SPATIAL COGNITION AND THE ACQUISITION OF THE SPATIAL LOCATIVE

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ABSTRACT

Spatial Cognition and the Acquisition of the Spatial Locative.

This study investigated various aspects of spatial cognition with reference to the acquisition of spatial locative prepositions by young children. Two perspectives were considered in these experiments, represented by different groups of experimental subjects. Firstly, it was considered whether language-specific factors played a role in the development of spatial cognition and in the acquisition rate of specific locatives. The second aspect was concerned with whether certain linguistic or cognitive skills were necessary prerequisites for the development of spatial cognition. Thus, the experimental subjects consisted of either normal English- or Greek-speaking subjects, aged between 2;6 and 5;0 years for the cross-linguistic aspect, or mentally handicapped or language handicapped children for the cognitive aspect of the investigation. Both of the latter groups were Greek-speaking.

The seven experiments in the series tested the comprehension of five locative prepositions: **in**, **on**, **under**, **over** and **through**. Two basic methods were used to test the comprehension of these locatives: one was through showing or categorizing pictures of either abstract or concrete objects in these spatial configurations, and the other involved the subjects´ manipulation of toy objects. In this way, different hypotheses were tested concerning the relationship between spatial locative acquisition and spatial cognition.

The results of the experiments pointed to several variables upon which the development of spatial cognition is dependent. There appears to be a surprisingly close link between the perceptual-conceptual aspect and the linguistic, possibly in part explained by an underlying "common code", which is neither verbal, nor visual. As far as the linguistic aspects are concerned, it appears that pragmatic factors are those which primarily define the learning of spatial locatives. Thus, knowledge of congruent spatial situations seems to be a determining factor in the comprehension of locative terms. Finally, it was seen that language-specific factors may actually influence the perceptual-conceptual aspect of a task, even though they may not influence the overall rate of locative acquisition.

INTRODUCTION

Man´s concept of space, which is the focal point of this study, has attracted much investigative thought and philosophical speculation through the ages. Philosophy, from its origins, was concerned with the relationship between the world and humankind, and with ever increasing sophistication, modern philosophical thought, from Descartes through Kant to the present, has continued this tradition. Simply put, one of the fundamental questions asked was: to what extent is the "real world" real, and to what extent and how is it moulded by human experience and thought. Probably one of the most important breakthroughs in man´s conception of the universe, was the concept that each of us is capable of constructing our own external reality according to internal stimuli.

Space, probably because it represents a fairly clearly-defined aspect of that "real world", has naturally attracted more than its fair share of philosophical attention in the past, this attention shifting to the more contemporary sciences, such as psychology and cognitive science in the present. In parallel, space has also been the focus of other scientific viewpoints, such as physics, chemistry, geometry and mathematics.

Probably the feature which has contributed to man´s fascination with space is that it is so multi-faceted: for instance, let us begin by considering physical space, or that which can otherwise be called the "real world". It is perhaps obvious to state that this exists, in other words, that there is a physical reality. Yet, to what extent this physical reality is objective, may be measured in part by the cosmological theories, which have concerned themselves with its definition: thus, through Aristotle, Newton, Galileo and Einstein, this "real world" has taken some form or structure for humanity. These theories have led us to conceive of space in new and ever more enlightened ways. Furthermore, Pythagorean and Euclidean mathematics have managed to construct increasingly precise mathematical models of the universe for us, and this process is still undergoing continuous change and refinement.

How would human intellectual thought have advanced without the help of these theoretical frameworks? It appears that, since the physical sciences have enriched human intellectual capabilities so much, physical reality is dependent upon certain conceptual formulations, which we may have about it, in order to be truly meaningful to us. This assertion, was succinctly expressed by the physicist, Eddington when he said that "the universe we live in is the creation of our minds" (1958).

This statement characteristically distinguishes between the inanimate universe of physics, chemistry and geometry and that "real world" in which the human animal moves, which he may handle, interact with, manipulate and, of course, conceptualize and think about. The real world of our experience involves the simultaneous integration of colour, sound, movement, shape, as they are related to our feelings, values, memories and intentions. This implies that the "real" or physical world is a personal and unique experience at each point in time. It also implies that our perceptions are not objective, but imbued simultaneously with meaning: that "meaning" is, in turn, related to our conceptualization of the real world.

Such a complex notion leads us, naturally, to question the means which human cognition uses in order to interpret, organize and represent the world, in order to make it meaningful. Classically, perception is thought to be the process through which this outside information about the real world is made available to the human organism for interpretation and classification. The nature of perceptual mechanisms has also undergone considerable conceptual change, since until quite recently it was thought that perception merely involved the pick-up of stimulus information from the environment. It was Gestalt psychology which first provided many demonstrations that perception did not merely preserve a visual copy of that which is in the real world, but that it provided an already interpreted structure to the cognitive system. The visual arts provided much of the framework for this line of thought and was a viewpoint which was readily adopted by eminent art critics. Gombrich, in his historic work, "Art and Illusion", claims that "we can never neatly separate what we "see" from what we "know" (1960, p394). Meaning, therefore, appears to be a central part of perception, much as it appears to be in the centre of language.

Spatial cognition, which concerns human knowledge about space and the spatial relations between objects, is an interesting domain because it is directly linked to the perceptual mechanisms. The concern of spatial cognition is how spatial features, properties, categories and relations are organized, stored and remembered, when we perceive objects, persons and events. How is this information used in order that we may construct explicit and meaningful representations in other forms, whether linguistic, geometric, cartographic or artistic? Spatial information is critical in our ability to perform this very detailed organization.

Traditionally, spatial cognition has been considered a non-linguistic process. Yet, it would be a conceptual error to claim that it is merely "imagistic", for it concerns itself with meaning, much the same way language does. Pylyshyn (1977) went to the core of this implication when he said: "perception can best be characterized as the construction of an internal description of an event using an internal vocabulary of available concepts". An analysis of this statement leads to a very refined definition of perception, which is or can be directly linked to the processes involved in other higher-level cognitive processes, such as language. The feature analysis of semantic concepts has for many years been a viable solution for semantic theory. Pylyshyn's suggestion that perception may also consist of "internal descriptions" using an "internal vocabulary of available concepts" or, in other words, features, makes a definite link between the process of perceptual interpretation and language.

This suggestion has far-reaching implications: if our interpretation of the "real world" takes place through a feature analysis of meaningful percepts, these percepts will be influenced by the depth and breadth of our "vocabulary", whether for cultural, environmental or personal reasons. Secondly, the link between language and perception may be much more inter-dependent than previously conceived. It is, for instance, quite viable that the information of the visual features of a percept go into a common pool with the conceptual features, used for semantic interpretation. This suggests that this common pool is itself neither linguistic nor non-linguistic, but stores features which may be used by both modalities.

A further point concerning man's spatial cognitive abilities is that they are directly linked to man's biological endowment. It must be remembered that man's intellectual abilities are elaborated in view of his mobility, his ability to grasp and manipulate objects, as well as his sensitivity to changes in position, size, distance through time. Humans are therefore biased to code spatial relations in a way appropriate to action, objects and events, which serve the kind of activities in which they engage.

Developmentally, children progress through an ever more refined ability to code and categorize objects, properties and events, thus permitting the recognition of new objects and events. Simultaneously, they progressively explicate the implicit structures, which make up the representation of objects. The language of space is just one of these forms of explicit representations of visual spatial information. It is, furthermore, one of the primary means for making that spatial information explicit.

The link between spatial cognition and spatial terms is best viewed as a two-way system: to understand the meaning of spatial terms, one must know something about space. Does the linguistic structure learned by every speaker of a specific language determine the way he organizes, codes or even perceives the universe, as Whorf (1956) would have wanted us to believe? Or does the structure of the perception of space determine the subsequent structure of the language of space? It may indeed be that human language reflects human activity and assigns an explicit linguistic form only to those features, which are important to the successful outcome of that activity. Sometimes, when linguistic representation is inadequate, other forms may be used, such as drawing, which makes different aspects explicit. The spatial lexicon may be more elaborated in some cultures than in others, indicating that those features, which are made explicit by language are, in part, determined by situational and communicational demands.

This interest in the link between perception, language and the thought processes led to the design of the experiments to follow. Each experiment was designed to test one or more of the hypotheses, which were suggested by the above theoretical framework. As we have already mentioned, spatial cognition provided the basis of this investigation, because it is an area through which the relationship between perception, language and cognition can be more clearly viewed. As far as language was concerned, the focus of our investigation was the acquisition of locative terms. These are the overt or explicit linguistic forms, through which spatial relationships are defined by the linguistic system. A sound grasp of the use of locative terms by the language user means that he has an ability to classify and process spatial relationships in the "real world" the way the majority of language users in his particular culture do, and that he is able to successfully negotiate between that external reality and his communicative needs. Furthermore, spatial or locative terms are important for the successful outcome of our logical thinking processes, for without this ability to manipulate our thoughts through a well-tried linguistic system, using precise spatial analogies, our abstract and logical thinking would be extremely confused, if not impossible.

These experiments moved freely from one aspect of spatial cognition to another, since it was impossible to cover all the areas in one set of experiments. The questions which were addressed each time, were fairly confined within a certain framework: locative term acquisition was viewed from a developmental standpoint as only a secondary feature of these experiments. The primary interest was to what degree spatial cognition was influenced by locative term acquisition. Could spatial cognition really be thought of as non-linguistic or does language play an important role in spatial knowledge? If the "real world" is really a mental construct, is everything that we perceive immediately assigned a meaningful or canonical interpretation? Is this a prism which filters all our processes, including our ability for linguistic interpretation?

Cultural or linguistic differences were investigated by using experimental subjects from different cultural and linguistic backgrounds in some of the Experiments: thus, in Experiments I-III, and again in Experiment VII, children from Greece and Great Britain were compared in tasks concerning non-linguistic and linguistic aspects of spatial cognition. These tasks were designed to test whether children from different cultural or linguistic backgrounds responded differently to visual stimuli concerning spatial relationships of objects, according to language-specific criteria. Furthermore, did these language-specific criteria influence the way that they interpreted visual material?

The importance of certain cognitive or linguistic abilities in spatial cognition were investigated by comparing language-impaired and mentally handicapped subjects in these experimental tasks: thus, in Experiments I-VI, children who were either impaired specifically in their linguistic abilities or had a more global intellectual disability were tested on the tasks concerning spatial cognition and locative term acquisition. Of particular interest here was to what extent language per se can be thought to have an effect on the cognitive aspect of spatial functioning. If one could isolate language functioning from other aspects of cognitive functioning, what would be the effect in specific tasks involving space, which traditionally has been considered a non-verbal ability?

Perhaps, some light will be shed on these ambiguous questions, through the experiments conducted in this study.

CHAPTER 1

The Concerns of this Study: A Review.

In the Introduction, some of the more general questions pertaining to this study were exposed. The issues and concerns of these experiments will now be addressed and what some of the investigators and researchers in this area had to say about them, will be reviewed.

The issues, which arise in this study, are many and interwoven amongst themselves in such a way that it is difficult to isolate certain elements. Language development and spatial cognition are vast issues, and include many areas, which will not be reviewed here. An attempt, however, will be made to cover some of the chief elements, which are of interest to us, such as, the language-cognition problem, spatial perception, perceptual development, the acquisition of locative terms, the problem of language and perception, understanding two-dimensional pictorial representations of three-dimensional events, semantic and pragmatic constraints in the understanding of language and other issues. Cross-cultural and, more specifically, cross-linguistic research are also areas which have attracted an extensive body of literature. Obviously, no attempt will be made to cover all of this topic, only that which is pertinent to our present concerns. Finally, we will discuss the issue of mental and language handicap, since this, too, is a relevant to our investigation.

1.1 The Language-Cognition Interface Problem.

Central to all research on child language acquisition is the now generally accepted idea of a conceptual or cognitive basis of language learning. Cognitive growth, some claim, is prior to and relatively independent of language acquisition. Moreover, the acquisition of language itself depends heavily on previous conceptual development. Thus, language learning may be considered, according to Bloomfield (1933), to be man´s "greatest intellectual feat" and, in addition, it is a feat which all humans through all cultures are equally capable of, owing to their common cognitive endowment. Spearman (1927), in his treatise on the origins of intelligence, had already laid the way for this idea when he had claimed, referring to language, that meaning is linked by a further relation, which is of "higher order". Furthermore, he claimed that "collective meaning" or the "purport" of a series of words need manifold cognitive operations, a view which was quite advanced for the times and was not adopted till much later.

Bruner (1966), one of the chief later exponents of this concept, concluded, after gathering experimental data from other cultures, that cognitive functions are common across all cultures and that cultural dissimilarities are merely different manifestations of common underlying cognitive structures, which are limited by the constraints of a common cultural heritage. In other words, the cultural differences may lie in what objects and phenomena are classified together to form a common concept, and what are the attributes or features used for the particular classification. But, all classifications are arrived at by the same process of abstraction and generalization.

Levi-Strauss (1966), the structural anthropologist, had a similar theory: he maintained that different cultural "thought systems" simply represent different strategies by which man makes nature accessible to rational inquiry. In other words, Whorf´s (1956) thesis, claiming that language is actually a mold which shapes our thoughts, appears to have a limited application. It appears that his propositions of linguistic relativity and determinism would make any form of objectivity impossible and would impede the communication across cultures.

The conceptual basis of language development has led many researchers into concluding that, not only is the child capable of major cognitive achievements independent of language, but that language acquisition itself is largely dependent on prior cognitive development (Sinclair de Zwart, 1973; Slobin, 1973; E. Clark, 1974; Nelson, 1974)

Even within this framework, the theories are varied. For instance, H. Clark (1970) maintains that the conceptual basis of early language consists of perceptual information, which the child has interpreted and organized successfully. On the other hand, Sinclair de Zwart (1973), a follower of Piaget, says it is not perception but action, which is the source of interpretative strategies. He argues that the structural properties of sensori-motor intelligence provide the child with a set of basic assumptions about the structural properties of language.

According to Piaget (1952), perception alone cannot be the basis of early word meaning: it depends on the prior establishment of relatively stable internalized representations or "preconcepts", which early words mark as internal actions, rather than as perceptual images. Piaget's views on language development are particularly interesting because he links it with the emergence of the symbolic function in the child's development. He explains that the child's ability to represent an object or event, which may not be present, is a symbolic function manifested not only in language, but also in other behaviours and processes, such as, symbolic play and drawing. This ability to represent one thing for another can be seen as one of the most fundamental cognitive prerequisites for language acquisition. Furthermore, children with problems in the basic processes of symbolizing will experience difficulties with language. For instance, language delayed children may have a general deficiency in representational ability and do poorly in tasks involving imagery, while their basic intellectual development may be adequate (Inhelder, 1976).

Whatever is the case, it seems that the child comes to the language learning task already equipped with a stock of basic concepts, which he has built up through his non-linguistic interactions with the world (Bever, 1970). His problem, now, is to discover the linguistic forms and devices, by which these concepts are expressed in his native language. That is, he must "map" these experiences onto language.

There is evidence, however, that language interacts at points with conceptual growth, in ways that are not predicted by the hypothesis that language is acquired to express only what the child "knows" (Slobin, 1982). When the child reaches the level where he must categorize his experiences into language-relevant concepts, there appears to be an interplay between concept and the semantic or linguistic form (Bowerman, 1978). Categorization of objects and events, which is needed for the purpose of speaking and understanding, is a necessary prerequisite to language acquisition. It is not independent of the language learning process and may be one of the reasons why cross-linguistic variability in semantic categories is observed (Rosch and Lloyd, 1978). It is likely, although there is an intimate relationship between cognitive universals and linguistic universals, that many semantic categories are learnt through the requirements of mastering a specific language (Carey, 1982).

Chomsky´s viewpoint (1965; 1968) was that the child has innately a number of formal linguistic mechanisms which are part of what is called his "language acquisition device". Since they are innate they will be universally found in the structure of all of the world´s languages. The fact that a child easily and effortlessly acquires his mother tongue and proceeds generally through similar stages of acquisition as other children even from very diverse linguistic backgrounds, seems to suggest that children bring specifically linguistic information and strategies to the language learning task. Because, Chomsky says, these features are innate, they will therefore be found universally. Moreover, although more general cognitive and perceptual strategies may play an important role in the acquisition process as well, at least some mechanisms are thought to be purely "linguistic". This is a view which is related to Vygotsky´s (1962), who had stated in the 1930´s that he felt that language and thought came from separate roots and he hypothesized the existence at a very young age of both a prelinguistic phase of thought and a preintellectual phase in the development of speech.

Problem-solving may be largely dependent on language mediation (Bem, 1970). Other investigators (Furth, 1961) claim that the influence of language in concept formation is extrinsic and specific.

The present state of the language-thought interface problem is an attempt to adapt both the cognition-first and the language-influence schools of thought into what may be called an "interactivist hypothesis" (Bowerman, 1981), which claims to be neutral as to whether categories that are formed purely to meet the requirements of language, in fact have an effect on the child's general cognitive or non-linguistic way of interpreting his environment.

1.2 Cross-linguistic research

Cross-linguistic research is triggered from just such a hypothesis: what, in fact, is universal and what is specific in the language acquisition of particular language or cultural groups? (Comrie, 1981; Bowerman, 1975; 1981; Luria, 1976)

From a linguistic point of view, Chomsky's (1968) theories about an underlying structure to language has obvious repercussions on cross-linguistic research. He maintained that all sentences are generated from a limited number of base components and a complex system of rules, to which all humans, competent in their specific language, have access. The underlying structure, therefore, is universal: it is the surface structure (or specifics) which vary, according to each individual linguistic system.

The universality issue of language acquisition has progressed from Chomsky's (1965) initial theorem, which claimed that linguistic competence or "the mental reality underlying actual behaviour" was more important than actual linguistic performance. Later investigators (Hymes, 1970; Slobin, 1970) included social context, as one of the variables influencing language acquisition. Slobin (1982) proposed some language definitional universals. These were that language everywhere consists of utterances:

1. performing a universal set of communicative functions (that is, asserting, denying, etc.)
2. expressing a universal set of underlying semantic relations
3. using a universal set of formal means (such as, combinable units of meaning made up of combinable units of sound, etc.)

Communicative competence was considered a more appropriate term to describe these functions, since it included pragmatic rules governing the contextually appropriate use of language, as well as syntactic, semantic and phonological rules.

These pragmatic rules define the regularities in the child´s social and physical environment, as well as his internal experiences and reactions. In this way, the child is able to build up a complex system of meanings, ways of categorizing and interpreting the significance of events in the world (Dore, 1975).

The "mapping" of these experiences onto their linguistic forms was recognized as being the language learner´s most demanding task, for there is no one-to-one correspondance between experience and language. Rommetveit (1985) points out that the potential aspect of an object is contingent on the viewer´s perspective and "private domain" of salient experiential alternatives at the moment. Therefore, he claims, there are no unequivocal "literal" meanings of expressions.

However, people do manage to communicate, so there must be some semantic invariance within language, some shared knowledge of the world must be embedded in the meanings of ordinary words and expressions.

A number of new questions arose from the consideration of this task of "mapping". How does the child categorize and interpret the non-linguistic events of his environment, so that he may make them meaningful? Does he have an inherent predisposition to categorize in certain ways? Does language influence the way he thinks about and conceptualizes his social surroundings? Or does he interpret his environment independent of language? What factors influence "mapping" negatively or positively? What strategies does the child use to reach his goal?

Cross-cultural research on language acquisition now took a quite new impetus, in order to elucidate some of these questions.

The introduction of pragmatics, or social context, provided a new dimension to the problem and made the link between language and cognition much more obvious: language learning may be universal, if it is linked to inherent knowledge of the world or if it is due to biological predispositions (Lenneberg, 1966). It may be universal, if the experiences of early childhood are universal It may, indeed, be universal due to an innate language learning device, which somehow regulates and synchronizes the above (Slobin, 1970).

Researchers now realized that they must arrive at a theory, which would explain how children acquire language, accounting for any observed universals of language development and also flexible enough to explain variability, by referring to the way knowledge interacts with a particular language and the particular characteristics of the social milieu.

Cross-cultural research determined many interesting problems: differences in lexicon and syntactic structure to categorize world experience, some semantic categories were found in some languages and not in others, rules for language use and discourse conventions varied from one culture to another, cross-cultural variation in child-rearing practices. And yet, the overall course of language acquisition was very similar from one social group to another. Could it be that whatever aspects of language acquisition were considered universal, were exactly those that were due to a child's general cognitive knowledge ?

Such a suggestion became all the more plausible, when semantics started to be seen as having an intimate connection with non-linguistic modes of organizing and conceptualizing experience. This cognitive-perceptual orientation was used to account for linguistic universals, reflected in the universals of semantic structure (H. Clark, 1973). E. Clark (1973a) tried to identify the types of semantic distinctions that children's early words encode, and then to determine the ontogenetic origin of these distinctions. She studied reports on how children in various language communities extended words to new objects and found that visual perception plays an important role in this process. That is, objects were primarily categorized according to shape and the same properties of shape appear to be relevant in acquisition: for instance, roundness and length are very salient features. She concludes that word acquisition and the classifier systems of natural languages are similar, because they both depend on a universal "a priori", non-linguistic categorization process. Furthermore, important experimental work by other investigators corroborated this theory, showing, for instance, that children universally show a tendency to categorize their experience in certain ways. Berlin and Kay (1969) found that the best exemplars (focal colours) for colour categories in different languages cluster in certain areas of colour space, rather than being randomly distributed across it. Rosch (1973; 1975) furthered the issue of colour categorization and other aspects of human categorization, showing without a doubt that categorization is a universal human ability, which follows certain universal laws. She attributes this to her hypothesis that the basic content of core meanings are "given" by the human perceptual system, therefore they are universal across all languages.

The "cognition first" hypothesis, however, cannot explain language development completely. It is obvious, for a start, that perceptual non-linguistic experience cannot simply be mapped onto the semantic categories needed for language. Something else must account for language-specific variability.

A partial answer to this question may be that a certain concept may vary in the time it takes to be mapped onto a specific language structure, owing to certain language-specific constraints. Slobin (1985), a proponent of this view, claims, however, that: "the rate and order of the development of the semantic notions expressed by language are fairly constant across languages, regardless of the formal means of expression employed".

In cross-linguistic research, it is necessary to disentangle those differences in performance, which may be the result solely of linguistic differences, to those caused by real differences in the cognitive operations under investigation. In order to determine whether any particular set of distinctions, encoded in a specific language, are comprehended by individuals whose language lacks this set, one must have some means of measuring perceptual and conceptual discriminations independently of language discriminations.

In spite of the problems, which may arise from the heterogeneity of languages amongst themselves, as we have already mentioned, all languages share certain common ways of coding experience. With regard to language, Greenberg et al. (1966) have singled out various features of phonology, grammar and the lexicon, which all languages share. Miller (1970) refers to these as "general design features" of language and suggests that their existence points to common physiological and psychological processes and capacities shared by all human beings. Dore (1975) proposes that language universals may be found in a child's pragmatic intentions, which are gradually grammaticalized as semantic and syntactic structures.

Although one may acknowledge the existence of universal relations between language and cognition, this does not automatically mean that culturally relative differences are impossible. On the contrary, this complex relationship has interwoven effects on both language and cognition. Our understanding of this relationship can only grow through cross-cultural and cross-linguistic research, which will elaborate both the universal and the specific aspects in greater detail.

1.3 Word Order: A perceptual or cognitive constraint on language?

As we observed above, word order is one aspect of language acquisition which has been of great interest to many researchers. Greenberg (1966) after studying a fairly wide sample of languages, observed that in the majority, the subject of an utterance precedes the object: SVO patterns being the most frequent, followed by SOV and VSO patterns in that order.

With regard to the primacy of SVO word order as a linguistic universal, Slobin and Bever (1982) claimed that according to his cross-linguistic experimental data, the SVO word order held a universal attraction for the language learner, whatever the specifics of the particular language he was learning. They based this observation on the fact that young children learning highly inflectional languages, such as Serbo-Croatian, prefer to denote grammatical relations through SVO word order initially. Yet, other researchers (Gleitman and Wanner, 1982) have criticized this view, blaming these children's preference on SVO on the unstable and unreliable inflectional system in that particular language. Since young children search for rules, they resort to using a word order rule when all else fails them. On the other hand, when the inflectional system of a language is reliable, as it is in Turkish, children master the whole system before the age of two and are not constrained to word order.

Sinclair and Brockart´s (1972) research shows evidence that children chose different strategies to interpret utterences in different word order patterns, according to their age. However, the developmental trend was that the first noun was taken to be the subject and the second was taken to be the object.

In another study concerning the development of word order, de Villiers and de Villiers (1973) observed the spontaneous production of word order was more advanced than the comprehension of it in children under three years of age. They say that semantic constraints to the Agent-Action-Object semantic relations may cause this difficulty.

In other words, does SVO word order represent a "psychological" phenomenon, a need to express in language something that is observed in the real world? Do word order rules arise from canonical correspondences in the real world? For instance, the "actor" in an event is he who is perceived as the "subject" of an utterance, and the "subject" syntactically goes first since the "actor" is perceived as being first (Chapman and Miller, 1975; Tomlin, 1986).

According to this logic, this would mean that the non-linguistic environmental perception of events, leading to the representation of events and the role of the people in the events, are those which cause the acquisition of linguistic structures. This view has led to some interesting theories: Talmy (1978) uses the terms "Figure" and "Ground" with regard to semantics. He says that the Figure object is a moving or conceptually moveable point, whose path or site is conceived as a variable, and whose particular value is under question. The Ground object, on the other hand, is a reference point having a stationary setting within a reference frame, with respect to which the Figure´s path or sites receives characterization. This is a canonical view of the universe and leads to certain linguistic structures.

Herskovits (1986), too, in her study of locative expressions places great emphasis on the concept of a canonical word order. She agrees with Talmy that the entity, whose location is at issue, is referred to in the subject position of the expression; the entity whose location is taken for granted is referred to in the object position. She carries this point further by saying that there are typical patterns of "conceptual moveability". Expressions that relate them in converse order are often unacceptable, however rational they may be in terms of speaker´s purposes.

Huttenlocher and Strauss´ (1968) experiment well illustrates the above points. Here, it was shown that children had more difficulty moving the grammatical object of a sentence, than the grammatical subject. Thus, in a sentence, such as, "the red block is on top of the green block", it was easier to execute when the moving was done by the subject, than by the object. They explained this by saying that it is easier to understand a sentence when there is a correspondence between the form of a linguistic description and the extralinguistic state of affairs. So, when the mobile block was the grammatical object, (for instance, in "the red block is on top of the green block", the green block is the mobile one) the child may have had to translate the extralinguistic situation, in order to understand it, thus: "oh, that means the green block goes **under** the red block". Huttenlocher and Weiner (1971) found that the role of the grammatical object was only determined explicitly when the task required it.

Huttenlocher, Eisenberg and Strauss (1968) continued this line of thinking by testing active and passive statements. Thus, in the active form, a grammatical subject may also be the logical subject, but in the passive form, the logical subject is the grammatical object. Their data showed that comprehension is easiest, when there is a correspondence between the perceived actor in the situation and the logical subject of the statement. The subjects claimed that they mentally operated on the extralinguistic situation rather than on the statements heard.

Pinker, Lebeaux and Frost´s (1987) experiments on the use of the passive voice show a semantic constraint, a constraint depending on the mapping between "thematic" roles and the grammatical functions specified by the verb. Thus, children resist passivizing verbs, whose subjects are patients and whose objects are agents.

An interesting study was conducted by Mohanty and Mishra (1982) on the effect of context on word order in young Hindi children´s expression of locative propositions. The subjects were asked to describe pictures depicting locative relationships between pairs of nouns in three context conditions. The subject was shown one of three context cards, before the locative test card was shown: one showed the subject of the locative proposition in the subject context condition, the other showed the object of the locative term in the object context condition and finally, there was a neutral condition, where the object was unrelated.

In Hindi, a child may use one of two grammatical forms:

1. (cat) (table under) (sitting is)
   S ADV.PHRASE VP

2. (table under) (cat) (sitting is)
   ADV.PHRASE S VP

Compared to the neutral condition, subject-first word order was more frequent in the subject-context condition and less frequent in the object-context condition, showing that context played a significant role in the choice of grammatical forms. The results were interpreted as showing a pragmatic topic-comment strategy in syntactic ordering of Hindi locative propositions.

Finally, McClellan, Yewchuk and Holdgrafer (1986) interpret their results on the comprehension and production of word order by two-year-olds, by saying that the children appeared to be using a probable event strategy in determining subject-order assignment. They too found that productive control of the ordering of subject and object preceded comprehension, although this may have been due to the semantic likelihood of occurrence of some of the stimuli. For instance, some sentences such as "car hit boy" are more congruent with a child's experiential knowledge than the converse sentence "boy hit car". The researchers call this phenomenon "semantic interference", in that knowledge of likely relations between objects in the real world interfered with performance on those sentence types in which semantically unlikely relations between subject and object were expressed.

1.4 Space Perception

Space perception involves the pick-up of external stimulus information from the "real world" about the location of objects and the relation of these objects to each other, about their shape and size, and their relative distance from each other and from the beholder. This is primarily achieved through the evolved abilities of the human eye and visual apparatus (J. J. Gibson, 1966)

Many as yet unanswered issues arise from this ability we humans have of "reconstructing" a three-dimensional world in our mind´s eye, through which we can make reliable inferences about how to move or how to avoid objects or touch and handle other objects. Another major issue is the question of perceptual judgements of spatial location. At this point, it seems reasonable that they are the result of applying conceptual knowledge to sensory inputs. Can one talk therefore, of "pure" perception? To a certain degree, our ability to distinguish depth, pattern, texture, colour and hue, shape and size may be considered "pure" percepts in that they are an automatic process, which occurs when we open our eyes. Our ability to interpret these visual cues meaningfully, in such a way as to be able to act on them, is however, a more involved process (Gregory, 1973).

Many investigators have claimed that there is no such thing as an uninterpreted precept. There are ample examples, where the stimulus information is automatically assigned a meaning: in other words, the visual stimulus is not a mere copy of the "real world".

1.5 The Development of Space Perception.

It will be remembered that there is a cognitive process through which we are able to organize the information provided by our senses, in such a way that space may be perceived in a three-dimensional form. Perception of space does not solely depend on the visual modality, but has an intersensory aspect, using auditory, visual and kinaesthetic cues, especially in the first year of life.

The development of spatial perception requires the gradual increase and extension of the spatial coordinate systems, which can be interrelated, until the general space contains a structure of interrelated objects and surfaces, including the perceiver himself (Van Geert, 1983).

H. Clark (1973) proposed a psychological characterization of "egocentric perceptual space", in terms of coordinates, established by the vertical, which is unmistakeably defined by gravity, and by reference to the perceiver´s anatomical properties, such as, front and back, bilateral symmetry, etc. The first emerging forms of orientation seem to be connected with man´s position as a two-legged mammal: verticality. Young children seem to be able to appreciate the vertical easier than they appreciate the horizontal.

E. J. Gibson (1969) commented that "distinguishing what´s up and what´s down is a primitive accomplishment". Right-left differentiation on a horizontal plane results in more confusion: in fact, these concepts are often acquired quite late, and may be determined by non-perceptual factors, such as language. Bryant (1974) notes that children have a problem with oblique lines, because they are not parallel to anything in the real world, and therefore they have no way of representing their orientations and remembering them.

Is perceptual development a process of integration of all the different perceptual functions present in a perceptual act or is it a process of differentiating between these functions? According to Piagetian developmental terms, development proceeds by the integration of a series of "schemas". But, according to E. J. Gibson (1969), perceptual development is a process of differentiation: the child begins with the perception of undifferentiated wholes and gradually acquires the ability to differentiate them into constituents. These two theories could be accommodated however, since they are not mutually exclusive.

Locomotor development, it is interesting to note, brings about changes in cognitive functioning, specifically in the domain of spatial orientation (Bertenthal, Campos and Barrett, 1984). According to these researchers, self-produced locomotion brings about fundamental changes in the way the infant perceives space and the strategies available to the infant for solving spatial problems. The child then begins to pay more attention to other features in his environment, such as landmarks. Visual attention is an important by-product of self-produced locomotion, so at last views are coordinated, distances are calibrated and landmarks achieve significance. In this way the infant´s capacity for mental representations improves.

Visual attention is another important aspect of perception. When we look at an object, we focus on one feature selectively, while the rest of that object and the surrounding space, constitute the periphery of the looking action. Focus of attention is spatio-temporally limited: it consists of a series of focal shifts.

Finally, depth perception develops reasonably early in life. By the first month of life, the basic reflexes of binocular convergence and accommodation begin to function and by the time the infant is able to crawl, his depth perception is good enough to enable him to avoid dangerous cliffs (Gibson and Walk, 1960). Bornstein (1988) provides a comprehensive review of recent literature in the field of children´s, and especially infants´, perceptual development.

1.6 Spatial Cognition

The differentiation between space perception and spatial cognition is a delicate and difficult one, leading inevitably to many "fuzzy" areas. An attempt will be made to tackle some definitional issues. In fact, the first issue is, of course, whether space itself is ideal or real (Hart and Moore, 1973). Historically, a breakthrough in our philosophical thinking concerning reality occurred when Kant disputed the Cartesian concept of space as an innate idea before experience. Kant argued that the **matter** of all phenomena is given in experiences, but that their **form** is given a priori. Thus, he claimed, since there was no way for us to comprehend the nature of "reality" except through man, it is impossible to completely separate the process of knowing from the resultant knowledge. What we take to be "real" is a product of the act of knowing, in other words, a construction of thought. Neisser (1976) provides a fascinating account from a contemporary psychological point of view.

Liben (1988) claims that spatial knowledge identifies the individual´s knowledge about particular places through his understanding of space in the abstract. So, does it contrast between relative and absolute space, Euclidean versus non-Euclidean, psychological versus physical space ?

Spatial "cognition", is thus called because it is concerned with what the individual knows about space, his representational and conceptual space, whether this knowledge is conscious or not. Spatial thinking makes use of space in some way, information one can reflect upon and manipulate and of which one is cognizant. It is, needless to say, a necessary prerequisite for most of logical reasoning.

Olson and Bialystok (1983) make a distinction between spatial cognition and linguistic cognition. They say that it is well-known that verbal abilities and spatial abilities are quite distinct. They continue by stating their position: "the conceptual trap is to infer that verbal thought is propositional, while spatial thought is "imagistic" or non-verbal....Both verbal and spatial thought rely upon underlying propositional representations consisting of predicates and their related arguments". The difference, therefore is not in the structure of the mental representation per se, but in their expressibility through language, drawing, etc.

Olson and Bialystok define spatial cognition as the problem of inner space, that is: "the spatial features, properties, categories and relations in terms of which we perceive, store and remember objects, persons and events and on the basis of which we construct explicit lexical, geometrical, cartographic and artistic representations".

Miller and Johnson-Laird (1976) point out that we must remember that the understanding of space is not derived entirely from seeing it, but that the other senses of touch, proprioception and hearing make their own contributions. These must "be integrated with the visual information into a spatial concept that transcends any single sense modality".

Spatial cognition has not only been of interest to psychologists, but has also attracted a considerable amount of attention from environmentalists, town-planners, geographers and cartographers. One could say that macro-spatial cognition, which concerns itself in part with the "cognitive mapping" of large-scale environments, is a distinct scientific entity, within the region of spatial cognition. Spatial cognition concerns itself with the development of the fundamental concepts of space, whereas macro-spatial cognition differentiates and elaborates these concepts into the development and representation of large-scale environments. We will not concern ourselves here further with this aspect of spatial cognition.

Finally, although spatial perception and spatial cognition appear to be, and are in fact, very closely linked, one could offer Piaget´s (1963) view on the subject, which is fairly succint. He claims that knowledge of the world includes two aspects: one is essentially "figurative" and relates to the percepts or images of the world by direct and immediate contact, and the second aspect is essentially "operative", related to the operations which intervene between successive states and by which the subject transforms parts of the world into reconstructable patterns or schemas. Visual perception is one form of figurative knowing, whereas cognition is based on the operative mode. As development proceeds, perception becomes subordinated to the higher mental processes.

1.7 Visual Cognition and Visual Imagery

As we have already described, the human visual system must make a symbolic representation of the three dimensional world, which makes explicit "what" is "where". This is a model of the scene in three dimensions, which makes explicit everything on the scene. These elements can be accessed and manipulated by specifying their positions on three coordinates.

Recognition depends on mental models (Johnson-Laird, 1983). If we are familiar with the objects on the scene or have some knowledge of the shapes of things, through our interaction and experience with the world, this recognition will be successfully completed. Our visual system will construct a description of the perceived object and compare it with some sort of mental catalogue of three-dimensional objects.

Marr and Nishihara (1978) argued that since identification of an object can occur from many different viewpoints, the shape of the object must be specified, not in a coordinate system centred on the observer, but in coordinates that are determined by the shape of the object itself. Thus, they propose a catalogue of shapes through which the mind can match and map all the objects it sees, thus being able to recognize them, even if it has not seen them before.

Miller and Johnson-Laird (1976) argued, in turn, that an object can be identified as a member of a category, because its form is perceived as appropriate for a particular function. This depends on high-level knowledge.

The recognition of objects leads to the question of visual imagery. This is a complicated and controversial issue, which we will merely touch on to lead us to the issue of mental representations.

The major issue about imagery is its underlying nature. Kosslyn´s (1975) hypothesis is that images are represented in a two-dimensional internal array. thus we remember either an object´s literal appearance (like a two-and-a-half dimensional sketch) or a more abstract structural description (akin to the three-dimensional model used for its recognition). Both sorts of memory may be used to generate an image.

The distinction between two sorts of knowledge may mark the boundary between "pure" perception and cognition. That is, the knowledge built into the processes of the nervous system and the knowledge gathered through a lifetime. Thus, there are innate constraints governing information retrieval, just as the identification of objects cannot possibly occur without the use of personal knowledge.

Paivio (1971), by summarizing a vast amount of experimentation, reached the conclusion that concrete imagery can facilitate perception, learning and memory. Imagery obviously plays an important role in cognitive economy (Miller and Johnson-Laird, 1976). Masongkay et al. (1974) provide evidence of the ability of children as young as two or three to infer the visual percepts of others.

Olson and Bialystok (1983), who claim that structural descriptions of objects and events underlies all of knowledge, state that imagery involves the process of bringing some aspects of structural descriptions into consciousness: this is both a matter of using meanings to retrieve the structural descriptions and of developing symbolic forms for "interrogating" them.

In an interesting experiment, Banks, Clark and Lucy (1975) show that there is a "semantic" congruity effect in comparative judgements based on the perceptual coding of objects. In other words, some things are coded in terms of height, for instance, balloons, and others in terms of lowness, for instance, yo-yos.

Herskovits (1986) claims that a level of mental imagery mediates between perceptual representation and language: "It is because these mental images are anchored on the canonical description -systematically related to it- and because the canonical description has some fit with the world, that we can count on utterances, such as "the fog is in front of the mountain", to be functional, to provide information on which others can act".

Finally, Huttenlocher (1968) suggests that, in order to solve problems, such as "Tom is taller than Sam...", subjects use a strategy whereby they imagine the items to be material objects, which they must move about in space, to correspond to the verbal descriptions. The mental operations are analogous to those involved in making actual spatial arrangements of real objects.

1.8 Mental Representations and Meaning

Perception, as we have already noted before, is not merely the preservation of a visual copy of a display, but is an interpreted structure. So what we "see" depends on what we "know", that is, on the schemata, concepts and codes available. Mental representation, therefore, combines necessarily with meaning.

According to Olson and Bialystok (1983), structural descriptions are a propositional representation of the properties or features and their relations, constructed by the mind, which permit the recognition of and assignment of meaning to objects. It is the identification of features, properties and their organization, which make up the structural descriptions of objects and other visual displays. These are non-linguistic, they are constructed from a "vocabulary of available concepts" (Pylyshyn, 1977), to form an appropriate representation.

They are similar to a feature list, but are an ordered, hierarchically organized set of descriptions, therefore they constitute the language or code for the mental representation of experience.

Olson and Bialystok claim that, in this way, information can be presented either linguistically or visually. Thus, this common format would explain how one can perform cross-modality tasks, such as verifying pictures against sentences.

This view is in agreement with Pylyshyn´s (1973). He argued, with regard to mental images, that the mental representation of objects and events must be in the form of propositions or "structural descriptions". Therefore, mental images are analyzed, in order to enter memory and cognition. He says, characteristically, that: "whatever merits the proposals for imagistic or analogue representations may have, they clearly do not help the language-perception interface problem, since sooner or later the representation must be analyzed in such a way as to be commesurable with natural language terms" (1978). He appears to be paraphrasing Fodor, Bever and Garrett´s (1974) eloquent claim that "utterances can communicate thoughts only because hearers know how to translate them into the language in which thinking is done".

Meanings, however, are not part of the structural descriptions of objects, but are the criterion in terms of which features are selected and added to the structural description. A concept consists of a structural description **plus** a meaning. These two systems develop together: the formation of a structural description leads to a search for meaning and the formation of meaning leads to the attempt to construct an appropriate structural description. Unlike others before them (Neisser, 1976; J.J.Gibson, 1966;), Olson and Bialystok claim we project our meanings back onto the objects, after we pick up the stimulus, according to our intentions. Thus, "meanings are in the heads of the knowers (where they belong), rather than in the stimulus".

Miller and Johnson-Laird (1976) seem to agree with this: differentiating between percepts and concepts, they say that labels are tied to concepts.

Thus, meaning does not only originate in our plans and intentions, but they also serve to organize the construction and elaboration of the perceptual routines. Furthermore, the meaning system, as it becomes articulated, serves as the basis for language learning.

This contrasts with initial views of mental representations, which, according to Bruner et al.(1966), consisted of codes, which differentiated between enactive, iconic and symbolic forms of representation. The first two were considered prelinguistic, and only the third was linguistic.

Schema theory (Bartlett, 1932; Piaget, 1952) was a precursor to the structural descriptions. A schema was the basic organizational unit of knowledge. It was the mental unit, which coordinates perception and action, by representing both what is known about an object or event and the meaning or significance of that event to the knower.

Bransford and Johnson´s (1972) experiment illustrates this point very well. They showed that context aided memory in a retrieval task: thus, a picture aided the retrieval of facts from a written passage, before it was given but not after. Therefore, it is not sufficient to know all the words and to interpret all of the sentences out of context. It is necessary to provide a "schema", in terms of which new information can be given a conceptual place.

Prototype theory (Rosch, 1977) claimed that the best or typical example served as the basis of a representation, rather than a set of properties or features. Judgements of similarity and the recognition of new objects and events are made by comparing that display to the prototype. Rosch asserts that a mental representation is "an image of an average category member".

Semantic theory, of course, ties in very closely with all of these theories about the mental representation of the world. Jackendoff´s (1978; 1983) theories attempt to tie all of the loose ends concerning the interactive relationship between semantics, perception and cognition. Jackendoff (1987) addresses the problem of how it is possible to talk about what one sees. He proposes that propositional representation alone are not adequate to account for this. There must also be an additional level of representation. Thus, these two levels are coordinated and can therefore explain spatial thought and its linguistic expression. Therefore, one must go beyond "pure" linguistic theory and "pure" visual theory.

Johnson-Laird (1987) presents a theory of lexical meanings, which contains seven principle assumptions: these include mental representations of contextual inferences about the specific referents of an expression, a mental dictionary, the development of knowledge of lexical items, semantic networks and semantic primitives, including default values and truth conditions. In this way, he wisely accommodates theories by leading theorists in semantics: Bransford, Barclay and Franks (1972) on inferences, Bartlett (1932) and Minsky (1977) on schema theory and knowledge representation frames, Schank (1972) on semantic primitives, Katz and Fodor (1963) on semantic features. Furthermore, Mani and Johnson-Laird's (1982) results imply the existence of two sorts of encoding: propositional representations that are hard to remember, but correspond closely to the sentences in the descriptions; and mental models that are relatively easy to remember, but are analogous to spatial arrays and consequently poor in linguistic detail.

The fact remains, as Herskovits (1986) notes, that concepts must constantly be bent and stretched, in order for us to be able to communicate and describe facts about the complex and imperfect world that surrounds us. This is constrained by "the need to preserve mutual comprehension".

1.9 Spatial Relations and the Spatial Locative.

Spatial organization is extremely important for human cognition. Language puts spatial words into a variety of uses in nonspatial contexts and spatial metaphors dominate speech and thought. In many languages, indeed, the specification of the spatial attributes of objects is obligatory. Friedrich (1970) quotes the example of Tarascan, an American Indian language spoken in some parts of Mexico, whose grammar requires a speaker to add, through a grammatical form, whether an object is stick-like (one-dimensional), tortilla-like (two-dimensional) or ball-like (three-dimensional).

Cross-linguistic studies have often been occupied with the different ways of relating perceptual and linguistic space in different cultures. English, for instance, like other Indo-European languages, does not have obligatory spatial morphemes, but has a rich spatial lexicon to denote shape, space and spatial relations. These words are called spatial locatives, since they do not merely apply to prepositions, such as "in", "on", etc. Herskovits (1985) points out that a locative expression is an expression involving a locative prepositional phrase, together with whatever the phrase modifies (noun, clause, etc.). The subject normally refers to the located entity and the object to the reference entity: for instance, in the case of "the bicycle is near the house": the opposite, that is, "the house is near the bicycle", would not be appropriate, since houses are normally too big to be moved and are generally used as reference points.

Another point is that locatives may be static ("at", "in" , "under", and others) or dynamic ("to", "from", "via" and others). However, static prepositions may be used in dynamic contexts ("the cat ran under the bed") and dynamic ones in static contexts ("the lamp is two feet from the wall"). It is obvious that context is very important with regard to meaning interpretation.

The acquisition of spatial relations, as we have already noted begins from infancy. The infant's first words include their observations on the spatial relations between objects and their location in space: for instance, "cup down" may mean "the cup has fallen down", "cat box" may mean "the cat is in the box".

Children appear to show a preference for some spatial relations, as we have been shown by many investigators, a point we have already touched and to which we will, no doubt return (Johnston, 1988).

For the time being we will mention that ordinary language deals with relative space, that is, with space relative to the objects that occupy it (Donaldson and Wales, 1970). Each language, naturally has its own precise spatial locative system. In English, there are a number of excellent and detailed studies of English prepositions and locatives (Leech, 1969; Bennett, 1975; Herskovits, 1986; Miller and Johnston-Laird, 1976). Furthermore, there have been many studies to determine the developmental sequence of locatives.

The studies show agreement in some ways, but differ widely in the way that they interpret their results. For instance, with respect to the locative preposition "in", Brown (1973), and E. Clark (1973b) list it as being amongst the first to be acquired by young children, yet E. Clark interprets her findings by attributing the children´s (as young as 21 months) success with instructions containing the spatial locative "in", to their attraction to the physical properties of the object. In other words, if the object could take something **in** it and because they prefered putting things **in** other things, then they would make this placements, whether they actually understood the word "in" or not (E. Clark, 1980; for further evidence of non-linguistic strategies in the acquisition of orientation).

Space has one vertical coordinate and two horizontal coordinates. The horizontal coordinates are easily confused, both when learning the appropriate terms and when they are used in communication. It is claimed that children master "up" and "down" first, then "front" and "back". "Right" and "left" appear to be the most difficult (Ames and Learned, 1948).

Study of the acquisition of the spatial locative has inevitably come across the problem of matching words to what we know through our senses. According to Herskovits (1986), it is pragmatics which will help us to clarify this issue. She proposes that there are certain canonical conditions, which aid us in our understanding of situations, and which help us to encode a situation in the most appropriate way. The normal situation type, for instance, confirms the laws of physics and also confirms where objects "belong". Thus, the hearer can make successful inferences about what is being described to him, according to his world knowledge and conversational principles. Both the speaker and the hearer have a shared common-sense knowledge of the world on which they can base their understanding. This, of course, does not make the world "objective" in any sense of the word, but it does give a helping hand to the problem of mapping experience onto language.

Herskovits continues by saying that pragmatic principles may be used to account for some aspects of locative meaning, which cannot be predicted by a simple relations model. Thus, the meaning representations for complex locative expressions may be built up using the semantic information attached to the preposition, as well as world knowledge and the four pragmatic "near-principles" of relevance, salience, tolerance and typicality.

The relation between spatial language and the nature of spatial information was described, amongst others, by H. Clark (1973). He maintains that there are two systems: perceptual space (P-space) and linguistic space (L-space). These are highly correlated and organized around the concepts of dimensions, reference points, etc. He says that the congruity occurs because they both map onto the same physical and biological reality, that is, they both describe the same world. It is probable, he adds, that this congruity is due to the fact that L-space is derived from P-space and that they are not independent systems.

