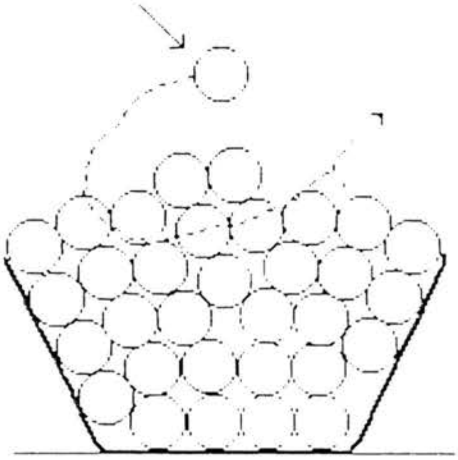
scene 310



ball moving slow speed, freeze frame

**The ball is ---- the bowl.**

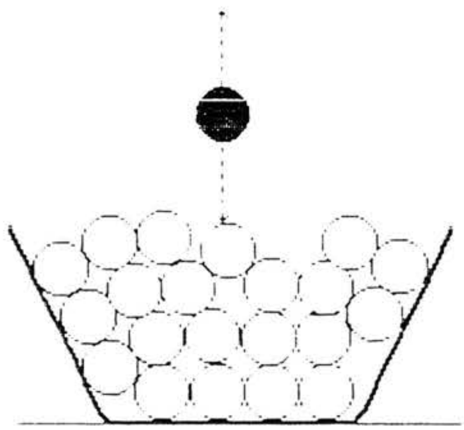
scene 311



ball moving around medium speed

**The ball is ---- the bowl.**

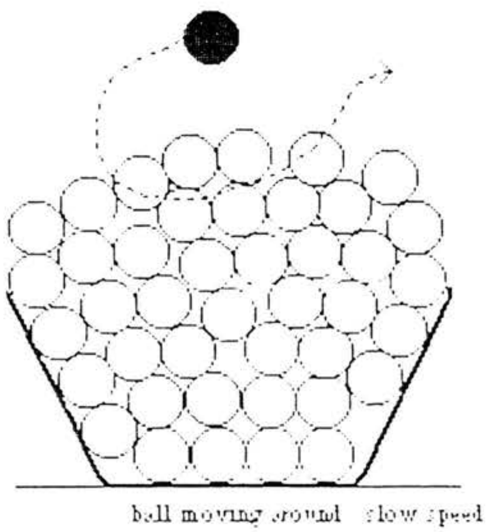
scene 312



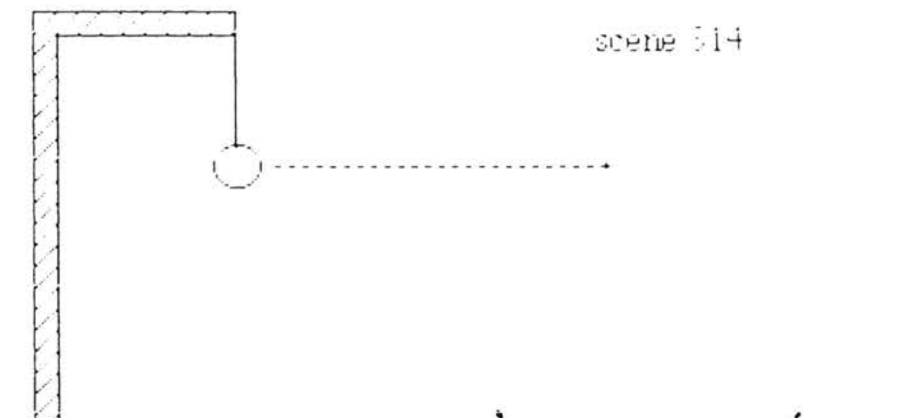