The a priori knowledge about the structure of space, which humans have, according to H. Clark and many other investigators, means that the linguistic community decides what is important enough to be assigned an explicit linguistic representation, according to its needs. Sometimes, this may be inadequate or impossible and other means may have to be saught.

One of the first proponents of a conceptual basis for the acquisition of locative terms was Bierwisch (1967). He expounded a theory of universal semantic markers. He assumed these markers are connected with certain classes of objects, types of relations or properties of the universe. These semantic markers are "deep-seated, innate properties of the human organism and the perceptual apparatus, properties which determine the way in which the universe is conceived, adapted and worked on".

Thus, although the base components, these semantic primitives, are innate, they can be combined freely and differently in each language to form meanings and concepts.

Using this methodology, Bierwisch analyzed features of German adjectivals in terms of positive and negative polarization markers and spatial dimension markers. He claimed that these rules were universal and that, to a certain extent, they represent the organization of space structures by human beings.

Bierwisch´s theories triggered a vast body of literature on the subject of semantic markers and on the universality of such a theory (Teller, 1969; Grimm, 1975; McDonald, 1983; Carey, 1978; Nelson, 1974; Brewer and Stone, 1975). E. Clark (1973) extended the semantic feature hypothesis into the domain of child language acquisition. She tried to show that it could account for children´s overextensions of word use, in that they may not as yet have acquired all of the semantic features for that particular lexical item. Early features, she maintained, have a perceptual basis and, as the child grows and adds more features to a concept, so it becomes more specific and precise.

Cross-cultural research with regard to the semantic feature hypothesis, produced mixed results. For instance, McDonald (1983) found that his research with Maori children supported the view that word meaning is learned and refined gradually, but did not support other predictions based on the SFH, concerning the order of locative acquisition. Moreover, Abrakarian (1983) did not find evidence of the SFH in 3 and 4 year old children´s comprehension of the locative prepositions "in front", "in back" and "ahead of".

Holzman (1981) analyzes the semantic feature hypothesis and proposes that verbal concept development in young children is a three stage process. In the first stage, the verbal concept consists of the association between the verbalization and memories of one or more instances of experiences. In the second stage, separate instances have coalesced into an iconic abstraction, that is, there is a perceptual match. Finally, the verbal concept becomes an abstraction, having a dimensional or featural structure, although the features or dimensions may not be independent. Furthermore, there is a whole network of concepts, connected and related to each other, through various combinations.

Holzman tested this model of concept development on children´s comprehension of 15 spatial prepositions. She concluded that a significant proportion of preschool children do not have abstract featural concepts of "under", "underneath" and "below", as well as for "over". They used abstract featural concepts more reliably, when the situation bore a closer resemblence to their experience.

Another aspect of spatial locatives, which has attracted a lot of research attention, is that of their specific developmental sequence. This approach has, in part, been confounded by different methodologies and theoretical frameworks, but a consistent picture does seem to emerge with regard to the sequence of development.

It is generally agreed by most investigators, who concerned themselves with those prepositions, that "in", "on" and "under" are the first to emerge. "In" is usually a precursor to the other two prepositions and is generally comprehended before the age of two (Ames and Learned, 1948; E. Clark, 1972; Dromi, 1979; Johnston and Slobin, 1979; Walkerdine and Sinha, 1981). This developmental sequence seems to be true cross-linguistically, since some of the above studies referred to languages other than English (for instance, Johnston and Slobin compared the acquisition of locatives in English, Serbo-Croatian, Italian and Turkish; Dromi´s data was Hebrew). Furthermore, Kluwin´s (1982) research investigating the comprehension of prepositions by deaf adolescents showed that their comprehension follows the same sequence as normal children´s acquisition.

The locative "next to" appears to be acquired at around two to three years of age (Dromi, 1979; Grimm, 1973; Johnston and Slobin, 1979; Washington and Naremore, 1978). "Between" is comprehended between the ages of three and four years (Ames and Learned, 1948; Durkin, 1981; Johnston and Slobin, 1979; Washington and Naremore, 1978). "Back" and "front", it will be remembered, cause a little confusion, owing to the intrinsic backs and fronts of objects. These prepositions are finally comprehended, according to each investigator, between the ages of three years and four years and eight months (Grimm, 1973; Johnston and Slobin 1979; Kuczaj and Maratsos, 1975; Walkerdine and Sinha, 1981; Washington and Naremore, 1978; Tanz, 1980; Cox, 1979). "Through" and "over" have not been investigated so extensively, but are amongst the last prepositions to be acquired, at or around the age of five (Grimm, 1973; Ames and Learned, 1948).

It may be seen that, although there is a predictable developmental sequence in the acquisition of these terms, the precise differences in ages of acquisition between specific languages reflects each one´s locative system: the factors which influence them are lexical diversity, synonymity, homonymity and etymological transparency (Johnston and Slobin, 1979).

The body of research, also, provides interesting information regarding the relationship between verbal and non-verbal spatial cognition. Some researchers, such as Halpern, Corrigan and Aviever (1981), showed that success on a non-verbal problem involving knowledge of "under" relations, preceded problems requiring linguistic comprehension and expression.

How can the course of this underlying development be characterized? Some researchers have appealed to physical laws or to geometries to build models of meaning (for instance, gravity, shape, etc.) (Takahashi, 1969). Others have borrowed a Piagetian model and distinguished between topological, projective and Euclidean concepts (Piaget and Inhelder, 1956; Parisi and Antinucci, 1970; Windmiller, 1976). It may also be that spatial concepts of one sort are constructed before those of another sort, due to the complexity of multiple elements or features (Olson and Bialystok, 1983).

Piaget and Inhelder's (1956) thesis on children's development of space dominated the field for many decades and led to a great many researchers trying to find evidence for these theories (Lauredeau and Pinard, 1970). Many researchers, however, have found that their data did not confirm Piaget's theories: for instance, Lempers, Flavell and Flavell (1977) showed that two year olds had some knowledge of a projective system. At this period, relative magnitude judgements, which depicted Euclidean concepts, were seen to be established. Ninio (1979) claims that most of Piaget's hypotheses concerning space perception are unproven and that there is no direct evidence to show that the infant's perception of visual change is qualitatively different from that of an adult.

An interesting experiment by Kelly, Philp and Lewis (1982) on conservation, showed that migrant and Australian children were not able to conserve unless they could measure and unless they knew the relevant words. This put Piaget's contention that cognition precedes language in question: these authors proposed that language could actually facilitate cognitive growth.

Spatial reasoning and judgements were investigated by Sugarman (1982). She provides evidence that children at about two-and-a-half years of age are capable of simultaneously considering two classes in their classification of objects and they also refer to relations between classes, whereas children between one and two are able to look for one thing at a time. She claims that some higher level equivalence judgement seems to facilitate the children's easy movement from one sort of comparative judgement to another and back again, and that this coordination involves a more complex interplay of judgements, than Piaget's account would allow. Such mental organization and reflection, of course, is central to conceptual thought.

Fenson, Vella and Kennedy's (1989) investigation of children's knowledge of thematic (dog-doghouse) and taxonomic (dog-horse) relations at two years of age shows that thematic matches develop first, increasing in range in children nearer three years. Taxonomic matches were identified by 26 month-olds only if they had a perceptual basis, but 34 month-olds had a more general understanding of categories, which were less tied to perceptual features.

Turning yet again to the relationship between context and language acquisition, we find many investigators questioning research methodologies, because of their lack of sensitivity to this issue. Characteristically, Houssiadas and Brown (1980) question whether one can really get reliable data from "artificial situations", such as those used in experiments. After all, they claim, language is socially tuned even by the age of two.

It is interesting that the context of language was noted even by Ames and Learned (1948), who said that children understood phrases with "in", "on" and "under", which were pertinent to them earlier than more abstract ones.

As we have already mentioned, Huttenlocher and Strauss (1968) saw in their experiment, that children´s understanding of a statement depends on the relation between the statement and the extralinguistic situation it describes.

Durkin (1980) notes in his data, that children´s usage of their lexical knowledge will vary as they respond to the demands of different contexts.

E. Clark (1973b) revised her initial semantic feature hypothesis, to include her observation that children often use non-linguistic strategies based on their perceptual knowledge, when solving a task. Thus, their preferences or response biases (according to the given context) will often confound their comprehension of word meanings. She, therefore, adopted a revised interactive model to account for the comprehension of lexical meaning.

Wilcox and Palermo (1974) also note that an important feature of the comprehension of locatives is context. They point out that there are such things as "congruent" and "incongruent" tasks. Thus, children aged between one and a half and two and a half years of age tend at first to make the simplest motor response, when asked to perform a spatial instruction; later, they tend to put objects in their most normal or "congruent" contextual relationship.

Wilcox and Palermo (1982), in a later study, investigated other non-linguistic strategies young children may use, when responding to commands. They called the children´s strategy to systematically vary their responses, alternation; their strategy to systematically fail to vary their responses, perseveration. The alternation strategy shows knowledge of variation and perseveration shows attempted error correction. These strategies account for the children´s different responses. In this experiment, they tested children aged between two and six-and-a-half years of age on three congruent tasks (that is: "boat under bridge", "road under truck", "drawer in desk"), three incongruent tasks (that is: "boat on bridge", "road in truck" and "drawer on desk") and a nonsense word task, where a nonsense word ("maf", "yer" and "dax") substituted the locative preposition. Their results show that, except for the two year olds, all of the other groups did worse on the incongruent task. The results indicate that the two hypotheses were correct, "knowledge of variation" predominating over "attempted error correction", except for the two year olds. Over half of all responses to the nonsense word were accounted for by these two strategies. The "error correction strategy" appears to be more primitive, however. As they grow older, children pay more attention to the lexical content of utterances. Furthermore, children appear to think they will usually be asked to place objects in normal relationships and that the repetition of a request usually indicates the child's prior response was incorrect. The investigators conclude that, as children grow older, their incorrect responses are more likely to be a function of linguistic-based strategies, whereas younger children respond by virtually ignoring the locatives and trying to work out meaning from other sources of information.

Many other researchers have reported evidence of non-linguistic or contextual-bound strategies being used in the interpretation of language (Grieve, Hoogenraad and Murray, 1977; Donaldson and McGarrigle, 1974; Carey, 1978; Eilers, Oller and Ellington, 1979).

Herskovits (1985) sums up the evidence by saying that general knowledge and object knowledge, plus pragmatic principles, lead to the normal interpretation of locative expresssions.

1.10 Space and Picture Perception

We have already seen how, according to Olson and Bialystok (1983), spatial development proceeds to the progressive explication of the structural descriptions of objects as "representations" of space. This makes the perception of form possible, which may in turn be captured by the development of symbolic systems, such as language and drawing. Language and drawing, therefore, are different symbolic ways of describing space. It is helpful to distinguish between external representations and internal representations. We can only infer internal representations from external representations (e.g. drawing, maps, verbal reports, models) (Hart and Moore, 1973).

Piaget and Inhelder (1956) also relate the development of representational space to such symbolic activities as drawing, noting nonetheless that "there is no evidence that the spatial relationships of which this image is composed are on the same plane as those revealed by the corresponding perception".

Gombrich (1960), who though an art critic, concerned himself with the visual image from a psychological point of view, said in his famous treatise on "Art and Illusion" that the artist´s schema or conception regarding an event influences both his perception of the event and its subsequent portrayal. These schemata are invented, not discovered by simply looking at nature. In this way, Gombrich points out the complex relationship between the artist, the object and his "representation" of it, how "man-made" these representations in fact are. Consequently, what an important role the processes of learning and development have to play in the execution and interpretation of two-dimensional representations of three-dimensional reality.

We will begin our thoughts on this issue with some cross-cultural data concerning picture perception (Cole and Scribner, 1974). Are the cues used to refer to three-dimensional space in pictures identical with the pictorial cues produced by "real" three-dimensional space? For most people living in a western culture, it is a matter of course to view the pictorial cues of pictures as being identical with the natural spatial cues. However, the western pictorial perspective representation of space is as artificial as, for instance, that of the ancient Egyptians. Segall, Campbell and Herskovits (1966) note that the iconic representation of space is "an arbitrary linguistic convention and one who is not familiar with its communicative intent does not find this "language" at all obvious".

In order to depict a three-dimensional scene on paper, one must use certain depth cues, such as overlap, size, texture and other techniques, which are developed by each culture and are learnt by the people of that culture. There is considerable evidence, as Segall, Campbell and Herskovits point out, that formal schooling and immersion in a culture containing pictures, books and magazines, are factors that heavily determine the tendency to employ depth cues when viewing two-dimensional representations of objects in three-dimensional space. Thus, even though certain rural African subjects were unable to "rightly" interpret the Hudson pictures, this does not necessarily mean that they are not capable of viewing pictures as representations of spatial, three-dimensional states of affairs. It is the pictorial conventions for depth cues which are different (see Deregowski, 1968a; 1968b; for examples of fascinating work in this field).

With regard to space concept and the ability to manipulate three-dimensional space, Jahoda and McGurk (1974) found that African, Chinese and European children between four and ten years of age showed little intercultural differences in model building of depicted situations. On the other hand, Berry's (1974) research on spatial skills in various cultural groups showed that these ranked according to hunting requirements.

It is clear, therefore that pictorial representation and the interpretation of pictorial material have a very large experiential component to them, which involves the mastery of conventional forms of representation.

The development of picture concept, that is, the ability to deal with the conflict between pictorial and dynamic-kinaesthetic cues have been studied by Kennedy (1974) and Olson, Yonas and Cooper (1980).

The presence of picture concept is also expressed by the ability to use pictures as particular carriers of information about properties and positions of objects. Three and four year olds seem to prefer pictures with a perspective produced by central projection, since this is dependent on a particular station point. Yet, the ability to recognize depicted forms emerges very early and is not limited to "naturalistic" pictures, but also includes the recognition of very impoverished and abstracted pictures (Van Geert, 1983).

Experiments have shown that "overlap" can be used reliably at the age of three years (Olson, 1975). Linear perspective and perspective size differences are not used before the age of five (Olson, 1975).

Another way of studying the development of pictorial depth is to examine children's drawings of spatial situations. It seems obvious, based on the above data, to state that there is a learning process through which the child must progress, in order to be able to use an overall consistent spatial reference system, necessary for drawing.

Arnheim (1974) claims that the development of children's art is in terms of a pictorial schema, that the child has learnt, that is, that he has constructed out of forms available to him at the time. Improvements in drawing occur through refinements and precision in the use of these schemata or forms.

Awareness of pictorial representation requires the transformation of the world of concrete objects into symbolic representations. Washington and Naremore (1978) investigated whether subjects responded to spatial relationships represented in pictures (2-D space) in the same way that they responded to spatial relationships in 3-D space. They hypothesized that when the relative position of two objects is based on vertical and horizontal relations, requiring a three-dimensional framework of spatial orientation, it may be difficult to depict in pictures. Therefore, very young children would perform better with three-dimensional objects in tasks involving spatial concepts, since they have more "action-oriented" experience with three-dimensional objects. Transfer of experience to a two-dimensional frame of reference requires an additional cognitive activity: that of imagining a third dimension.

They used subjects aged between three and five years of age, testing them on their receptive and expressive knowledge of the prepositions "inside", "on", "around", "under", "over", "behind", "in front of", "between" and "beside". The tasks involved three-dimensional and two-dimensional objects.

The results showed that children of both sexes grew better as they grew older, were better at comprehension than production, and were better on three-dimensional than two-dimensional tasks. The prepositions were acquired in predictable sequence, "over" being the last to be acquired with 70% success in the concrete task at the four-and-a-half plus age group.

They conclude that "a child´s performance with spatial prepositions depends on the age of the child, the nature of the stimulus materials, the type of task (comprehension or production) and the semantic complexity of the given preposition". Asso and Wyke´s (1973) research concerning children´s ability to describe spatial relations depicted in line drawings confirms these views.

Silliman (1979) investigated how the stimulus dimension of pictorial representation affects school-age children´s comprehension of terms, which have projective spatial concepts as their referents. She used a modified test of pictorial space, adapted from Hudson (1960) and she concluded that embedding language comprehension tasks within the pictorial medium may actually increase conceptual complexity for the language delayed and learning disabled child.

Clark and Chase´s (1972) research involved the comparison of sentences against pictures. Their hypothesis was that there is a common mental format which represents the interpretations rather than the acoustic or pictorial properties of the sentence and picture. These interpretations are coded in terms of propositions. They concluded that sentences and pictures are coded in an abstract semantic format: "underlying both language and perception...is a common interpretative system that must be handled by one set of principles, no matter whether the source of a particular interpretation is linguistic or perceptual".

Ives (1980) found that children are able to solve perspective problems involving toy objects, more easily through linguistic description than through picture selection. These linguistic processes are accessible for problem-solving at an early age (from three years) and they question the notion that a visual mode precedes a verbal mode in the preschool years.

Ives observed that the children who succeeded in the picture selection condition were those who first formulated the label for the correct response and then searched for the appropriate picture. He concludes from this data that each means of symbolic representation has its own characteristics. O´Connor and Hermelin (1961) had found that their mentally retarded subjects were able to pick out pictures from spoken words with accuracy.

Furthermore, naming pictured objects was easier than matching pictures, that is, picking out pictures they had seen before.

This question is, of course, at the centre of the argument: is there a common code procedure? That is, do we translate both the perception and the linguistic description into a common code and then determine if the experience and the description are congruent (Clark and Chase, 1972)? Or do we use a translation approach, that is, assume that perceptual experience and descriptions are kept in different codes and that one relates the two by determining if one code can be translated into the other? Other posssibilities are discussed by Smith, Balzano and Walker (1978). Klatzky and Stoy (1978) argue the cases for separate or unitary coding systems for pictorial and verbal stimuli and present a review of research in this area. They tentatively suggest that both pictorial and verbal information are represented in memory in a common format, which must be labelled with a general term "semantic". Semantic knowledge, they claim, is applied to the processing of both verbal and non-verbal material.

Pinker (1981) suggests that visuospatial representations and syntax acquisition have little in common "apart from both components interfacing with semantic knowledge or recruiting atomic information processes, such as searches and comparisons". He suggests each ability involves computational mechanisms, which are highly specific to the tasks they must perform. He is in favour of the idea of distinct "mental organs", rather than proposals about a universal mental interlingua of elementary information processes.

Dore (1979), too, says there is no empirical support for a single cognitive source for conceptual and linguistic structures. He exposes the conflation of semantics and perception by saying: "even if the word initially "means" no more than the perceptual and functional features of the referent, those represented features cannot in themselves determine the word´s semantic representation. Semantic representation supercedes the perceptual inputs to concepts". Cognitive approaches, he claims, do not distinguish adequately between different sorts of mental representaion. For instance, conceptual, linguistic and communicative aspects each represent a distinct type of knowledge.

Yet, the concept of a central function of semantic knowledge, spanning across different modalities and encompassing both world knowledge and experience and language, seems to a greater or lesser degree to have gained the attention and gradual respect of all those who concern themselves with the perception-cognition-language triangle.

1.11 Mental Handicap and Language Handicap.

Theories defining mental and language handicap are many, too many to be reviewed here. Obviously at the centre of these theoretical works is the relationship between language and cognition (Cromer, 1974a; 1974b; Detterman, 1987; for review).

Generally speaking, mentally handicapped children are found to have a general developmental delay in their language development, which is not qualitatively different from normal children. However, some researchers, who are sensitive to the importance of detailed investigations into the specific modalities which lead to a general impaired "intelligence", have reported that that mentally handicapped children have slightly different processes of language acquisition from normal children (Rondal, 1987). For instance, they may have an additional difficulty in word generalization (Cromer, 1976), maybe due to the fact that mentally handicapped subjects, when faced with a new task, were less ready to search for and to use strategies available to them, in order to solve it. They also appear to be less able to generalize new rules as readily as their normal counterparts.

In studies where language is used as a mediating function, Bryant (1970) found that mentally handicapped subjects were reluctant in forming verbal labels in recognition tasks, when they were paying attention to objects. However, when they were forced to verbalize, the differences between the normal and the mentally handicapped groups disappeared. Bryant argued that the severely subnormal suffer from a restriction of attention, unless verbal labelling is introduced. This was confirmed by other studies: that is, that the benefit of verbalization was not due to the mediational properties as such, but solely to the increased attention to the stimulus material, which results from the enforced verbal labelling. They differ from normal children in the use that they put language.

Hermelin and O´Connor (1975) showed that there is a dependence between the storage of visually presented material and speech by comparing normal and handicapped children´s coding of visual displays. Whereas normal children coded these displays temporally, the handicapped groups (deaf, autistic and mentally handicapped children) tended to code this information spatially. Storage codes for the handicapped groups may have been in some other form, for instance, in terms of visual imagery, where it could subsequently be retrieved (c.f. Paivio, 1969). The interesting thing noticed by the above investigators, was the handicapped groups´ "disinclination" to use words as tokens spontaneously in a coding operation. Does this mean that these children do not spontaneously translate and store visually presented items in a verbal code? Thus, there appears to be a distinction between normal and handicappped children´s use of language as a "mental tool" (Luria, 1961). This function may be defective or, at least, malfunctioning in the mentally handicapped and thus, may directly affect certain cognitive processes (Detterman, 1987)

O'Connor and Hermelin (1975), in another experiment on how different groups of children dealt with spatial information, found that mentally handicapped children were able to make a code transfer (as were normal and deaf children) from the kinaesthetic to the visual modality. They concluded that mentally handicapped children seemed to remain stimulus bound only when the recoding must necessarily take place in language terms.

Previously, O'Connor and Hermelin (1963) had found that severely mentally handicapped children tended not to use speech as a mediator, but on the other hand could match and recognize patterns as well as normals of the same mental age, and were also equal to the normal children in their ability to discriminate between visually presented materials.

Another problem which seems to handicap the mentally handicapped groups even more is that they appear to have a shorter memory span and a slower rate of semantic-analytic processing (Merrill and Mar, 1987). Furthermore, it may be, these latter researchers' data suggests, that the quality of the semantic representation encoded during sentence processing may be different from that of the normal groups. On the other hand, Winters and Hoats (1986) found that there was a striking similarity in the structure of the semantic memory of retarded and nonretarded persons, and Nigro and Roak (1987) found that mentally retarded individuals did not show any differences in the recall of spatial locations. This ability, they suggest, of the automatic encoding of spatial location may be an area of strength for retarded invividuals.

It may, therefore, be seen that there is no clear-cut picture as yet as to whether mentally handicapped individuals have specific difficulties with regard to the cognitive and perceptual abilities, necessary for language acquisition. Or indeed, whether they have certain disabilities specifically in the linguistic domain.

This same does not apply to language disability, which is considered a specific developmental dysfunction, automatically leading to both specific linguistic disabilities, as well as to various degrees of cognitive malfunctioning. The view, in general, is that these children exhibit a heterogeneous clinical picture, although there are some common characteristics, including short-term memory limitations (Menyuk, 1969), auditory sequencing and temporal order (Tallal and Piercy, 1974).

Inhelder (1976) reports her findings as strong evidence for the primacy of thought over language: she says that dysphasic children usually show a representational deficit in several areas of symbolic behaviours as well as in language. They found a striking correspondence between deficits in language and those of figurative representation. All spatial relations are not affected, but the possibilities of evoking or anticipating transformations in spatial configurations are. Spatial representation is affected in some forms of aphasia. She says that the apparently frequent correspondence between language problems and difficulties with spatial representations suggest a possible link between the dysfunctions, which affect the formation of figurative symbols and those which retard or disturb the formation of verbal symbols in language acquisition.

Yet, studies in hemisheric specialization provide evidence that the left hemisphere is specialized for linguistic tasks and the right is more specialized for spatial-visual tasks (Petitto and Bellugi, 1988; Morrow and Ratcliff, 1988). Interestingly enough, some interference effects have been found, when an attempt is made to process spatial positional information and verbal information simultaneously (Palef, 1978).

Finally, we will briefly mention the question of sign language, since this too is relevant to our study. It has been found that highly iconic signs facilitate memory through both the ease of encoding and availability of meaningful retrieval cues. Paivio (1969) demonstrates that high-imagery provoking words and statements were better retained than low-imagery words and statements. A similar effect for signs was reported by Schwam (1982), in her study on the effect of iconicity on recall.

In another study, Schwam (1982) tested the signs for "on", "in" and "under" and found that despite their high-iconicity rating, "on" and "under" were acquired at an older age by the deaf than the corresponding words by the hearing. The potentially facilitative effect of iconic sign for the acquisition of locative meaning by the deaf appears to be offset by a more persistent reliance on the non-linguistic strategies, according to E. Clark (1973b).

However, in other studies by the same author, the hypothesis predicting a facilitative effect for iconic signs was confirmed: this concerned the acquisition of spatial antonym pairs and comparatives. Furthermore, it was found that some signs can iconically provide full or partial cues to facilitate interpretation and memory.

SECTION I

CHAPTER 2

Foreword to Experiments I-IV

The purpose of this chapter is to explain the rationale behind the first three experiments conducted in this study and to analyse in some detail the common characteristics of these experiments. The questions posed in each experiment separately are, of course, different, but since the three experiments, which will be described in this section, represent a serial progression, there are also certain questions, which are not only interconnected, but also interdependent for and across all three studies. This means that there is an overall rationale behind the design of these three investigations, questions posed and hypotheses made, pertaining to all three experiments as a whole, in parallel to the specific questions posed in each experiment separately. Finally, some of the questions posed in the second and third experiments were dependent on the results and observations of the experiment preceding them.

Furthermore, it must be added that the common characteristics of these studies include a common experimental design: that is, the same experimental subjects, the use of the same experimental materials, the same test criteria. In this chapter, therefore, we will also explain in detail how the subjects for the experiments were chosen, why and how many groups were tested, what the materials for the tests were and what the test criteria were.

2.1 Rationale for Experiments I-III

As we have already discussed, the purpose of this study is to take the discussion concerning spatial cognition and children's understanding of locatives a small step forward. The direction we chose to do this, in these initial experiments, was to address ourselves to the age-old language-thought dichotomy. It seems obvious that, in any discussion concerning cognition and the acquisition of semantic terms, the relationship and mutual dependence of thought and language comes into primary focus. In this study, our main concern is, of course, space, which is of necessity fundamentally linked to the perceptual mechanisms. Here, from the interconnection between perception and cognition, we move to the inextricable and complex relationship between perception and semantics. Particular to our concerns is the link between perceptual phenomena and their conceptual and linguistic categorization. The question, of course, which arises is what exactly is the relationship between them: how are the links formed, how are they maintained, are they constant or do they have many variables? Can one enumerate or quantify these variables?

Perhaps these questions will never be satisfactorily resolved, as they may be too elusive for quantification and experimental investigation, and will forever remain the source of philosophic speculation. Despite this, the questions which arise are still fascinating enough to summon enthusiastic attention, these experiments being a part of this.

In these three experiments, which will be described in the following section, the prism through which we will be investigating the issue of our concern, is categorization. Categorization, whether linguistic or perceptual, seems to be central in our ability to function adequately on a cognitive level. The process of categorization is conducted on several levels throughout human development and is basic to our understanding of the universe around us. Naturally, perceptual categorization and linguistic categorization are linked and together form the core of conceptual or cognitive categorization, which is the stepping-stone to higher mental functions and the organization of complex thought processes.

Let us, however, for the moment, confine ourselves to the young child, who is in the process of developing his awareness and understanding of the world around him. This world consists of many and varied perceptual phenomena, which he must try and make some sense of. For the sake of convenience, because the process is far more complicated than we can ever begin to describe, we may assume that one of the ways that the child can begin to make the world more comprehensible, is to start trying to discern the common characteristics among these phenomena: for instance, some things have legs but don´t walk and some things have legs and move around by themselves. These form two separate perceptual categories. In essence, these perceptual categories do not consist merely of percepts, but are now concepts, in that they are inexorably linked to the way the child thinks about things. This perceptual-conceptual categorization process forms the core of mental representations.

On a different level, but often parallel to the previous function, is the process we shall name semantic categorization. Semantic categorization is, of course, largely dependent on the perceptual-conceptual mechanism. Often, too, it is mapped onto knowledge, which is directly linked to the perceptual world. For instance, the word or semantic category "dog" is not in the least ambiguous, when it is eventually learnt, since it refers to one very particular animal, which has certain well-defined characteristics. Other semantic categories are not, however, so well-defined, and may well cause some confusion. In particular, more abstract categories, such as space or time, can be the cause of considerable confusion in the process of perceptual-conceptual to linguistic mapping. This may be because there is no real objectivity where space and time are concerned.

Categorization, therefore, involves many processes and taps many cognitive abilities. There appears to be one aspect of categorization which is perceptual-conceptual and consequently, non-linguistic. In the case of space, this would involve the processing on a cognitive level of visual percepts. At this level, this process is independent of any linguistic mapping. It appears, furthermore, that this process is a universal attribute, although the precise perceptual categories may, in part, be influenced by the specific needs of each culture. However, the ability to categorize on a perceptual-conceptual level, independent of language, is common across all cultures.

This study is, however, concerned with spatial cognition and the acquisition of locative terms, or the connection between what we see and what we say about space. This was investigated, firstly, on subjects who were culturally and linguistically different (Greek-speaking and English-speaking children) and secondly, on subjects who were cognitively "different" (mentally handicapped children and language handicapped children). The investigation began with an initial experiment, which would be essentially perceptual-conceptual and consequently non-linguistic. The first experiment in this series, therefore, involved the non-verbal categorization of pictures, which depicted three specific spatial entities: **in**, **on** and **under**. This experiment was considered the baseline of any subsequent investigation concerning the semantic development of these spatial categories.

In the second experiment of this series, the subject was requested to perform the same spatial categorization task, as that in Experiment I, but this time certain verbal instructions were given, which cued the subject to the fact that this task involved the spatial perspective of the pictures. Whereas in the first experiment, the child was instructed to model his behaviour on the experimenter´s and was expected to draw information on how to complete the task from this example, in this second experiment, the child was aided in his decoding of the task by the verbal instructions, which the experimenter gave him. In other words, the experimenter pointed to the item on the picture, whose position was changeable, and asked the subject to notice "where it is". The subject was, in this way, encouraged to notice the spatial aspect of the task, but the specific spatial positions under investigation were not named. The question raised here was whether this general verbal instruction would act as a facilitator to the task or whether, on the contrary, it would cause interference, since it was not specific in naming the positions.

The third experiment, again using the same experimental materials as the previous two, was primarily linguistic, in that the three spatial categories under investigation, were finally labelled by the experimenter. In other words, the experimenter told the subject to notice that the item which changed position, was either "on", "in" or "under" another object. These semantic-linguistic categories were then visibly matched by the experimenter onto the perceptual-conceptual categories. The subject was then expected to do the same. The question raised here was whether this mapping would actually "work" in similar ways across children from different linguistic groups and children with different cognitive abilities.

To summarize, therefore, the chief aims of the three experiments were:

Experiment I: to investigate the non-linguistic spatial categorization abilities of different groups of children.

Experiment II: to investigate whether this task was facilitated or hindered by a general verbal cue, which focussed on the spatial aspect of the task.

Experiment III: to investigate whether performance on this same task was significantly improved, when the specific spatial categories under investigation were linguistically defined by the experimenter.

These three experiments were conducted with the same experimental materials, on the same experimental subjects, in serial order: in other words, all subjects were presented with Experiment I first, then after a few days with Experiment II, and finally after a lapse of time, were tested with Experiment III. This of course raised the question whether the results of these experiments were influenced by a practise effect. In order to test for this, it was necessary to conduct a fourth experiment, which would eliminate any suspicion of this possibility. After completion of Experiments I to III, the practise effect experiment (which we shall name Experiment IV) was carried out. This experiment will be described in greater detail in a later chapter. At this point it suffices to mention that no practise effect was found to question the validity of the results of Experiments I-III.

In the following sub-sections, the issues which will preoccupy us in the first three experiments will be described in greater detail. These are: the specific spatial categories under investigation, the cross-linguistic aspect of the study, mental and language handicap, the pictorial representation of spatial concepts and the perceptual, conceptual and semantic differences between abstract configurations and pictures of concrete objects, and finally the developmental issues, which are also touched on by these experiments.

2.2 The Spatial Categories under Investigation

The spatial categories under investigation in the first three experiments were "in", "on" and "under". The purpose of these experiments was not to trace the development of these three spatial concepts in different groups of children. Already there are many adequate studies tracing the development of these three spatial concepts. In fact, one of the reasons why we chose these spatial categories for our first set of experiments was precisely this: these three spatial concepts have a wealth of experimental data backing them (see Literature Review) and also, they are relatively clearly-defined categories, both perceptually and semantically. Maybe the fact that they have a high degree of consistency and a low degree of ambiguity is yet another reason why they are the first spatial concepts understood by young children and consequently, the first spatial locatives expressed by them. Thus, by the age of three years, most children are able to differentiate between these three spatial concepts and can usually produce the spatial locatives "in", "on" and "under" appropriately as well.

The rationale, therefore, for using these spatial categories in our initial experiments was as follows:

1. It is a well-established fact that these spatial concepts are the first to be attained both perceptually and conceptually by young children.

2. The subsequent acquisition of these spatial locatives has been well documented by previous investigators and there are fairly consistent guidelines as to their developmental patterns.

3. A considerable amount of cross-linguistic research has been conducted on these spatial locatives, which, as will be seen later, was a very important factor in our investigation.

4. Finally, since the objective of these experiments was spatial categorization and since this was to be investigated with pictures, it was necessary that there would be as little ambiguity as possible between the pictorial representation and the spatial concept to be investigated. It was noted that as far as this was concerned, the "mapping" between these three spatial concepts and their pictorial representations was quite adequate for our purposes.

2.3 The Cross-linguistic Aspect of these Experiments.

In these experiments, two of the experimental groups consisted of children from different cultural and linguistic backgrounds. For purely practical reasons, the nationalities, which were compared in this investigation, were Greek and British.

The reason why it was considered necessary to make this a cross-linguistic investigation is easily justified. One of the primary aims of this study was, as will be remembered, to investigate the relationship between spatial cognition and the acquisition of spatial locatives. In order to do this, two routes were followed: one of the routes involved the comparison between children from different linguistic backgrounds, and the other route involved the comparison between children who, although from the same linguistic background, had "inherent" differences, either in their cognitive or in their linguistic functioning. For the time being, we will confine ourselves to the reasons why it was necessary to test children from different cultural and linguistic backgrounds, in order to elucidate the point we wished to make.

First of all, we wished to investigate whether there is a certain cognitive function involving the categorization of spatial representations, which is non-linguistic. In order for this cognitive function to be basic, it would have to be true universally. In other words, when faced with a task involving the matching of certain objects or configurations on a visual perceptual basis, without verbal instructions, would all children, whether English, Greek or from any other language group, perform similarly? If this proved to be the case, then it would mean that this particular task was not contaminated by cultural-specific or language-specific factors. Furthermore, it would mean that the categorization of spatial relations was a cross-cultural cognitive attribute.

Building on this information, the next question, which interested us was whether, and if so, at what stage, language-specific properties "contaminated" this non-linguistic ability. Would the comparative complexity of the semantic categories in each language aid or impede the language-learning child in his task? The aim of these three experiments was to expose these questions and, optimistically, to shed some light on them.

Thus, Experiment I was designed to investigate the non-linguistic spatial categorization abilities of the subjects, whereas Experiment II investigated whether general verbal instructions aided or hindered the subjects in this same task. Here, language-specific factors may play an important role in determining the performance of children from different linguistic backgrounds.

Later, Experiment III, which was designed in order to investigate whether actually naming the spatial relation would significantly improve the children's performance in the spatial categorization task, tested for further language-specific factors in the performances of the two groups. Since there is no one-to-one relationship between the field of perceptual relations and that of semantics, it would be a reasonable supposition to make that children from different linguistic backgrounds may perform differently in this task. The child would now have to match what he sees with a word. If this results in a good fit, the child will be successful in his task. If it is not such a good fit, some discrepancy may arise between the performances of children from different linguistic backgrounds. Obviously, there are many factors, which may lead to such a discrepancy, however it was hoped that by comparing well-matched groups from two different linguistic backgrounds, the differences, which possibly would arise from performance of this task could be directly linked to differences between the two languages in question.

The two groups of subjects, who were either Greek or English, were most meticulously matched for this very reason. Obviously, one could not erase the fact that the children were being brought up in different cultures. However, although superficially the Greek and English cultures are quite different, no-one would argue that this could possibly result in a difference in, for instance, the non-linguistic perceptual-conceptual functioning of children in either culture. Furthermore, we would like to maintain, with a minimum of reservation, that in Greece as well as in Great Britain, there is a middle-class culture in the inner cities, which may be considered cross-european.

It was from this "social class" of children in either culture that the experimental subjects for these experiments were selected. The children from both cultures had parents with similar educational and socio-economic backgrounds. The Greek children were all living in Athens and the English children were all living in London. Furthermore, all the children were attending nurseries and playgroups and had regular exposure to toys, picture books, television and advertisements. This would, we assume, result in similar visual perception abilities.

The interest, therefore, in this study centres on whether whatever differences we may see in the performance of these two different language groups may be due to differences between the two languages in question. Thus, the aim was to test whether these differences, if observed, were due to specific differences between the spatial locatives, under investigation, in either language.

In order to elucidate this fact further, it is necessary to analyze how these spatial locatives are formed in either language, and what, if any, are the differences between them.

The spatial locative is that grammatical form, which is used to describe a spatial relationship, which exists in the perceptual world. Such a spatial locative may sometimes differ from one language to another in grammatical terms. In English, for instance, the spatial locative usually takes the grammatical form of a preposition (such as "on"), but sometimes may be a more complex adverbial phrase (such as "on top of"). The following is a list of the different locative terms used in the English language to describe the three spatial relations, which are the focus of our experimental attention in these first experiments:

SPATIAL RELATION	ENGLISH LOCATIVE TERMS
in	"in" "inside"
on	"on" "on top of" "above"
under	"under" "underneath" "below"

As may be seen, the English language-learning child is faced with many locative terms, which denote the same spatial relation as far as physical space is concerned, but which do have certain fine differences between them and cannot often be used interchangeably. So, before the English-speaking child can be said to have mastered the locative, he must sift through all these different meanings and learn which term is appropriate for each situation.

In general, the Greek language-learning child must do the same thing but the specifics of his mastery of the spatial locative in his language are slightly different, as will be seen below.

SPATIAL RELATION	GREEK LOCATIVE TERM
in	"mesa sto"
on	"pano sto"
under	"kato apo"

These locatives are the equivalent of the English locative preposition, in other words they are always followed by a noun. This noun, since Greek is an inflected language, must be in the accusative (see Joseph and Philippaki-Warburton, 1987, for a detailed discussion of Modern Greek prepositional phrases).

It will be noted that, unlike their English equivalents, the Greek locative terms correspond on a one-to-one basis with the spatial relation they represent. In other words, the spatial relationship "on" is always denoted by the prepositional phrase "pano sto", and so on. The semantic terms, which carry the main meaning of the prepositional phrases, are the adverbs, which are "mesa", "pano" and "kato". These adverbs, it is most interesting to note, function as markers for the main spatial location to which one is referring to, for instance, "mesa" means "inside" and refers generally to anything that has to do with containedness or "in-ness". The modifier in semantic terms, is the preposition, which changes according to what specific meaning one wishes to denote.

For example:

1. / bike **mesa sto** spiti /

   he went into (entered) the house (denoting movement)

2. / ine **mesa sto** spiti/

   he´s in (inside) the house

3. / valto **mesa sto** kuti /

   put it in (into) the box (denoting movement)

4. / ine **mesa** /

it´s inside

5. / o janis ine **mesa** /

John is indoors

6. / ine **mesa sti** dulapa /

it´s in the cupboard

7. / ton vlepo **mesa apo** to dzami /

I can see him through the glass

8. / pernai **mesa apo** to parko /

he´s walking through the park

Note: In Examples 1-3, the prepositional phase is followed by nouns in the neuter declension. In Examples 4-5, examples of the adverb "mesa" may be seen. In Example 6, the modification in the preposition may be seen when the noun following it ("dulapa") is in the feminine declension. In Examples 7-8, the complete change in meaning can be observed, which occurs when the preposition "apo" follows the adverb "mesa": the prepositional phrase "mesa apo" means "through" or "across".

This is also the case for the other spatial adverbs under investigation. For instance: "pano sto" means "on", but "pano apo" means "over".

The point we would like to make is that the English and Greek languages have considerably different ways of expressing locative terms. Could it be that this fact may actually lead to different rates of semantic mastery of the locatives in either one language or the other? At this point in the investigation, one cannot speculate further on the specifics of this issue nor make any predictions. One can merely point out the differences between the two languages: English appears to be a language with more linguistic diversity in the locative terms examined, in that there are many different words for one semantic category; Greek, on the other hand, reveals more syntactic-morphological complexity as far as these terms are concerned (Johnston and Slobin, 1979).

As to which language presents more difficulty for the language learning child, it is hoped that some light will be shed by these experiments.

2.4 Mental and Language Handicap

Apart from the normal subjects from two different linguistic backgrounds, these experiments were also conducted on groups of mentally handicapped and language handicapped children. This was considered necessary as a continuation of our initial theoretical question concerning the language-thought dichotomy.

The mentally handicapped group of experimental subjects were matched with the normal group for language abilities. Their perceptual abilities were matched with the normal groups' chronological ages. Their chronological age were, of course, much higher.

The question, to which we addressed ourselves at this point, was to what degree the task of spatial categorization was dependent on language and perceptual abilities, independent of general cognitive functioning. If it was mostly dependent on perceptual or on language abilities, then the mentally handicapped group's performance, we hypothesized, would be similar to that of the normal group. If, however, a general cognitive impairment results in the impairment or suppression of certain higher order abilities, such as spatial categorization, in the mentally handicapped, over and above their specific language and perceptual abilities, then this could result in an inability to access and organize such a task.

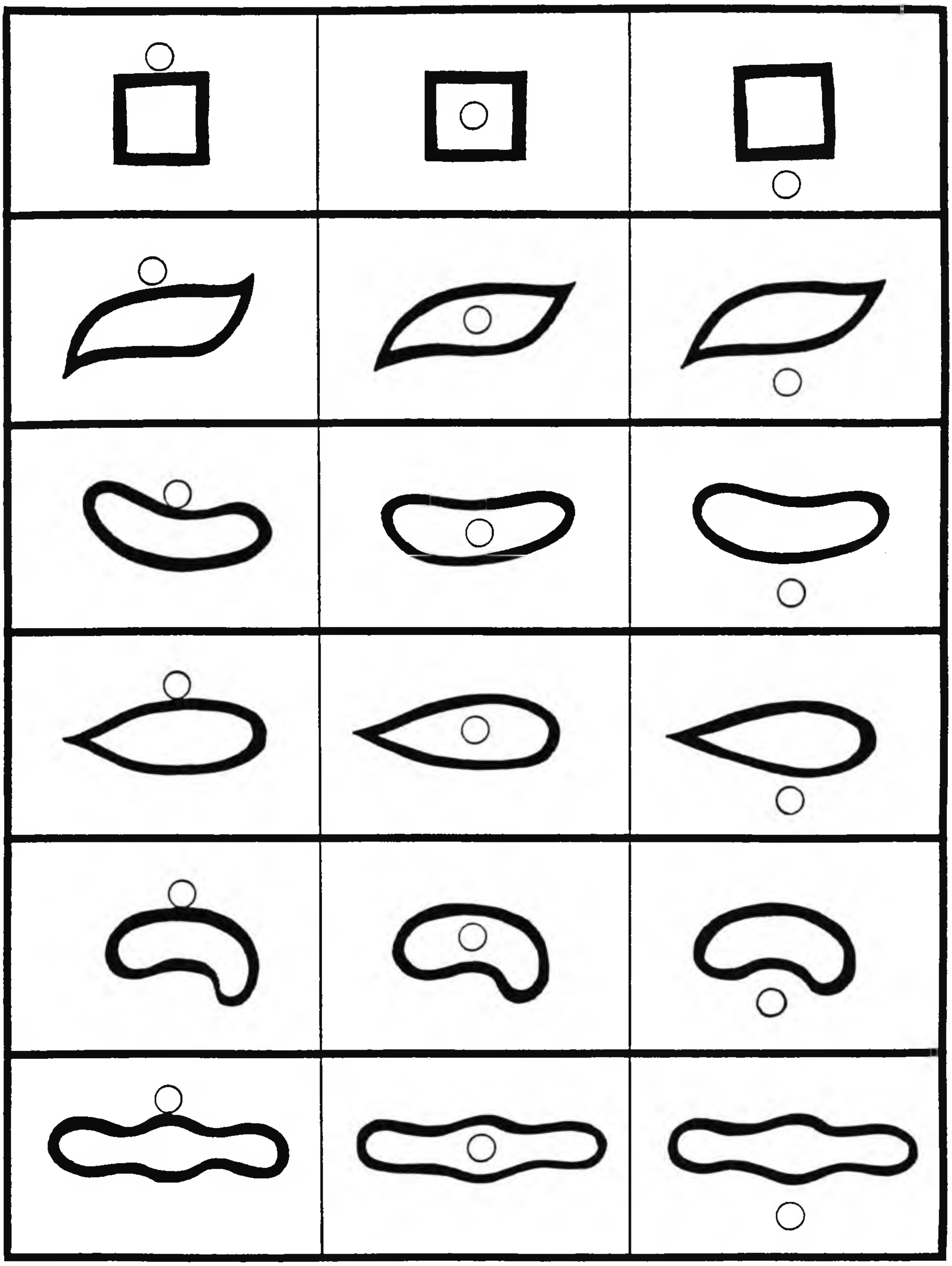
The language handicapped group of experimental subjects were matched with the normal group of subjects in their receptive language abilities, but their perceptual abilities were at a much higher level, higher than either the mentally handicapped group or the normal groups. This was necessary in order to test which function would determine the level of performance in this categorization task: the intellectual, linguistic or perceptual function. Does language, in fact, play such an important role in the mediation of intellectual processes, as some investigators seem to think, or are some cognitive functions independent of language?

2.5 The Pictorial Representation of Spatial Concepts

In this first series of experiments, two sets of materials were presented to the subjects for sorting: the first set consisted of pictures of three-dimensional objects and the second set consisted of pictures of two-dimensional abstract shapes. Thus, there were two conditions, one "abstract" condition and the other, the "concrete" condition. Both sets of pictures had the objects or shapes in three spatial configurations, either "in","on" or "under" another shape or object. In Figure 2:1, the pictorial representations for the "abstract" condition may be seen and, in Figure 2:2, the "concrete" condition may be seen.