ball moving slow speed

**The ball is ---- the bowl.**

scene 313

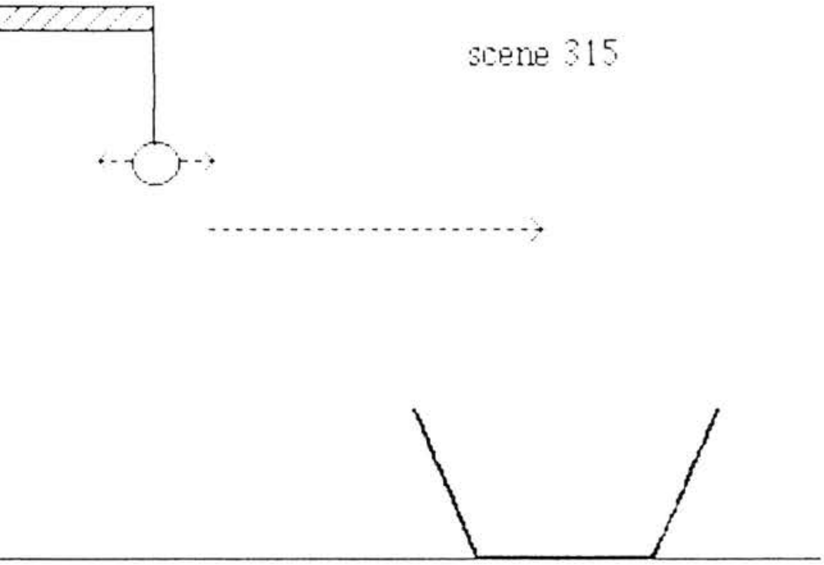



**The ball is ---- the bowl.**




**The ball is ---- the bowl.**

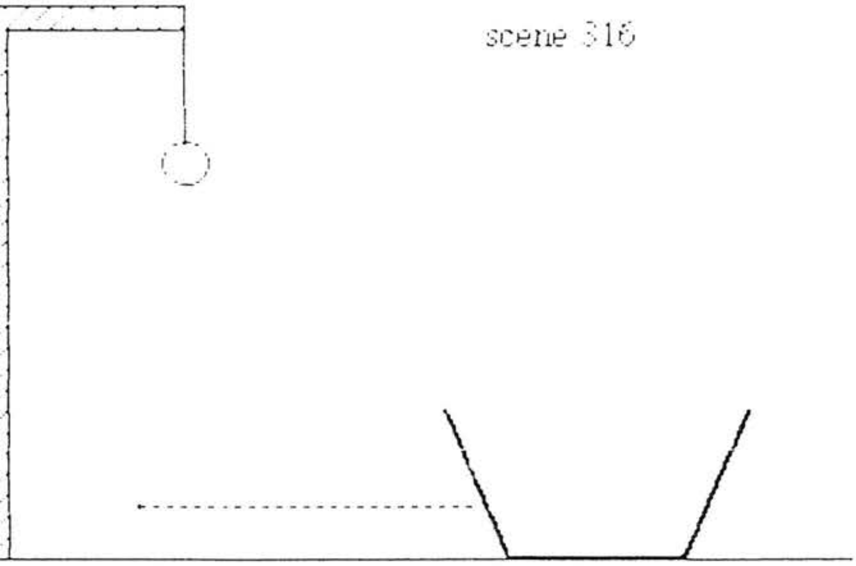
scene 315



frame moving towards bowl : slow speed ; ball moving

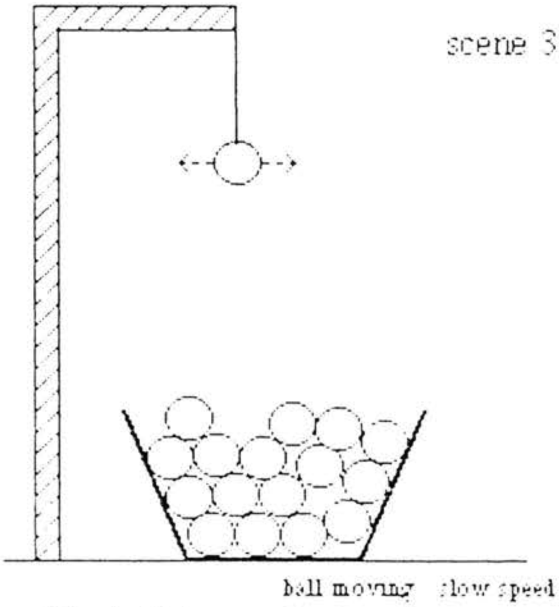