Our concern, at this point, was whether such an inherently complex function as spatial cognition could be adequately tested by pictures, which, by their very nature, need a certain perceptual interpretation and which may not always be a satisfactory match for reality. It must be said that this was an

Figure 2:1
Materials for the Abstract Condition in Exps. I-IV

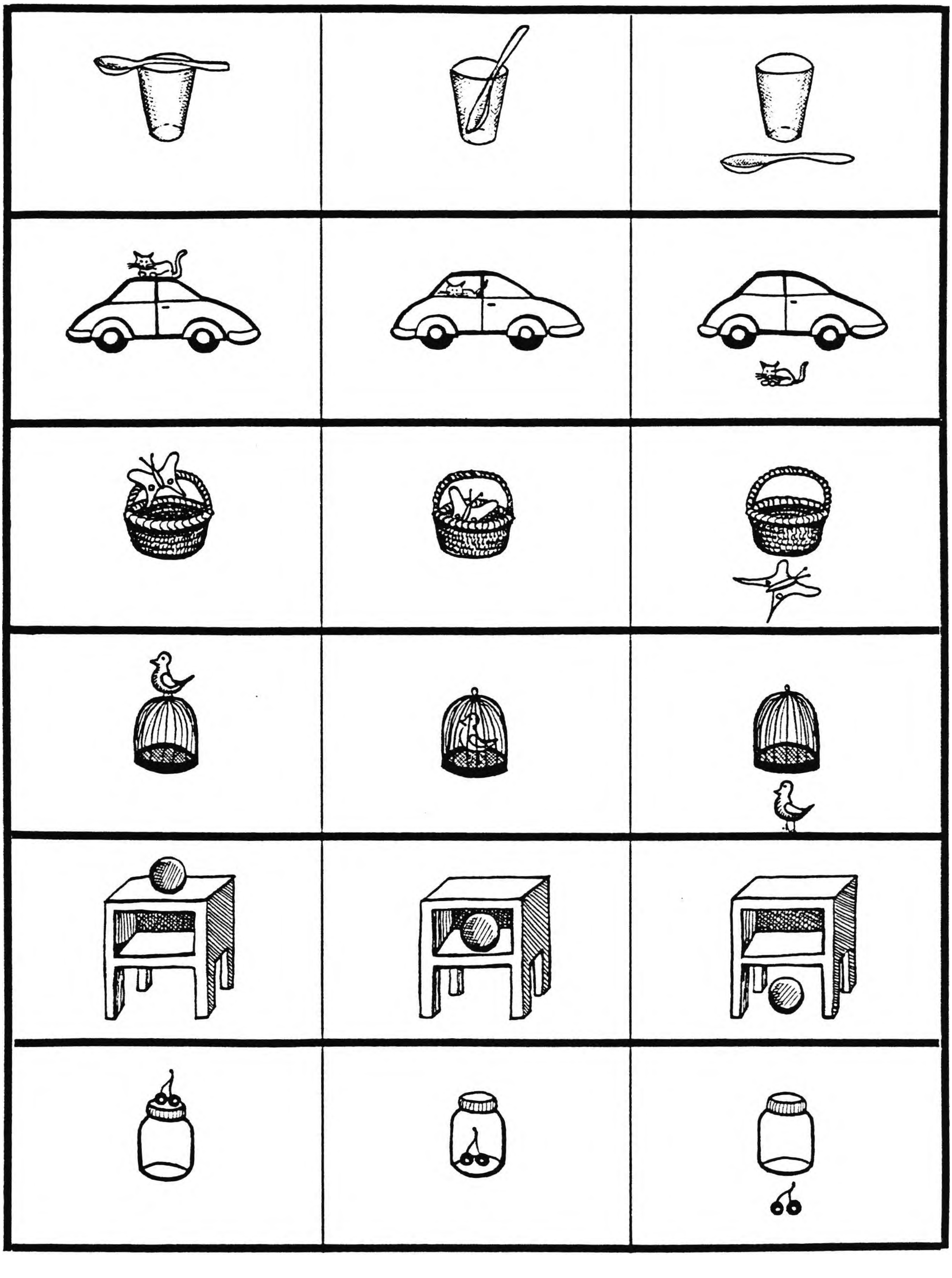


issue, which was foreseen from the beginning, which was kept constantly in mind when designing the test material, but which it was difficult to avoid.

Despite our initial concern, we were reasonably put at ease by the fact that several investigators have proved that even very young children are perfectly capable of interpreting even the most schematic of drawings and that mentally handicapped children do not show a significant difference from normal children in this ability (Refer to the Literature Review for a more detailed discussion). We, therefore, concluded that, even though pictorial representations may not ever adequately represent reality, at least the difficulties, which they may present to the experimental subjects, would be uniform and not for any one group of subjects in particular.

Referring yet again to Figure 2:1 and 2:2, a further analysis of the test materials in either condition, may further elucidate the point which we are trying to make. First of all, let us observe the pictures in the Concrete condition (Fig. 2:2): here, we see six sets of objects, which are familiar to the young child, for example, a cat and a car or a cage and a bird. A child at the ages, in which the experimental subjects were, would definitely have a well-formed idea of how these pairs of objects can be related to each other in reality. Looking at these pictures, one sees that all the spatial configurations are possible in the real

Figure 2:2
Materials for Concrete Condition in Exps. I-IV.



world, although some are more "correct" or congruent than others. For example, the bird is more likely to be in the cage than outside it, the butterfly is more likely to be seen flying on top of the basket than inside it, etc., however none of the examples are completely impossible. Therefore, one could maintain that this task has a further element to it: semantic and pragmatic factors may play an important role in determining the subjects´ performance of this task. It could be that the fact that this condition consisted of pictures, which were semantically and pragmatically congruent to the subjects, would make the task more meaningful for the children, and hence their performance on it better. Conversely, the effect may not be so positive, in that a more complicated process was required of the subject in this condition than in the Abstract condition: that of ignoring the semantic and pragmatic content of the pictures, in order to focus on the object´s location. This needs considerable abstraction on the part of the child, which he may not be in the position to do (Olson and Bialystok, 1983).

On the other hand, it will be observed that the Abstract condition (Fig. 2:1) involves sets of pictures depicting unfamiliar two-dimensional shapes and dots. These do not convey any meaning, whether semantic or pragmatic, to young children and were chosen for this very reason. These rather monotonous pictorial representations have what could turn out to be an advantage: they are perceptually consistent, in that, although the shapes are different, the "moving object" or the thing that changes location in the picture, is always, in all six sets, a large red dot. This perceptual consistency may lead to an easier decoding of the task, even though the pictures were more unfamiliar to the children (Miller and Johnston-Laird, 1976, note the perceptual salience of "red spots").

Finally, since the experimental groups consisted of children with very different abilities, it could be that there would be a differentiation between the different groups in their performances between the two experimental conditions. For instance, the mentally handicapped group may be better at the Abstract condition than at the Concrete condition, whereas for all the other experimental groups the reverse may be true. This remained to be seen.

2.6 The Developmental Aspect of the Experiments

Since the developmental aspect of these spatial categorization tasks was also of great interest to us, each experimental group was further divided into two age levels. These corresponded to the following chronological ages for the two normal experimental groups (Greek and English):

Age level 1: 2;6-2;11 years/months

Age level 2: 3;0-3;11 years/months

With regard to the mentally handicapped and the language handicapped groups, these age levels corresponded to the subjects´ language levels and not their chronological ages.

The spatial concepts under investigation in these experiments are usually well understood by the young child at around three years of age. It was interesting, however, to investigate at what point in the child´s learning of these spatial concepts, he was able to make use of verbal information and to successfully map the spatial locative onto an already learnt spatial concept. Furthermore, it would be interesting to discover whether this developmental pattern, if any was observed in the normal groups, would also be true of the two handicapped groups.

Up to this point, we have discussed the various issues, which were of interest to us in designing the first three experiments. We have also tried to describe some of the methodological issues, which we came up against, and how we were able to justify some of the decisions it was necessary to make, in order to proceed with our experiments. In the next few sub-sections, the common characteristics of the experiments will be described: such as, the subjects, the task design and materials used. Finally, the order-effect experiment, which was conducted, will be described in some detail.

2.7 The Experimental Subjects

It has already been mentioned that four groups of subjects were used for these experiments. These were as follows:

1. English children of normal intelligence.
2. Greek children of normal intelligence.
3. Greek mentally handicapped children.
4. Greek language handicapped children.

These experimental groups were further sub-divided into two age levels, according to certain developmental criteria. A more detailed account of how each group was formed and how they were matched will be given below.

2.7.1. Normal Greek and English Subjects

The normal subjects were all native speakers and monolingual. They were from urban middle-class backgrounds and were all attending a playgroup or nursery near their homes. The Greek subjects were all from Athens and the English subjects were all from London. Children were tested from three different playgroups in Athens, and from two in London.

As mentioned earlier, the subjects were sub-divided into two age levels, according to chronological age. The Greek and English groups were matched according to the following three criteria:

1. Chronological age
2. Language level
3. Visual perception level

The chronological ages of the subjects in age level 1 were between 2 years 6 months and 2 years 11 months. The chronological ages of the subjects in age level 2 were between 3 years and 3 years and 11 months.

The subjects' language level was tested with the Peabody Picture Vocabulary Test (PPVT) (Dunn, 1959). This test has not been standardized in the Greek language, but neither has any other test. However, the present investigator has translated this test into Greek and has been using it for several years prior to this study, in clinical work with Greek children. She is quite satisfied that it is a reliable measure of Greek children's vocabulary development and that it could be used in this study without hesitation.

Visual perception level was tested with the Seguin Formboard, which is one of the sub-tests of the Merrill-Palmer Test. In the manual of the above test (Stutsman, 1948), it states that the child should be given the Seguin Formboard three times and the score used in his evaluation should be that of the best trial. However, since it was seen, in the present study, that the children scored in this test far above the standard age of the test, it was decided that the children would be tested only once and that they would be matched according to that age level. It will be seen in Table 2:1 below that this is still above their chronological ages, probably because children nowadays are more familiar with this type of play material than they were when the Merrill-Palmer Test was first standardized.

TABLE 2:1 Matching of two Experimental Groups: Normal Greek Subjects with Normal English Subjects

Age Level	Years/Mths	Greek Group	English Group
1	2;6-2;11	N=9 Mean C.A.=2;9 (SD=0.14) Mean PPVT=3;1 (SD=0.34) Mean Seguin=3;6 (SD=0.63)	N=9 Mean C.A.=2;9 (SD=0.16) Mean PPVT=2;10 (SD=0.14) Mean Seguin=3;8 (SD=0.5)
2	3;0-3;11	N=12 Mean C.A.=3;6 (SD=0.25) Mean PPVT=3;7 (SD=0.81) Mean Seguin=4;4 (SD=0.75)	N=14 Mean C.A.=3;7 (SD=0.29) Mean PPVT=3;9 (SD=0.5) Mean Seguin=4;4 (SD=0.54)

In Table 2:1, the mean chronological ages (C.A.), language (PPVT) and visual perception (Seguin) scores may be seen for each experimental group at each age level, as well as their respective standard deviations. It can be seen that the groups are quite well matched.

We encountered no difficulty finding children to cooperate with us in either age level. However, in the younger age group, it was difficult maintaining the children's cooperation throughout the whole series of three experiments. Since the results were dependent on each subject's responses for each experiment in turn, when attention could not be maintained, that particular subject's test results were not used in the final analysis. This happened in some cases, both in the English and in the Greek samples, and helps explain why there are uneven numbers in the subject groups.

It must be said however, in all fairness to these young children, that their cooperation in these very difficult tasks was exemplary. We are quite satisfied that the results represent a fair example of each child's abilities in the tasks performed.

Finally, since the investigator was in Athens at the time, the first group to be tested was the Greek one. Consequently, the English group were matched onto the Greek group.

2.7.2. The Mentally handicapped and Language handicapped Groups

The subjects were all Greek and living in Athens. They were all attending a Special School in Athens, called "Theotokos". This school, which has about 350 students ranging in age from 4-18 years of age, is subsidised by the EEC and by the Greek Health and Education Authorities. It is considered to have a high educational standard.

Both mentally handicapped and language handicapped children attend this school. The children were matched, as were the normal ones, according to their language level scores (Peabody Picture Vocabulary Test) and their visual perception (Seguin Formboard). Their chronological ages were, of course, much higher.

For both of these handicapped groups , the control group used was part of the group of normal Greek experimental subjects, described above. The criteria for each handicapped subject´s selection for each level was different, depending on whether the child was diagnosed as being mentally handicapped or merely language handicapped. If the subject was mentally handicapped, then he was matched according to his language level (PPVT) score; his visual perception (Seguin) score was matched to the normal subjects´ chronological age. The language handicapped group were matched to the normal control group only with respect to their language level. Their visual perception scores were at a much higher level, for reasons which will be described in greater detail below.

In Table 2:2, the mean scores for both the language (PPVT) and the visual perception (Seguin) tests for both the mentally handicapped and the language handicapped groups may be seen, as well as their mean chronological ages and standard deviations.

TABLE 2.2 Mean Scores used for Matching the Mentally Handicapped and the Language Handicapped Groups

Level	Mentally handicapped Group	Language handicapped Group
1	N=8	N=10
	Mean C.A.=6;5 (SD=0.83)	Mean C.A.=4;8 (SD=0.37)
	Mean PPVT=2;10 (SD=0.37)	Mean PPVT=2;9 (SD=0.16)
	Mean Seguin=2;6 (SD=0)	Mean Seguin=5;4 (SD=0.26)
2	N=8	N=9
	Mean C.A.=7;0 (SD=0.48)	Mean C.A.=5;6 (SD=0.33)
	Mean PPVT=3;6 (SD=0.52)	Mean PPVT=3;5 (SD=0.15)
	Mean Seguin=3;3 (SD=0.27)	Mean Seguin=5;6+ (SD=0)

If one were to compare the above table to Table 2:1, the following may be observed:

1. The mentally handicapped group, both at level 1 and at level 2, are fairly well matched with the normal Greek group in their PPVT scores. Their Seguin Formboard scores are matched with the normal group´s chronological ages, thus the mentally handicapped group have **lower** visual perception abilities, according to the Seguin Formboard, than their respective normal Greek control groups. As is to be expected, the mentally handicapped group have a much higher chronological age than the normal groups, which shows that the children in the former group were moderately retarded.

2. The language handicapped group were matched according to their PPVT scores, but not according to their Seguin scores. This was part of the experimental design and purposefully done, in order to test whether language level or visual perception level would play a determining factor in the results. This group of subjects had much higher scores on the Seguin Formboard, which meant that their visual perception skills were much closer to their chronological age. The mean chronological ages of both levels of the language handicapped groups were higher than their matched normal Greek counterparts, as may be seen in Table 2:1, hence also their higher Seguin Formboard scores.

Since the language handicapped group have these rather uneven criteria, we will attempt to describe the children of this group in somewhat greater detail. These children, though showing a much greater ability in tasks of visual perception and with high social skills, had severe difficulties in the comprehension and in the production of language. Many of the children in the group had no verbal language whatsoever and the rest had very little. This impairment made it impossible for a precise measurement of their cognitive functioning. It is believed, however, that the severity of their language handicap had a detrimental effect on their intellectual abilities, and as a result of this, they were unable to attend normal schools. Most of the children were presently attending a programme which taught them to use alternative means of communication (sign language).

The subject group samples are uneven for reasons beyond our control: one child moved, another became ill during the period we were testing. Furthermore, it must be kept in mind that it was with considerable difficulty that these groups were matched onto the normal Greek subjects.

2.8 Task Design

There was a common task design in all three experiments. In other words, all the experiments had two conditions, which were tested with the same experimental material. One condition was the

Abstract condition and the other was the Concrete condition.

The experimental materials consisted of a pack of cards, designed specifically for each condition. They were prepared by the experimenter and have already been presented in Figures 2:1 and 2:2. Each card was approximately 4.5 x 4.5 inches and was covered with transparent plastic adhesive paper.

A fuller description of the materials used for each condition may be seen below.

2.8.1. Abstract Condition

The materials used in this condition for Experiments I-IV consisted of a pack of 18 cards. Each card depicted an abstract shape with a dot in one of three positions: "on", "in" or "under". The shapes were all coloured in dark brown and the dots were all bright red. We will name the abstract shape the Fixed Object, since its position on the card never altered. In contrast, the dot was the Moving Object, since its position on the card varied.

In Figure 2:1, it will be noticed that the pack consisted of six Fixed Objects, one of which was a square, and the rest were amorphous shapes. The abstract shape, which was most familiar to the child, that is, the square was used as an example. The other shapes, which could not be named, were used to elicit the subjects´ responses. The reason for this, will be made clearer at a later stage.

There are three spatial configurations for each Fixed Object, according to the position of the Moving Object (the dot) on each card: that is, whether the dot is in , on or under the shape. It will be noticed that for the "on" configuration, the dot sat approximately in the middle of the upper horizontal plane of the shape. For the "under" position, the dot was floating under the shape, and not touching it. It was directly, vertically below both the "on" and the "in" positions. Finally, the "in" position depicted the dot enclosed by the shape.

To summarize, therefore:

6 Fixed Objects x 3 Moving Objects (each in three positions) =
18 configurations

2.8.2. Concrete Condition

The test materials for this condition also consisted of a pack of 18 cards. The difference was that the objects depicted were easily recognizable, and nameable, by young children. They were simple line-drawings with colours. These may be seen, as mentioned previously, in Figure 2:2.

The Fixed Objects were chosen because it was possible for them to have something else "in","on" or "under" them. Since there are not that many objects, which can take all of these three spatial relations, this was a more difficult project than first meets the eye. One of the main criteria for our choices was that the pictures should be semantically congruent, as we discussed in a previous section. It is believed that this was achieved.

Below are listed the six Fixed Objects used in the test materials with the Moving Objects which accompanied each one:

Pair	Fixed Object	Moving Object
1	glass	spoon (example set)
2	car	cat
3	basket	butterfly
4	jar	cherry
5	cage	bird
6	cupboard	ball

To summarize, yet again:

6 Fixed Objects x 3 (1 Moving Object in 3 positions) = 18 configurations

2.9 Test Criteria

The final common characteristic of the three experiments was that the test criterion was, of course, identical. This consisted of the number of ERRORS, which the subject made during each test.

The TIME (in seconds) in which the subject completed the task was also taken, but after the first experiment, where it was seen that this had a high positive correlation with the ERROR scores, the TIME scores were no longer used as a test criterion since they did not add any new information to our study.

2.10 The Practise Effect Experiment (IV)

After testing was concluded for all experimental subjects in all three experiments (I-III), it was considered necessary to conduct one final experiment, in order to test whether the results of the first three experiments were due to a practise effect. It was hypothesized that this would not be so and that the results would be solely due to the different tasks in each separate experiment. In order to test this, the following experiment was designed:

2.10.1 Subjects

A control group of Greek subjects of normal intelligence were matched according to chronological age and language score (Peabody Picture Vocabulary Test) with children who had completed the whole series of three experiments. The control group sample were eight children with a mean chronological age of 3;5 years, a mean language score (PPVT) of 3;5 years, a mean visual perception (Seguin) score of 4;0 years.

2.10.2 Procedure

The control group were tested with the Abstract condition and the Concrete condition of Experiment III, according to the instructions and procedure followed for that experiment (see Chapter 6 to follow). As in all the experiments, the subjects were alternately tested first with the Abstract condition or the Concrete conditions.

This experiment will be described in greater detail after the completion of the descriptions of Experiments I-III. At present, it suffices to mention that no practise effect was found. This leads us to conclude that these experiments revealed results, which were **only** due to the different tasks given to the subjects in each experiment.

2.11 Conclusion

In this chapter, an attempt was made to explain the rationale behind the first three experiments, which were treated as a series. Experiment IV was an appendix to this series.

A brief summary of their general purposes is as follows:

Experiment I: this was a non-linguistic spatial sorting task, aimed at tapping different groups of children´s spatial perceptual categorization abilities.

Experiment II: this task was complemented by general verbal instructions, which served to "cue" the subject into the spatial component involved in the task.

Experiment III: the task was linguistically defined, the spatial component being verbally labelled in the instructions.

Experiment IV: this was conducted in order to test whether there was a practise effect in the series of three experiments already completed.

In this chapter, we discussed the common characteristics of the experiments, described the four groups of children used as subjects and explained why each group was necessary, in order to test our hypotheses.

The rationale behind the choice of two conditions for each experiment (Abstract and Concrete) was discussed, and the material used for each condition was described. Finally, we mentioned briefly why it was considered necessary to conduct Experiment IV.

In the next four chapters of this section, we will describe and discuss each experiment separately. Finally, this section will close with a chapter, which will attempt to treat the experiments described globally and to present the general conclusions drawn from these results.

CHAPTER 3

A Non-Linguistic Spatial Categorization Task: Experiment I

3.1 Introduction

In the previous chapter, a general overview was given of the first three experiments in this study, which deal with spatial cognition and its relationship to spatial locative terms. The theoretical framework was discussed and it was proposed that the first three experiments should be seen as an entity.

In this chapter, Experiment I will be described in detail, the results will be analysed and discussed and some first conclusions will be drawn from these.

3.2 Test Materials and Conditions

To recapitulate briefly, it will be remembered that this experiment consists of a non-linguistic spatial categorization task, where the subjects were requested to sort some cards according to two conditions: Abstract and Concrete. The Abstract condition used cards of two-dimensional shapes and dots in three spatial positions (in, on or under the shape). The Concrete condition consisted of the sorting of cards with drawings of three-dimensional objects familiar to the subject (e.g. a car and a cat, a bird and a cage, etc.). These may be seen depicted in

Figures 2:1 and 2:2 in the previous chapter.

3.3 The Subjects

The subjects were divided into four experimental groups at two age levels each. The number of subjects in each experimental group can be briefly summarized as follows:

Age Level	Eng.Norm.	Gk.Norm.	Gk.M.R.	Gk.L.H.
1	N=9	N=9	N=8	N=10
2	N=14	N=12	N=8	N=9
Total N	23	21	16	19

The age levels were determined by chronological age in the two normal groups (Greek and English-speaking). Thus, Age Level 1 consisted of children between 2;6 years and 2;11 years, and Age Level 2 consisted of children between 3;0 years and 3;11 years.

In the mentally handicapped group, age levels were determined according to language scores (PPVT) and visual perception scores (Seguin Formboard), which were matched with the chronological ages of the normal Greek subjects. The chronological ages of the mentally handicapped children were, of course, higher:

Age Level 1: between 5;7 yrs and 7;9 yrs (Mean 6;5 yrs)

Age Level 2: between 6;3 yrs and 8;9 yrs (Mean 7;0 yrs).

In the language handicapped group, the age levels were determined by the language scores only, which were matched with those of the normal Greek group. The visual perception scores of these children were much higher and close to their chronological ages, which were greater than those of the normal groups, but less than those of the mentally handicapped group. Their chronological ages were:

Age Level 1: between 4;2 yrs and 5;3 yrs (Mean 4;8 yrs)

Age Level 2: between 5;1 yrs and 5;11 yrs (Mean 5;6 yrs)

More details, concerning the matching of the groups, can be seen in Tables 2:1 and 2:2, presented in Chapter 2. The testing conditions have also been described and it will also be remembered that the test criterion was the number of errors each child made during each test.

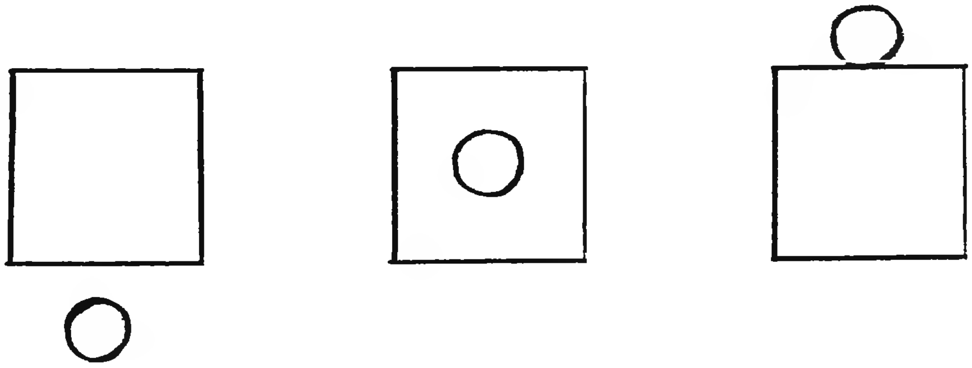
3.4 Procedure

All the subjects were tested with both experimental conditions: Abstract and Concrete. The order of these, however, was alternated from subject to subject, so that some subjects were treated with the Abstract condition first and others with the Concrete condition first. All the subjects were tested with both conditions on the same day (with a suitable break in between treatments), or on consecutive days. This depended on their attentional capabilities.

3.4.1 Abstract Condition

In this condition, the task was to sort cards in such a way that those cards, which had a dot in the "in" position were put on one pile, those which showed the dot "on" the shape on another pile, and those cards with the dot "under" the shape on a third pile. The materials used for this condition may be seen in Figure 2:1, in the previous chapter.

In order to begin testing, the experimenter sat opposite the child. She then proceeded to place the example set, in all three of its configurations, in front of and facing the child. This example set consisted of the following cards and they were set in random order. For instance:



The rest of the cards, fifteen in number, were shuffled randomly and placed face down in a pile in front of the experimenter.

Test Trial: A test trial was conducted before the scoring was begun. The experimenter said the following to the subject:

E: "We're going to play a game. First, I'll show you how we'll play and you must watch very carefully. Then you can do what I did."

The experimenter then points to the three cards on the table in front of the subject and says:

E: "Look, shapes and dots."

The experimenter, then picks up one of the cards from the shuffled pile and shows it to the subject:

E: "Now, look at this card. I wonder where this goes? Oh, yes! It goes with this one, so I'll put it right here."

The experimenter then places the card on top of the one it "goes with". She continues with the task, making a show of comparing the cards, but she does not, under any circumstance, draw attention to the dot, or where it is, nor of course, name the spatial position. She places each card on the pile, which has other cards with dots in the same position. Her comments are confined to: "This goes on this pile". She does not say that the cards are the "same", since this would be even more confusing to the child.

After completion of the test trial, in which all of the fifteen cards are placed on the appropriate piles, the experimenter collects all the cards, leaving the three cards of the example set on the table, facing the child. The experimenter tells the child that it is now his turn to play the game and that the experimenter will help. The same pile of cards is shuffled thoroughly by the experimenter and the test begins.

The experimenter shows the first card to the child and asks:

E: "Where does this go?"

If the child points to the correct pile, the experimenter places the card on that pile, says a word of encouragement and shows the child the next card. If, however, the child points to the wrong pile, then the experimenter says: "Try again". This may occur two times with each card shown, since there are three possible responses, that is, three piles on which the card may be placed.

The maximum number of errors, which a child can make is 30, that is, 15 cards x 2 incorrect positions. The experimenter notes all errors made by the subject.

The three Greek-speaking groups (the normal, the mentally handicapped and the language handicapped groups) were, of course, given all instructions in Greek. These may be seen in the Appendix.

3.4.2 Concrete Condition

The procedure followed for this condition was the same as in the Abstract condition. Again the task was to place all the cards onto their appropriate pile, according to whether an object was positioned "in","on" or "under" another object.

The materials used for this condition may be seen in Figure 2:2, in the previous chapter. As mentioned previously, the most representative pictures were used as the example set and placed in front of the child. These were the glass and the spoon:

The rest of the cards, fifteen in all, were shuffled and placed in a pile face down in front of the experimenter. These cards consisted of the following pairs:

1. Car and cat
2. Basket and butterfly
3. Cupboard and ball

4. Jar and cherry

5. Cage and bird

Test Trial: This was conducted by the experimenter in the same way as in the Abstract condition. The experimenter points to the three cards of the example set, which are on the table in front of the subject, and says:

E: "Look at these glasses and these spoons."

She then picks up a card from the shuffled pile, shows it to the subject and says:

E: "Now, look at this card. I wonder where this goes? Oh yes! It goes with this one, so I'll put it on this pile."

She continues with the task, comparing the cards and saying that "this goes with" this or that, but without actually mentioning or naming the precise criteria for this matching. After completion, the experimenter again collected the cards from the piles and left the three examples in a line facing the child. She then shuffled the cards and told the subject it was now his turn to play the game.

The experimenter showed the first card to the subject and prompted the subject's response by saying : "Where does this card go?"

Again, the subject was corrected by the experimenter, when he made an "error" in the same way as in the Abstract condition. The maximum number of possible errors was again 30. The experimenter noted the number of errors made by the subject.

The instructions for the three Greek-speaking groups may be seen in the Appendix.

3.5 Results

The experimental design consisted of:

1. One between subject variable. This was the subject groups, which were four, that is, the English normals, the Greek normals, the Greek mentally handicapped and the Greek language handicapped.

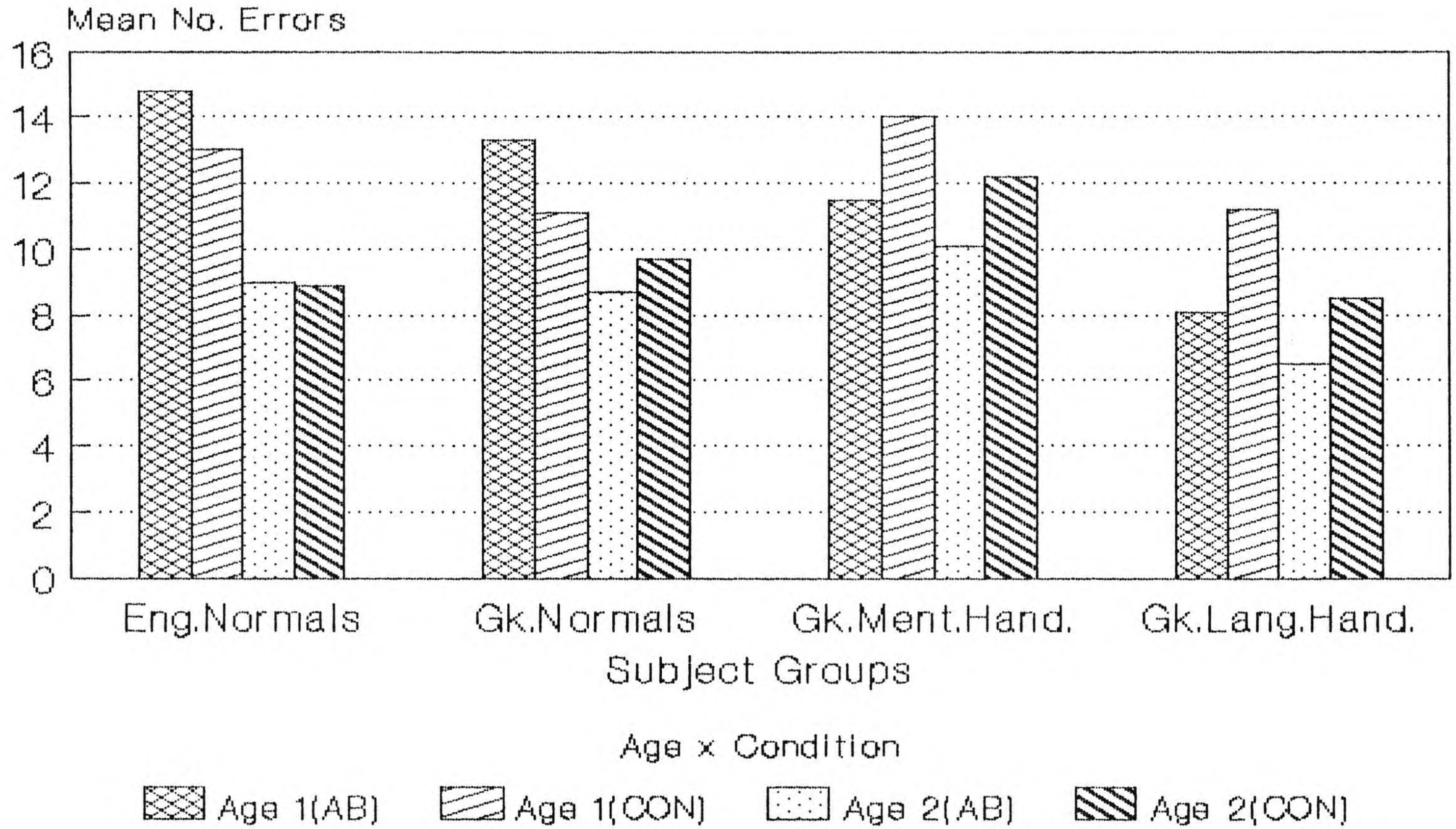
2. Two within subject variables which were:

   a. Age (level 1 or level 2)

   b. Condition (Abstract or Concrete)

This is a 4 x 2 x 2 design for the purposes of analysis of variance, which was used to analyze the results.

Figure 3:1
Result Summary for Experiment I
(Subject Group x Age x Condition)



*Age 1=Age Level 1 (2;6-2;11 yrs),
Age 2=Age Level 2 (3;0-3;11 yrs).
Condition=Abstract(AB)/Concrete(CON).

3.5.1 Main Effects for the ERROR scores

In Table 3:1 and Figure 3:1, one can see a summary of the results by subject group, age level and for the two conditions separately.

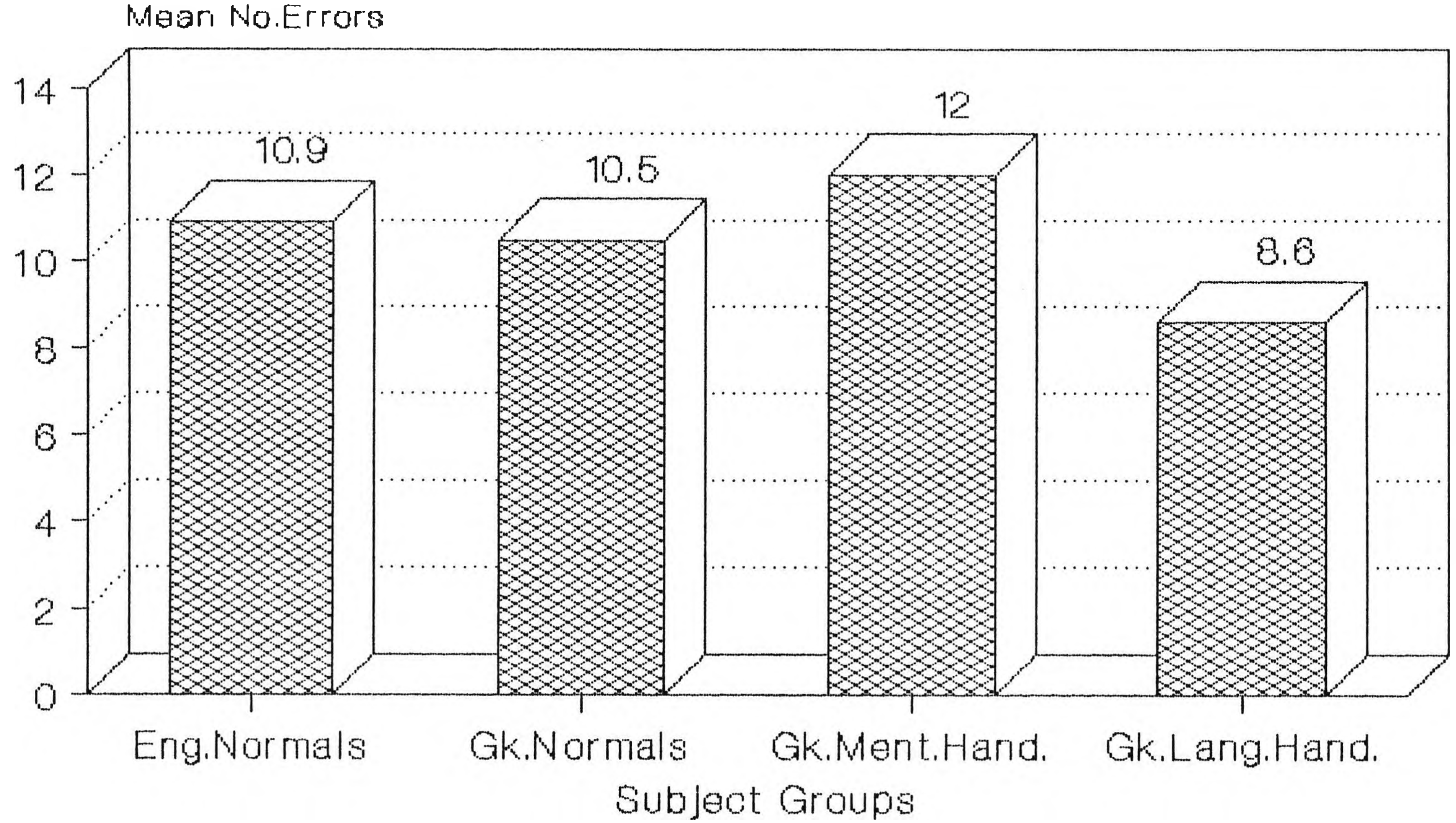
Two main effects were found for these results:

a. Subject Group ($F=3.517$, $df=3/71$, $p<0.01$)
   (See Figure 3:2)

b. Age level ($F=16.720$, $df=1/71$, $p<0.001$)
   (See Figure 3:3)

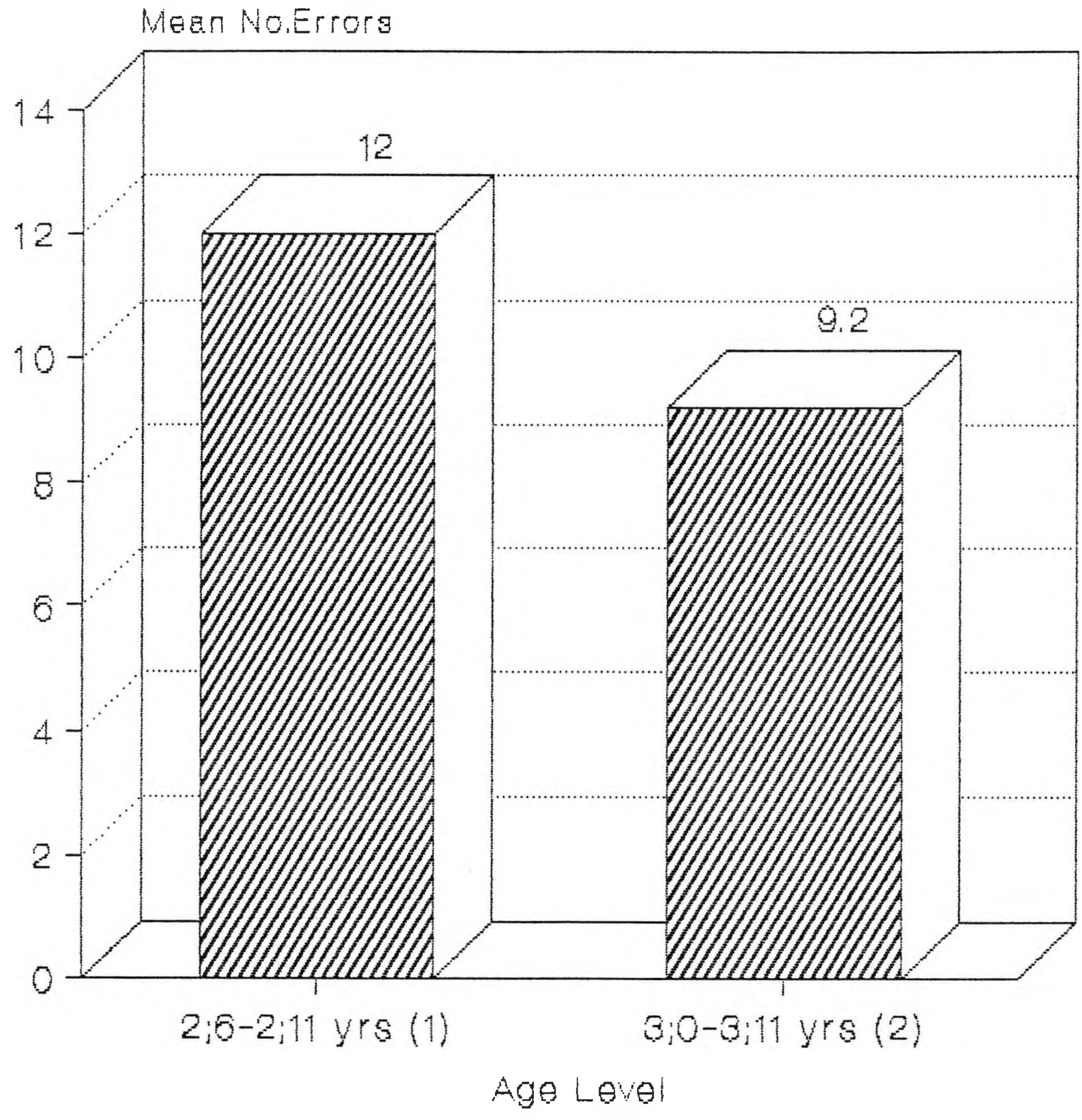
No significance was found between the Abstract and Concrete conditions.

Figure 3:2
Main Effect between Subject Groups
in Experiment I



$F=3.517$, $df=3/71$, $p<0.01$

Figure 3:3
Main Effect between Age Levels
in Experiment I



$F=16.720$, $df=1/71$, $p<0.001$

TABLE 3:1 Result Summary for Experiment I:

Mean Error Scores, out of a Maximum Possible of 30, for all the Subject Groups, according to Age Level, and Abstract/Concrete Condition.

	Eng. Norm.		Gk. Norm.		Gk. M. H.		Gk. L. H.	
Age Level	Ab.	Con.	Ab.	Con.	Ab.	Con.	Ab.	Con.
1	14.8 *(1.9)	13 (1.7)	13.3 (2.6)	11.1 (2.0)	11.5 (2.9)	14 (2.7)	8.1 (4.0)	11.2 (5.4)
2	9 (4.0)	8.9 (3.8)	8.7 (4.6)	9.7 (2.8)	10.1 (3.4)	12.2 (2.7)	6.5 (5.6)	8.5 (4.9)

* Standard Deviations are in the brackets.

Since there were four subject groups, a further analysis of the data was necessary to find which group differed significantly from which group. Since the groups were of uneven number, an unplanned comparison was performed on the data, using the Newman Keuls test (the Behrens Fischer approach).

The results of this unplanned comparison (tabulated in the Appendix) are that only the difference in scores between the Greek language handicapped and the Greek mentally handicapped groups is significant ($q=3.34$), whereas the comparisons between all the other groups are not significant.

The other significant main effect result was for age level.

The mean number of errors for each age level were:

Age level 1: 12.042 Errors

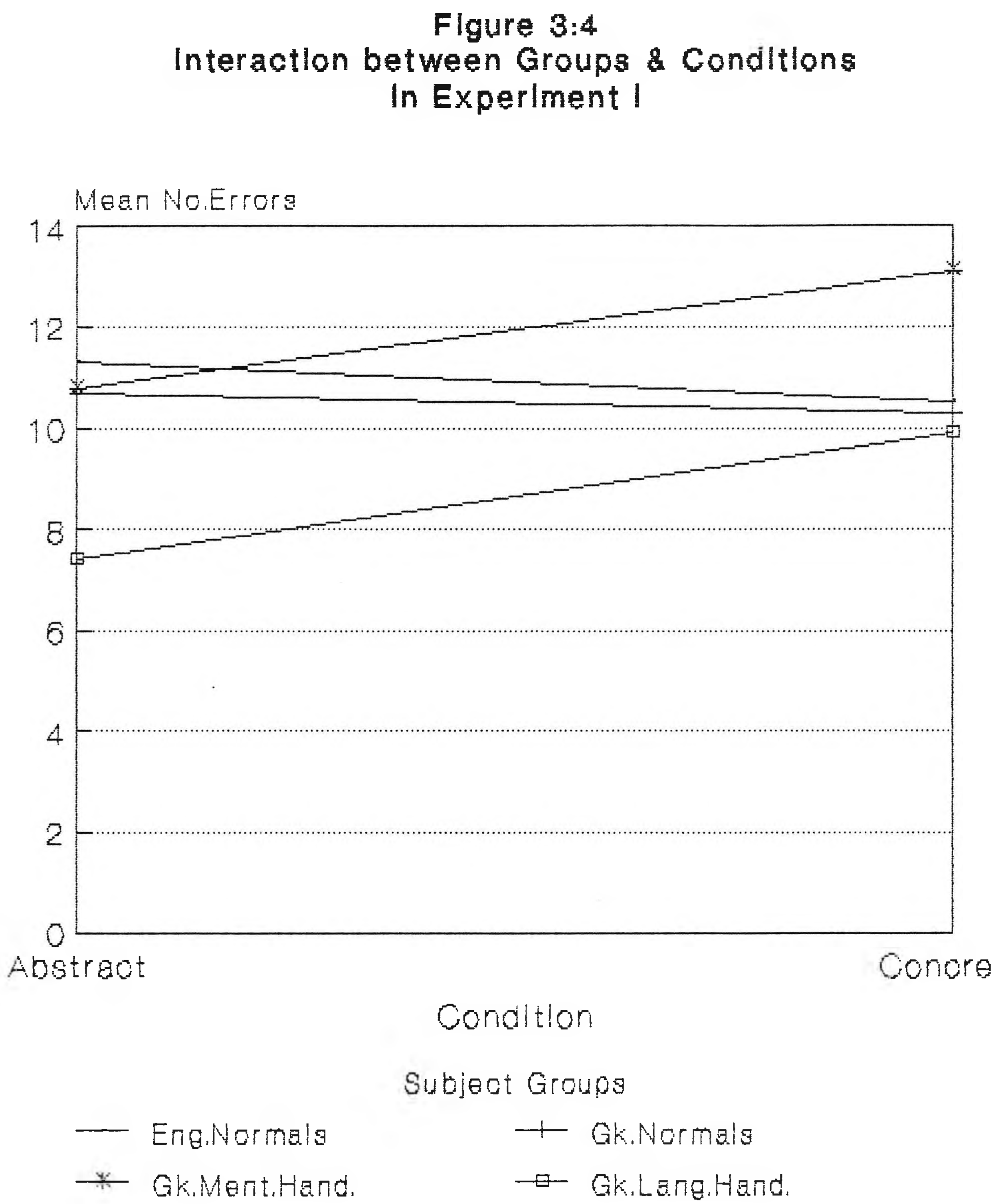
Age level 2: 9.163 Errors

It will be remembered that the subjects in age level 1 were "younger" than the subjects in age level 2, so the obvious conclusion is that the younger subjects, whether in terms of chronological age or language level, make more errors on average than do the older ones. There was, therefore, no need for further analysis of this effect.

3.5.2 Interactions for the ERROR scores

A significant interaction was found between subject group and Abstract/Concrete condition ($F=3.926$, $df=3/71$, $p<0.001$) (Figure 3:4).

Related t tests were conducted on this data, which can be seen in Table 3:2. These tests revealed significant differences between Abstract and Concrete condition scores in the language handicapped and in the mentally handicapped groups. The Concrete condition elicited significantly more errors. This was not found for either of the two normal subject groups.



F=3.926, df=3/71, p<0.01

TABLE 3:2 Related t tests for the Interaction between Group and Abstract/Concrete Condition in Experiment I (ERROR scores).

	Eng. Norm.	Gk. Norm.	Gk. M. H.	Gk. L. H.
	N=23	N=21	N=16	N=19
Ab. (Errors)	11.3	10.7	10.8	7.4
Con. (Errors)	10.5	10.3	13.1	9.9
t value	1.068	0.429	2.512	2.426
df	22	20	15	18
p	n.s.	n.s.	<0.05*	<0.05*

N.B. * denotes significance.

3.5.3 Result Summary

In this experiment (I), where 4 groups of children were requested to sort cards according to the spatial configuration on each card, the following results were seen:

1. The English and Greek normal groups had a similar number of errors in both age levels and in both experimental conditions (Abstract/Concrete), as seen in Figure 3:2. In both groups, there was a significant improvement over age, as seen in Figure 3:1. There was no significant difference between their ability to sort pictures with abstract or concrete drawings on them.

These results are noteworthy in that there is no significant difference between the performances of these two groups of children from different linguistic backgrounds. It confirmed our initial hypothesis, that this aspect of spatial cognition, which relies on perceptual-cognitive functions and that this function has a universal nature, because it is non-linguistic.

2. According to the main effect results for all the subject groups, both the language handicapped and mentally handicapped groups appeared to improve, overall, from one age level to the other. The mentally handicapped group, however, made significantly more errors than the language handicapped group. The mentally handicapped group also made more errors than the two normal groups, but the difference was not significant. Furthermore, though the language handicapped group tended to make somewhat fewer errors than the two normal groups, yet again the difference was not significant (see Table 3:1).

These results did not conform entirely with our initial hypothesis that this task was a non-linguistic task, which would tap the children's non-verbal spatial perceptual abilities only. If this were entirely true, the language handicapped group should have been performing at this task according to their spatial perceptual abilities, which were of course much higher than any of the other groups'. These results will be discussed further in the final discussion in this chapter.

3. Both the language handicapped and the mentally handicapped groups made significantly more errors in the Concrete task than in the Abstract task. As we mentioned previously, this was not true of the two normal groups. This, too, was unexpected and will be discussed further.

4. One final interesting point is raised by these results: that all subject groups, though not all individual subjects, performed significantly above chance level, which has quite important implications for young children's categorization abilities. This is especially significant, if it is remembered that in the normal groups, the age level sub-groups represent the following chronological ages:

Age Level 1: 2;6-2;11 years

Age Level 2: 3;0-3;11 years

This will also be discussed in the following section.

<u>3.6 Discussion and Implications from the Results.</u>

This experiment was designed in order to provide some data, which would shed some light on the following questions: When children from different linguistic or cultural backgrounds are given a non-linguistic task, in which they must sort pictures according to spatial categories, will their performance be the same? Does this type of task tap some universal functions of spatial cognition at a perceptual level or might it be expected that one modality could be "contaminated" implicitly by another modality: in this particular case, the perceptual-conceptual modality by the semantic-linguistic modality?

The results of this experiment lead us to the conclusion that this task was indeed independent of language-specific or cultural factors, and appears, on the surface at least, to tap a universal ability of young children to sort according to spatial categories. This, it seems, is a non-linguistic ability, depending largely on perceptual skills and on the cognitive organization of spatial stimuli.