**The ball is ---- the bowl.**

scene 316

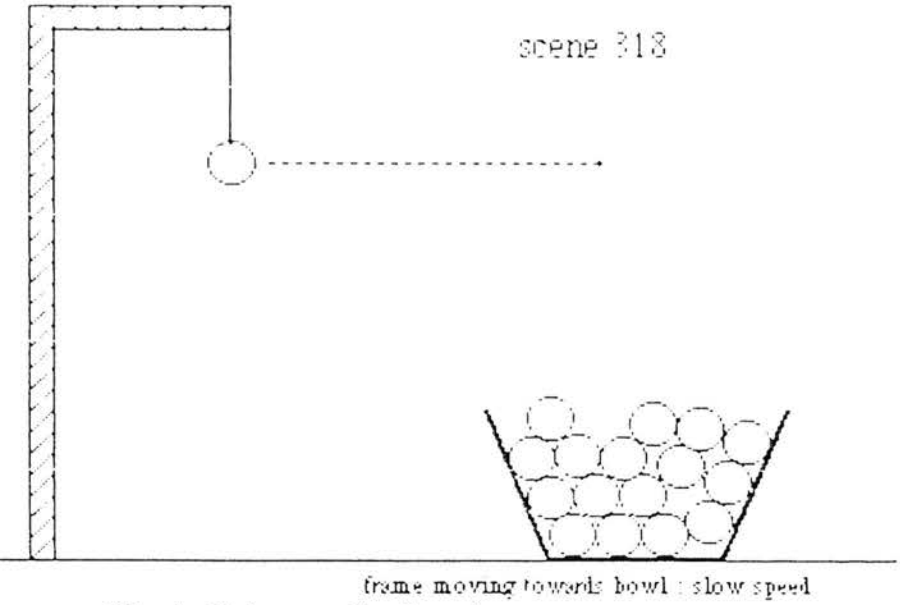


bowl moving towards frame : slow speed

**The ball is ---- the bowl.**

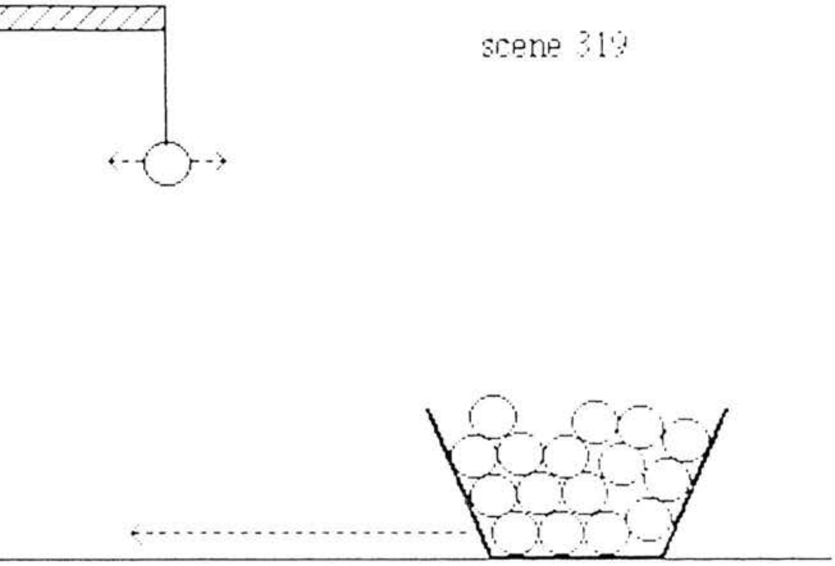



**The ball is ---- the bowl.**




**The ball is ---- the bowl.**

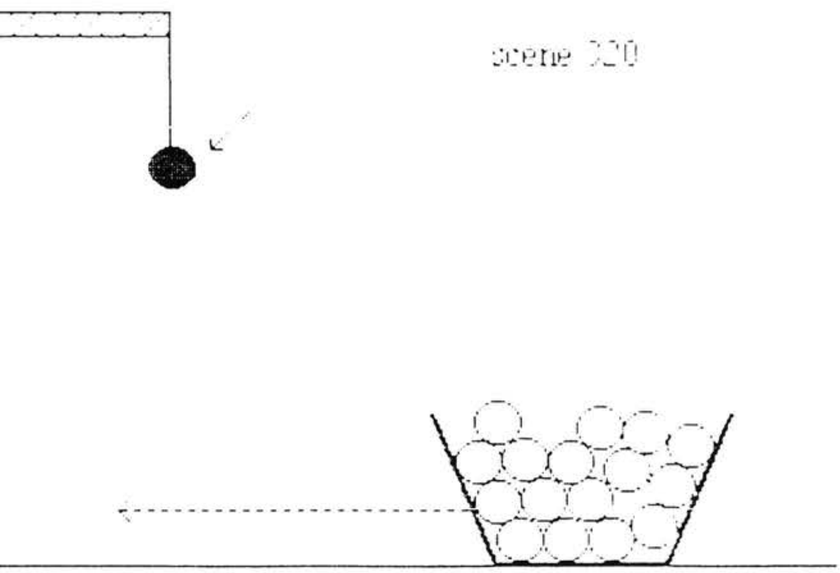
scene 319