The second question, which was asked in this investigation was whether mentally handicapped children, matched with the normal group for language ability (PPVT) would perform similarly to the normal groups in this non-linguistic categorization task. Our hypothesis was that since they were matched on their visual perception scores according to the chronological ages of the normal groups, it was likely that their performances would be similar. A slight reservation was that the normal group had higher visual perception (Seguin Formboard) scores than their chronological ages, as we have already mentioned. However, we did not rule out the possibility that over and above visual perception and linguistic abilities, the mentally handicapped group could possibly reveal a cognitive organizational disability, which would impede their performance at this rather complex spatial categorization task.

The results, however, confirmed our initial hypothesis, and temporarily laid aside any doubtful thoughts. Although the mentally handicapped group were making somewhat more mistakes than the normal groups, this difference was not statistically significant. We can, therefore, conclude that these mentally handicapped children, when matched for visual perception and linguistic ability with normal children, perform similarly in this non-linguistic spatial categorization task and that they reveal no greater or more complicated disability than that which has already been pinpointed, notably, a retarded developmental pattern.

The third question, which was asked in this study, and which was potentially the most exciting one, was whether language handicapped children, matched for language ability with the other three groups, but whose visual perception abilities were much higher, would perform according to their higher visual perception abilities and, therefore, be significantly better than all of the other groups.

The hypothesis being tested was that if this task was non-linguistic, then a group of children with similar language abilities as the other groups, but with much more advanced visual perception skills, would make fewer errors in this task, than the other groups, since they would be performing according to their visual perception skills and not their verbal skills.

Although, at first sight, the data seem to correspond to this expectation, the strict unplanned comparison of the Newman Keuls test revealed that, although there was a significant difference between the scores of the language handicapped and the mentally handicapped groups, there was no significant difference between the language handicapped children's scores and the normal groups' scores.

With regard to the difference between the mentally handicapped and the language handicapped group, this indicates that there is a difference in cognitive efficiency between these two groups of subjects. The lack of difference between the language handicapped and the normal groups, in spite of the former's higher visual-spatial abilities, seems to imply that visual perception skills are not the only necessary prerequisites to successful spatial categorization. It is possible that impaired language ability has a more pervasive cognitive influence, which may be apparent even in "non-linguistic" tasks.

Another possibility is that the normal children and the language handicapped children may have used different strategies to solve the problem, in spite of the similar results they attained. For instance, the good results of the language handicapped group may be due to their superior visual-perceptual skills (due to age), which they were able to employ in order to solve the spatial task problem.

From this, we can only conclude that a specific language disability has a much more complex effect on cognitive functioning, than do other disabilities, such as general mental retardation, implicitly affecting perhaps, as is indicated here, other areas of cognitive processing, such as visual-spatial ability.

Another point, which we believe it is necessary to make, is that there was a lot of discrepancy between the individual scores of the language handicapped children. This may be seen in Table 3:3, where the individual test scores for each child in the language handicapped group are tabulated and may be compared next to their normal Greek-speaking matched counterparts. Here, it will be noted, that children A,B,C and E in the language handicapped group's younger age level made five errors or less in the Abstract condition, whereas none of the normal children made so few errors. In the Concrete condition, only children B and C made so few errors. It appeared that the Concrete condition was considerably harder for them. As anybody who has worked clinically with language handicapped children will testify, these children's abilities vary considerably and that is why their diagnosis and assessment is not such a straightforward matter. In fact, one could almost say that they reveal more heterogeneity than homogeneity in their clinical pictures, something which should always be kept in mind by the clinician-diagnostician. Likewise, it must be kept in mind by the researcher: these results are offered as a spark for further investigation, rather than as conclusive evidence.

On a developmental level, the next question which we ask ourselves is the following: would all the groups concerned in this study improve their performance with age? At what age level would the children perform above chance level?

TABLE 3:3 A Comparison between the ERROR scores of Individual Subjects in the Greek Language Handicapped and Greek Normal Groups, for both Age Levels and Experimental Conditions (Abstract/Concrete).

AGE LEVEL 1

Subject	Greek.Norm. Ab.	Greek.Norm. Con.	Greek.L.H. Ab.	Greek.L.H. Con.
A	16	10	5	8
B	13	11	3	5
C	11	11	4	5
D	15	14	9	7
E	10	12	3	11
F	12	10	9	14
G	13	13	14	10
H	12	12	11	18
I	18	7	11	20
J			12	14

AGE LEVEL 2

Subject	Greek.Norm. Ab.	Greek.Norm. Con.	Greek.L.H. Ab.	Greek.L.H. Con.
K	14	15	0	1
L	10	11	15	14
M	4	9	2	5
N	4	10	15	7
O	3	4	5	17
P	10	9	6	8
Q	10	11	8	9
R	10	13	1	5
S	7	9	7	11
T	9	9		
U	5	7		
V	19	10		

Having developmental evidence in mind, we hypothesized that between two and three years of age, the subjects would perform this task at chance level. At around this age level, we would expect the child to have a good perceptual knowledge of "in", but not yet consistently of "on" and "under".

A close examination of the demands made of the subjects in this experiment, reveals how truly daunting it was! The children were expected to put the pictures in categories and the only cue, which was given to them in order to solve the problem, was the experimenter's modelling of the task, according to "which cards go together". Not, we would expect, very elucidating information for a young child! According to this scant information, they were expected to understand that this matching process had something to do with objects located in different spatial relationships to each other. The children were expected to screen out or ignore all other confounding information from the pictures. They were expected to be capable of interpreting these particular drawings. Furthermore, they were expected to concentrate for the length of time it took to complete this rather tedious task.

In view of all this and in view of the results, we can merely state that young children's perceptual-cognitive functioning and their ability for spatial categorization are at a much more sophisticated level than expected.

The final question, which remains to be answered, is which of the two conditions is easier for the subjects. That is, whether pictures of abstract two-dimensional configurations or whether pictorial representations of three-dimensional objects which are familiar to the child, are easier to interpret for the purposes of this sorting task. It could be, we hypothesized, that because the abstract drawings had fewer distractions on them, they would be easier to sort. Furthermore, the dot displayed in various positions on the cards was always and consistently coloured red, which may be considered, visually, quite an attention-focussing feature. On the other hand, in view of semantic congruity and pragmatics principles, it could be that the distracting element of these concrete pictures would be compensated for by this congruity.

Some interesting results arose from this question. First of all, the normal groups did not reveal a significant difference between their Abstract and Concrete scores. On the other hand, both the language handicapped and the mentally handicapped groups did show a difference between these two scores. In both groups, they made less errors in the Abstract task than in the Concrete task. This is probably due to the fact that the abstract drawings were less visually confusing to the children, since there was less visual information to interpret. On the other hand, it was "meaningless" in that the children could not glean information from contextual cues. By comparison, the concrete drawings required the ability to process and interpret more complex information concerning the translation of three-dimensional space into two-dimensional space. The contextual or pragmatic factors of this task, however, played a role in the interpretation of the information.

It, therefore, appears that the language handicapped and mentally handicapped groups found the Abstract task easier, since they were not able to make use of the contextual information of the Concrete condition. On the other hand, in the two normal groups, it appears that this contextual information helped raise their Concrete condition scores, although indeed the Abstract condition was, objectively speaking, easier.

The conclusion to be drawn from this analysis, is that both the mentally handicapped and the language handicapped groups appear not to be so capable of using meaningful information from their environment in learning or problem-solving situations. This, of course, has interesting therapeutic implications. Conversely, normal children are able to compensate and enhance their problem-solving abilities, through the use of contextual or pragmatic cues.

Finally, we would like to conclude this chapter by reiterating that one of the apparent discrepancies of these results can be explained, if we bear in mind that certain ambiguities are merely different sides of the same coin and can co-exist, indeed must co-exist.

We are referring to two apparently contradictory results seen in this experiment: that, on the one hand, different language groups behave similarly in this experiment, leading us to the conclusion that the task is non-linguistic; and, on the other hand, that language handicapped children, who are matched according to their language ability, but who have superior perceptual skills, perform fractionally but not significantly better than their normal counterparts, who have less well-developed spatial perceptual skills.

If one were to retain the assumption that this was a non-linguistic task, then the results of the language handicapped group would be inexplicable, because, if that were the case, they should be performing according to their perceptual skills and not according to their language ability.

It is necessary to review what is meant by "non-linguistic" in this context, in order to elucidate this apparent confusion.
First of all, the two different language groups' (that is, Greek- and English-speaking) similar results prove that the task was "non-linguistic" to the degree that language-specific factors did not influence the children in their performance. However, the ability for spatial cognitive processing appears to be influenced

to some degree implicitly by a general linguistic function, as can be seen by the discrepancies in the results of the language handicapped group. It will be remembered that most of the subjects in the language handicapped group had no verbal output, although some had non-verbal means of communication. This produces a difficulty in the interpretation of the results since we cannot tell precisely which variable, that is, the input process or the output deficit, is the significant one. Suffice it to say, at this particular point, that further investigation is necessary in this particular field.

In the next chapter, we will present the experiment, which followed this one in the series, Experiment II. Experiment I had aimed at investigating the non-linguistic factors present in a spatial categorization task. In Experiment II, the aim was to investigate whether general verbal instructions, which would cue the subjects into the spatial aspect of the task, would help or hinder their performance of the task.

CHAPTER 4

Verbal Mediation and Spatial Categorization: Experiment II.

4.1 Introduction

In the previous chapter, the experiment, which was conducted, was designed in order to test whether spatial cognition is at any level independent of language. This was done through a spatial categorization task using different groups of children.

It was found that spatial cognition, as revealed by categorization tasks could be independent of language-specific variables on the level of visual-perceptual processing, but that perhaps language disability (or ability) in some way "seeps" into the semantic-pragmatic component of the task.

These results are interesting, even though they do not actually seem to further the language-thinking issue, because they seem to confirm that there are too many variables at stake in this complicated question. However, if one were to leave aside, for the time being, any high-level philosophical ambitions, and if one were to concentrate on amassing further information on the topic, it may be that some light may eventually be shed on the issue. With this in mind, we will continue the journey, by investigating one more quite fascinating aspect of spatial cognition and cognitive processing on a visual-perceptual or linguistic level.

The question we wished to test in this second experiment was whether, given the same experimental conditions, but adding a verbal cue to the instructions, the experimental subjects would be able to make different use of this information and thus cause further discrepancy in the experimental results.

Thus, in Experiment II, using the same test materials as in Experiment I, when the investigator showed the child how to proceed with the spatial sorting task in the test trial, she pointed to the Moving Object in the picture and told the child to notice where it was placed. She did not actually name the spatial position, nor did she encourage the child to do so. But it is quite clear that, this time, the child was given new information as to how he was expected to successfully negotiate the task. How the child was able to interpret or make use of this verbal information was reflected in the results of this experiment.

This experiment, therefore, was still non-linguistic in the specific sense, but had a verbal component, in that there were general verbal instructions, cuing the subject into the spatial dimension, involved in this categorization task.

Our hypothesis was that this would require more complex spatial information processing on the part of the subject, since he would have to match this new information to the strategy he had used to complete the task in the previous experiment. The question is whether this "new" information would be helpful, whether it would be confusing or whether it would not be put into use.

Furthermore, it was expected that there would be a differentiation in the way this information would be used by each subject group. For instance, the mentally retarded group may find it especially difficult to integrate this new information. On the other hand, would the language handicapped groups become confused by the verbal information provided? If one were to assume that, in this experiment, words would be used as mediators in a non-linguistic task, how in fact would this affect children who find it difficult to make use of verbal information generally? The cross-linguistic group comparison might also result in some group differences, because language-specific instructions were now being used to mediate the categorization task. Therefore, in this case, it could be that language-specific factors, such as semantic or syntactic complexity may hinder one or the other group in their performance. There was no concrete evidence to corroborate this hypothesis, concerning either the English or the Greek languages, but it was an interesting point to speculate upon.

Finally, although the main question of this experiment was to test the effect, which verbal mediation would have in cuing children into the spatial aspect of this particular task, the results of this experiment could not be seen in vacuo, but they were, of course, compared to those of the previous experiment.

4.2 The Subjects

The subjects in this experiment were the same as those in the previous one. Briefly, there were four experimental groups with two age levels each.

The experimental groups were:

1. English children of normal intelligence
2. Greek children of normal intelligence
3. Greek language handicapped children
4. Greek mentally handicapped children

The age levels corresponded to the following chronological ages:

1. 2;6-2;11 years
2. 3;0-3;11 years

This was measured according to language age and perception age for the normal children; for language and perception mental ages in the mentally handicapped children; and just for language age in the language handicapped children. Further details of the matching of the experimental groups may be seen in Chapter 2.

The subjects had all previously been tested in Experiment I, before proceeding to Experiment II.

4.3 Test Materials and Conditions

The materials, used in this experiment, were exactly the same as those used in the previous experiment. This consisted of two packs of 18 cards each. These corresponded to the two experimental conditions, Abstract and Concrete.

4.3.1 Abstract Condition

The materials, used for this condition, were a pack of cards, which consisted of drawings of two-dimensional shapes with dots in one of three spatial configurations ("in´,"on" or "under"). These may be seen depicted in Figure 2:1, in Chapter 2.

4.3.2 Concrete Condition

The materials consisted of a pack of cards, which had drawings of pairs of three-dimensional objects in the same three spatial configurations as above (for instance, a cat in, on or under a car). These may be seen depicted in Figure 2:2 in Chapter 2.

It will be remembered that the common denominator in both packs of cards (and consequently in both experimental conditions) was that there were three possible spatial positions, in which the Moving Object could be in relation to the Fixed Object in the picture. In the Abstract condition, the Moving Object was always the same, that is, a red dot, whereas the Fixed Object was one of six shapes. In the Concrete condition, the Moving Objects were six familiar items (such as: cat, ball, bird, etc.), which were paired to six Fixed Objects (such as: car, cupboard, cage, etc.).

The two conditions were presented serially to the subjects, sometimes in the same session, sometimes after a break, which was never more than a day or two. This depended upon the subject's attentional ability.

As before, the conditions were alternated between subjects: some were tested with the Abstract condition first and others with the Concrete condition first.

4.4 Test Criteria

As in Experiment I, the test criterion was the number of errors which the subject made during the task (ERROR score). Each subject had a separate ERROR score for each condition: Abstract or Concrete.

4.5 Procedure

The testing conditions were the same as those in the previous experiment: that is, in the playgroup or nursery of each subject. (For further details, please refer to Chapter 2.)
The test itself was preceded by a test trial, in which the subject was shown what to do by the experimenter.

4.5.1 Abstract Condition

Test Trial: The experimenter placed the example set (squares with dots) in front of and facing the child. She placed the rest of the pack, which was already shuffled, in a pile face down in front of her. The experimenter pointed, in turn, to the three cards which were on the table, and specifically, she drew attention to the dots by saying:

E: "Look at where this dot is! Now look at that dot....and now look at this last one!"

The experimenter did not name the spatial position of the dots, but merely drew attention by pointing to them, and cued the child to the fact that their position was of interest.

The experimenter continued the test trial by picking up one of the cards from the shuffled pile and by showing it to the child.

She told the child to look at the dot on the card.

E:" Look at the dot on this card. I´m going to put this card that I´m holding with this one here, because these two cards have dots in the same place."

She then points to the appropriate card in the example set on the table and places the card on that pile.

She proceeds with the test trial by picking up another card from the shuffled pile. She repeats the whole procedure, by pointing to the dot and asking the child to note "where" it is. Unlike the previous experiment, the experimenter does not repeat this procedure for all the cards during the test trial. She continues for approximately half the pack. She then shuffles the pack again and proceeds with the test proper.

It must be mentioned, at this point, that many of the children verbalized the position of the dot, that is, they said that it was "in", "on" or "under" correctly. This was not acknowledged nor reinforced by the experimenter, neither were those children, who verbalized the spatial position of the dots incorrectly, corrected.

During the test, the experimenter showed the cards one by one to the subject and asked him to point to the pile on which it goes.

If the subject pointed to the wrong pile, the experimenter told him to "try again" until the subject pointed to the right pile.

As in the previous experiment, the experimenter noted the total number of errors that the subject made.

4.5.2 Concrete Condition

The presentation of the test material was made in precisely the same way as in the Abstract condition. The example set, the spoon and the glass, were placed in front of the subject and the experimenter then picked up a card from the shuffled pile. She pointed to the Moving Object on it and asked the subject to notice "where it is". She then proceeded to match the spatial position in question with one of those in the example set, for instance:

E: "Look at where the cat is. It´s in the same place as this spoon. So, I´m going to put them together."

Again the experimenter repeats the process a few times and then asks the child to do the task.

The experimenter again notes the total number of errors, which the child makes.

As already noted, all of the above instructions were, of course, given in Greek to the three Greek-speaking groups. A full transcript of the Greek version may be seen in the Appendix.

4.6 Results

For statistical purposes, the experimental design was the same as the previous experiment:

1. One between subject variable (4 subject groups).

2. Two within subject variables (2 age levels and 2 experimental conditions, Abstract/Concrete).

It was, therefore, a 4 x 2 x 2 design. The results were analyzed with analysis of variance.

4.6.1 Main Effects for the ERROR Scores

In Table 4:1 and Figure 4:1, one can see a summary of the results by subject group, age level and experimental condition separately.

Two main effects were found:

a. between subject groups ($F=7.958$, $df=3/71$, $p=<0.001$) (See Figure 4:2)

Figure 4:1
Result Summary for Experiment II
(Subject Group x Age Level x Condition)

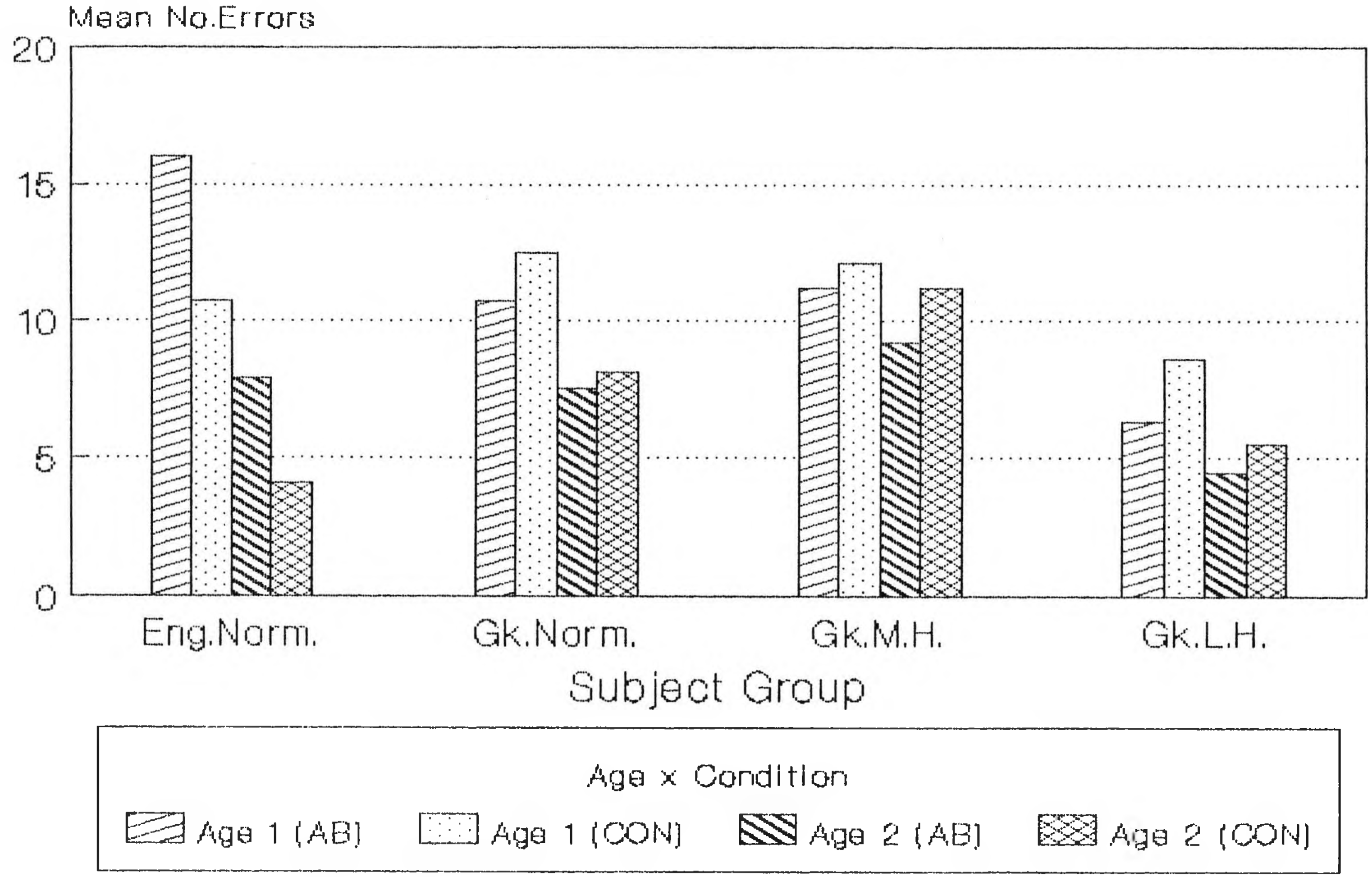
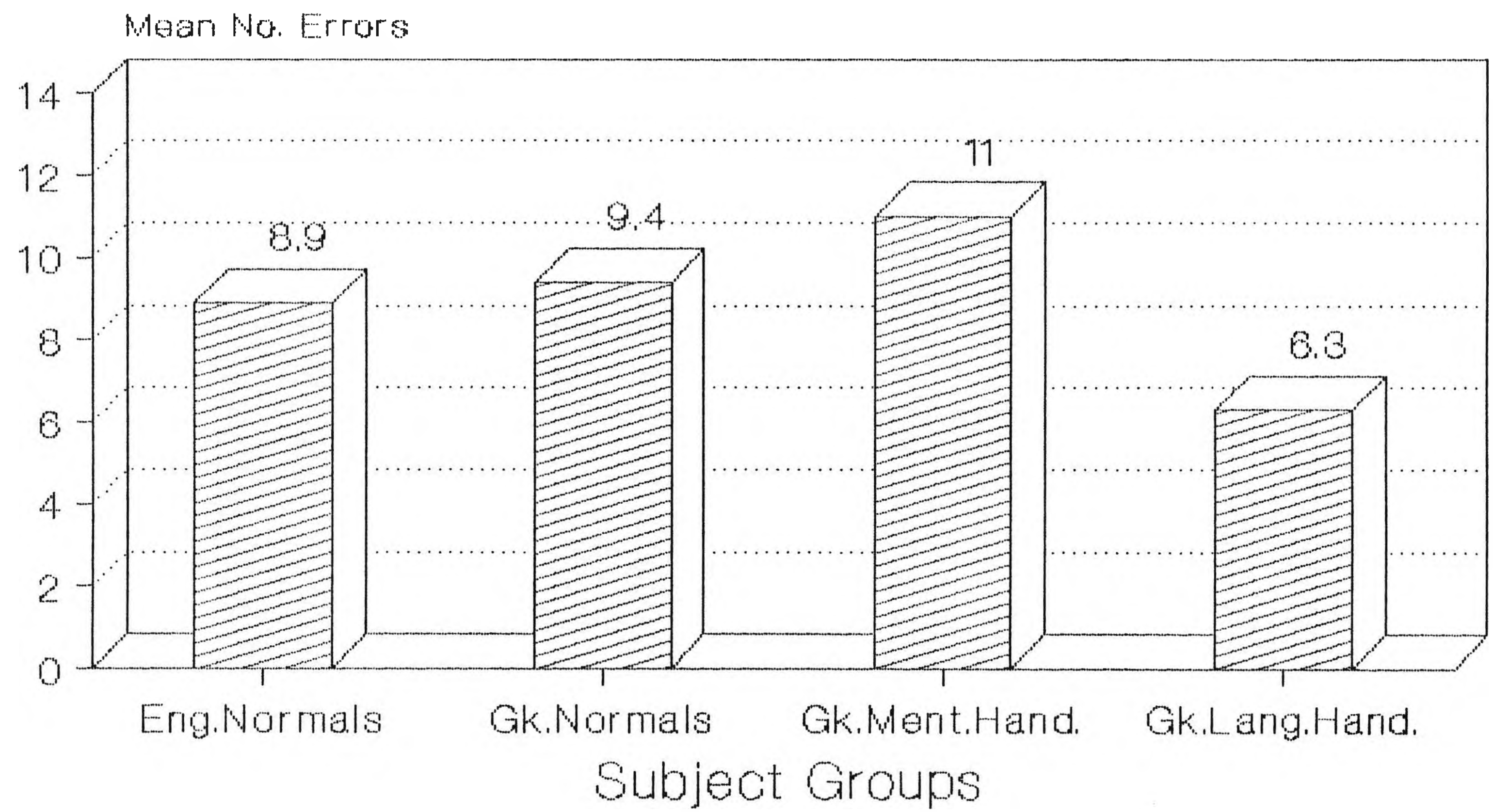


Figure 4:2
Main Effect between Subject Groups
in Experiment II.



$F=7.958$, $df=3/71$, $p<0.001$

b. between age levels (F=33.827, df=1/71, p=<0.001)

(See Figure 4:3)

No main effect was found between Abstract/Concrete conditions.

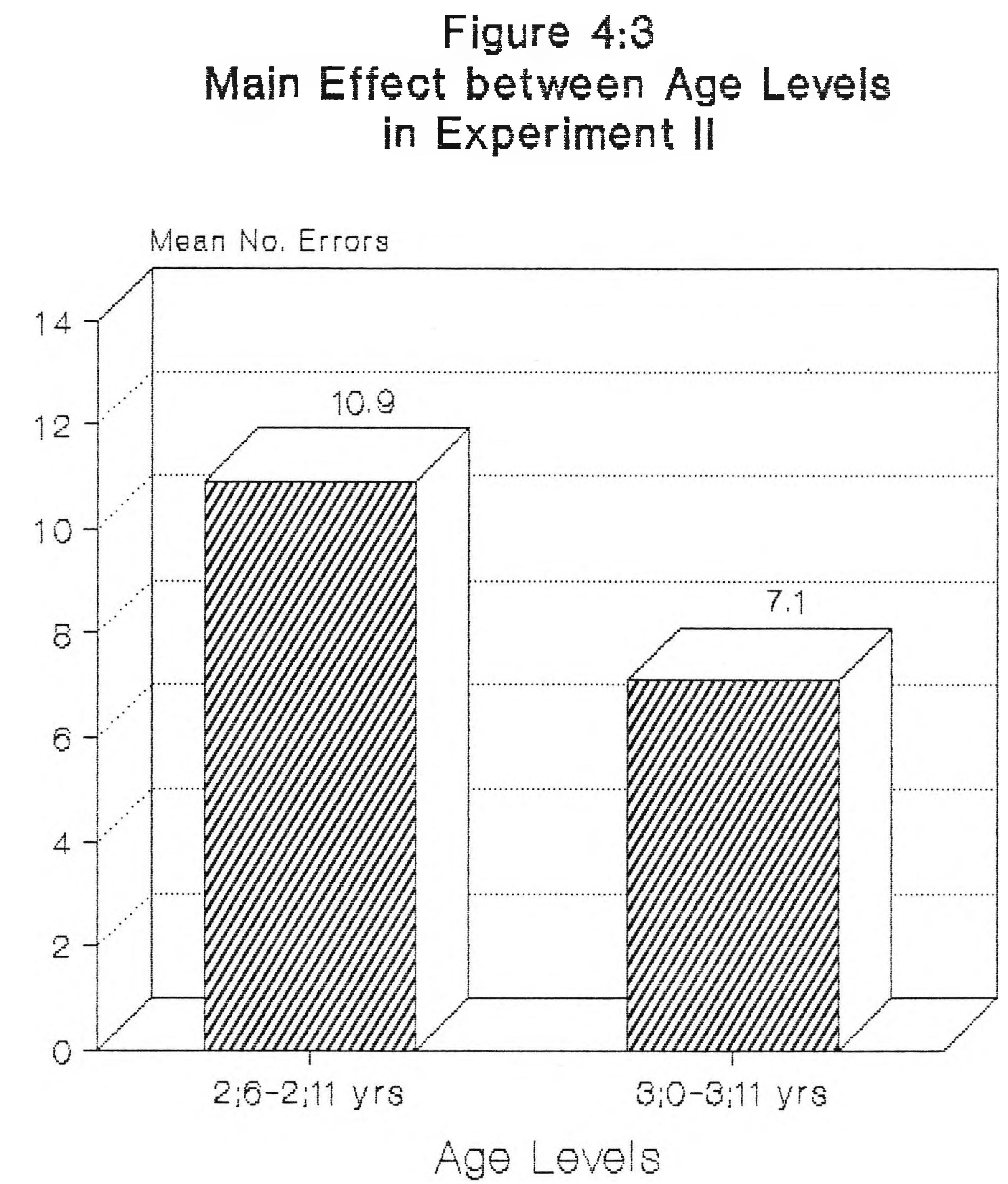
TABLE 4:1 Result Summary for Experiment II:

Mean Error Scores, out of a Maximum Possible of 30, for all the Subject Groups, according to Age Level, and Abstract/Concrete Condition.

	Eng.Norm. Ss.		Gk.Norm. Ss.		Gk.M.H. Ss.		Gk.L.H. Ss.	
Age Level	Ab.	Con.	Ab.	Con.	Ab.	Con.	Ab.	Con.
1	16	10.8	10.7	12.5	11.3	12.1	6.3	8.6
*	(3)	(3.5)	(1.5)	(2.5)	(3.6)	(1.6)	(3.3)	(4.4)
2	7.9	4.1	7.5	8.0	9.3	11.3	4.6	5.6
	(5.2)	(3.5)	(3.9)	(4.4)	(2.8)	(3.5)	(3.2)	(4.7)

* Standard Deviations are given in brackets.

With respect to the different subject groups, it was necessary to analyze the data further. This was done with unplanned comparisons, using the Newman Keuls test (the Behrens-Fischer approach).



F=33.827, df=1/71, p<0.001

The results of this test were as follows:

1. Most surprisingly, the language handicapped children actually made the fewest errors and performed significantly better than both the normal groups.

2. Both the normal groups, English and Greek-speaking, performed significantly worse than the language handicapped group. They did not, however, differ significantly from each other nor from the mentally handicapped group.

3. The mentally handicapped group performed significantly worse than the language delayed group, but not from the two normal groups.

The results of the Newman Keuls test for the main effects of subject group can be seen in the Appendix.

The other significant result is the main effects for the age level. As before, the children at the "older" age level performed better than the ones at the "younger" age levels. Since there were only two age levels, it was not necessary to investigate this any further.

4.6.2 Interactions for the ERROR scores

Two significant interactions were found for the ERROR scores:

1. an interaction between group and age level (F=4.828, df=3/71, p=<0.005)
2. an interaction between group and condition (F=9.469, df=3/71, p=<0.001)

Figures 4:4 and 4:5 respectively show a graphic representation of these results.

Independent t tests were carried out on the data in the Group x Age interaction, the results of which may be seen in Table 4:2.

TABLE 4:2 Independent t Tests of the Interaction between Group and Age Level in Experiment II.

	Eng. Norm.	Gk. Norm.	Gk. M. H.	Gk. L. H.
	N=23	N=21	N=16	N=19
Age Level				
1 (Errors)	13.5	11.6	11.7	7.5
2 (Errors)	6.04	7.8	10.3	5.1
t value	6.109	3.561	0.580	1.513
df	21	19	14	17
p	<0.001*	<0.01*	n.s.	n.s.

N.B. * denotes significance

Related t tests were carried out on the Group x Condition interaction, the results of which may be seen in Table 4:3.

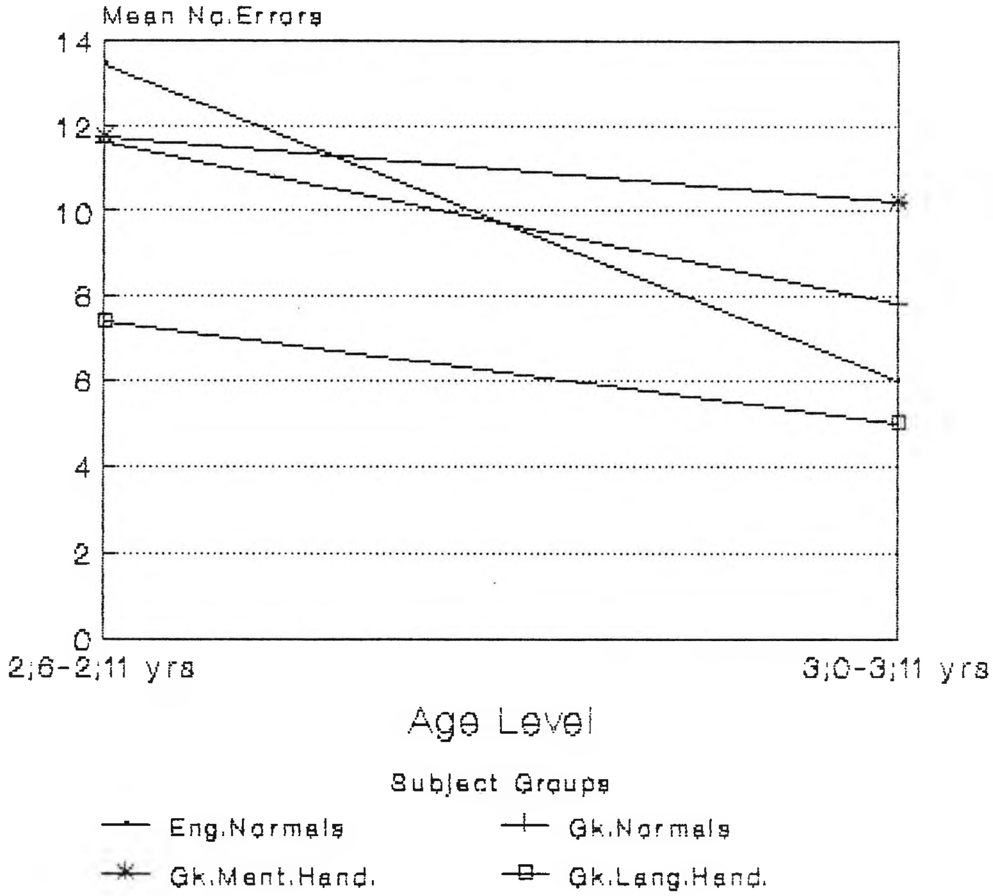
In summary, for the Group x Age interaction, the following was found: there was a significant difference in age levels in the English normal children and in the Greek normal children, but the difference in age levels was not significant in either the mentally handicapped or the language handicapped groups. In other words, both the normal groups improved significantly in their performance as they grew older, but the same was not true of the other two groups as mental age increased.

TABLE 4:3 Related t Tests of the Interaction between Group and Abstract/Concrete Conditions.

	Eng. Norm.	Gk. Norm.	Gk. M. H.	Gk. L. H.
	N=23	N=21	N=16	N=19
Mean Errors:				
Abstract	11.1	8.9	10.3	5.5
Concrete	6.7	10	11.7	7.2
t value	3.578	-1.304	-2.105	-2.149
df	22	20	15	18
p	<0.01*	n.s.	<0.05*	<0.05*

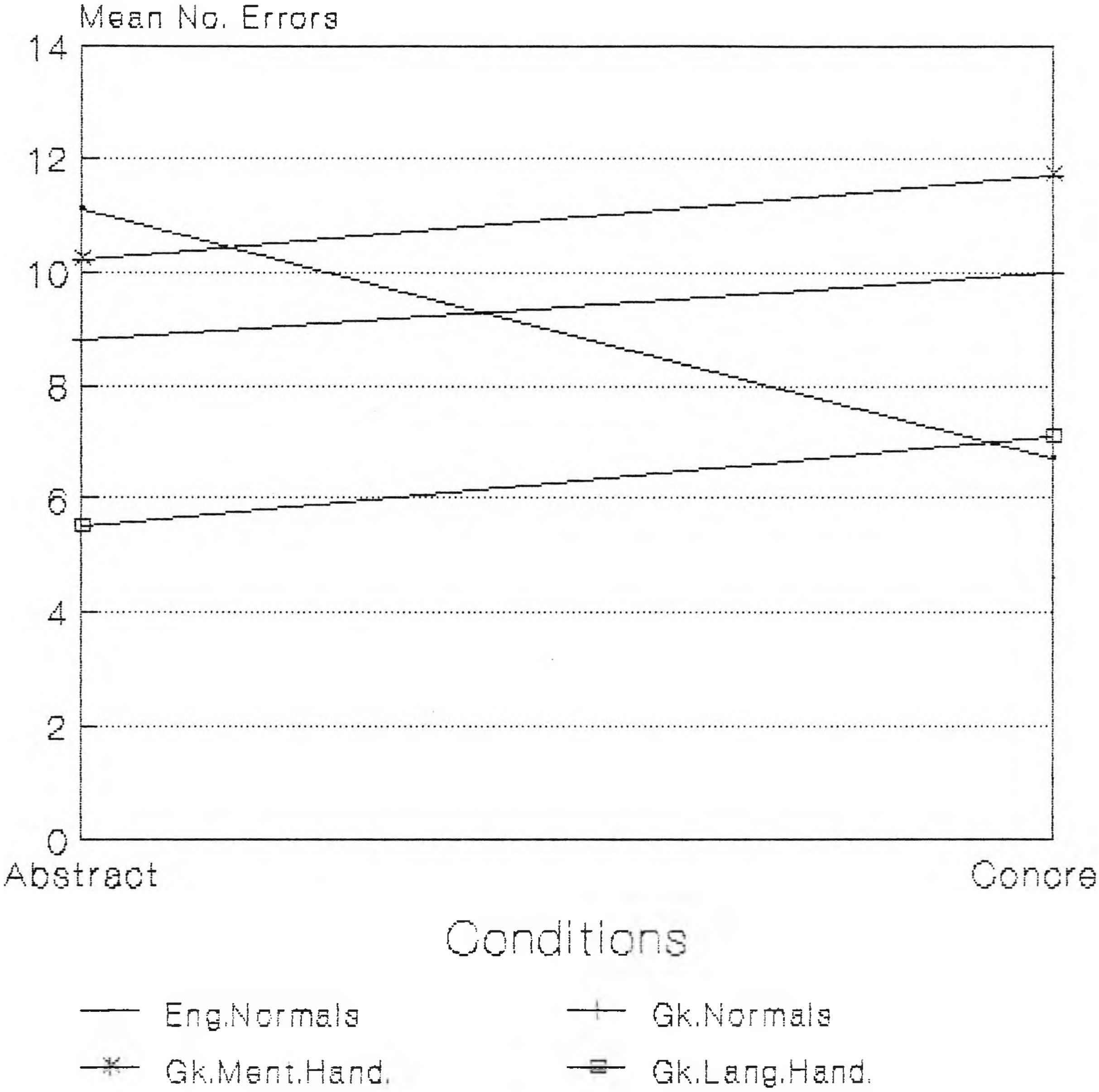
N.B. * denotes significance

Figure 4:4
Interaction between Group and Age Level
in Experiment II



F=4.828, df=3/71, p<0.005

Figure 4:5
Interaction between Group and Condition in Experiment II



F=9.469, df=3/71, p<0.001

For the interaction between Group and Abstract/Concrete Condition, the following was found:

1. The English normal group performed significantly better in the Concrete condition.

2. The difference in the ERROR scores for Abstract and Concrete conditions for the Greek normal group was not significant.

3. The language handicapped group showed a significant difference in their Abstract/Concrete scores, performing better on the Abstract condition, as they had done in the previous experiment.

4. The mentally handicapped scores barely reached significance, and as can be seen, were also better on the Abstract condition.

4.6.3 Result Summary

The results of this experiment, in which subjects were given the same material to sort into specific spatial categories, as in Experiment I, but which differed from this last experiment in that the subjects were given verbal cues to focus on the relevant dimension of the task, were:

1. The language handicapped group were significantly better at

the task than all the other subject groups, including the normal groups.

2. The English and Greek normal groups showed no overall difference in their ERROR scores, and their performances improved with increasing age.

3. Although the Greek normal group did not show a significant difference between their Abstract and Concrete scores, the English normal group did. The latter performed significantly better in the Concrete condition. Further investigation of this data was necessary.

4. The Greek mentally handicapped group showed no overall difference in errors from the normal groups. However, when compared with the language handicapped group, there was a significant difference, in that the language handicapped group performed with considerably less errors.

5. Both the normal groups improved their performance with increasing age significantly, but this was not true of the language handicapped and the mentally handicapped groups. Both these two groups showed a slight improvement with mental age level, but it did not prove to be significant.

6. The language handicapped and the mentally handicapped groups

performed significantly better in the Abstract condition. The Greek normal children also performed better in the Abstract condition, but this was not significant.

4.7 Discussion and Comparison with the Results of the Previous Experiment

Many fascinating points arise from the results of this experiment and, of necessity, in order to understand them better, one must compare these results with those of the previous experiment.

The first characteristic of the present results is a significant difference between Abstract and Concrete conditions in the English normal children, which was however not apparent for the Greek normal children.

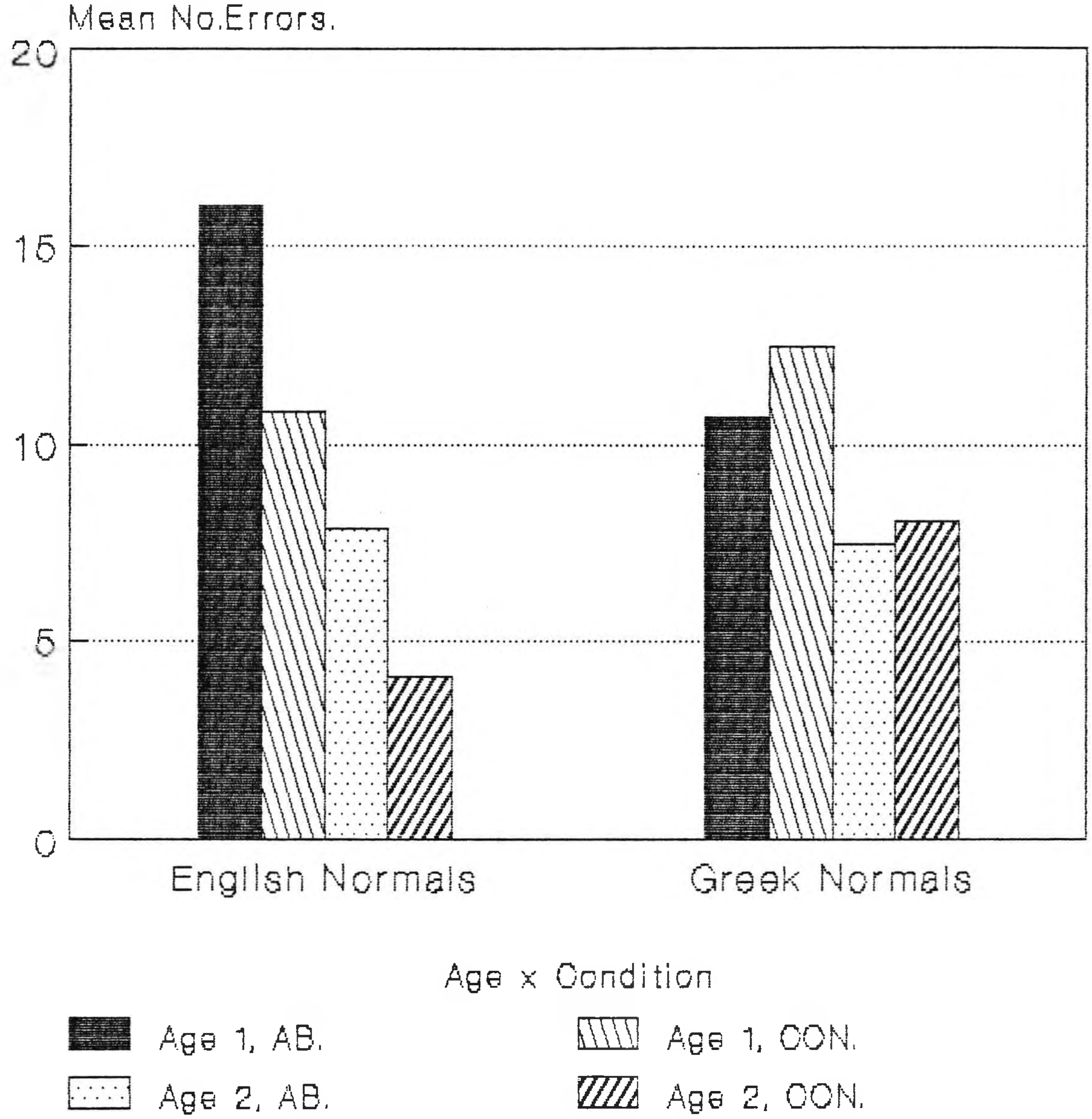
In the previous experiment, the results had satisfied the hypothesis that in a non-linguistic spatial sorting task of this nature, we would not expect to see any language-specific differences. Thus, no significant differences were seen between the two normal groups, neither in their overall ERROR rates nor specifically between the two conditions. In the present experiment, we are faced not with an overall difference between the two normal subject groups, but with a specific difference in behaviour in one of the two groups. We are, of course, referring to the fact that the English children are significantly better at the Concrete than at the Abstract task, a result which was not repeated by the Greek normal group.

In Figure 4:6, a summary of the results of Experiment II may be seen for the two normal groups: the differences between the two groups' results are striking. A closer inspection of the results reveals a discrepancy between Abstract and Concrete scores for the two groups at two specific points. Firstly, the younger English children appear to be making **more** errors in the Abstract condition than their Greek counterparts, whilst this latter group appear to be making approximately the same number of errors in both Abstract and Concrete conditions. The difference between the the younger English and Greek groups' errors in the Abstract condition was found to be significant ($t=4.98$, $df=16$, $p<0.001$). Secondly, the older English children appear to be making **less** errors in the Concrete condition than their Greek counterparts. This difference was again found to be significant ($t=3.1$, $df=24$, $p<0.01$). The new facts supplemented those which analysis of variance had previously shown us, concerning the two normal groups. These were:

1. that there was no overall significant difference between the results of the two normal groups, and

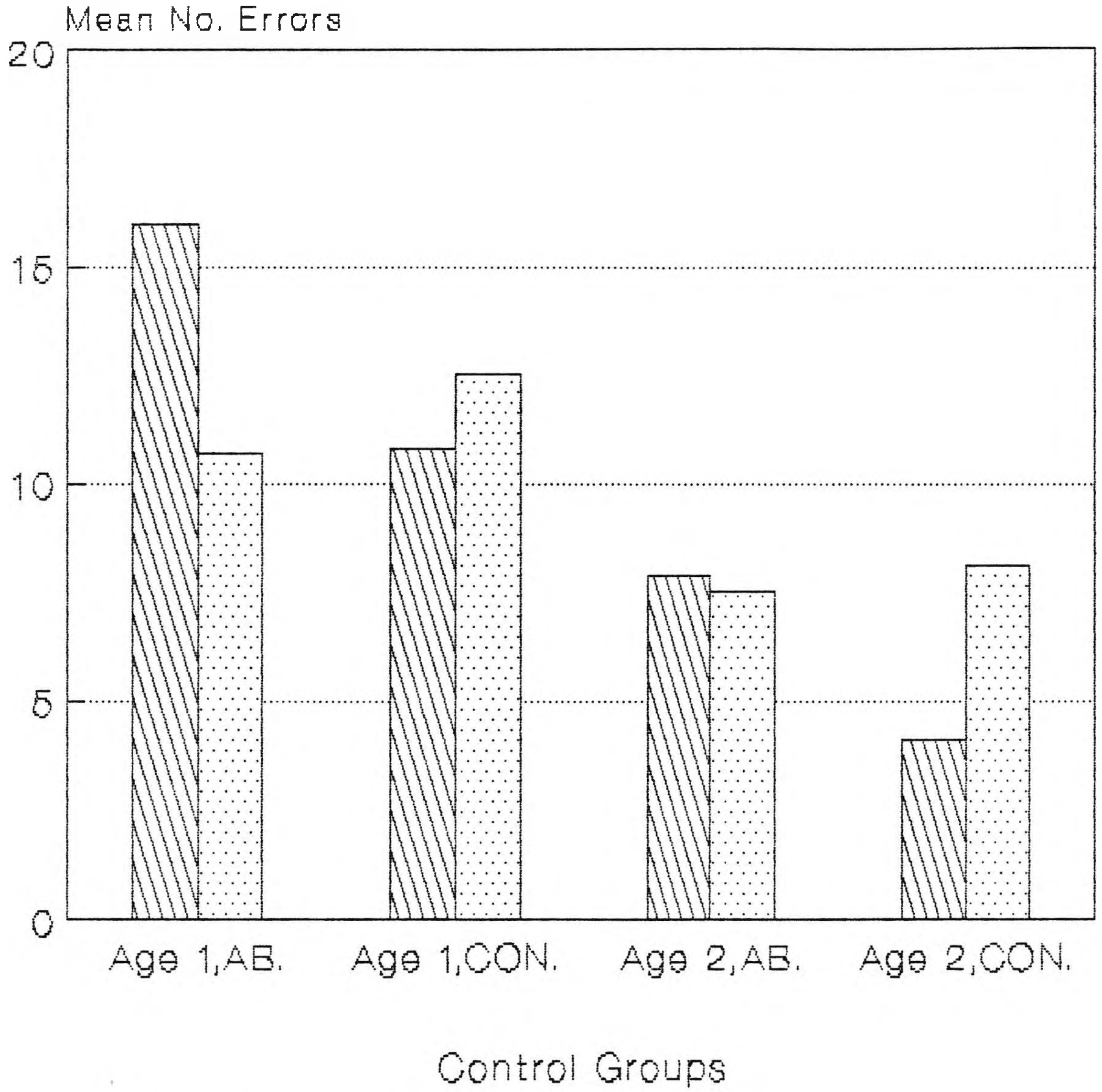
2. that the English group had a significant difference between their Abstract and Concrete conditions, making more errors in the Abstract one.

Figure 4:6
Comparison between Control Groups by Age Level and Condition



Age Level 1- 2;6-2;11 yrs.(Age 1).
Age Level 2- 3;0-3;11 yrs.(Age 2).
Conditions- Abstract (AB)/Concrete (CON)

Figure 4:7
Comparison between Control Groups by Age Level and Condition



Significant Differences between Groups
- Age Level 1, Abstract Condition and
Age Level 2, Concrete Condition

Since the only new factor introduced in the present experiment was the verbal instruction given to the subjects, we are forced to turn to these verbal instructions, in order to shed some light on this mystery.

It appears, specifically, that something in the instructions for the Concrete condition is particularly elucidating for the older English-speaking subjects, since there is such a dramatic difference between their Abstract and Concrete scores. Here, one is obviously faced with what we had hypothesized would be a language-specific difference: that is, the verbal cue appears to be selectively informative in only the one language and, as a result, to serve as a successful mediator for the task's improved completion. We must, however, be aware that this is probably true at a particular stage in the development of the English children's language learning, since it is not obvious at the younger age level (Figure 4:7). Here, we observed the reverse to be true: in other words, the same verbal instructions appear to be hindering the younger children's performance in the Abstract condition, since in this latter they performed significantly **worse** than their Greek counterparts. Another suggestion, which is equally feasible, is that something in the Greek version of the verbal instructions actually facilitated the younger Greek group in their performance. These are all possibilities, which cannot be solved conclusively at this point and are due to the different linguistic evocations of each particular language, problems which are inherent in any task involving translation.

We will, however, allow ourselves to make suggestions why the Greek and English versions of the verbal instructions appear to be causing a difference in the two language groups at this point in the experiments. In order to attempt to make some relevant comments, one must look carefully at what was actually said by the experimenter both in English and in Greek.

The instruction aimed to cue the subject into making a comparison between the placement of objects in relation to each other. The children were told to find something which was "in the same place" as something else. In Greek, it appears that the instruction was not helpful for the older children, in fact, if anything (since their performance in the Concrete condition was slightly worse than in the Abstract condition), it served to make things a little more difficult for them. It is interesting to note that this is consistently so for all of the Greek-speaking groups.

The semantic concept of "in the same place" is rarely verbalized in Greek: it suffers from a semantic complexity, which results in its use not being common-place. The Greek word, which one had to use in order to express the meaning which we wanted, to cue the child into the location of a particular object, was "thesis". This word, interestingly enough borrowed by the English language to mean "dissertation", denotes "place", "position" or "location" in Greek, but can also be used figuratively to mean "opinion" or "viewpoint". Since there is no simpler way of saying "in the same place" in Greek, it can be seen that the Greek word "thesis" has a much richer semantic content than the English word "place", which has a much more specific usage. This ambiguity in the Greek language may be the reason why these particular instructions did not facilitate the Greek-speaking groups, who, possibly, were too young to be able to interpret this word correctly.

For the English children, on the other hand, a familiar semantic concept, such as "in the same place", appears to give "meaning" to the perceptual-conceptual aspect of the task, and the subjects appeared, on the whole to be able to make use of this knowledge in their categorization of the concrete objects. It is interesting to note that, if this is the case, this same knowledge appears to have impeded their performance in the categorization of **abstract** objects, where it was "meaningless" and where solution depended primarily on visual spatial aspects, irrespective of pragmatic factors.

If we assume that some sublinguistic labelling was being carried out by the subject whilst completing the task, this labelling would, of course, be more successful with the concrete, and more semantically familiar, objects than with the unfamiliar abstract dots and shapes.

In fact, the instructions, in the Abstract condition, appear to have been a hindrance in the English children's performance. The reason for this may be language-specific yet again and, furthermore, seems to involve the integration of the conceptual, perceptual and linguistic factors of the task. In the Abstract task, the object of the task was to sort shapes and dots according to the latters' positions. Naturally, for children under three years of age, this was a difficult task, becoming even more difficult because they were probably unfamiliar with "dots" and "shapes". Although the younger English children appeared to be confused by the verbal instructions given to them, Greek children of the same age found the instructions relatively helpful. As we are well aware, however literal one tries to be in one's translation from one language to the other, the semantics of each language cannot be translated literally. Thus, in this case, we see the following: in Greek, the familiar word for "dot" is "balitsa", which also means "little ball", the same "little ball" which any young child has some experience of throwing, rolling and kicking. It is possible that the discrepancy in the results between the English and the Greek groups may be due to this small, but significant detail. For, of course, a child comprehends a task differently when he is dealing with an impersonal and unfamiliar "dot", than when he is dealing with a conceptually and semantically familar "ball", with which he has had direct experience.

In conclusion, it seems that the most plausible explanation for this result rests on the language-specific properties of the verbal instructions given in the two different languages. This, of course, is a fascinating issue, which we are unable to solve at this point, nor to pursue further, but which is a spark for further, more in-depth research.

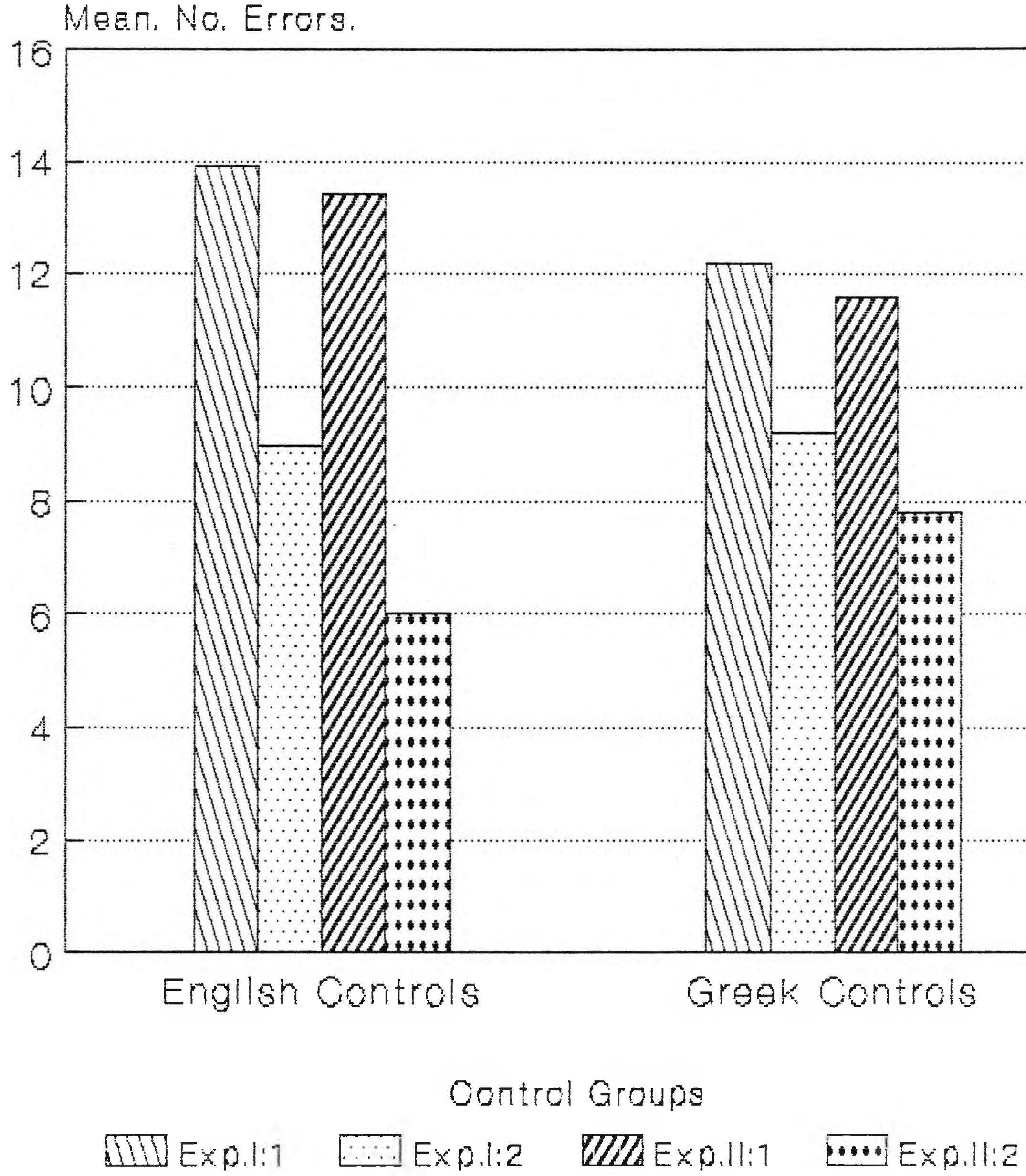
The next very important result of the second experiment is the fact that the language handicapped group performed significantly better than all the other groups. It will be remembered that our initial supposition had been that this group would possibly be hindered in their performance, once language was introduced, since they would not be able to make use of this linguistic information.

It has, of course, already been mentioned that the experimenter gave the verbal instructions to the subjects accompanied by pointing. It is highly possible that this pointing was the positive cue in the case of the language handicapped group, and not the verbal instructions being used. These language handicapped children, as we have already mentioned, had very well-developed visual-spatial skills, better than any of the other experimental groups. This fact, plus the well-known fact that gestural cues are important facilitators for children with language handicap in their problem-solving, probably could explain why the language handicapped children´s performance was so much better than the other children´s.

These language handicapped children, as in the previous experiment, performed significantly better in the Abstract task than in the Concrete task. The explanation for this is probably the same as that given in the discussion for Experiment I: that it was an easier task to perform on a perceptual level and had less semantic content. With the pointing, which had accompanied the instructions, serving as an attention-focussing cue, they could then use their superior age-related visual-spatial abilities most effectively with the Abstract task. However, additionally or alternatively, it should be noted that explicit verbal attention-focussing overall seemed to have helped the language handicapped subjects.

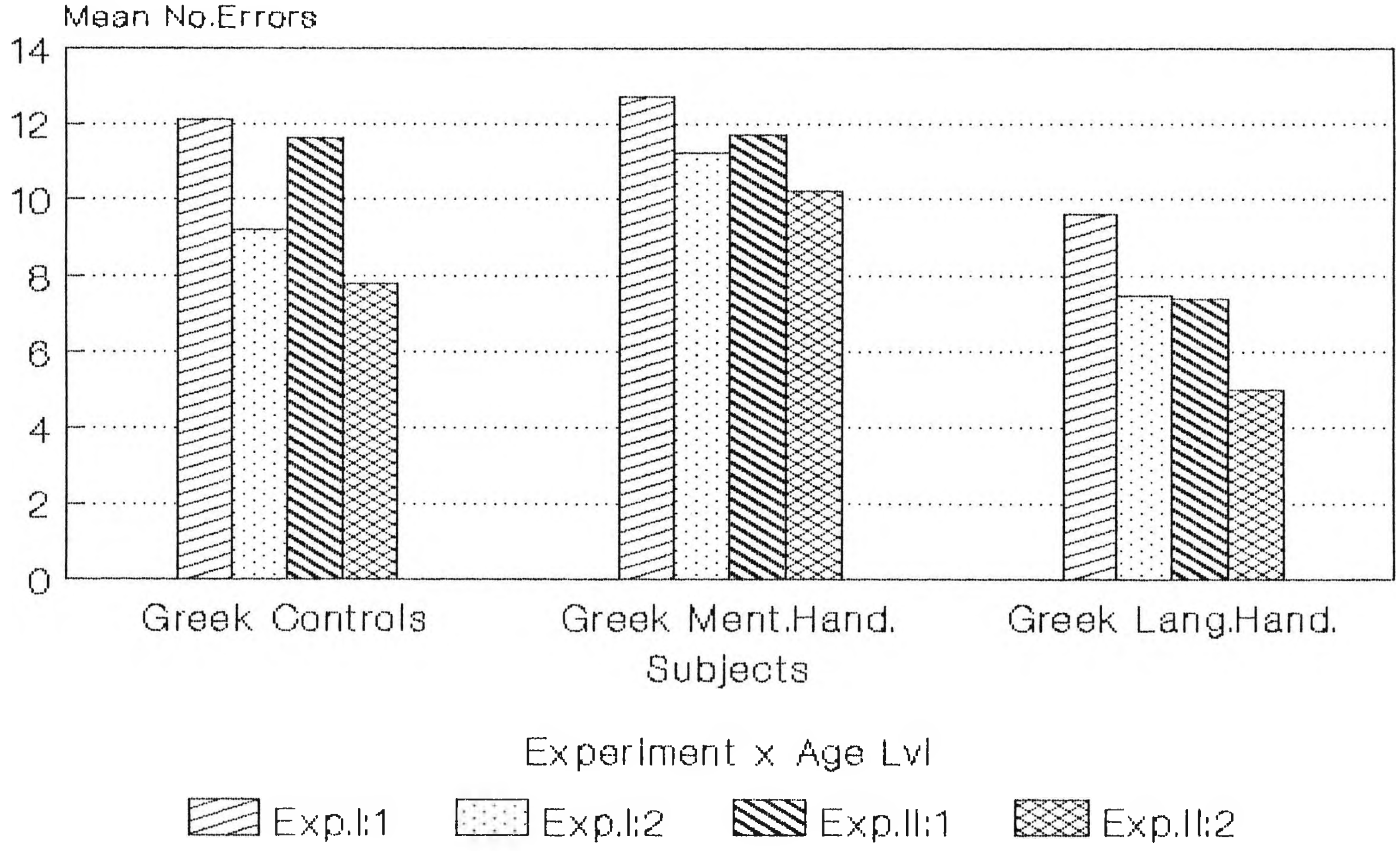
Finally, it is necessary to now compare the results of Experiments I and II, in order to ascertain whether in fact "cuing" to the spatial component, whether verbal or gestural, facilitates or hinders performance on these tasks. For this, we must turn to Figure 4:8 for a comparison of the results of the two control groups, and to Figure 4:9 for a comparison between the three Greek-speaking groups. Here we can compare the mean ERROR scores for the two experiments for all four experimental groups and at both the age levels.

Figure 4:8
Results of Experiments I and II
for the Control Groups



Exp.I:1- Age Level 1 in Exp.I.
Exp.II:2- Age Level 2 in Exp.II. etc.

Figure 4:9
Results of Experiments I and II
for the Three Greek Groups



N.B. Exp.I:1 = Age Level 1 in Exp.I,
Exp.II:2 = Age Level 2 in Exp.II,etc.

From this, the following can be observed:

1. Both of the younger age levels in both the English and the Greek normal groups have made no significant improvement in their scores after the verbal cues were given to them. This must mean that either they ignored the verbal instructions and continued using the strategy that they had used in Experiment I, or the instructions themselves were not useful and informative, so they discounted them.

2. In the older age level, one can see a significant improvement in the English normal group ($t=5.5$, $p=<0.001$). In the Greek normal group there was also significant improvement ($t=3.8$, $p=<0.01$).

3. As the language handicapped children, at both age levels, improved from Experiments I to II, it appears that the "cuing", either in its gestural or verbal aspects or both, was also helpful to this subject group. The difference between the scores for Experiment I and II, in the younger language handicapped age group is significant at $p=<0.001$ ($t=4.4$) and is similarly significant for the older age group ($t=5.5$).

4. The only experimental group which did not reveal any significant improvement from Experiment I to II was the mentally handicapped. It appears, therefore, that neither the verbal nor

the gestural cuing was of any use to them.

We may thus conclude that the younger age groups of normal children, who were under three years of age, did not seem to be able to make use of verbal or gestural cues, which could have served as mediators in problem-solving on this task. This is also true of the mentally handicapped groups, which do not appear to be able to use this information either.

After three years of age, the children in both normal groups were able to make constructive use of the verbal cues given to them, in order to improve their performance of this task.

The language handicapped children are also helped by "cuing", though in their case we assume that it was primarily the gestural component in the cue (pointing to the dot) which was of help to them. However, it is also possible that they were helped by explicit verbal cuing of their attention towards the relevant aspects of the task.

A difference between group performances for the Abstract and Concrete task was not only seen between the two normal groups, but was seen in the other experimental groups as well. For instance, the language handicapped group (as did the mentally handicapped group, to a much lesser degree) performed significantly better in the Abstract condition than in the

Concrete condition. As we already mentioned in the previous chapter, this was probably due to the fact that these children relied less on semantic-pragmatic cues and more on perceptual cues to solve the task, and since on a purely visual basis, the Abstract task was simpler, these children were able to perform better on it. It appears that normal children's performance depends much more on semantic-pragmatic factors.

In conclusion, while language-specific factors were held responsible for the Abstract/Concrete differences in the normal children, such differences in the language handicapped children were probably due to perceptually determined strategies, by which this group used to solve the task. On the other hand, as all children, who did better with the Abstract than the Concrete, were Greek-speaking, it may be that some language-specific factors in the instructions may have helped even the language handicapped children do better.

This experiment's results have led to some interesting hypotheses and speculations concerning the language-specific factors, which may aid or hinder in a conceptual task. This was especially interesting with regard to the language handicapped group, which so unexpectedly performed better than all of the other groups. Furthermore, our initial hypothesis, that the verbal instructions would cause some differentiation between the two normal groups, was confirmed.

In the next and final experiment of this series, an attempt was made to investigate whether specific verbal labelling, of the spatial concepts under investigation, would further help the subject groups in their performance of this spatial categorization task.

CHAPTER 5

Verbal Labelling as a Mediator in a Spatial Categorization Task: Experiment III.

5.1 Introduction

This experiment, the last of the series, like the others before it, consists of a spatial categorization task with abstract or concrete pictures. This experiment, however, differs from the previous ones in that the spatial concepts, which are the focus of this investigation, are now specifically named by the experimenter.

In the first experiment, no verbal instructions were given to the subjects: they were merely requested to look at the way the experimenter performed the task and then to repeat this as best they could. The results of this experiment led us to conclude that this task was not dependent on language-specific or cultural factors, since there were no differences between the English and Greek normal control groups. The Greek language handicapped group's significantly better score from the mentally handicapped group's score proved that this task depended primarily on visual perceptual categorization abilities, rather than on semantic-linguistic categorization abilities. However, it was also suggested that a semantic component could be discerned even in such a primarily non-linguistic task, because although the language handicapped group's performance was generally better than the normal groups', this difference was not significant. This was especially interesting in view of the fact that the language handicapped group were matched with the normal group for language scores, but had considerably higher visual perception scores. One can only, therefore, express the suspicion that, even at this level, spatial cognition is not entirely independent of semantic factors.

The second experiment consisted of a repetition of the above task with the same experimental groups and under the same conditions. The essential difference in the tasks was that the experimenter, this time, gave some clues as to what aspect of the display to pay attention to, whilst completing the task: this was done by pointing to the Moving Object in the pictures and asking the child to notice "where" this Moving Object was in relatian to the Fixed Object. He was then asked to place the card with another, which had the Moving Object "in the same place". These instructions seemed, on the whole, to help the subjects to integrate the semantic and visual information better than they had done in Experiment I.

However, the results of Experiment II were rather complicated and not entirely conclusive in every aspect. The English and Greek normal groups showed differences between their performances in the Abstract and Concrete conditions, which were significant.

This could only be explained in terms of language-specific differences in the instructions given.

The language handicapped group's performance was significantly better in Experiment II than that of any of the other groups, which was surprising, since it seemed to imply that verbal cuing facilitated them in this task. It may, however, have been the pointing, which was of real help to them.

As for the mentally handicapped group, they again performed generally as did their normal mental age counterparts, but peculiarly enough, did not appear to improve their performance from one mental age level to the other, which is probably due to their much slower rate of development. This was also true of the language handicapped group, most probably for the same reasons.

The findings of these experiments partly concurred with our initial hypotheses and partly raised further questions, which could not be readily answered.

This final, third experiment was designed as the logical sequence of the previous ones. This time a specific verbal label was given to the spatial concepts under scrutiny, that is: "in","on" and "under". The subject was requested to repeat the sorting task, which was by now familiar to him, but he was given the "solution" to the mystery. The experimenter told the subject that he was to put all the pictures whose Moving Objects were "on" the Fixed Objects together, all the ones whose Moving Objects were "under" the Fixed Objects together, and all the ones whose Moving Objects were "in" the Fixed Objects together. The categories were not only semantically determined, but they were actually verbalized by the experimenter. The task now demanded the ability to match the semantic and spatial perceptual components of the pictures: that is, the word to the spatial configuration on the picture.

The primary question asked in this experiment was whether this information would further facilitate the task and whether it would be expressed in an improvement in the performance of all the experimental groups and at both the age levels. It was expected that, since the instructions were this time explicit, all groups would benefit from this information, whereas in the previous experiment, the verbal instructions needed much more interpretation on the part of the subjects. Ives and Rakow (1983) observed that language facilitated correct responses in perspective tasks, by fostering the proper "selective organization" of the array. In this way, children as young as three years of age managed a task which Piaget and Inhelder's subjects had managed at around nine years of age.

The other question, which was of course asked, was whether the very specific differences in locative constructions between the English and the Greek languages would lead to a different rate in acquisition of these terms. As we have already mentioned, the English locatives seem to be characterized by linguistic diversity, in other words there are many terms for the same spatial concept, whereas the Greek locatives are characterized by linguistic complexity and a certain degree of ambiguity (see Chapter 2 for a more detailed analysis). Which of these two factors, if indeed any, play a primary role in the rate of acquisition of these semantic terms? The results of this experiment would possibly also shed some light on this question.

5.2 Subjects

The subjects used in this experiment were the same as those in the previous two experiments. These consisted of four groups in two languages:

1. English normal group N=23
2. Greek normal group N=21
3. Greek mentally handicapped group N=16
4. Greek language handicapped group N=19

Each subject group was divided into two age levels, which corresponded to the following criteria:

Age Level 1: Chronological age of 2;6-2;11 years for the normal groups; mental age in both language and visual perception of 2;6-2;11 years for the mentally handicapped subjects; mental age only in language of 2;6-2;11 years for the language handicapped group. This latter group's visual perception scores were much higher than any of the other experimental groups'.

Age level 2: Chronological age of 3;0-3;11 years for the two normal groups; mental age in both language and visual perception of 3;0-3;11 years for the mentally handicapped subjects; language mental age of 3;0-3;11 years for the language handicapped group, their visual perception scores again being higher.

Details of the matching of all of the subject groups may be seen in Tables 2:1 and 2:2 in Chapter 2.

5.3 Test Materials and Conditions

The materials for this experiment were the same as those in the previous two experiments. These consisted of two packs of cards (18 cards each), which corresponded to the two experimental conditions:

Abstract Condition: representations of two-dimensional shapes and dots. The shapes, except for the square were not recognizable by the subjects, since they were amorphous shapes. These shapes were the Fixed Objects of the spatial configurations. The Moving Objects were red dots and were either in, on or under the shapes. The full set of cards for this condition may be seen depicted in

Figure 2:1 in Chapter 2.

Concrete Condition: the materials for this condition consisted of pictorial representations of three-dimensional objects, which were familiar to the children. There were six Fixed Objects (car, cupboard, glass, etc.), which had corresponding Moving Objects (cat, ball, spoon, etc.). The spatial positions were the same as those in the Abstract condition. These are depicted in Figure 2:2 in Chapter 2.

5.4 Test Criteria

The testing situations were the same as those in the previous experiments. A few days, sometimes even a week, elapsed between Experiment II and III, mainly for practical reasons.

The test criterion was the same as that in the previous experiments, that is, the total number of errors made by the subject during testing (ERROR score).

5.5 Procedure

As in the other experiments, the subjects were given alternately the Abstract or the Concrete condition first. These were both preceded by a test trial.

5.5.1 Abstract Condition

Test Trial: The experimenter sat opposite the subject and placed the example set of three cards in front of the subject. The experimenter then proceeded to point to each card and to say:

E: "Here's a shape with a dot **on** it. Here's another shape with a dot **in** it. Now, this shape has a dot **under** it."

The experimenter then picked up a card from the shuffled pile, looked at it and showed it to the child, whilst commenting:

E: "On this card, the dot is **on** the shape. So, it's like this card"

She pointed to the card, already exposed on the table, which had a dot in the same spatial position as the card she was holding. She mentioned that these two cards "go together" and then placed the one card on top of the other.

The experimenter repeated this process with a new card from the shuffled pack, whilst all the time verbally labelling the spatial position of each dot, and explaining why she was sorting the cards in the way that she was doing. She did not complete the task, but broke off after a few cards, reshuffled the pack, leaving the example set on the table for the child to see. She then told the child that it was now his turn.

The experimenter showed each card to the subject and asked him to point to the pile where the card should be placed. If the subject showed the wrong pile, the experimenter asked the child to have another go, till the card was placed on the correct pile. Many children now named the spatial position out loud and this was acknowledged by the experimenter. The language handicapped children often used the sign for the spatial position shown to them. This, too, was acknowledged by the experimenter.

The number of errors made was noted.

5.5.2 Concrete Condition

Test Trial: The presentation of this material was the same as that for the Abstract condition. The example set of glasses and spoons in three spatial configurations was placed before the child and the experimenter pointed to each card, verbally labelling the spatial configuration on each card:

E: "Look, the spoon is **in** the glass, the spoon is **under** the glass and the spoon is **on** the glass."

The experimenter then picked up a card from the shuffled pile and showed it to the subject, saying:

E: "Now, look at this cat. It's **under** the car. Just like this spoon, which is **under** the glass."

The experimenter pointed to the card on the table, and then told the child that these two cards "go together".

The experimenter proceeded in this way with a few more cards, then she collected the cards, leaving the example set on the table. She shuffled the pack again and told the child it was now his turn to play.

The experimenter showed each card from the shuffled pack to the subject and asked him to point to where it should go. This was continued for the whole pack of cards, while the experimenter encouraged the child, as previously, to make correct placements.

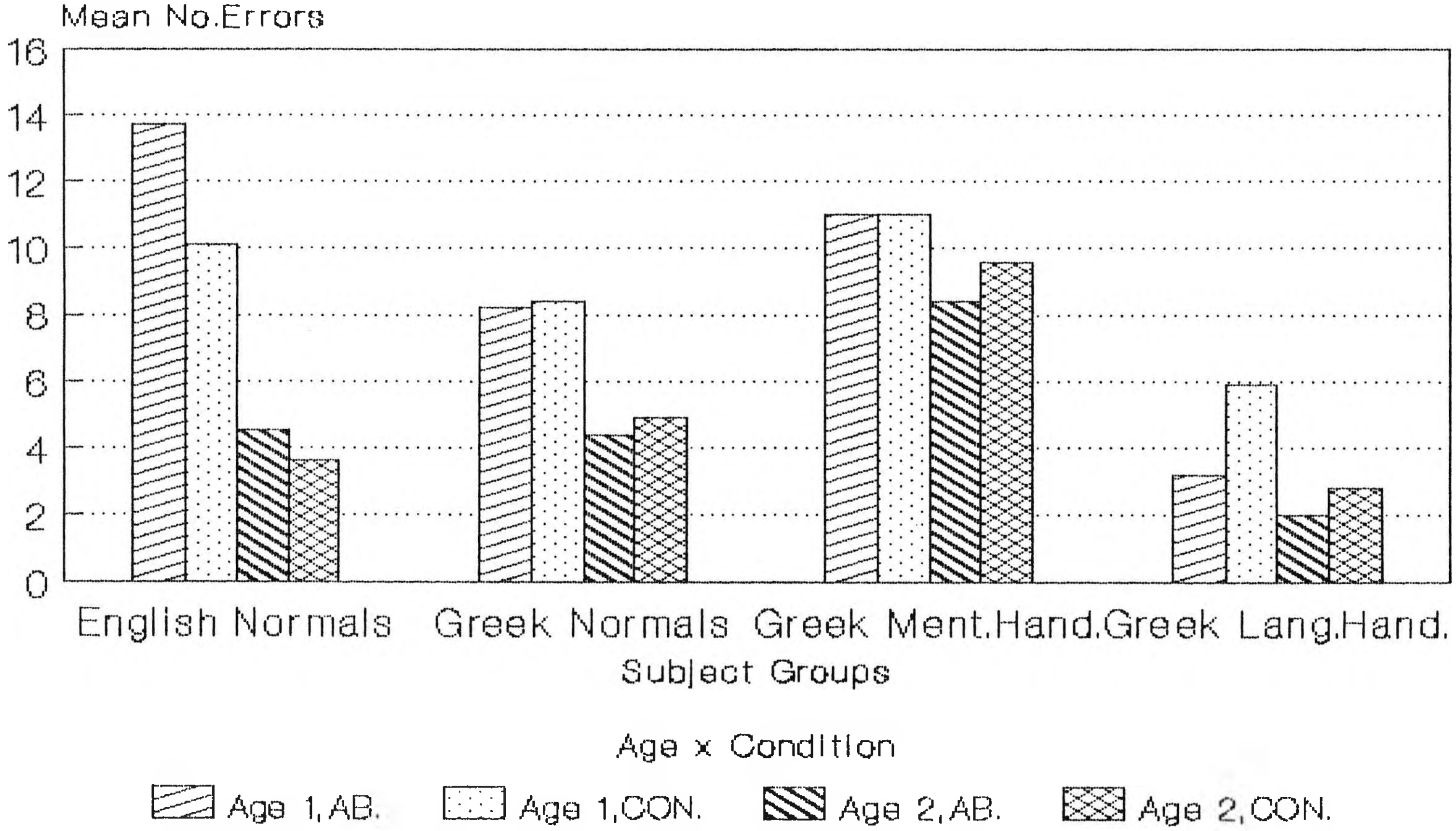
The number of errors made were noted.

The instructions given to the three Greek-speaking groups may be seen in the Appendix.

5.6. Results

A summary of the mean ERROR scores for each experimental group, by age level and condition, is shown in Table 5:1.

Figure 5:1
Result Summary of Experiment III
(Subject Group x Age x Condition)



N.B. Age 1 = Age Level 1 (2;6-2;11 yrs),
Age 2 = Age Level 2 (3;0-3;11 yrs),
Condition=Abstract(AB)/Concrete(CON)

Figure 5:1 shows a graphic representation of the results of this experiment, again by subject group and for each age level and condition.

The results were analyzed statistically, according to a 4 x 2 x 2 factorial design by analysis of variance.

TABLE 5:1 Result Summary for Experiment III:

Mean Error Scores, out of a Maximum Possible of 30, for all the Subject Groups, according to Age Level and Abstract/Concrete Condition.

	Eng.Norm.		Gk.Norm.		Gk.M.H.		Gk.L.H.	
Age Level	Ab.	Con.	Ab.	Con.	Ab.	Con.	Ab.	Con.
1	13.7 *(1.8)	10.1 (3.4)	8.2 (3.7)	8.4 (4.1)	11 (2.3)	11 (2.8)	3.2 (3.2)	5.9 (3.5)
2	4.5 (3.0)	3.6 (3.5)	4.4 (3.8)	4.9 (3.2)	8.4 (3.6)	9.6 (3.3)	2 (2.5)	2.8 (1.9)

* Standard Deviations are given in brackets.

5.6.1 Main Effects for the ERROR Scores

Two main effects were found for these results:

a. between subject groups ($F=16.25$, $df=3/71$, $p<0.001$)

b. between age levels ($F=40.13$, $df=1/71$, $p<0.001$)

These main effects are shown graphically in Figures 5:2 and 5:3 respectively.

There was no overall difference between the Abstract and Concrete conditions.

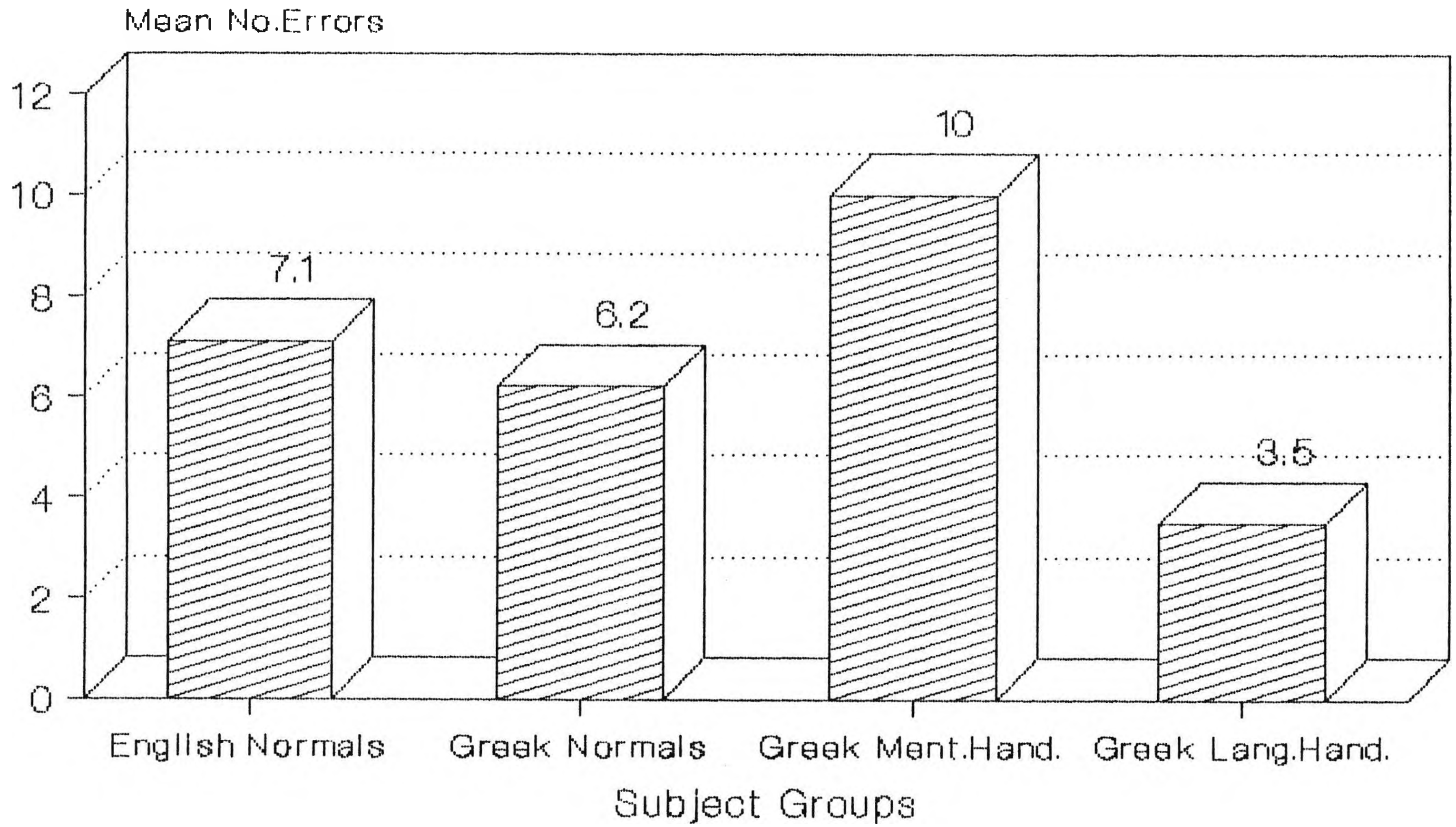
It was necessary to further analyze the main effect of the subject groups, since there were four groups. This was done using a Newman-Keuls test, through the Behrens-Fischer approach. The table showing the statistical results of this unplanned comparison may be seen in the Appendix.

In summary, the results of the Newman-Keuls test were the following:

1. Both the English and Greek normal groups were performing at approximately the same level and there was no significant difference between their scores, when taken as a whole.

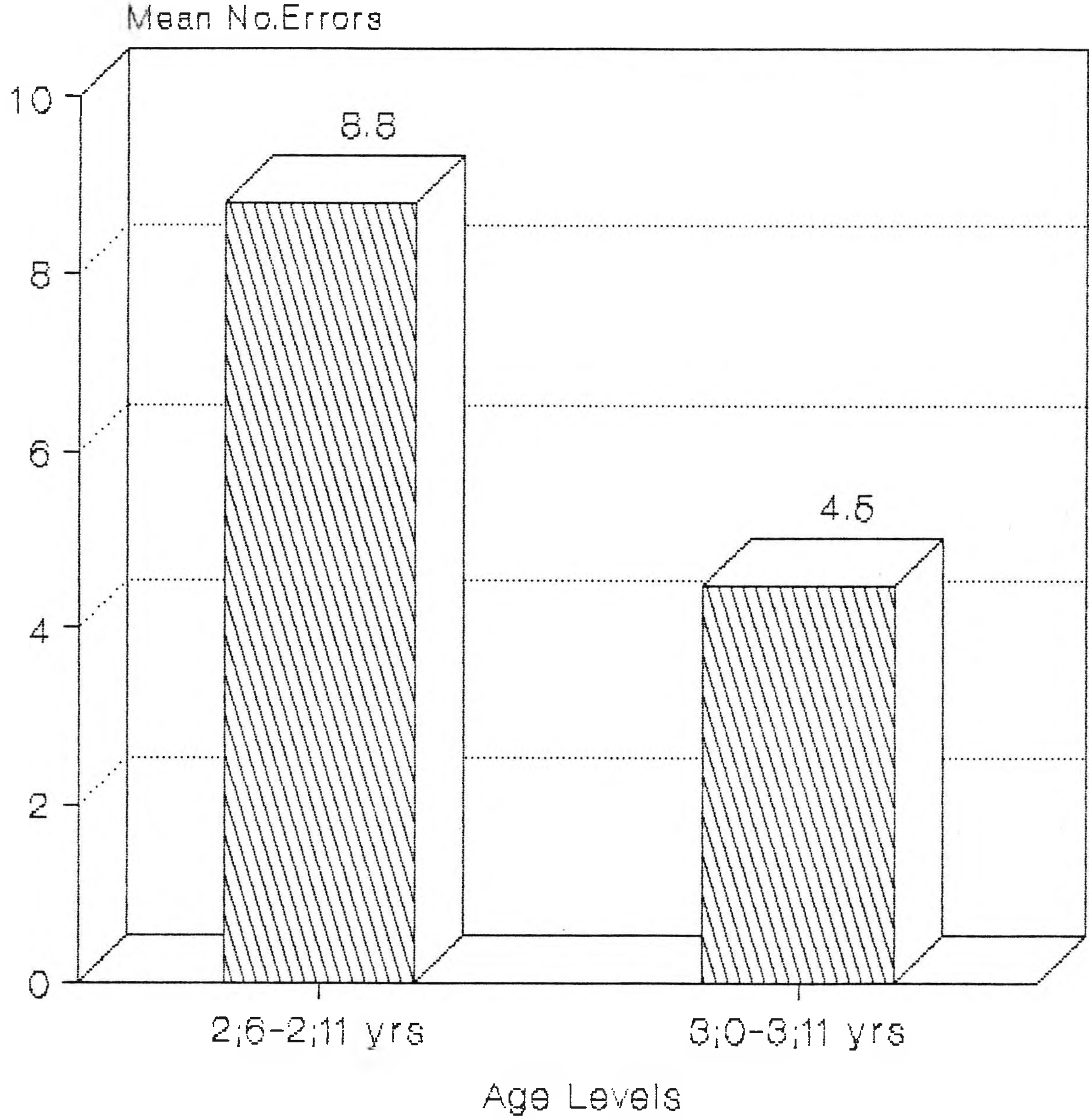
2. Both the normal groups performed significantly better than the

Figure 5:2
Main Effect between Subject Groups
in Experiment III



F=16.254, df=3/71, p<0.001

Figure 6:3
Main Effect between Age Levels
in Experiment III



F=40.129, df=1/71, p<0.001

mentally handicapped group, but significantly worse than the language handicapped group.

3. The mentally handicapped group made significantly more errors than every other group, and conversely the language handicapped group made significantly less errors than every other group.

As regards the age level difference, yet again the main effect shows that the "older" children made less errors than the "younger" children. This was a general trend, which was to be expected, and which needed no further elucidation.

5.6.2 Interactions for the ERROR Scores

Two interactions were found in the ERROR scores of Experiment III. These were:

a. between subject group and age level ($F=5.85$, $df=3/71$, $p<0.001$)

b. between subject group and condition ($F=5.24$, $df=3/71$, $p<0.002$)

A graphic representation of these results may be seen in Figures 5:4 and 5:5 respectively.

Of particular interest in these results is the English normal group's dramatic difference between the two age levels, which is

Figure 6:4
Interaction between Subject Group & Age
in Experiment III

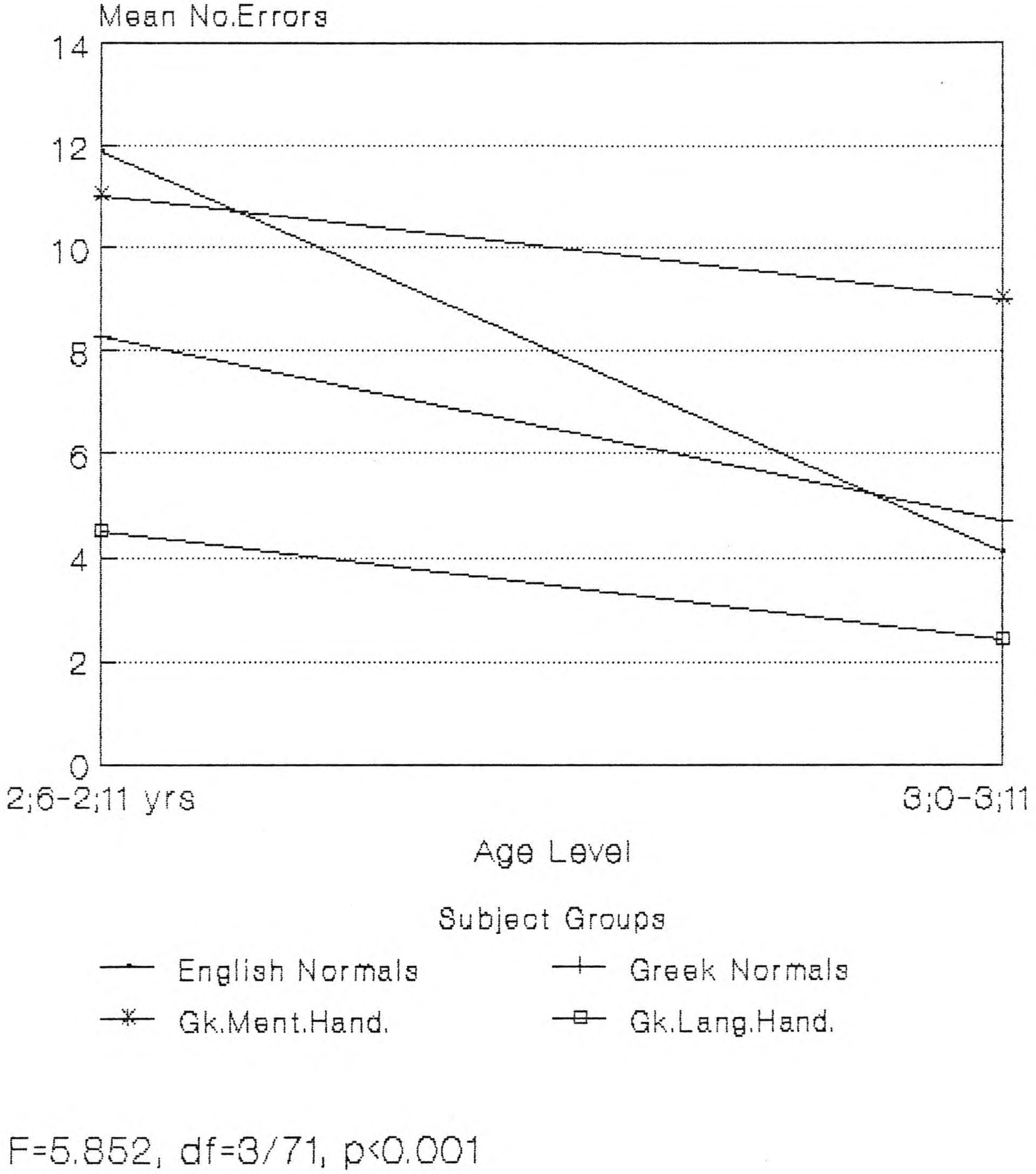
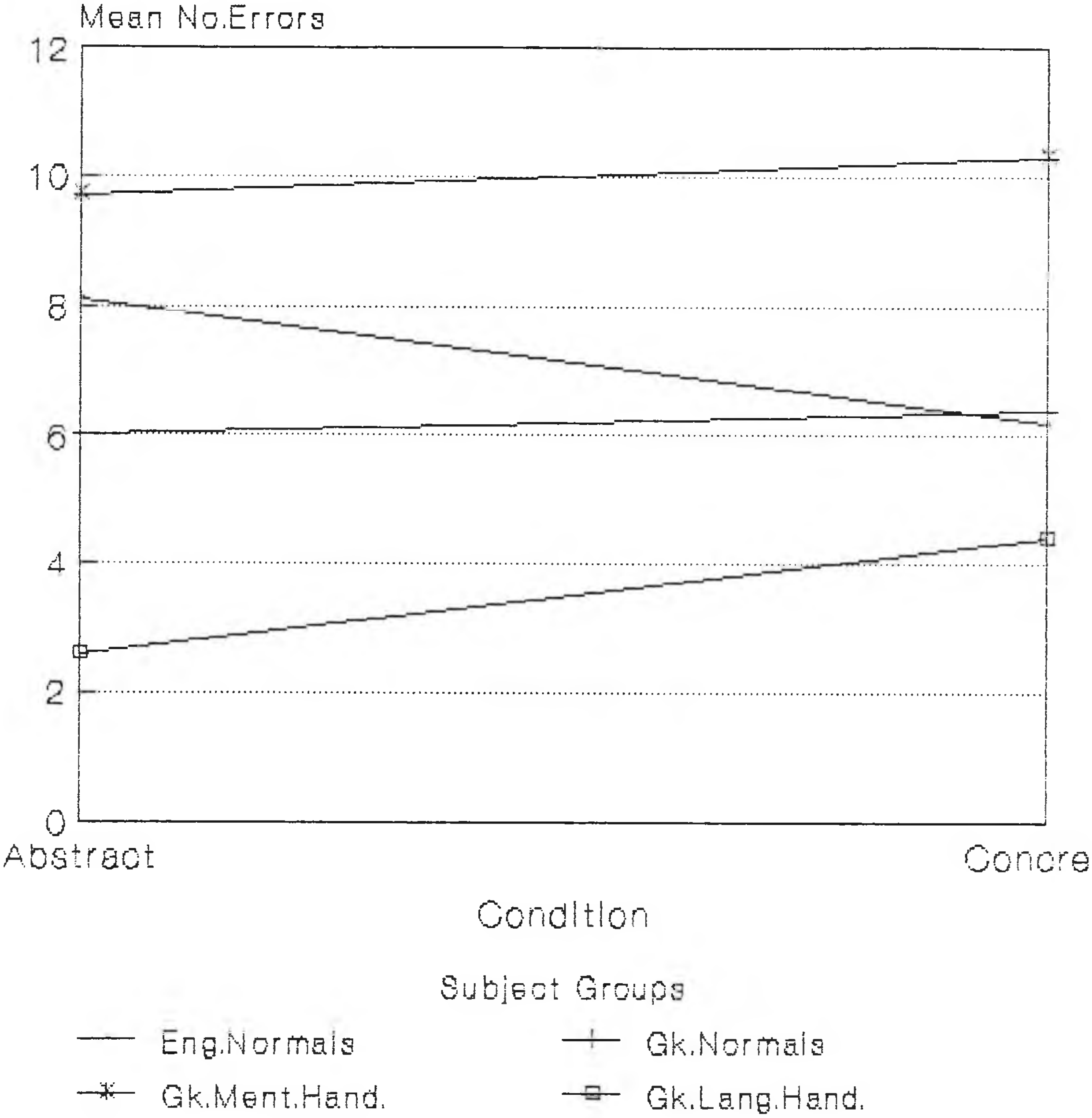


Figure 6:5
Interaction between Group and Condition
in Experiment III



F=25.584, df=3/71, p<0.005

shown in Figure 5:4. This subject group had a mean ERROR score of 11.9 errors in the under three age group, which dropped to a mean of 4.1 errors after three years of age. This latter score is comparable to that of their Greek counterparts at the same older age level (a mean of 4.7 errors). This was not the case for the under three-year-old age level, where the Greek normal children have a mean of 8.3 errors.