bowl moving towards frame : slow speed , ball moving

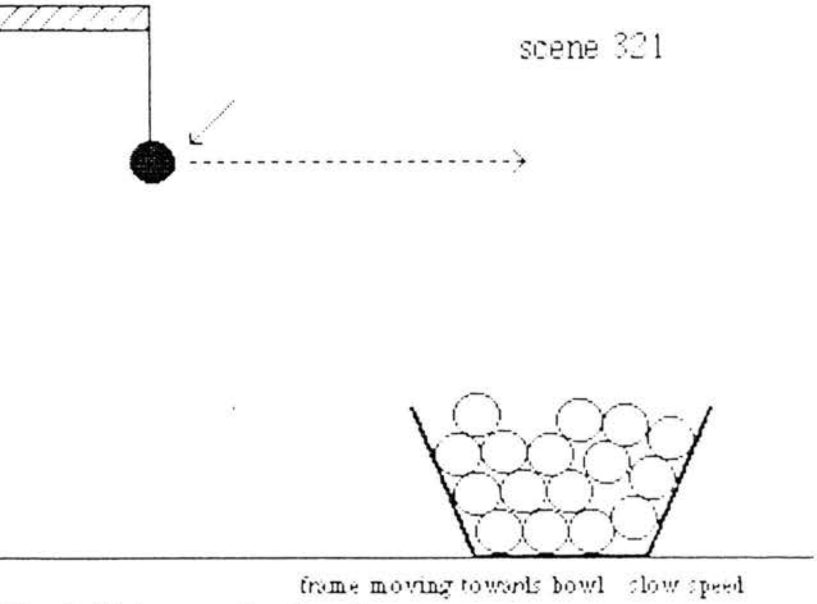
**The ball is ---- the bowl**

scene 320

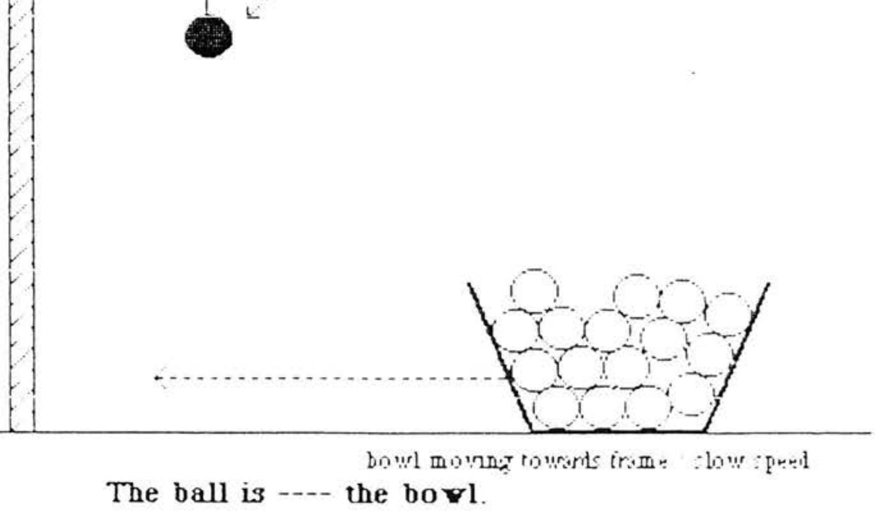


bowl moving towards frame : slow speed, freeze frame

**The ball is ---- the bowl.**




**The ball is ---- the bowl.**




**The ball is ---- the bowl.**