Independent t tests were performed on these results and the following was found, which may be seen tabulated in Table 5:2:

1. The Greek normal group improved significantly over age ($t=2.558$, $df=19$, $p<0.001$).

2. The English normal group has also improved significantly over age ($t=7.34$, $df=21$, $p<0.001$)

3. The Greek mentally handicapped and the Greek language handicapped groups have not improved significantly over age. It must be noted, however, that the Greek language handicapped also tended to improve over age quite considerably (4.5 errors as opposed to 2.4 errors). If one were to make this t test a one-tailed test, since it confirms our initial hypothesis, this result would be significant at $p<0.05$.

TABLE 5:2 Independent t tests of the Interaction between Subject Group and Age Level in Experiment III (ERROR scores).

	Eng. Norm.	Gk. Norm.	Gk. M. H.	Gk. L. H.
	N=23	N=21	N=16	N=19
Age Level 1	11.9	8.3	11	4.5
Age Level 2	4.1	4.7	9	2.4
t value	7.340	2.558	1.512	1.849
df	21	19	14	17
p	<0.001*	<0.02*	n.s.	<0.05*

N.B. * denotes significance for a one-tailed test.

As regards the subject group by Abstract/Concrete condition interaction, related t tests were conducted on the results, which may be seen in Table 5:3. These tests show that:

1. The English normal control group have significantly different Abstract/Concrete scores ($t=2.601$, $df=22$, $p<0.02$). It should be noted that their Concrete scores are the better of the two.

2. The language handicapped group show the reverse trend, their Abstract scores being significantly better than their Concrete scores ($t=-3.111$, $df=18$, $p<0.01$).

TABLE 5:3 Related t tests of the Interaction between Subject Group and Abstract/Concrete Condition in Experiment III (ERROR scores).

	Eng. Norm.	Gk. Norm.	Gk. M. H.	Gk. L. H.
	N=23	N=21	N=16	N=19
Abstract	8.1	6.0	9.7	2.6
Concrete	6.2	6.4	10.3	4.4
t value	2.601	-0.503	-0.850	-3.111
df	22	20	15	18
p	<0.02*	n.s.	n.s.	<0.01*

N.B. * denotes significance

3. Neither the Greek normal group, nor the Greek mentally handicapped group showed any significant difference between conditions. These results were not predicted, but continue the same trend as the results in Experiment II, and will be discussed in greater detail later.

5.6.3 Result Summary

This experiment revealed the following results:

1. The Greek and English normal groups made a comparatively

similar number of errors in their test scores. The English group, however, again revealed a discrepancy in their Abstract/Concrete scores, in that they were significantly better at the Concrete task than at the Abstract one.

A further analysis of this data revealed the following information: at the younger age level, in the Abstract condition, the English children made significantly more errors than their Greek counterparts (a mean 13.7 errors versus 8.2 errors) ($t=3.07$, $df=16$, $p<0.01$). At the same age level, in the Concrete condition, the English group made less errors than in the Abstract task, but still more than their Greek counterparts in the same task (a mean of 10.1 errors versus 8.4 errors respectively). This difference, however, was not significant.

This marked difference in the scores between the two normal groups is not so apparent at the older age level, where although the English group made less errors in the Concrete condition (3.6 errors) and the Greek group made slightly more (4.9 errors), the difference is not significant. Overall, at this older age level, the two normal groups appear to be making a similar number of errors across conditions (4.1 errors by the English group and 4.7 errors by the Greek group).

An attempt at an explanation to these apparently disparate results is given in the following section.

2. Both the English and the Greek normal groups reveal a significant improvement in their ERROR scores from one age level to the other. This, however, is not true of the mentally handicapped group, who showed a negligible improvement, which is not statistically significant. The language handicapped children's results, from one age level to the other, did seem to show some improvement, but this could not be proved statistically. However, these results were consistent with those of Experiment II, where the same trend was seen.

3. The Greek mentally handicapped group's performance was significantly worse in this experiment than that of all the other groups'. These subjects appear thus to be the least able to take advantage of the verbal labelling of the spatial concepts in this task.

4. The Greek language handicapped group performed significantly better than all of the other experimental groups, implying that they were able to take most advantage of the specific verbal semantic input they were given. This of course does not conform with our initial hypothesis and will be discussed later.

5. The language handicapped group again performed significantly better in the Abstract task than in the Concrete task. This was consistent with results in Experiments I and II. It has been

discussed extensively in previous chapters, and this data merely serves to corroborate that evidence.

In this experiment, however, the mentally handicapped children did not reveal a significant difference in their Abstract/Concrete scores as they had done in Experiments I and II. We will return to this point in the next section.

5.7 Discussion and Implications from the Results

The results of Experiment III, in themselves, present quite a few interesting facts, some of which are somewhat confusing. An attempt will be made to explain some of them in this section to follow. After this is done, we will of course compare the results of this experiment with those of Experiments I and II, which is where the greatest interest lies.

Let us, first of all, remind ourselves of the questions which we attempted to answer in this final experiment. First of all, we will deal with the question whether specific verbal labelling of the spatial concepts would cause discrepancies between the results of the two different language groups, Greek and English. It will be remembered that we had discussed the differences between the two languages as regards the locative terms in question, and we had concluded that the English language was characterized by linguistic diversity and the Greek language was characterized by linguistic complexity for these particular locative terms.

In this experiment, in a way, we were testing the rate of acquisition of these terms, since it would be expected that the child would use the verbal label given to him by the experimenter, in order to solve the task. In other words, if the child knows the word "on" and can match it successfully with his internal representation of this word, then he is able to better complete the task. In Experiment I, it was proved that both the English and the Greek groups had similar levels of acquisition of these spatial concepts on a non-verbal basis. So, we proceeded to test whether their acquisition of the locative terms themselves was on a similar level, despite language-specific differences.

The results of this experiment certainly shed some light on these questions, in a way which is initially complex, but which is a much more viable answer to this question:

Our first observation, therefore, from the data is that there is no overall difference between the English and the Greek control groups' ERROR scores in this experiment. This confirms the hypothesis that there are similar rates of language acquisition across languages. The qualifying statement to this hypothesis is made after a closer inspection of the results, and this must be done on several levels.

The first level is that there is a difference between the two groups in the Abstract/Concrete conditions. In Experiment II, where this phenomenon was first observed, this consisted of the younger English children's higher ERROR scores in the Abstract condition. Conversely, the older English children made less errors than their Greek counterparts in the Concrete condition. Thus, we have two separate observations, which are relatively disparate, and which were not observed in Experiment I, which was essentially non-linguistic and tapped the children's non-verbal abilities. It was concluded, therefore, that it was something in the verbal instructions given to the subjects in Experiment II, which was:

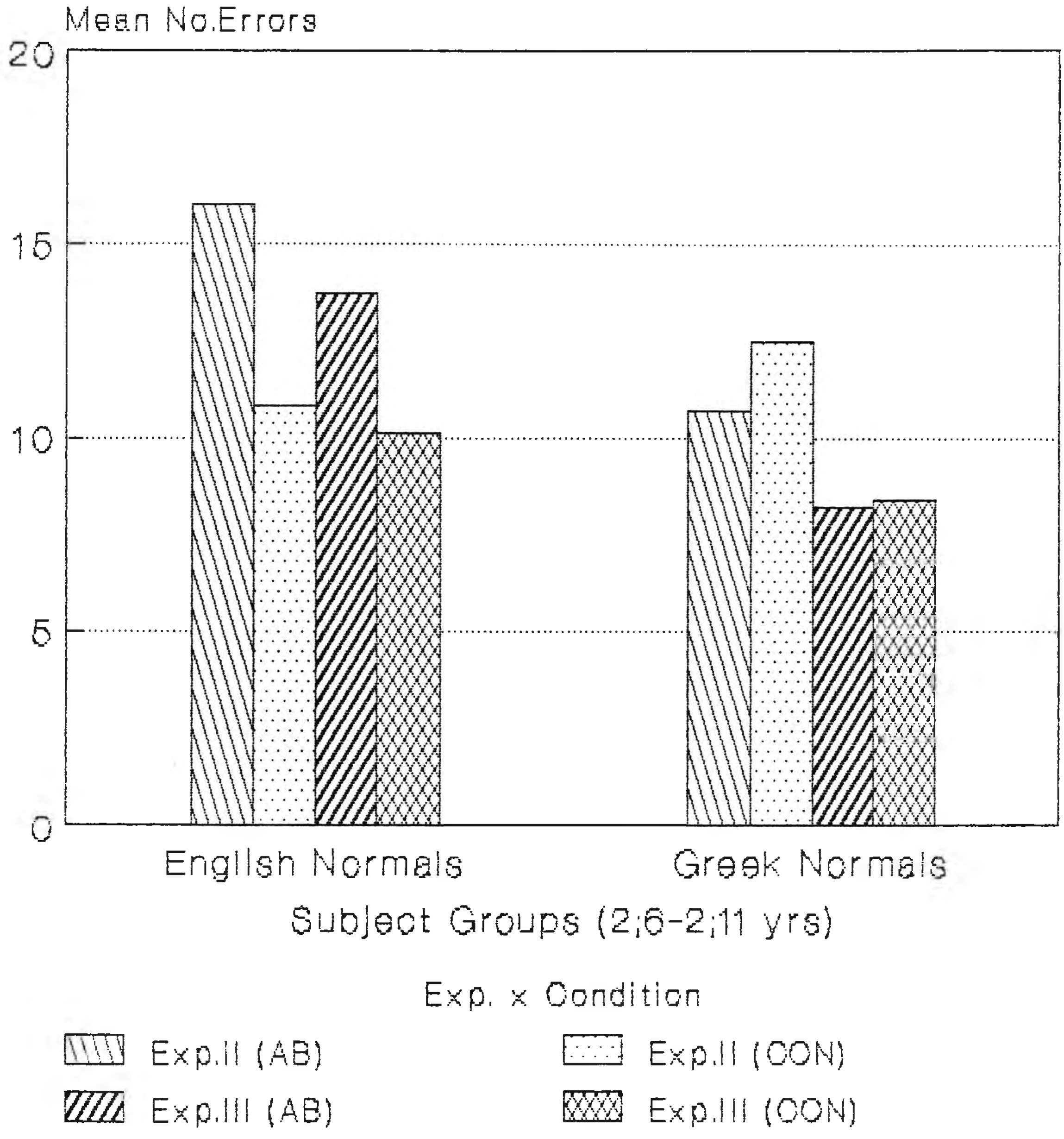
a. confusing for the younger English children concerning Abstract pictures

b. elucidating for the older English children concerning Concrete pictures.

These results were explained with regard to language-specific factors in the verbal instructions given to the subjects. It now remains to be seen whether these language-specific factors were carried into Experiment III, or whether new factors were responsible for the disparity between the Abstract/Concrete scores in the present experiment.

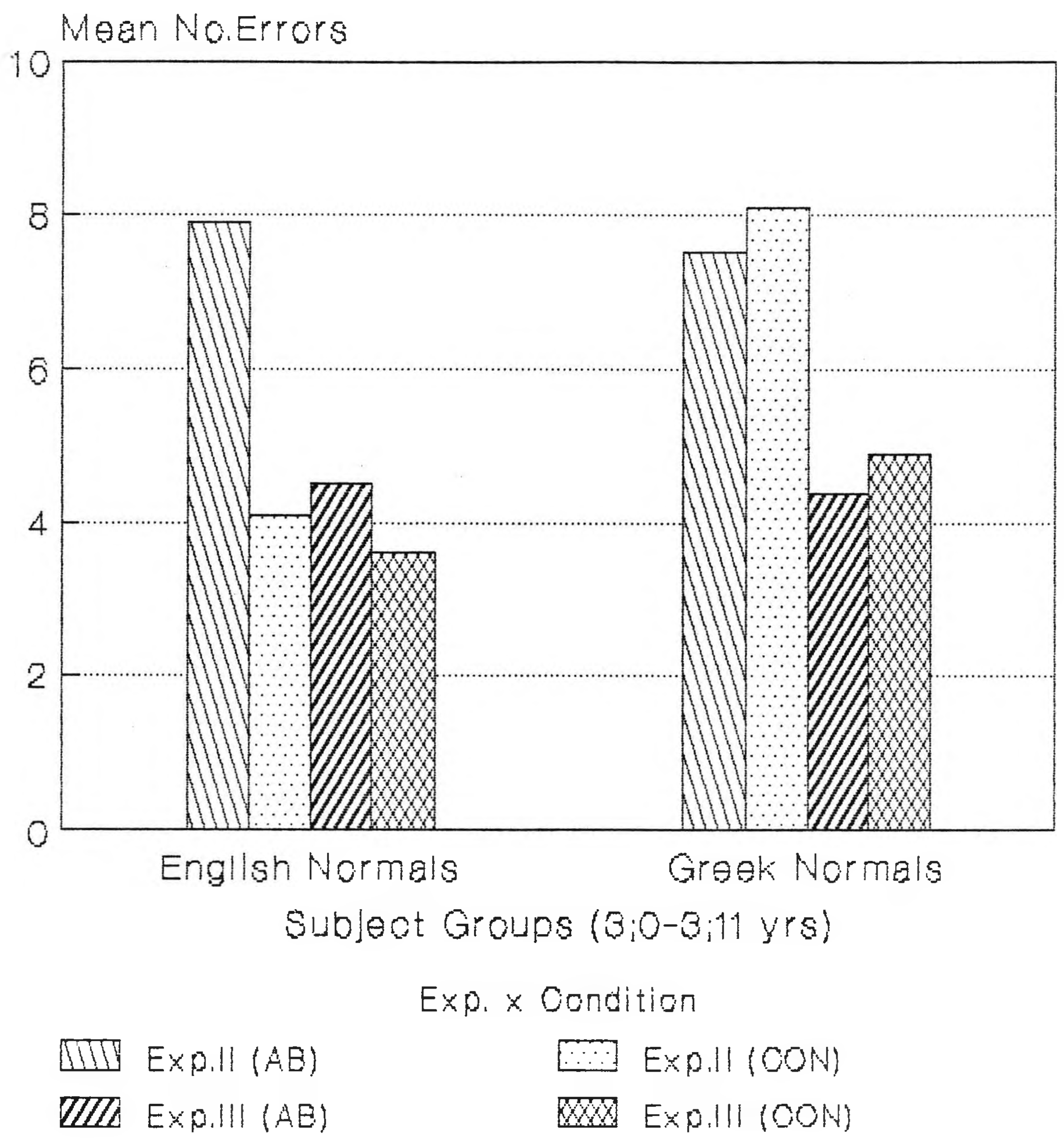
In Figure 5:6 and 5:7, one can see a graphic representation of

Figure 6:6
Comparison between Experiments II & III
for Younger Normal Groups (by Condition)



N.B. Condition - Abstract (AB) and Concrete (CON).

Figure 6:7
Comparison between Experiments II & III
for Older Normal Groups (by Condition)



N.B. Condition - Abstract (AB) and
Concrete (CON)›

the mean ERROR scores for the English and Greek normal control groups for each age level respectively. A comparison is made between the Abstract and Concrete scores in Experiments II and III.

Thus, in Figure 5:6, it may be clearly seen that the younger English children are still making more errors than their Greek peers, in both the Abstract and the Concrete conditions in Experiment III. This difference is significant with respect to the Abstract condition, as we noted above. One final point is that these younger English children do not appear to have made any improvement in their scores compared with Experiment II. This was tested with related t tests and it was found that, indeed, the difference between their Concrete condition scores for Experiments II and III was not significant, whereas the difference between their Abstract scores in the two experiments was significant ($t=3.38$, $df=8$, $p<0.01$).

This data becomes even more interesting when one compares it to that for the younger Greek group. These children made considerable progress in both the Abstract and Concrete conditions in Experiment III. Their results, in fact, reveal an impressive symmetry.

So, what can we conclude? At least for the younger Greek normal group, it can be said with a fairly certain degree of confidence, that this specific verbal labelling of the spatial concepts, aided them in the more successful completion of the task. This, it must be said, is also true of the older Greek normal group.

As for the younger English group, we can merely say the following: they were either so confused by the verbal cues given in Experiment II, that they were not able to take advantage of the verbal labelling of the spatial concepts in Experiment III, or the verbal labelling was not helpful, because these young children had not yet acquired the locative terms in question, for reasons which are relevant only to the English language. The answer probably lies somewhere in between.

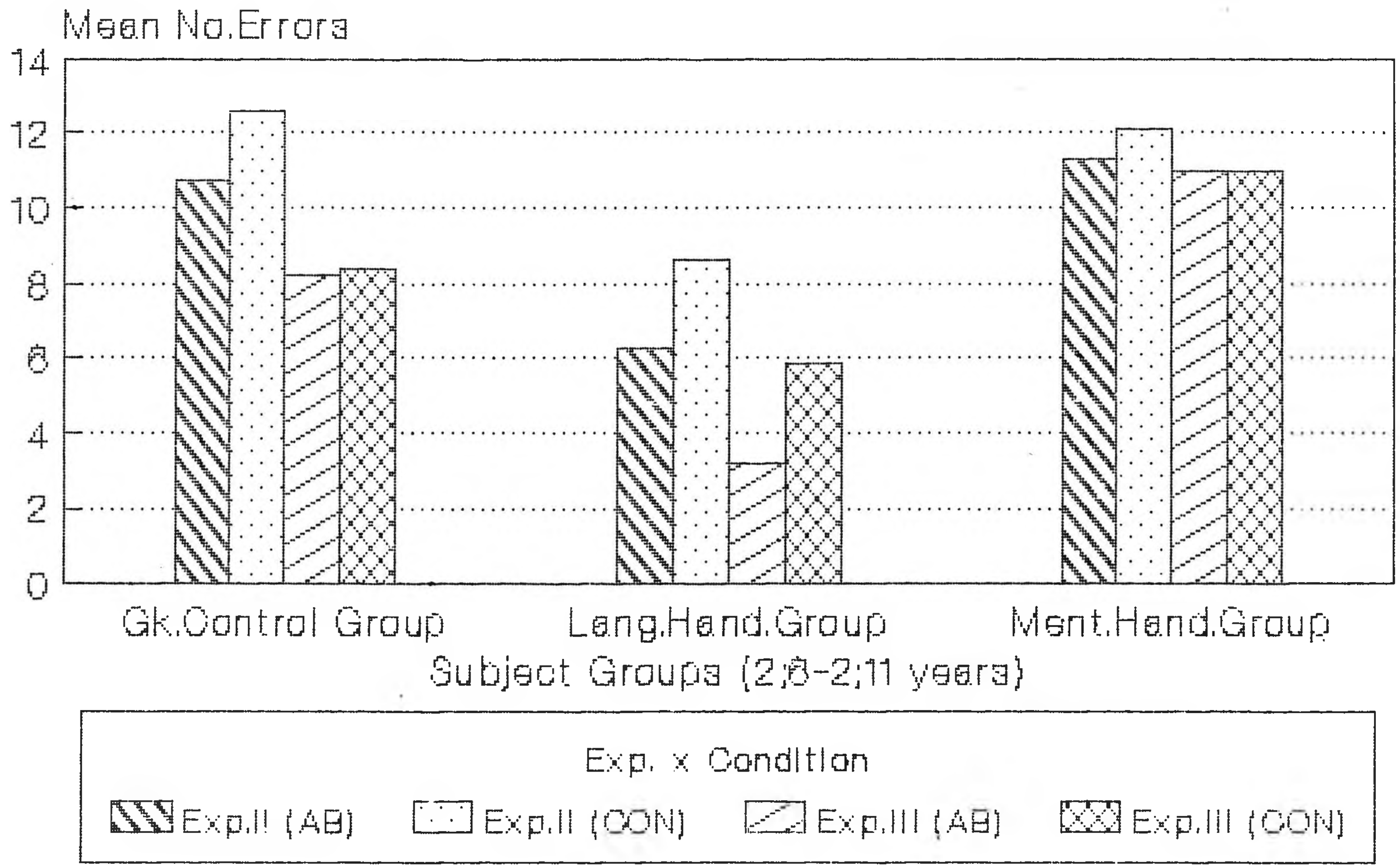
At the older age level, the English children seem to be able to make use of the verbal labelling of the spatial concepts, in the same way as the Greek children do, in the Abstract condition, but not as much in the Concrete condition, where improvement from Experiment II to III just barely reaches significance ($t=1.38$, $df=13$, $p<0.1$). In Experiment II, we have already mentioned that the verbal cuing resulted in a dramatic improvement in the older English children's performance on the Concrete task. In Experiment III, the verbal labelling did not cause much further improvement of an already good performance in the Concrete task.

This may actually be more logical than at first appears: in other words, it is not that these children were not able to make use of the verbal labelling, but that they had already achieved criterion level through the verbal instructions given to them in Experiment II. This result may, thus, be due to a ceiling effect.

So, in conclusion, in Experiment II, we had said that the two groups' differences in performance were due to language-specific properties in the verbal instructions given by the experimenter to cue the subjects into the spatial component of the task. In Experiment III, we must go one step further and say that the spatial locative terms themselves used by each language may further cause some differences in the performances of the two language groups. Specifically, it seems plausible that the younger English children were not able to successfully map the locative terms onto their internal representations of these concepts. This could only be due to the specific multiple semantic properties of the English locative, properties which the Greek locative terms do not seem to have.

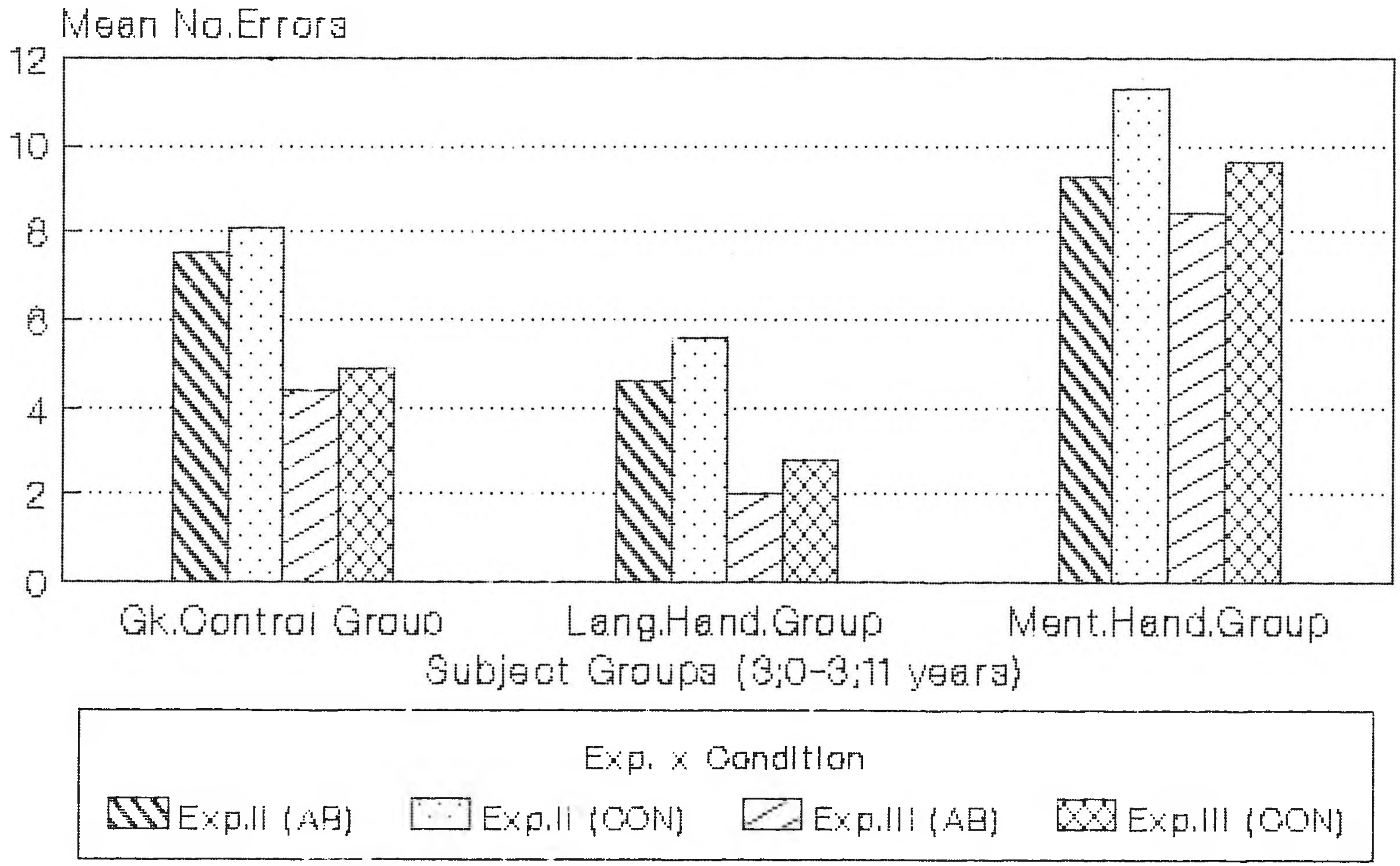
We must now return to the other two Greek groups, which have not yet been discussed. These are, of course, the language handicapped and the mentally handicapped groups. In Figures 5:8 and 5:9, the mean ERROR scores for the mentally handicapped and language handicapped groups, compared to the Greek normal control group, may be seen for each age level respectively. Abstract and Concrete conditions are seen here separately for Experiments II and III.

Figure 5:8
Comparison between Experiments II & III
for Younger Handicapped Groups (by Cond)



N.B. Condition - Abstract (AB) and
Concrete (CON).

Figure 5:9
Comparison between Experiments II & III
for Older Handicapped Groups (by Cond.)



N.B. Condition - Abstract (AB) and
Concrete (CON).

With regard to the two handicapped groups, Experiment III has revealed some quite interesting facts: the first and foremost being that the language handicapped group's performance was significantly better than that of any of the other group's. It is useful to remember that our initial hypothesis had been that this group would be least able to benefit from the verbal labelling of the spatial concepts in question. Yet, this hypothesis appears to be disproved by the results of this experiment.

First of all, we must begin by comparing the language handicapped children's performance across all three experiments:

1. In Experiment I, the language handicapped group had performed better than every other subject group. This was, however, statistically ratified only with regard to the mentally handicapped group. This fact had been explained with regard to the superior visual-perceptual skills of this group.

2. In Experiment II, the language handicapped group's performance was now statistically better than every other groups'. It was speculated at this point that the language handicapped group were able to make use of the gestural cuing, which had accompanied the verbal cuing given to the subjects by the experimenter, but that they were probably also able to make use of the verbal instructions per se.

3. In Experiment III, we observe a further improvement of the language handicapped children's performance. At this point, the only explanation can be that these children are actually taking advantage of the verbal labelling of the spatial concepts in question.

There appear to be two levels at which this may be functioning. The first is that these children are, by their very nature, unable to use adequate "inner" or implicit speech and that, therefore the more explicit the instruction, the better for their understanding of the task.

The second level is that they are actually able to understand the semantic information given to them in this particular task, and to put it to good use. It is useful to remember that these language handicapped children were actually matched to their normal counterparts, with regard to language mental age (PPVT), so therefore it is not altogether surprising that they were able to understand these locative terms. Since this was the linguistic level at which they were functioning anyway, and their visual-perceptual abilities were far superior to the other subject groups', they appeared to be most able on a cognitive level to integrate this new information. In other words, at this particular task, the language handicap did not impede these children's performance, since the spatial concepts and the locative terms were well within their capabilities. This, plus their more advanced visual-perceptual abilities, combined to make for better overall performances.

The reverse seems to be true with regard to the mentally handicapped group, who had significantly more difficulty with this task than any of the other subject groups. It appears that, although they were matched with the normal groups for language mental ages, they were not able to integrate the new verbal information with the visual information adequately, probably due to weaker internal representations of these spatial concepts. They appeared, therefore, to be functioning according to their lower visual perception (Seguin Formboard) mental ages.

In the next chapter, we will describe Experiment IV, which investigated order-effect. This experiment was conducted after the completion of the first three experiments.

The first section will conclude with a chapter, in which the results of Experiments I-III will be analyzed with respect to each subject group separately and the final conclusions will be made.

CHAPTER 6

Experiment IV: Practise Effect.

6.1 Introduction

The last experiment in this series was considered necessary in order to test whether the results of the first three experiments were due to the fact that the experimental subjects gradually learnt the categorization task and thus, performed with increasing ease from Experiment I through to Experiment III. Our hypothesis, contrary to this, was that the reason that the subjects performed differently from one experiment to the other was solely due to the differences in the demands of the tasks in each experiment. Since the instructions, given by the experimenter to the subjects for conducting each task, gradually became more explicit, it was expected that, at least, the normal subject groups would benefit from this process. This was, in fact, confirmed by the performances of both of the normal subject groups, English- and Greek-speaking, and also, surprisingly enough, by the language handicapped groups, but not by the mentally handicapped ones.

To recapitulate: even though all three experiments were conducted using the same materials, the same conditions and the same experimental subject groups, the difference lay in the way that the instructions, for completing the task, were presented by the experimenter. Thus, in Experiment I, no verbal instructions were given to the subjects and they were expected to model their performance on that of the experimenter. In Experiment II, the subjects were given general verbal instructions, intended to focus their attention on the spatial element of the task. Finally, in Experiment III, the instructions given were explicit, in other words, the subjects were now made aware that they were requested to match the cards according to whether the objects on them were located in certain positions.

If, however, the above groups' improvement in performance were due to learning, then this fact would invalidate our results. It was, therefore, necessary to test for just such a practise effect. This was accomplished through the procedure described below.

6.2 Subjects

The subjects consisted of a control group of Greek children of normal intelligence, matched according to chronological age, language level score (Peabody Picture Vocabulary Test) and visual perception score (Seguin Formboard), with a group of Greek children, who had already completed the whole series of three experiments.

In Table 6:1 below, the two subject groups are compared, according to mean chronological ages, mean Peabody Picture Vocabulary Test (PPVT) score and mean Seguin Formboard score.

The control group (A) were all new subjects. Conversely, the experimental group (B) were chosen from the older age level group of Greek children of normal intelligence. The children in this subject group were originally 12, that is, 12 children participated in Experiments I-III, and their scores were used in the data analysis. In Experiment IV, only 8 of these children's scores were used in the analysis. The criterion for using a subject's score in Experiment IV, was entirely based on how well the child's characteristics, that is, chronological age, language level and visual perception level, matched those of a child in the control group.

TABLE 6:1 Mean Scores used for Matching Control Group (A) with Experimental Group (B) in Experiment IV.

Control Group (A)	Experimental Group (B)
N=8	N=8
Mean C.A.= 3;7 (SD=0.23)	Mean C.A.= 3;7 (SD=0.28)
Mean PPVT= 3;7 (SD=0.34)	Mean PPVT= 3;7 (SD=0.43)
Mean Seguin=4;0 (SD=0.08)	Mean Seguin=4;0 (SD=0.08)

6.3 Test Materials and Conditions.

The materials used in this experiment were the same as those used in Experiments I-III. That is, they consisted of two packs of cards, numbering 18 cards ech, which corresponded to the two experimental conditions, Abstract and Concrete. The Abstract set of cards consisted of a series of shapes with dots placed in, on or under them (Figure 2:1, Chapter 2). The Concrete set of cards consisted of drawings of three-dimensional objects, such as cars, cages, baskets, etc., with other objects, such as, balls, birds, etc., in, on or under them (Figure 2:2, Chapter 2).

6.4 Test Criteria

The test criterion in this experiment was the number of errors a subject made, when completing this spatial categorization task. Since there were two conditions, each subject had two ERROR scores, one for the Abstract condition and the other for the Concrete condition.

6.5 Procedure

The control group (A) of 8 subjects were the only children tested in this experiment. An attempt was made to duplicate, as much as possible, the conditions under which the experimental subjects (B) had been tested in Experiment III.

The control group (A) were to be tested on Experiment III, without previously being tested on Experiments I and II. Their results would then be compared with those of the experimental group (B).

Half of the subjects were tested first with the Abstract condition, followed by the Concrete condition, and the other half were tested first with the Concrete condition, followed by the Abstract one. This, it will be noted, had been practised in Experiments I-III. Both conditions were preceded by a test trial, in exactly the same manner as had been applied to the experimental subjects in Experiment III.

6.5.1 Abstract Condition

Test Trial: The experimenter sat opposite the subject and placed the example set of three cards in front of the subject. The experimenter then proceeded to point to each card and say:

E: "Here's a shape with a dot **on** it. Here's another shape with a dot **in** it. Now, this shape has a dot **under** it."

The experimenter then picked up a card from the rest of the pack, which were already shuffled and in a pile face-down, looked at it and showed it to the subject, whilst commenting:

E: " On this card, the dot is on the shape. So, it's like this card."

She pointed to the card, already exposed on the table, which had a dot in the same spatial position as the card she was holding. She mentioned that these two cards "go together" and then placed this new card face-up on top of the other one.

The experimenter repeated this process with a new card from the shuffled pack, whilst all the time verbally labelling the spatial position of each dot, and explaining why she was sorting the cards in the way that she was doing. She did not complete the task, but broke off after a few more examples. She then reshuffled the pack, leaving the example set on the table in front of the subject. She now told the subject that it was his turn to play.

During testing, the experimenter showed each card to the subject and asked him to point to the pile, where it should be placed. If the subject showed the wrong pile, the experimenter asked the child to have another guess, till the card was placed on the correct pile. If the child named the spatial position, this was acknowledged by the experimenter.

The number of errors made by the subject was noted by the experimenter.

6.5.2 Concrete Condition

Test Trial: The presentation of this material was the same as that for the Abstract condition. The example set (glasses and spoons in three configurations) was placed in front of the subject and the experimenter pointed to each card, verbally identifying the spatial configuration on each card, thus:

E: "Look, in this picture, the spoon is **in** the glass. Here, the spoon is **under** the glass and here, the spoon is **on** the glass."

The experimenter then picked up a card from the shuffled pile and showed it to the subject, saying:

E: "Now, look at this cat. It's **under** the car. Just like this spoon, which is under the glass."

The experimenter pointed to the card on the table and told the child that these two cards "go together", placing the new card on top of the example card. She proceeded in this manner with a few more cards, then she collected the cards, leaving the example set in front of the subject. She shuffled the pack and told the subject that it was now his turn to play.

The experimenter showed each card from the shuffled pack to the subject and asked him to point to the pile where it should be placed. This continued till the whole pack had been correctly placed by the child. If the child pointed to the wrong pile, the experimenter encouraged him to have another guess, till the card was correctly placed. All errors made by the subject were noted.

6.6 Results

The data collected for the control group (A) was analyzed with the data, which had already been collected for the experimental group (B) in Experiment III. The latter subjects had already completed the whole series of experiments, I through to III.

In Table 6:2 below, the mean ERROR scores for both experimental conditions, Abstract and Concrete, for each subject group, may be seen.

TABLE 6:2 Result Summary for Experiment IV: Mean Error Scores for Control Group (A) and Experimental Group (B) in Abstract and Concrete Conditions.

	Control Group (A)		Experimental Group (B)	
Condition	Ab.	Con.	Ab.	Con.
Errors (mean)	4.5	4.4	5.4	4.6
Standard Dev.	(3.38)	(2.67)	(3.8)	(3.46)

These results were analyzed statistically, using analysis of variance. In this analysis, there was one between subject variable (Subject Groups), which had two levels:

1. Control group (A)
2. Experimental group (B).

There was one within subject variable (Condition), which also had two levels:

1. Abstract
2. Concrete.

No statistical significance was found between the results of the two subject groups ($F=0.16$, $df=1/14$, $p=0.695$). There were no interactions.

6.7 Discussion

This experiment had been designed, in order to avert any suspicion that the improvement shown by most of the subject groups in their performance of the tasks in Experiment III, was due to the fact that they had learnt the task, since they had already done it twice before in Experiments I and II. It was our contention, however, that those results were due to the differences in each experimental task.

In Experiment IV, therefore, we were comparing a group of children, who had completed the whole series of Experiments I-III, with a control group, who performed the experimental tasks, for the first time, under the conditions of Experiment III. Thus, if there was any question that there was a practise effect on the results of the first three experiments, it would be expected that this control group (A) would perform significantly worse at the task than those subjects in experimental group (B), who had supposedly improved on the task through learning.

The results of Experiment IV, where no statistical significance was found between the results of the two subject groups (A) and (B), proved conclusively, however, that no practise effect was influencing the results of Experiments I-III. This confirmed our hypothesis and allowed us to conclude that whatever results have been described above, in the previous experiments, were only due to the differences between the tasks, and specifically the instructions, given to the subjects in each experiment.

CHAPTER 7

A Comparison between Experiments I-III for Each Experimental Group

7.1 Introduction

This chapter aims to tie together the pieces of evidence, which have been revealed in the previous chapters, concerning each individual subject group's performance for the three experiments, which have been conducted.

The reason for this approach is that, although where necessary this collating of the information from one experiment to the other has been discussed already, the data has not been analysed statistically along this dimension. It was considered necessary to do so, and therefore each subject group was analyzed separately for the three experiments with analysis of variance.

7.2 English Normal Control Group

The English control group consisted of 23 children. These children were divided into two age levels:

Age Level 1: Chronological ages between 2;6 and 2;11 years.

N=9

Age Level 2: Chronological ages between 3;0 and 3;11 years.

N=14

All of the subjects were tested with all of the three experiments in serial order.

A summary of the results so far observed in each experiment, can be stated as follows:

Experiment I: this was a non-linguistic spatial categorization task with two experimental conditions, the Abstract and the Concrete.

1. In this experiment, the English group showed no significant difference in their ERROR scores from the Greek normal control group. This result confirmed the hypothesis that this task would be tapping the children's non-verbal spatial categorization abilities, which would not be influenced by language-specific factors.

2. The group, as a whole, did not show any difference between their performance of the Abstract or Concrete conditions.

3. Finally, as may be expected, the older children made significantly less errors than the younger children of this

group.

Experiment II: in this task, the experimenter focussed the subjects' attention on the spatial dimension of the task, by verbal and gestural cuing.

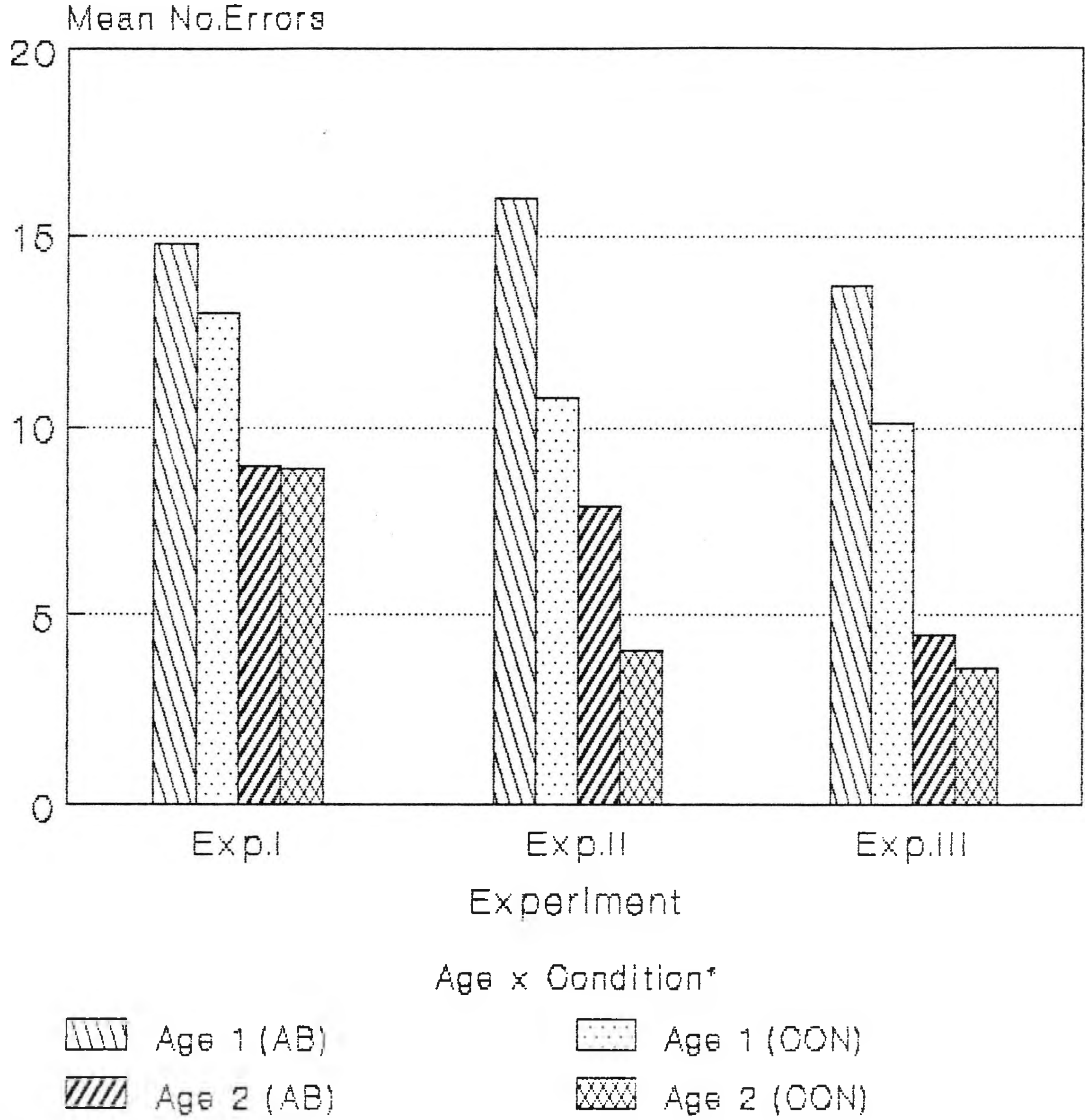
1. Here, the English group again, overall, made a similar number of errors as their Greek counterparts, and there was no observable statistical main effect between the performances of these two groups.

2. However, the interaction reveals that the younger English children were making more errors in the Abstract task of this experiment than they had done in Experiment I. This phenomenon was not noticed for the Greek control group.

3. On the other hand, the older English children performed much better than their Greek counterparts in the Concrete condition. As the only parameter, which had changed from Experiment I to Experiment II, was the verbal instructions, which the experimenter gave to the subjects, one can only conclude that some language-specific factor is responsible for the discrepancy in the performances of the two language groups (Figure 7:1).

Experiment III: in this task, the experimenter now verbally labelled the spatial concepts under investigation, using the

Figure 7:1
Results for the English Normal Group for Exps.I-III by Age & Condition



*Age 1 -2;6-2;11 yrs and Age 2 - 3;0-3;11 yrs
Condition -Abstract (AB)/Concrete (CON)

appropriate locative terms for each language.

1. Yet again, although a main effect was not observed between the English and the Greek group's performances, the interaction revealed the same phenomenon as in Experiment II. In other words, the younger English children were making considerably more errors than the younger Greek children in the Abstract condition. Conversely, the older English children were making less errors in the Concrete condition.

7.2.1 Analysis of Variance for the ERROR Scores

All the data for all three experiments for the English normal control group were analyzed together by analysis of variance. This was a 2 x 3 x 2 factorial design, which had one between subject variable (Age) and two within subject variables (Experiment and Condition).

Age had 2 levels: 1. C.A. 2;6-2;11 years
2. C.A. 3;0-3;11 years

Experiment had 3 levels: Experiment I
Experiment II
Experiment III

Condition had 2 levels: 1. Abstract

2. Concrete

7.2.1.1 Main Effects

There were three main effects:

1. between the age levels (F=59.45, p=<0.001) (Figure 7:2)

2. between the experiments (F=17.045, p=<0.001) (Figure 7:3)

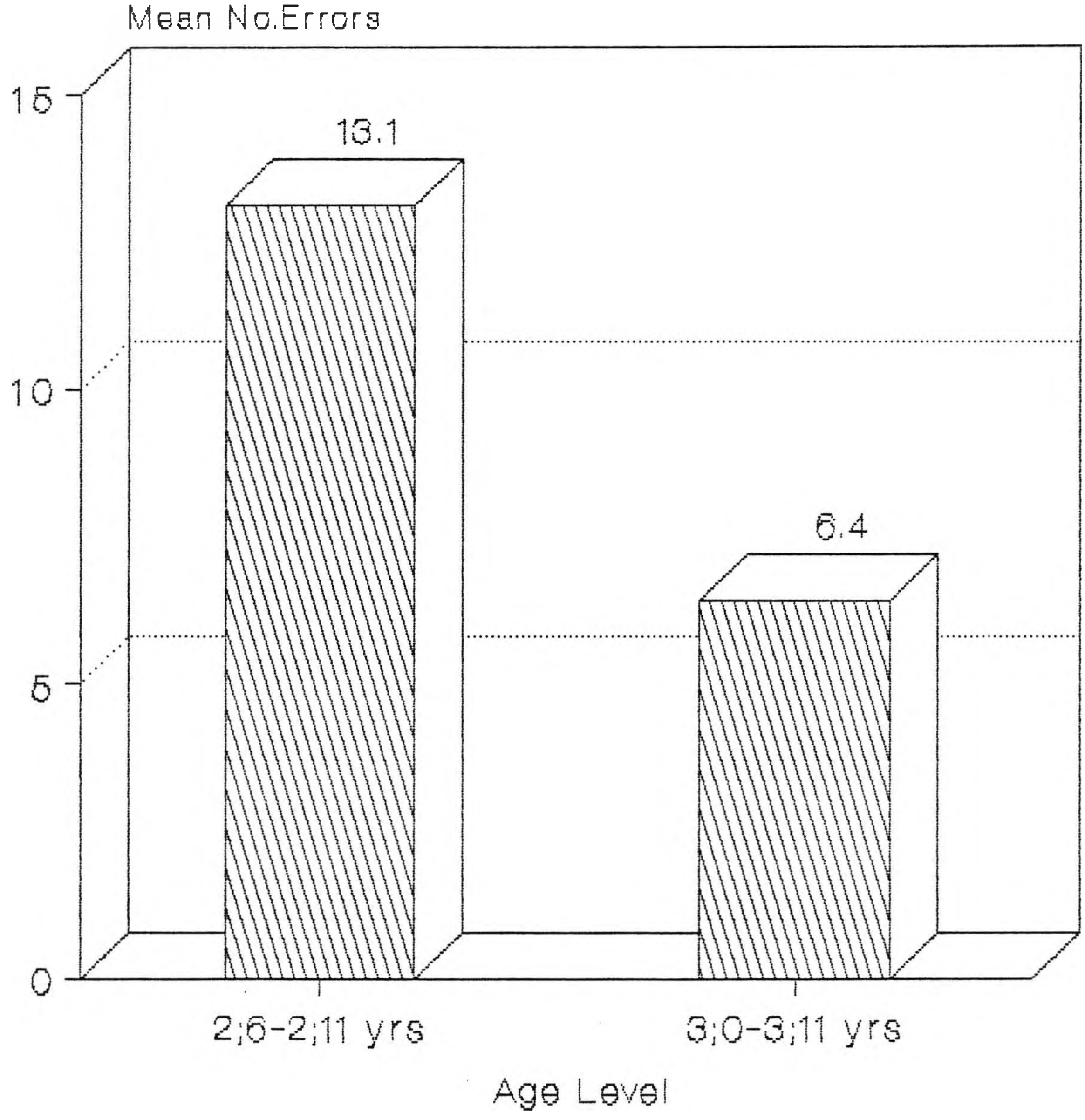
3. between the conditions (F= 13.69, p=<0.005) (Figure 7:4)

It may be seen quite clearly that, as regards the age level, these subjects made less errors the older they were; also, that there is a pattern of general improvement from Experiment I through to Experiment III. Because there were three experiments, the least difference (Experiment II to III) was further tested and this difference was also found to be significant (t=4.6, p= <0.001). As for the Abstract/Concrete condition, it appears that these children, in particular are significantly better at the Concrete tasks.

7.2.1.2. Interactions

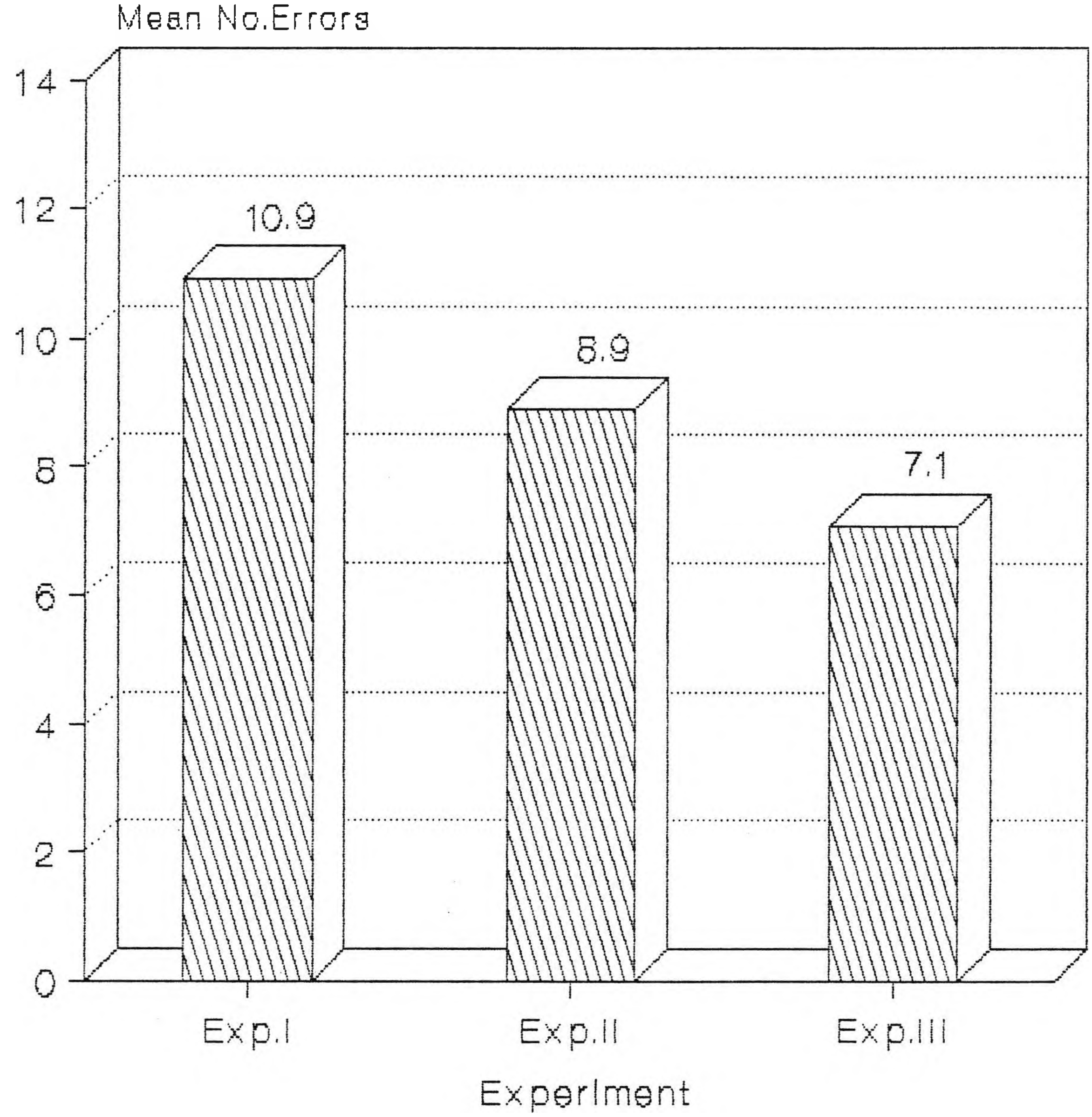
One interaction was found for these results: this was between experiment and condition (F=5.279, p=<0.01). A graphic

Figure 7:2
Main effect between Age Levels
for English Normal Subjects



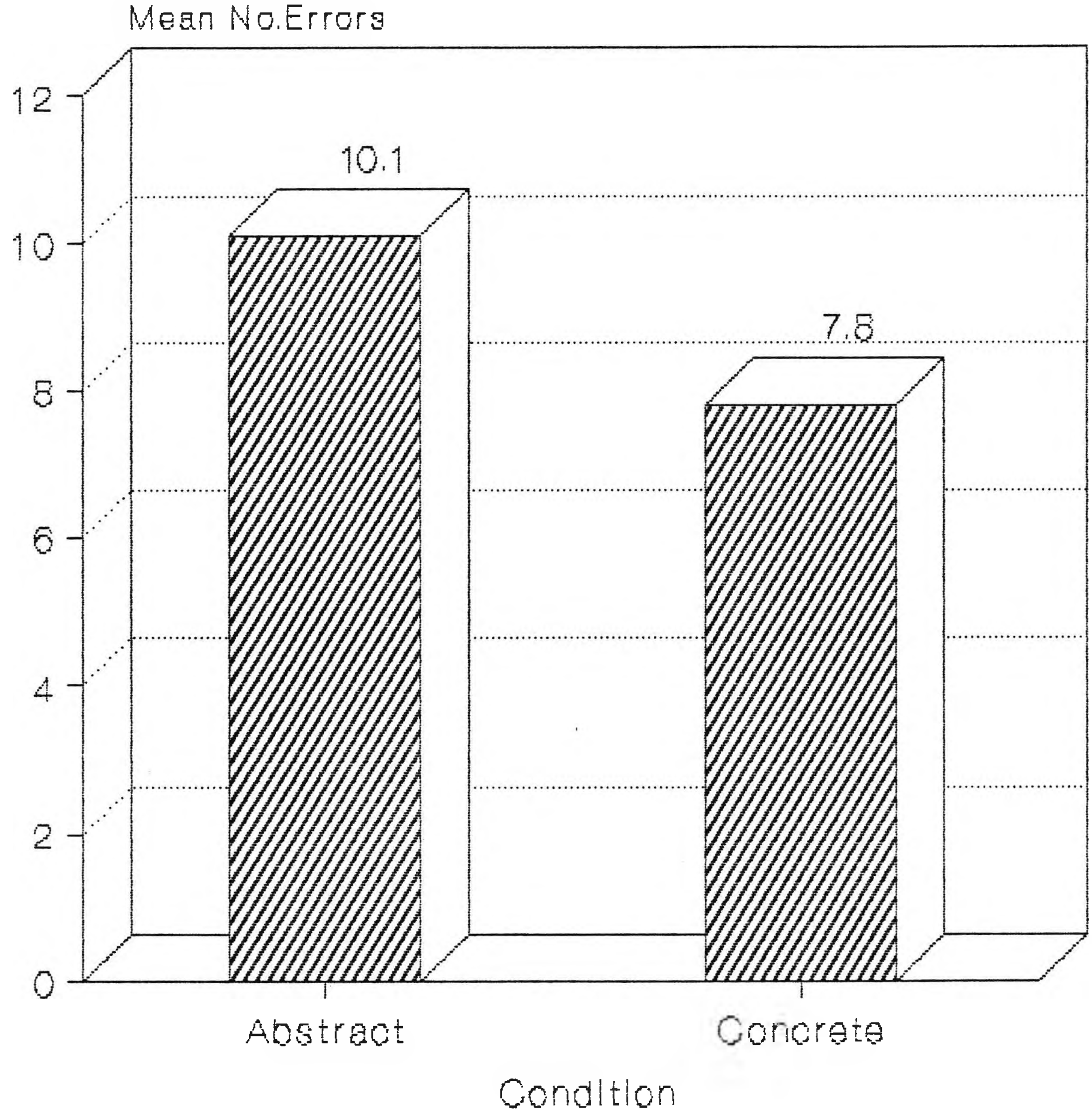
F=59.451, df=1/21, p<0.001

Figure 7:3
Main Effect between Experiments
for English Normal Subjects



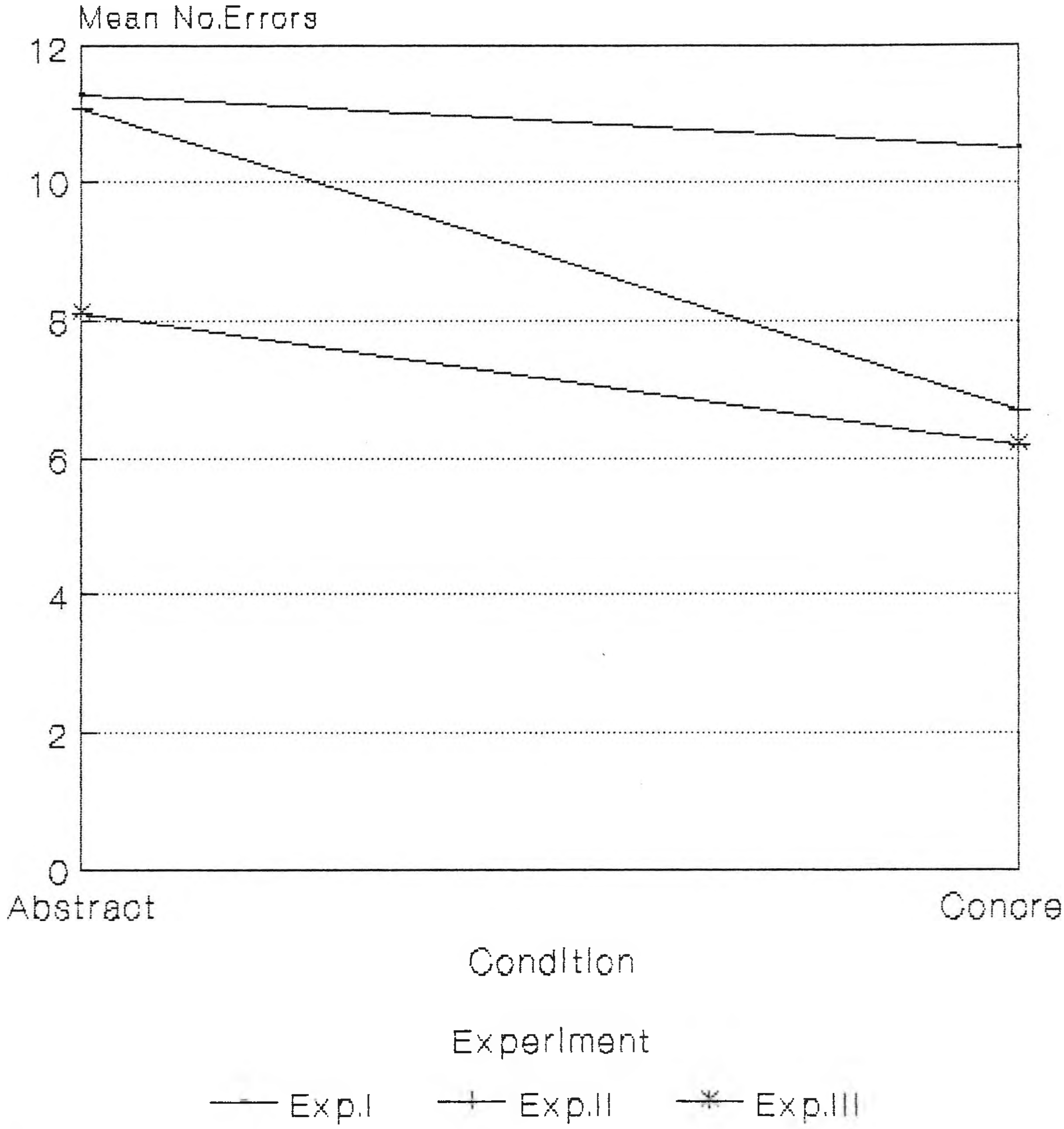
F=13.625, df=2/42, p<0.001

Figure 7:4
Main Effect between Conditions
for English Normal Subjects



F=15.514, df=1/21, p<0.001

Figure 7:5
Interaction betw. Experiment & Condition for English Normal Subjects



F=4.882, df=2/42, p<0.01

representation of this interaction may be seen in Figure 7:5.

This interaction was further tested and it was found that the difference between Abstract and Concrete conditions in Experiment I was not significant, but that in Experiment II, it was significant ($t=4.6$, $p=<0.001$), as it was also significant in Experiment III ($t=2.7$, $p=<0.02$). In both cases, the children's performance was worse in the Abstract condition.

7.3 Greek Normal Control Group

The Greek normal control group consisted of 21 subjects, who, like their English counterparts, were divided into two age levels:

Age Level 1: C.A. 2;6-2;11 years.
N=9

Age Level 2: C.A. 3;0-3;11 years
N=12

This group, like all the others, performed the three experiments in serial order.

A summary of the results for the Greek normal control group, in each experiment separately, is as follows:

Experiment I: in which the task consisted of non-linguistic spatial categorization, the following was observed:

1. there was no significant difference in ERROR scores from the English control group.

2. there was no significant difference in scores from either the mentally handicapped or the language handicapped groups.

3. there was no difference between the Abstract and Concrete conditions.

4. there was, however, a significant difference between the two age levels, as was to be expected, in that the younger children made more errors.

Experiment II: consisted of verbal cuing to the spatial dimension of the categorization task. The results were as follows:

1. no significant difference in ERROR scores from the English control group was found.

2. no significant differences between the Abstract and Concrete scores were found. This was in sharp contrast to the English control group, who did show a difference between conditions at

this point.

3. there was an improvement in performance with increasing age.

4. the Greek normal group's performance was not significantly different from that of the mentally handicapped group.

5. finally, unlike in Experiment I, their performance was now significantly worse than that of the language handicapped children's performance.

Experiment III: which consisted of the specific verbal labelling of the spatial categories under investigation, had the following results:

1. consistently, no difference from the ERROR scores of the English control group was found.

2. no difference, unlike in the English control group, was found between the Abstract and Concrete conditions.

3. there was again significant improvement in the ERROR scores in the older children.

4. in this experiment, their performance was significantly better than that of the mentally handicapped group.

5. their performance continued to be significantly worse than that of the language handicapped group.

These three experiments were now analyzed together for the Greek normal control group, in order to draw the necessary conclusions.

7.3.1 Analysis of Variance for the ERROR scores

All of the data for Experiments I-III for the Greek normal control group were analyzed with analysis of variance.
This consisted of a 2 x 3 x 2 factorial design, which had one between subject variable (Age with 2 levels), and two within subject variables (Experiment with 3 levels; Condition with 2 levels). This was exactly the same as for the English normal control group.

7.3.1.1 Main Effects

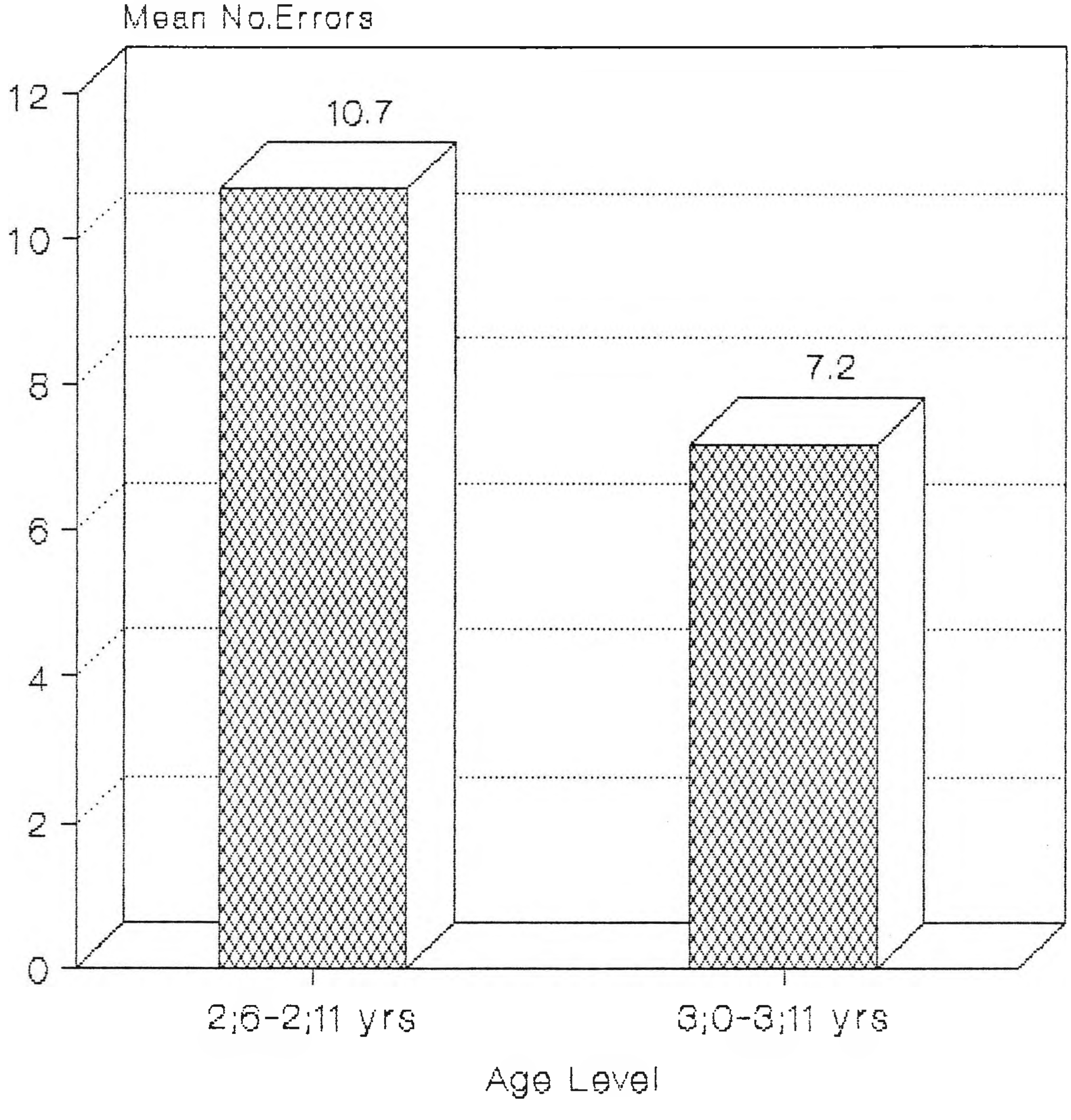
Two main effects were found:

1. between the age levels ($F=11.43$, $p=<0.005$) (Figure 7:6)

2. between the experiments ($F=25.04$, $p=<0.001$) (Figure 7:7)

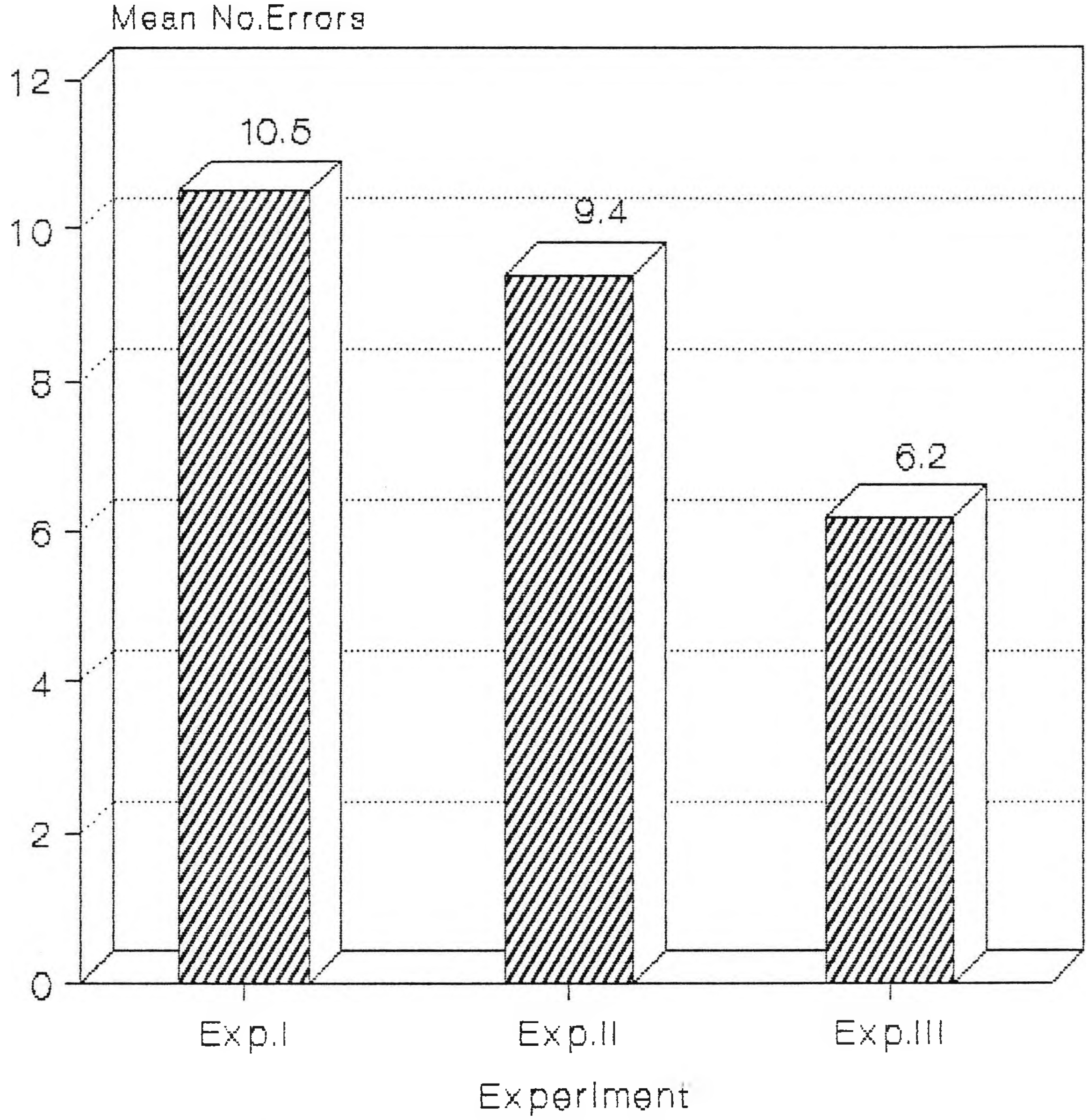
In the Figures, it may be seen that there is a definite

Figure 7:6
Main Effect between Age Levels
for Greek Normal Subjects



$F=11.434$, $df=1/19$, $p<0.005$

Figure 7:7
Main Effect between Experiments
for Greek Normal Subjects



F=24.129, df=2/38, p<0.001

improvement over age, and that there appears to be a progressive improvement from one experiment to the other. This was tested further: the least difference, that is, that between Experiments I and II, was tested and found to be significant ($t= 2.55$, $p=<0.002$). It can therefore be concluded that the difference between Experiments II and III is also significant.

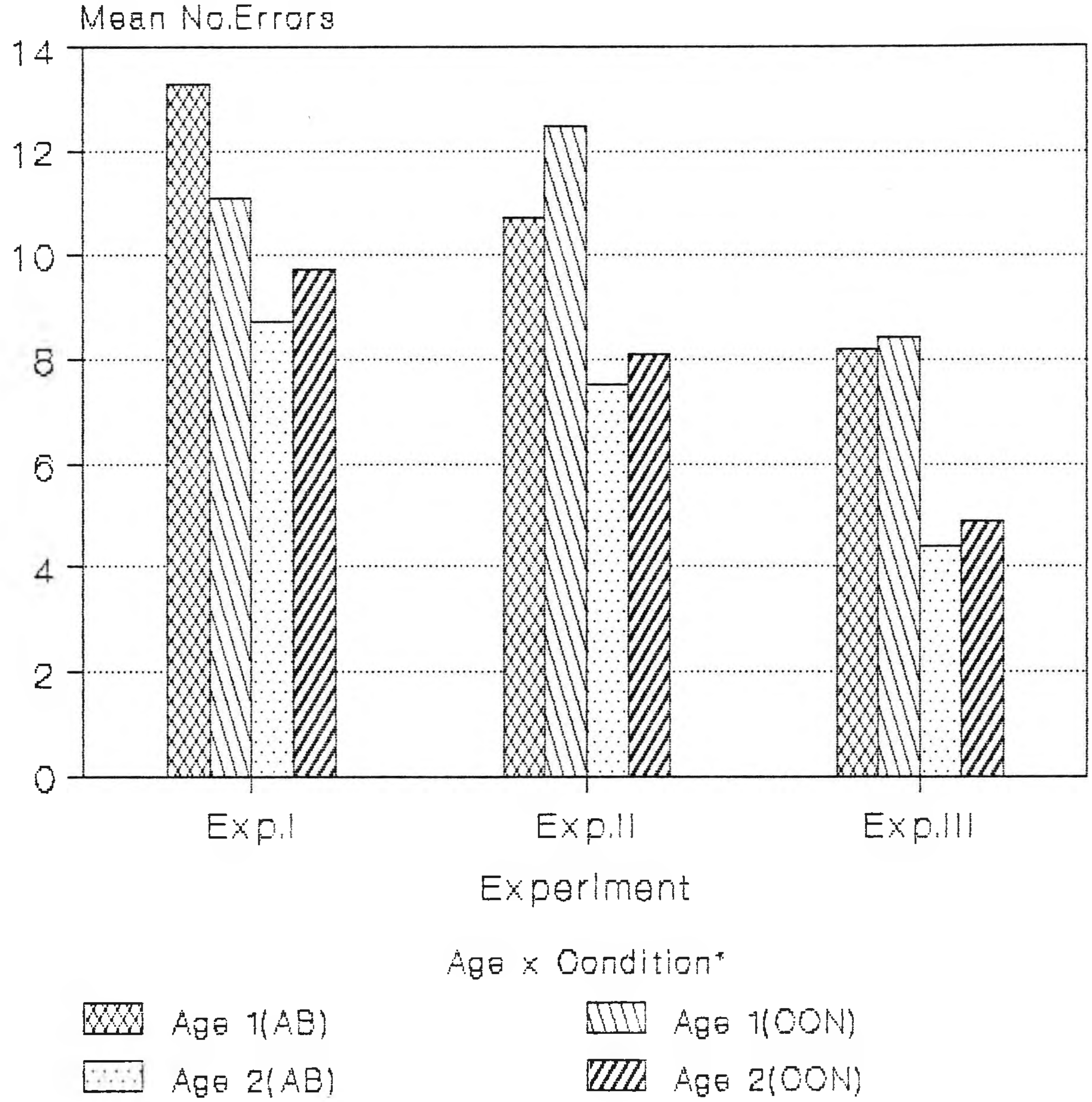
Notably, no main effect was found between the Abstract and Concrete conditions, which means that although, as can be seen in Figure 7:8, these Greek normal children performed slightly better in the Abstract condition (except the younger age group in Experiment I), this difference was not statistically significant. It will be noted that, in contrast, the English normal group's performances were better in the Concrete condition, and this difference was statistically significant.

7.3.1.2 Interactions

Unlike the English normal control group's, the Greek normal control group's data did not present any interactions.

In Figure 7:8, a graphic representation of the data is given for the Greek normal control group by Experiment, Age and Condition.

Figure 7:8
Results of Exps.I-III by Age & Condition for Greek Normal Subjects



* Age 1-Age Level 1 (2;6-2;11 yrs).
Age 2-Age Level 2 (3;0-3;11 yrs).
Condition-Abstract(AB)/Concrete(CON).

7.4 Greek Language Handicapped Group

The language handicapped group consisted of 19 children, who were sub-divided into two groups. These two groups were matched to the Greek normal control group and to the Greek mentally handicapped group according to their language Mental Ages (the Peabody Picture Vocabulary Test was used). Their visual perception Mental Ages (according to the Seguin Formboard) were much higher, as were their chronological ages.

Age Level 1: Language M.A. 2;6-2;11 years

N=10

Age Level 2: Language M.A. 3;0-3;11 years

N=9

The subjects were again given the three experiments serially, from I to III.

A summary of the results so far in each experiment, is as follows:

In Experiment I: which consisted of a non-linguistic spatial categorization task, the following was found for this experimental group:

1. they made the fewest errors of any other experimental group but this was found to be significant only with respect to the mentally handicapped group.

2. there was a difference between the two age levels, in that they improved with increasing age.

3. this group was significantly better at the Abstract task than at the Concrete task ($t=2.426$, $p=<0.05$).

In Experiment II: where there was general verbal cuing of the spatial dimension of the categorization task, the following was seen:

1. the language handicapped group were now performing significantly better than the Greek normal control group (and, although this is irrelevant, the English normal control group).

2. they continued to perform better than the mentally handicapped group, as in the previous experiment.

3. again, they were significantly better at the Abstract than at the Concrete task ($t=2.149$, $p=<0.05$).

4. the two age levels did not, now, show a significant difference between them.

In Experiment III: where there was now specific verbal labelling of the spatial concepts, the following was found:

1. the language handicapped group were still better than any other experimental group at this task.

2. they performed significantly better at the Abstract task than at the Concrete task, as before.

3. they were not showing any differences between age levels.

The data for the language handicapped group was now tested altogether with analysis of variance, in order to see the progression from one experiment to the other.

7.4.1 Analysis of Variance for the ERROR Scores

A 2 x 3 x 2 factorial design was used, as for the previous experimental groups.

7.4.1.1 Main Effects

There were two main effects:

1. between experiments ($F= 27.02$, $p=<0.001$) (Figure 7:9).

2. between conditions (F=20.18, p=<0.001) (Figure 7:10).

There was no main effect for age level.

The differences between each of the experiments were significant (t=4.86, p=<0.001). As for the conditions, it was yet again made clear that the language handicapped subjects were better at the Abstract condition.

No interactions were found for this data.

Figure 7:11 shows analytically the data for the language handicapped group by experiment, by age level and by experimental condition.

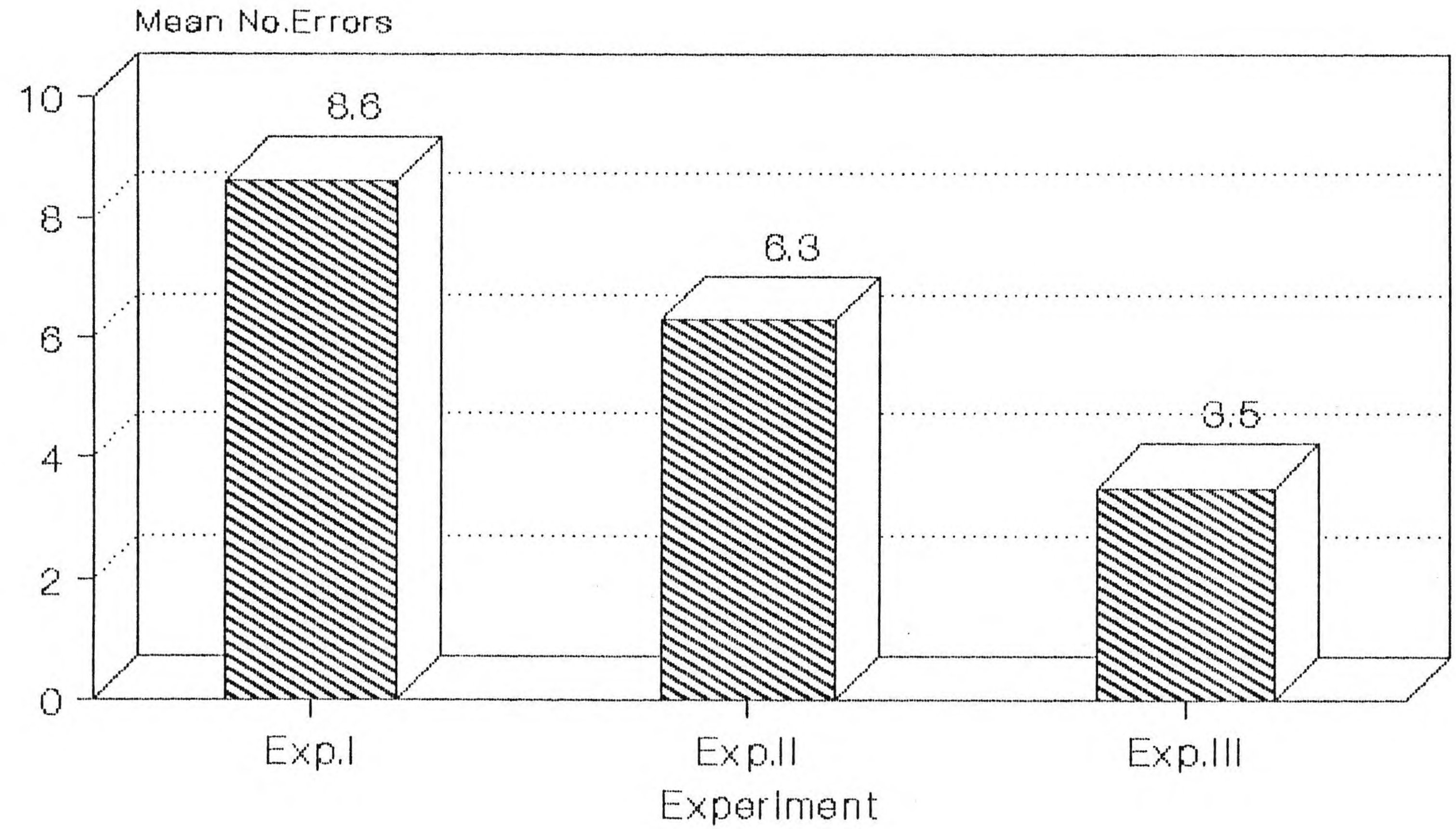
7.5 Mentally Handicapped Group

The mentally handicapped group consisted of 16 children, who were divided into two age levels, consisting of 8 children each:

Age Level 1: Language M.A. 2;6-2;11 years
Visual Perception M.A. 2;6-2;11 years

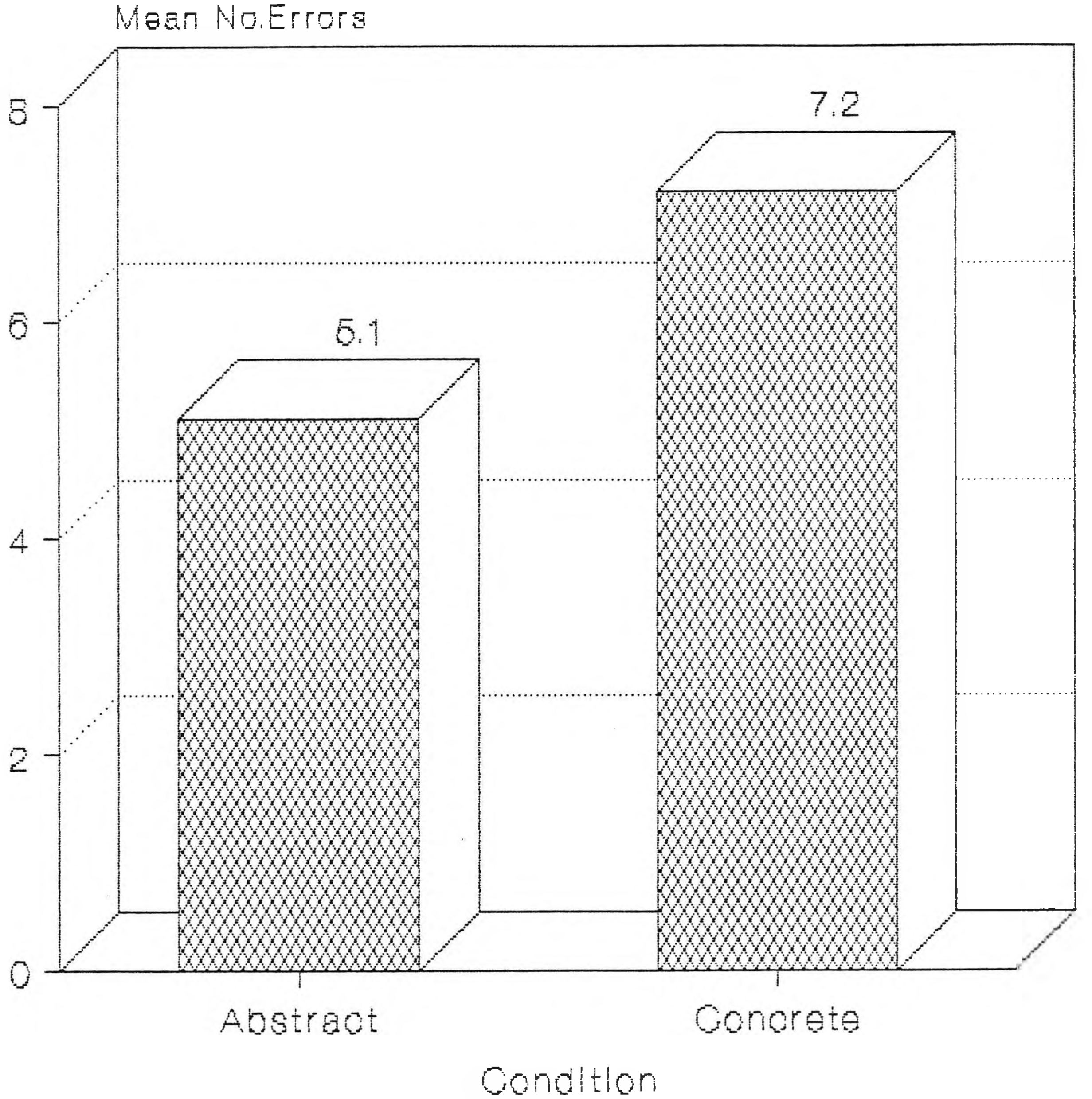
Age Level 2: Language M.A. 3;0-3;11 years
Visual Perception M.A. 3;0-3;11 years.

Figure 7:9
Main Effect between Experiments
for Greek Language Handicapped Group



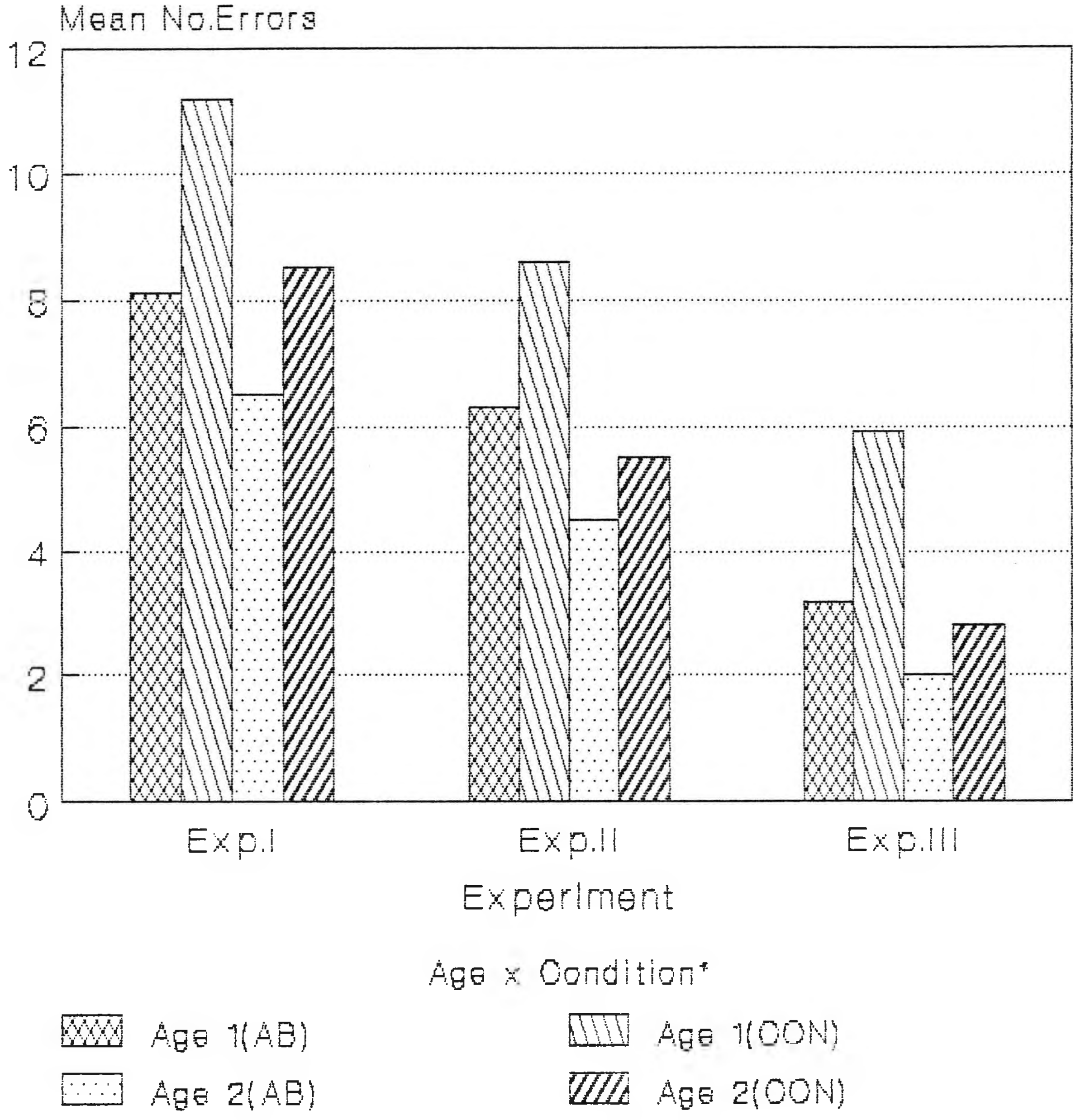
F=26.958, df=2/34, p<0.001

Figure 7:10
Main Effect between Conditions
for Greek Language Handicapped Group



F=19.372, df=1/17, p<0.001

Figure 7:11
Results of Exps.I-III by Age & Condition for Greek Language Handicapped Subjects



*Age 1-Age Level 1 (2;6-2;11 yrs).
Age 2-Age Level 2 (3;0-3;11 yrs).
Condition-Abstract(AB)/Concrete(CON).

All the subjects performed Experiments I through to III in serial order.

A summary of the results seen so far is:

In Experiment I: which is a non-linguistic spatial categorization task, the following was found:

1. the mentally handicapped group showed no significant difference in their ERROR scores from the two normal control groups.

2. their performance was significantly worse than that of the language handicapped group.

3. they had significantly more errors in the Concrete task than in the Abstract task, as the language handicapped group had done.

4. there appeared to be some improvement from one age level to the other.

In Experiment II: where there was verbal cuing of the spatial dimension of the same spatial categorization task, the following was found:

1. there was no significant difference between the performance of the mentally handicapped group and the two normal control groups.

2. there was, again, a significant difference between the performances of the mentally handicapped and the language handicapped groups: the former's was worse than the latter's.

3. there was no improvement from one age level to the other.

4. they were significantly better at the Abstract task, as they had been in Experiment I.

In Experiment III: which consisted of the specific verbal labelling of the spatial concepts under investigation, the following was found:

1. at this point, the performance of the mentally handicapped group became significantly worse than all of the other groups'.

2. there was no significant difference between the age levels.

3. there was no difference between the Abstract and the Concrete tasks.

7.5.1 Analysis of Variance

A 2 x 3 x 2 factorial design was used to analyze the data for the mentally handicapped group for all three experiments together.

7.5.1.1 Main Effects

Two main effects were found:

1. between experiments ($F=3.4$, $p=<0.05$) (Figure 7:12)

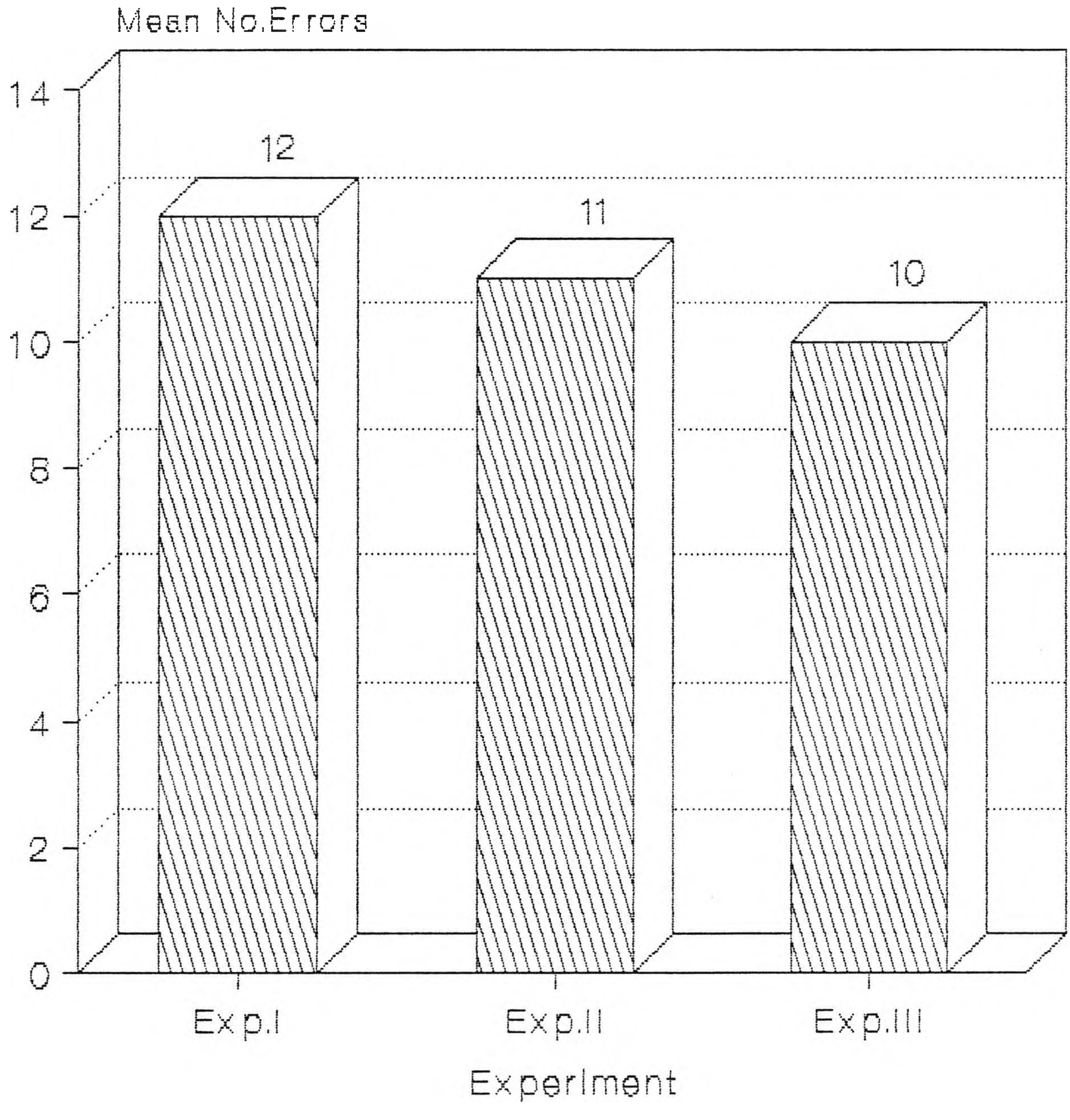
2. between conditions ($F= 8.7$, $p=<0.01$) (Figure 7:13)

The main effect between experiments was further tested and it was found that there was no significant difference between the mean ERROR scores for Experiments I and II, neither between the mean ERROR scores for Experiments II and III. The only significant difference was between Experiments I and III ($t=2.9$, $df=14$, $p<0.01$).

No main effect was found between the age levels.

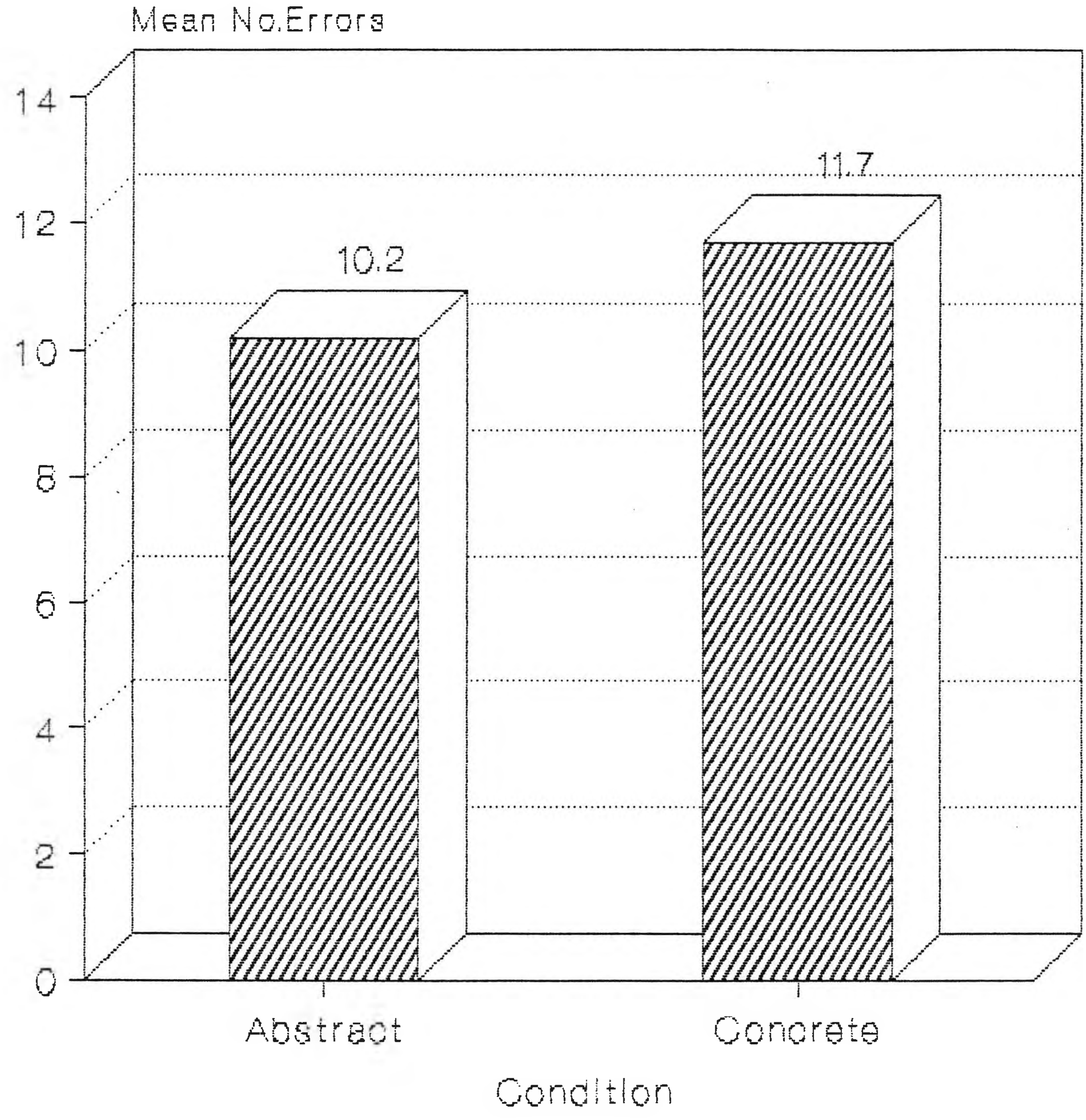
In Figure 7:13, it can be seen quite clearly that the mentally handicapped group scored significantly better, on the whole, with the Abstract tasks.

Figure 7:12
Main Effect between Experiments .
for Greek Mentally Handicapped Group



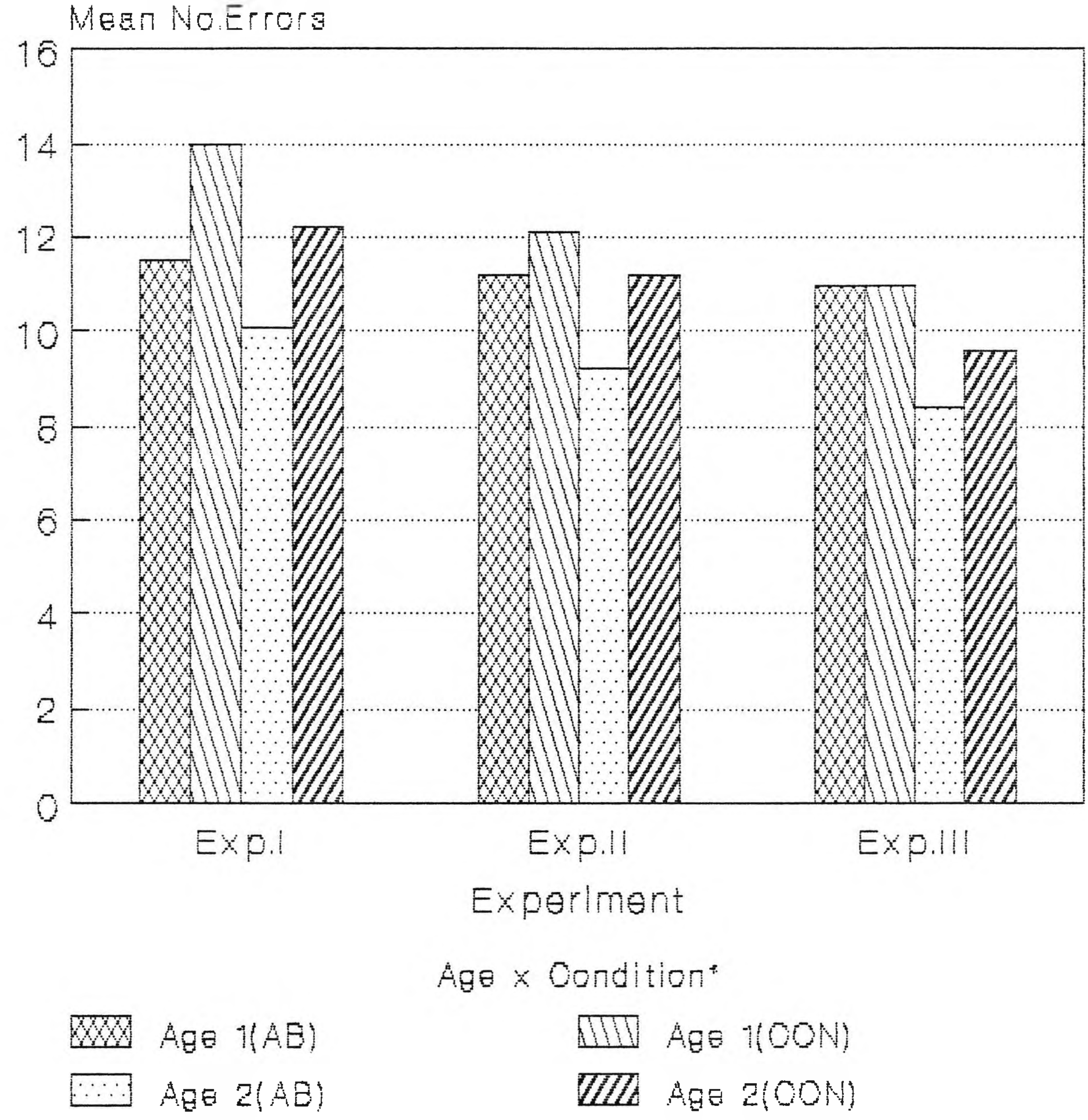
$F=3.402$, $df=2/28$, $p<0.05$

Figure 7:13
Main Effect between Conditions
for Greek Mentally Handicapped Group



F=8.719, df=1/14, p<0.01

Figure 7:14
Results of Exps.I-III by Age & Condition for Greek Mentally Handicapped Group



* Age 1-Age Level 1 (2;6-2;11 yrs).
Age 2-Age Level 2 (3;0-3;11 yrs).
Condition-Abstract(AB)/Concrete(CON).

No interactions were seen for this data. A summary of the results for the mentally handicapped group, by age and condition, across all three experiments, may be seen in Figure 7:14.

The main conclusions to be drawn from this analysis, is that this group of subjects behaved as a homogeneous one, irrespective of age differences, and secondly that they were not particularly helped by the instructions given to them. Finally, they appeared to be better able to deal with Abstract two-dimensional pictures than with pictures of three-dimensional objects, probably because these former are easier to interpret on a visual perceptual level.

7.6 Discussion

The analyses in the previous chapters, for Experiments I-III, had compared each experimental group's performance to the others, one experiment at a time. In the present analysis, we were interested in finding out how each experimental group fared from Experiment I through to III. Would any new information be brought to light?

Taking each experimental group at a time, some old information was highlighted through this analysis and, more rarely, some new facts emerged, which had escaped the previous analyses.

Beginning with the English normal group, it was observed, yet again, that, through all three experiments (I-III), they made less errors in the older age level, than in the younger age level, which was, of course, information which was to be expected and which had been met before.

The present analysis allowed us to confirm that this group improved, on the whole, from Experiment I through to III, though this improvement was less obvious in the younger age level than in the older one (Figure 7:1).

The one striking fact, in the English groups' results is the effect that the general verbal instructions for Experiment II had on their performance. Although in Experiment I, their performance was fairly consistent in both the Abstract and the Concrete conditions, in Experiment II, there was a marked discrepancy between conditions, where they appeared to be performing significantly better at the Concrete condition than at the Abstract one. In fact, the general verbal instructions of Experiment II, seemed to confuse this group of children, whereas this was not the case (as seen in Chapter 4) for their Greek counterparts. Reasons for this have been forwarded in Chapter 4, but remain mere speculation. An interesting line for further research is suggested by these results.

In Experiment III, it appears that the now explicit verbal instructions for this experiment help the older age level subjects to iron out this discrepancy between the conditions, but the younger subjects continued their confusion and did not improve significantly from one experiment to the other. As can be seen, there was a significant difference between Abstract and Concrete conditions for this English group in Experiments II and III.

Comparing the above results to those of the normal Greek subjects, it may be seen that, likewise, the normal Greek subjects also improved significantly at the task as they grew older and that they also improved significantly from one experiment to the other.

However, they did not reveal the same effect between Abstract and Concrete conditions as the English group. If one were to compare the results of the English normal group (Figure 7:1) with the results of the Greek normal group (Figure 7:8), it may be noted that the younger Greek group appear to definitely benefit from the explicit verbal instructions of Experiment III. Also, that they are not being influenced by the conditions. Furthermore, the older Greek children appear to be making more errors than their English counterparts, in Experiments II and III.

Since the two normal subject groups (Greek and English) did not show differences in performance, when the tasks were non-verbal in Experiment I, one can only conclude that language-specific factors influenced their performances during Experiments II to III. This was true of the English-speaking groups more obviously than for the Greek-speaking ones. Thus, a task which began non-verbally, was "contaminated" as soon as some verbal instructions, however general, were given to the subjects.

A possible question, to be kept in mind at this point, is how independent is a perceptual-conceptual task, as that which Experiment I appeared to be, from semantic-linguistic factors. Could it be that they are easily influenced by each other, because they appeal to a "common pool" of knowledge, to which different processes are applied either consecutively or simultaneously? This, of course, makes the process of objective experimentation very difficult, if not, impossible. This question will be returned to later, after more of the experiments are completed.

Meanwhile, another conclusion which may be made, is that, once the locative prepositions were used by the experimenter, the older children could more easily "solve" the categorization task. The matching of visual image and the semantic component, the spatial locative, was generally successful at this point. The younger children, however, could not do this so easily: they appeared to be more sensitive to the different stimuli and their comprehension was easily disrupted, if the instructions were in any way ambiguous. This is well illustrated by the younger

English group's performance in Experiment II.

Turning now to the language handicapped group, the interesting new information, which emerged from this analysis, was that there was no significant difference between the two age levels. In other words, these two groups were performing as a homogeneous one. It will be remembered that "age level" was determined according to their language level, as determined by the Peabody Picture Vocabulary Test. In the "younger" age level group, the subjects had a language level between 2;6 and 2;11 years of age. In the "older" age group, the subjects had a language level between 3;0 and 3;11 years of age. The visual perception mental age, according to the Seguin Formboard, was at or above 5;6 years. Their chronological ages were even higher.

It appears, therefore, on a superficial level, that this task was dependent principally on visual perception skills, and not on verbal ones, hence the language handicapped children were performing as a homogeneous group, since their visual perception abilities were approximately the same. Furthermore, it will be remembered from previous chapters that their performance was significantly better than all of the other experimental groups' in Experiments II and III (although they performed better than the other groups in Experiment I, this difference was significant only with the mentally handicapped group). Language comprehension for these children was the same as their normal counterparts, since they were matched according to the Peabody Picture Vocabulary Test. Therefore, if and when, during the task linguistic skills were asked for, they were just as capable of using theirs as the normal Greek group. Thus, this fact does not in the least lessen the possible potency of a "common pool" theory, as we suggested above, and to which we will return later.

Finally, the mentally handicapped groups lack of significant difference between age levels may be attributed to the same factor as that for the language handicapped group. In other words, if this task initially and principally, tapped the children´s visual perception abilities, then their performance would be determined by their Seguin Formboard scores, and not their PPVT scores. It will be remembered that the mentally handicapped group´s Seguin Formboard scores were, according to standardization, at the chronological ages of the normal groups, that is, between 2;6 and 3;11 years, **but** were lower than the normal groups´ scores were, since the normal children all performed above standardization norms. The mentally handicapped groups´ homogeneity may not, therefore, be attributed to their Seguin Formboard scores, but rather that since their visual perception skills were generally lower than the other groups´, they were not able to understand the task. They did not improve from one experiment to the other, as one would expect, but merely showed a significant difference between the results of Experiment I and III. It appears that the naming of the spatial locatives in

Experiment III, did help them, since it was within the range of their capablities, according to the PPVT.

The final observation, which has been made before, is that both the language handicapped groups and the mentally handicapped groups performed significantly better at the Abstract than at the Concrete condition. It has already been suggested that these groups were not able to use pragmatic cues to solve this categorization task, as the normal groups appeared to be able to do. This phenomenon was seen again in Experiments V and VI, and will be discussed more extensively at a later stage in the argument.

SECTION II

CHAPTER 8

The Influence of Language Specific Factors and Semantic Congruity on Spatial Cognition and the Understanding of Locative Terms: An Introduction to Experiments V-VII.

In the first section of this study, a series of experiments was described, which consisted of a spatial sorting task conducted under various conditions. The groups of subjects tested were either from two different linguistic backgrounds, Greek or English, or they were children with two different disabilities, mental or language handicap. A recapitulation of the results of these experiments will not be made here.

The next three experiments, which will be described in this section, address themselves to specific questions, which arose from the results of Experiments I-IV. Thus, the rationale for Experiments V-VII, which will be expounded in this introduction, will naturally link them to the previous experiments. In the following chapters in this section, each of the three experiments will be described in detail.

In Experiments I-IV, it was demonstrated that there are many factors, which contribute to the development of spatial cognition and to the acquisition of locative terms. An attempt was made to select some of these factors and to investigate them further in these last three experiments.

In Experiments I-III, it was demonstrated that there was a significant difference between the two normal groups on the one hand and the two handicapped groups on the other hand, with regard to their sorting of abstract or concrete pictures. The mentally handicapped subjects and the language handicapped subjects appeared to perform, on the whole, better at the Abstract condition, where the pictures were of unfamiliar shapes and dots, than in the Concrete condition, where the pictures were of familiar objects. The two normal groups, English- and Greek-speaking, did not show such a preference for the Abstract condition, in fact, with respect to the English group, the reverse seems to be true from Experiment II onwards. It was suggested that the normal subjects were facilitated in the task by semantic-pragmatic information in the Concrete condition, of which the handicapped groups were not as capable of taking advantage. Taken a step further, if normal children are better able to interpret pictures which have meaning for them, does this also apply to their ability to respond to more meaningful verbal instructions. Thus, according to this schema, when asked to do something meaningful or "congruous", such as, placing a doll in a cot, children should be better able to perform correctly, than when asked to do something "incongruous", such as, placing the doll under the cot. Yet again, according to the results of Experiments I-III, it would be expected that the handicapped groups would not be as influenced by semantic-pragmatic factors, as the normal children.

Experiment V, the first in the present series, was designed to investigate these questions. Here, toy objects were used as the test material instead of drawings. Furthermore, the children manipulated the objects according to the verbal instructions given by the experimenter. These verbal instructions were divided into two categories: those which were semantically congruous and led to the canonical arrangement of the toy objects, such as, "the doll in the cot"; those which were semantically incongruous, resulting in the non-canonical arrangement of the toy objects, such as, "the doll under the cot". There was a third condition in this experiment, which allowed the subjects to manipulate and arrange the toy objects, according to their own pre-conceived schema of how the particular objects should be arranged. This was achieved by giving the subjects instructions, in which the crucial semantic element, the locative preposition, was inaudible. This allowed the subject to perform according to what he thought he heard, not to what he actually had heard. In this condition, would the subjects make a canonical arrangement of the toy objects? According to previous experimental data and to our present hypothesis, there would be a marked preference for the spontaneous canonical arrangements of the toy objects. On the other hand, the subjects may be seen to perform according to other, as yet unidentified, rules.

This experiment did not aim to investigate cross-linguistic differences, since the results of the previous experiments did not reveal a significant difference between the two language groups in this particular area under investigation. Thus, all the subject groups were Greek-speaking.

The control group consisted of children of normal intelligence at two age levels. The two experimental groups consisted of subjects, either with mental or language handicap.

Next, Experiment VI attempted to unravel some of the linguistic factors, which influence young children's understanding of locative instructions. The question asked was whether it was syntactic, semantic or pragmatic factors, which played a more important role in the understanding of sentences containing spatial prepositions.

Syntax was investigated with respect to word order; semantics with respect to the locatives themselves; and pragmatics with respect to the canonical arrangement of the toy objects.

In this experiment, the same subjects were tested as in Experiment V.

The final experiment in this study, Experiment VII, again returned to some of the questions raised in the first section, regarding the language-specific aspects of spatial cognition and the acquisition of locative terms.

It will be remembered that in Experiment I, where the task was non-verbal, both normal experimental groups, whether Greek- or English speaking, performed similarly in the spatial categorization task given to them. However, when verbal instructions were introduced in the task, in Experiment II, the performance of the two language groups began to be differentiated, according to the language-specific properties of the two languages. At that particular point, the precise nature of the language-specific properties, leading to the differences in the performance of the two language groups, could only be speculated upon. There was, furthermore, an indication that these language-specific properties influenced the perceptual field.

In Experiment VII, an attempt was made to investigate the influence of some of the language-specific properties, with regard to the acquisition of locative terms. It will be remembered that we had made an initial hypothesis that Greek locatives were characterized by linguistic complexity and by a certain degree of ambiguity, whereas English locatives were more diverse and consisted of many synonyms. Would this, indeed, lead to a different rate of locative acquisition in the two languages? Or would it merely result in an uneven pattern of the acquisition of specific locatives, that is, those representing the most difficulty?

The second question, which was investigated in this experiment, was whether there would be a concomitant cross-cultural "unevenness" in the mapping of these linguistic terms onto perceptual models. To what degree, that is, does specific language structure play a role in our perception of reality?

In the chapters that follow, the three experiments briefly mentioned here, will be described in greater detail, and the results will be discussed for each one separately. An attempt will be made to answer the questions raised here, along with other questions which arose as the experiments were under way.

Finally, the last chapter will attempt to unite the threads leading through each of the experiments in a final discussion of the results. This will be concluded by the indications these experiments have raised for further investigations.

CHAPTER 9

Semantic Congruity, Semantic Incongruity and the Canonical Placement of Objects: Experiment V.

9.1 Introduction

One of the questions, which arose from the previous experiments, was concerned with the role of semantics and pragmatics in young children´s understanding of locative instructions. When asked to perform tasks with familiar toy objects, would young children listen to the locative instruction and perform equally well, whether the information was semantically congruent or incongruent, or would they tend to ignore the verbal instruction and perform according to some non-verbal pragmatic rules, about the canonical placement of objects. There is considerable evidence that children under three years old, are more likely to "hear" or interpret verbal instructions according to their knowledge of the real world, than to hear what is really being said to them (E. Clark, 1973b; Wilcox and Palermo, 1982). Thus, when told to put a doll under a cot, even though they may be perfectly capable of understanding the syntax of the sentence, they would ignore the semantic content, and perform according to what is "correct" or canonical in the arrangement of these two objects in the real world: that is, they would put the doll **in** the cot. In other words, when hearing something semantically incongruous, they would prefer to interpret it as if it is semantically congruous.

This tendency to misinterpret verbal instructions, according to knowledge representations of the real world, tends to decrease as the young child grows older. Thus, at approximately four years of age, young children pay more attention to specific verbal instructions, which they are able to interpret correctly, laying aside whatever tendency they may have had at a younger age level to perform according to congruity principles. It was decided to test this hypothesis further by introducing a third condition to this experiment. In this condition, in the verbal instruction given to the subject, the locative preposition would be inaudible, thus giving the subject the opportunity to react in several possible ways: to behave as if he had heard the locative preposition, most probably that which was most semantically congruous to the situation at hand; to ignore the verbal instruction altogether and to make a random arrangement; to make an arrangement according to motoric simplicity (for instance: it is easier to put shoes **on** a bed, even though this is a non-canonical arrangement, than to put the shoes **under** the bed, where it is a well-known fact that they "belong"); the subject has one final alternative, to tell the experimenter that he did not hear what the instruction was and to ask her to repeat it.

Another aim of this experiment was to investigate whether the "on", "in" or "under" locative prepositions presented equal difficulty to the children. A further point of interest was whether the toy object pairs presented equal difficulty or whether some evoked a more "congruous" response than others. Several investigators (Schwam, 1982; E. Clark, 1973b; Wilcox and Palermo, 1974) had observed that locative accuracy was in part a function of the reference objects, indicating a response bias.

Moreover, a comparison between the subject groups tested in this experiment could answer some further questions: first of all, what rules would the normal children apply for the comprehension of the verbal instructions given to them? Would these rules be primarily pragmatic, leading to the canonical arrangement of the objects, or would they be primarily syntactic, leading to a correct interpretation of the instructions? Would this apply to children under four years of age, as well as for children over four?

In order to test this, children of normal intelligence were compared at two age levels:

Age Level 1: 3;0-3;11 years/months

Age Level 2: 4;0-4;11 years/months

It was expected that the younger subjects would be more likely to respond according to pragmatic rules of canonical arrangement of objects, than to syntactic rules as would the older children.

Second, we compared the performances of the mentally handicapped subjects with the normal control group. Third, a small group of young dysphasic (language handicapped) children was compared with the mentally handicapped and the children of normal intelligence.

It will be remembered that this study is concerned with the differences in the comprehension of spatial locatives between groups with different cognitive and linguistic abilities. In the previous experiments, it was demonstrated that the two handicapped groups did not pay as much attention to pragmatic factors as did the subjects of normal intelligence. The mentally handicapped subjects were not helped in their performance of the task by the linguistic information given. On the contrary, the language handicapped group, surprisingly, made the most positive use of the linguistic information given to help solve the task. This was an unexpected finding, which the present experiment aimed to investigate further with respect to the language handicapped group. In particular: would they again pay particular attention to the linguistic information given them, and ignore conflicting factors concerning semantic congruity or incongruity? It was hoped that some further light would be shed on these interesting questions.

9.2 The Subjects

The subjects in this experiment were all Greek and living in

Athens, Greece. There were three main categories of subjects: children of normal intelligence, mentally handicapped children and dysphasic (language handicapped) children. None of the subjects had participated in the previous Experiments I-IV.

9.2.1. Normal Subjects

The first comparison to be made in this experiment was between two groups of children of normal intelligence. There were twelve children in each group and the characteristics of each group, divided according to age level, were as follows:

Age Level 1: Twelve children of normal intelligence, aged between 3;0 years and 3;11 years, with a mean chronological age of 3;6 years (SD=0.32), and a mean Peabody Picture Vocabulary Test (PPVT) score of 3;7 years (SD=0.57).

Age Level 2: Twelve children of normal intelligence, aged between 4;0 years and 4;11 years, with a mean chronological age of 4;5 years (SD=0.34), and a mean PPVT score of 4;6 years (SD=0.24).

All 24 subjects were attending one of two playgroups in middle class areas of Athens. All of the children were tested with PPVT before the experiment was begun. Children, whose test scores were too high or too low for their chronological age, were not used as subjects in the experiment.

9.2.2. Mentally Handicapped Subjects

The second comparison to be made in this experiment was between a group of mentally handicapped subjects and a control group of children of normal intelligence, taken from the normal sample.

The mentally handicapped group consisted of 10 children attending a special school in Attica, Greece. These children were matched, according to their PPVT scores, with 10 children from the group of normal intelligence, aged between 3;0 and 3;11 years.

The characteristics of each group were as follows:

i. Ten children with moderate mental handicap (IQs 45-60), with a mean chronological age of 8:9 years (SD=1.03) and a mean PPVT score of 3;8 years (SD=0.6).

ii. Ten children of normal intelligence, with a mean chronological age of 3;7 years (SD=0.26) and a mean PPVT score of 3;8 years (SD=0.58).

9.2.3 Language Handicapped Subjects

The final comparison made in this experiment was between a small group of language handicapped subjects and two matched control groups, one consisting of children with normal intelligence, and the other consisting of mentally handicapped children, matched for language level (PPVT).

These language handicapped children were unfortunately few, only six, since it was difficult to find children, who fitted our rather exacting criteria. All six of these children were bright dysphasics, whose development in all spheres, excepting language, was perfectly normal. However, they had no or minimal verbal output and their semantic comprehension was well below their chronological age.

These six dysphasic subjects were attending one of two language units, presently operating in Athens.

The characteristics of the three experimental groups were as follows:

i. Six language handicapped (dysphasic) subjects with a mean chronological age of 5;6 years (SD=0.52) and a mean PPVT score of 3;5 years (SD=0.44).

ii. Six children of normal intelligence with a mean chronological age of 3;6 years (SD=0.31) and a mean PPVT score of 3;5 years (SD=0.26).

iii. Six mentally handicapped children with a mean chronological age of 9;0 years (SD=1.06) and a mean PPVT score of 3;5 years (SD=0.28).

Both of the last two groups, the normal and mentally handicapped groups, consisted of subjects who had already been tested in Experiment V, but were now matched to the language handicapped group.

9.3 Task and Conditions

The task consisted of the active manipulation of sets of toy objects by the subject, according to verbal instructions. These verbal instructions involved the spatial arrangement of the toy objects.

The sets of toy objects were six and were chosen with the following criteria:

1. they were toys familiar to young children

2. they lend themselves to a canonical arrangement, which is semantically congruent to young children. For instance, in the

case of the doll and the cot, the canonical arrangement of these two items is that the doll is in the cot. Therefore, an instruction, such as "put the doll in the cot", should be semantically congruent to the child.

3. the toys could also be arranged in a manner which was non-canonical. For instance, a non-canonical arrangement for the doll/cot set of objects would be to put the doll under the cot. Thus, an instruction, such as "put the doll under the cot" would be semantically incongruent to the child.

4. these toys could be used to test the locative prepositions "in", "on" and "under". It was difficult, if not almost impossible, to find enough items with which it was possible to test all three prepositions (for instance, a car is an object to which one can apply all three locative prepositions: something can be "in" it, "on" it or "under" it"). We took account of this limitation by having several possible combinations of toy objects, which would be testing all three prepositions.

Each of the six pairs of toys consisted of a Fixed Object, which was the reference toy, and a Moving Object, which was the toy that would move position. The object pairs were as follows:

FIXED OBJECT	MOVING OBJECT
bed	shoes
rail	train
cot	baby
bridge	boat
table	telephone
cupboard	dress

Thus, syntactically, the Moving Object was always the subject of the instruction given to the child, and the Fixed Object was always the predicate of the instruction. The syntactic element, which underwent change, was the locative preposition. For instance:

PAIR 1 Fixed Object = bed

Moving Object = shoes

Instructions: " Put the shoes on the bed "

" Put the shoes under the bed "

" Put the shoes (....) the bed "

All of the six pairs of toy objects were used in three experimental conditions. Thus, there were eighteen instructions which each subject had to execute for the completion of this experiment (6 toy pairs x 3 conditions = 18 instructions).

As we have already mentioned, there were three conditions in this experiment. These were:

<u>Condition 1: Semantically congruent</u> instruction requiring the canonical arrangement of the two toy objects, as described above.

<u>Condition 2: Semantically incongruent</u> instruction, requiring an unusual or irregular arrangement of the two toy objects.

<u>Condition 3: Inadequate message.</u> An instruction, in which the locative preposition was masked by a noise, thus making the message inaudible and, of course, inadequate.

This last condition, as has been mentioned above, was designed to test whether the subject would proceed in the task, as if he had heard the message adequately and, in that case, how he would arrange the objects, or alternatively, whether he would ask the experimenter to repeat the message.

In Table 9:1, the six pairs of objects, used in this experiment, are presented with the instruction for each pair at each of the three conditions. It may be noted that in the semantically congruent condition, the three prepositions "in", "on" and "under" were represented equally often, whereas in the semantically incongruent condition, there was no instruction

Table 9:1
Verbal Instructions for Each Condition

Condition 1	Condition 2	Condition 3
Semantically Congruent	Semantically Incongruent	Inadequate Message
shoes under bed	shoes on bed	shoes....bed
train on rail	train under rail	train....rail
baby in cot	baby under cot	baby....cot
boat under bridge	boat on bridge	boat....bridge
telephone on table	telephone under table	telephone...table
dress in cupboard	dress on cupboard	dress...cupboard

involving the preposition "in", but the instructions were equally divided between the locatives "on" and "under". This was done, because it has often been reported that young children show a marked preference for instructions, involving the locative "in", and this fact would have biased the results of the semantically congruent condition towards that particular spatial location. In other words, their fascination with things that go into other things, could lead to falsely correct responses, something we wished to avoid.

9.4 Materials

The materials used in this experiment were all toy objects, with which all of the subjects were familiar. All the toys were quite large and easily handled. They were all, with one exception (the bridge was wooden), made of plastic. The rail was part of a toy railway and was about 10 cms. long.

The instructions for the task were all in Greek and may be seen in the Appendix. The instructions were 18 in all, since there were six object pairs and three conditions. These instructions were randomized across conditions and object pairs, so that there was no fixed sequence, neither for objects, nor for conditions.

The 18 instructions were pre-recorded on a tape by the experimenter. This was considered necessary, especially for the inadequate message condition. In this latter condition, the inadequate message was achieved by scrunching a plastic bag at the point were the locative preposition was said in the instruction. This managed to mask the preposition very effectively. Furthermore, it was convincing since the flow of the sentence was uninterrupted.

The test objects were placed in a box with six compartments, one for each object pair. Every time, during testing, that the subject completed the instruction for one object pair, the experimenter removed the toys from the table and replaced them in the box. She then placed the next object pair on the table, in preparation for the next recorded instruction. Since this procedure took a certain amount of time, the tape-recording was temporarily stopped, whilst this was done.

9.5 Test Criteria

The experimenter completed a form for each subject. The form listed all 18 instructions, in the order in which they appeared in the tape-recording. For the semantically congruent and the semantically incongruent instruction, it was noted whether the subject´s response was correct or incorrect. If the response was incorrect, a notation was made concerning the spatial arrangment of the objects. A note was made concerning any comments that the subject might make, concerning the task. For the inadequate message condition, since there was no "correct" or "incorrect" answer, a notation was made concerning what spatial arrangement the objects were placed. It was also noted whether the subject questioned the experimenter concerning the inadequate message, whether he made any comment whatsoever, looked puzzled or hesitated in any way.

Upon completion of the task, the experimenter transferred these results to a general index for each group, according to condition. For the semantically congruent and the semantically incongruent conditions, ERRORS were counted. This was interpreted as any time that the child misunderstood the verbal instruction given to him and placed the toy objects in a different spatial arrangement than that asked of him. In the inadequate message condition, an "ERROR" was counted every time that the spatial arrangement made by the subject was non-canonical or "semantically incongruent". The fact that these spatial arrangements were counted as ERRORS was for the sake of convenience and not, by any means, that we judge them as being so.

9.6 Procedure

The children in all groups were tested at their respective schools. The test was conducted, in all cases, one time only and in a room without other distractions. The experimenter sat opposite the subject at a low table. The tape-recorder was placed on the table and the box with the toys was placed on a low chair next to the experimenter, hidden from the child´s view.

Test Trial: The experimenter gave the subject some general instructions, concerning the task:

E: " We´re going to play with some toys. First of all, I´ll show them to you and then we´ll turn on the tape-recorder and listen to what we are told to do."

The experimenter then removed the first set of objects from the box and placed them in front of the child, whilst naming each of the objects. The experimenter allowed the subject to handle the items for a few seconds, before removing them. This procedure was repeated for all six pairs of toy objects.

Test: The experimenter told the subject that it was now time to play the game, to listen carefully to what the person on the tape-recording said and to follow the instructions given.

The experimenter placed the first set of toys in front of the subject and then switched on the tape-recorder. The subject listened to the recorded instruction and, when it finished, the experimenter put the tape-recorder on PAUSE, while the subject responded by arranging the objects. The experimenter verbally reinforced the child, noted how he responded to the instruction, removed the set of toys and replaced it with the next set. This was repeated for all 18 instructions on the tape-recording.

All the children tested were extremely cooperative during the task. The taped instructions were successful, in that they kept the children´s attention from straying, since the idea was novel to them. None of the instructions had to be repeated, since the subjects payed such close attention to what was being said. Generally, they did not comment on the instructions given to them. One child made such mischievous comments as: "Did you hear what she said? (Giggling)...put the baby **under** the cot!" Another child´s comment, when told to put the shoes on the bed, was: "It´ll get dirty!"

As for the inadequate message condition, surprisingly few children appeared puzzled or asked what was said. Some supplied the missing locative preposition themselves. Greater details will be given below of the children´s responses to this task and will be discussed at some length later.

9.7 Results

The data was analyzed in three separate analyses of variance. These consisted respectively of:

1. Normal Greek children compared at two age levels:

Age Level 1: 3;0-3;11 years/months

Age Level 2: 4;0-4;11 years/months

2. Mentally handicapped group compared to normal control group.

3. Language handicapped group compared to both a control group of mentally handicapped subjects and a control group of normal subjects.

9.7.1. Normal Greek Subject Group

This analysis of variance consisted of one between subject variable, which was age (two levels), and one within subject variable, which was condition (three levels).

The two levels of age were:

i. 3;0-3;11 years/months

ii. 4;0-4;11 years/months

The three levels for condition were:

i. Semantically congruent condition

ii. Semantically incongruent condition

iii. Inadequate message condition.

9.7.1.1 Main Effects for the ERROR scores

Two main effects were found for the ERROR scores:

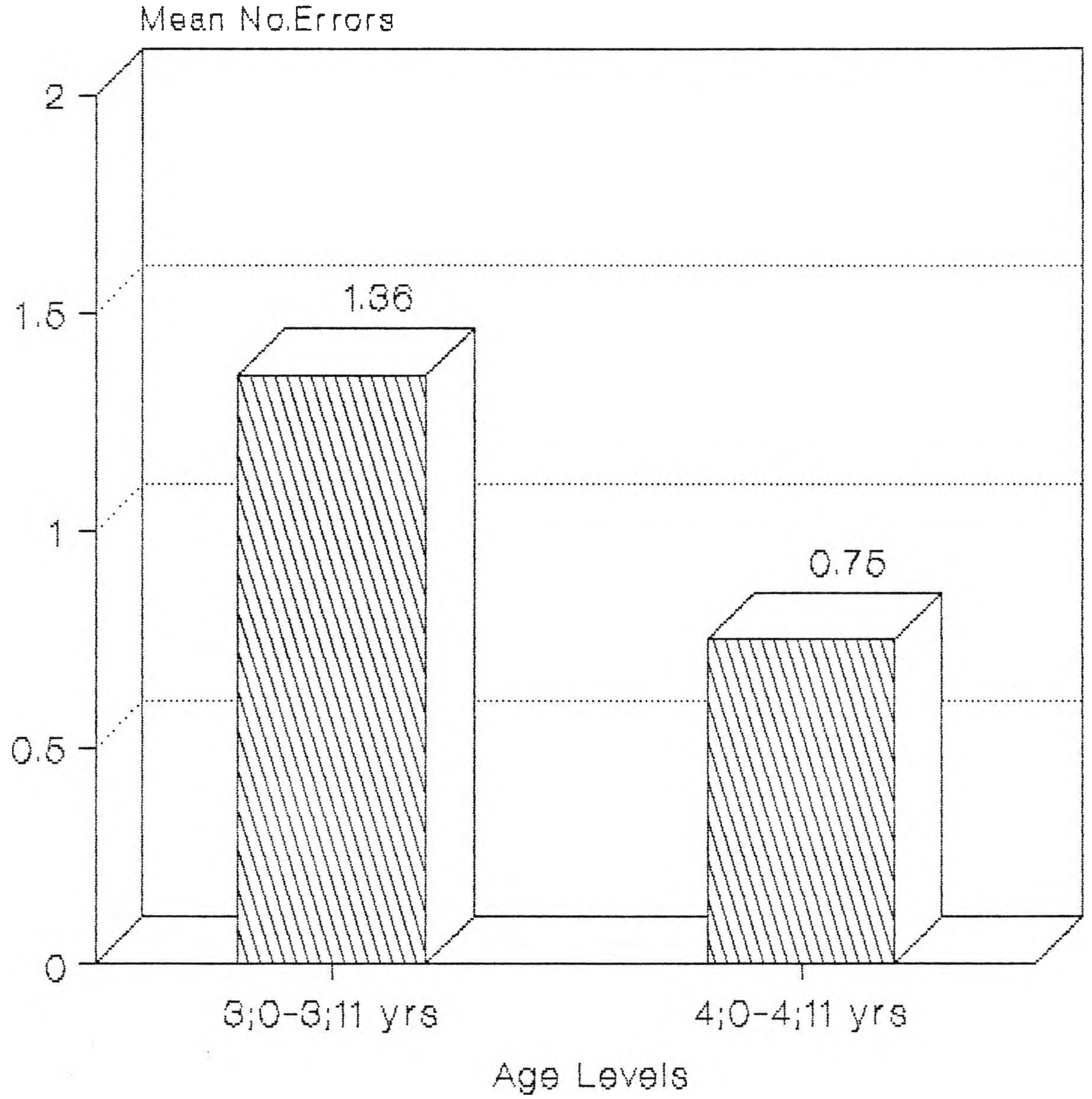
1. between age levels ($F=8.042$, $df=1/22$, $p<0.001$) (See Figure 9:1)
2. between conditions ($F=22.293$, $df=2/44$, $p<0.001$) (See Figure 9:2)

As can be seen from Figure 9:1, there is a significant improvement from the younger to the older subjects. It was not necessary to analyze these results any further. In Figure 9:2, it is apparent that, because there are three conditions, it was necessary to further analyze the results through planned comparisons.

Through this latter procedure, it was found that, when the semantically congruent was compared with the semantically incongruent condition, there was indeed a significant difference in the results, in favour of the former ($F=18.98$, $df=1/44$, $p<0.001$).

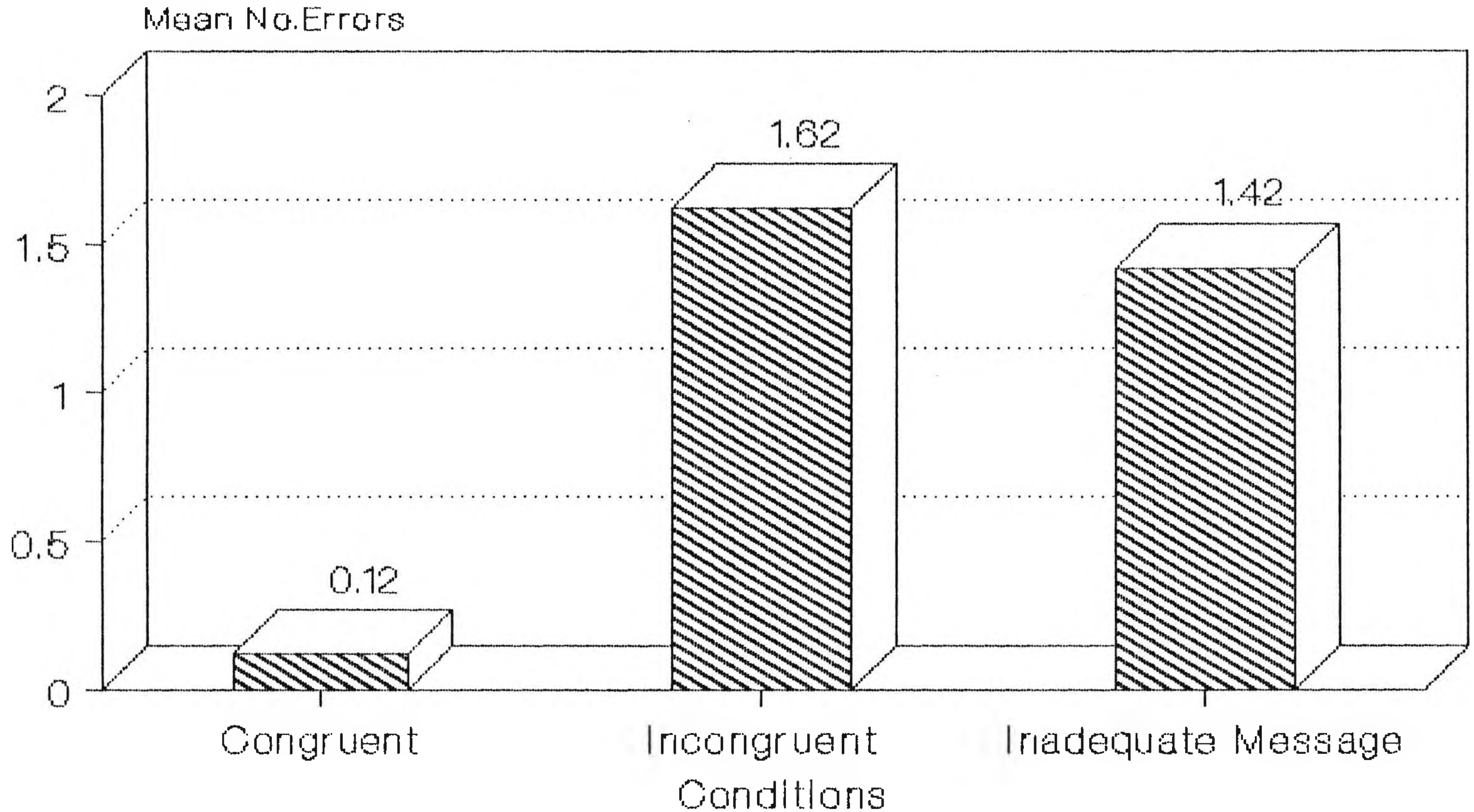
There was also a significant difference between the semantically congruent and the inadequate message ($F=14.08$, $df=1/44$, $p<0.001$). However, there was no significant difference between the incongruent condition and the inadequate message condition.

Figure 9:1
Main Effect between Age Levels in Exp.V.
(Normal Subject Groups)



F=8.042, df=1/22, p<0.001

Figure 9:2
Main Effect between Conditions in Exp.V.
(Normal Subject Groups)



F=22.293, df=2/44, p<0.001

9.7.1.2 Interactions

The interaction between group and conditions was not significant, although it came quite close to significance ($p=0.08$). In Figure 9:3, a graphic representation is shown. Since this represents quite an interesting trend, we will allow ourselves the indulgence to speculate on this in a later section.

9.7.2 Mentally Handicapped Subject Group

Ten mentally handicapped subjects were matched and compared with 10 of the subjects of normal intelligence, aged between 3;0 and 3;11 years.

Analysis of variance consisted of one between subject variable, which was intelligence. This variable had two levels, referring to the two groups of subjects:

i. mentally handicapped subjects

ii. normal subjects

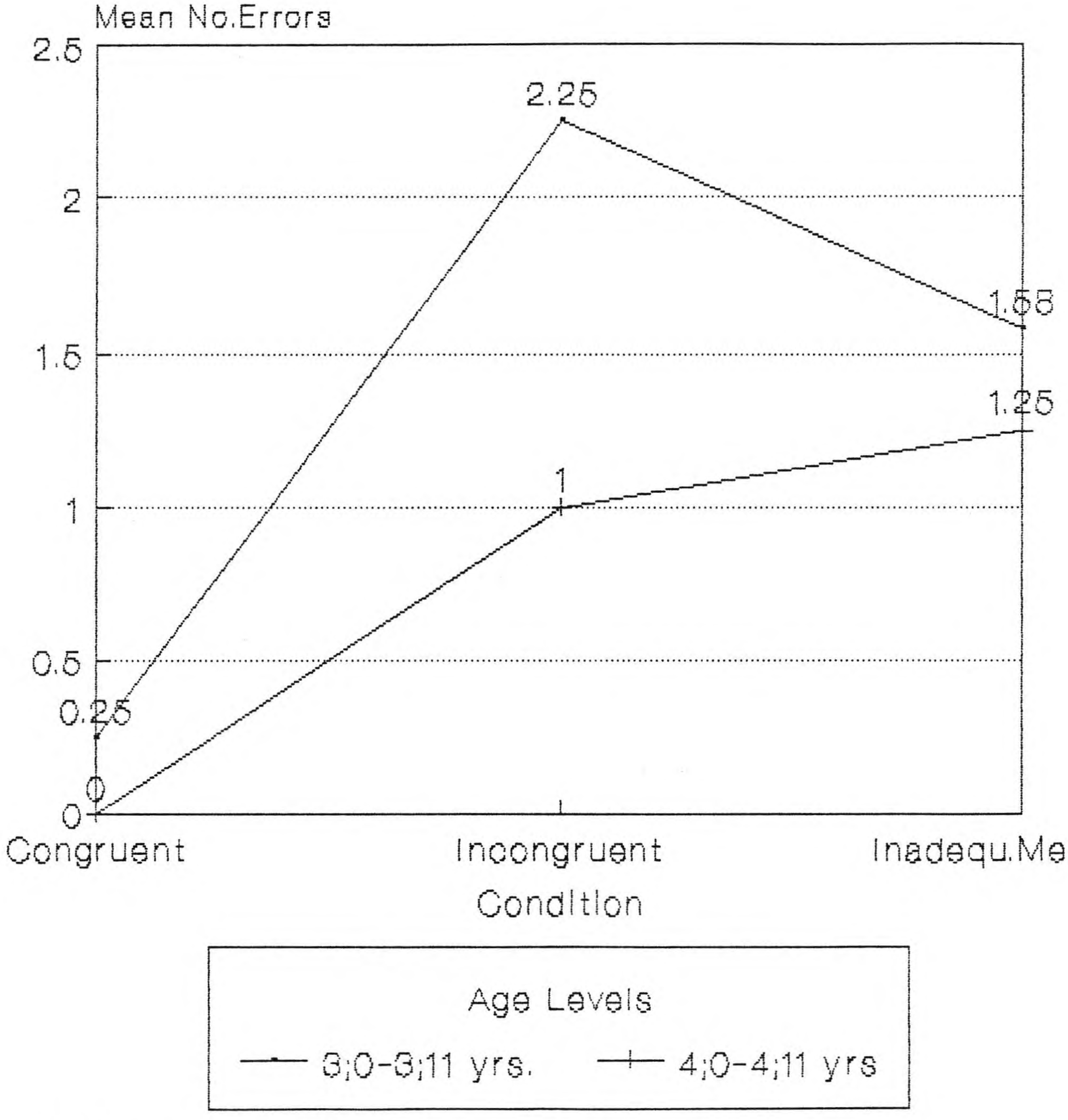
There was also one within subject variable, which was condition. This consisted of three levels:

i. semantically congruent

ii. semantically incongruent

iii. inadequate message

Figure 9:3
Mean Error Scores for Normal Subjects
(by Condition and Age Level)



N.B. Analysis of Variance revealed no Interaction in this data.

9.7.2.1 Main Effects for the ERROR scores

The results of the analysis of variance produced one main effect, which may be seen in Figure 9:4. This was between the conditions ($F=15.308$, $df=2/36$, $p<0.001$). This result was further tested with planned comparisons, which produced the following results:

1. When the semantically congruent instruction was compared with the incongruent instruction, there was a significant difference, in favour of the former ($F=14.64$, $df=1/36$, $p<0.001$).

2. When the congruent instruction was compared with the inadequate message, there was again a significant difference, in favour of the former ($F=7.2$, $df=1/36$, $p<0.025$).

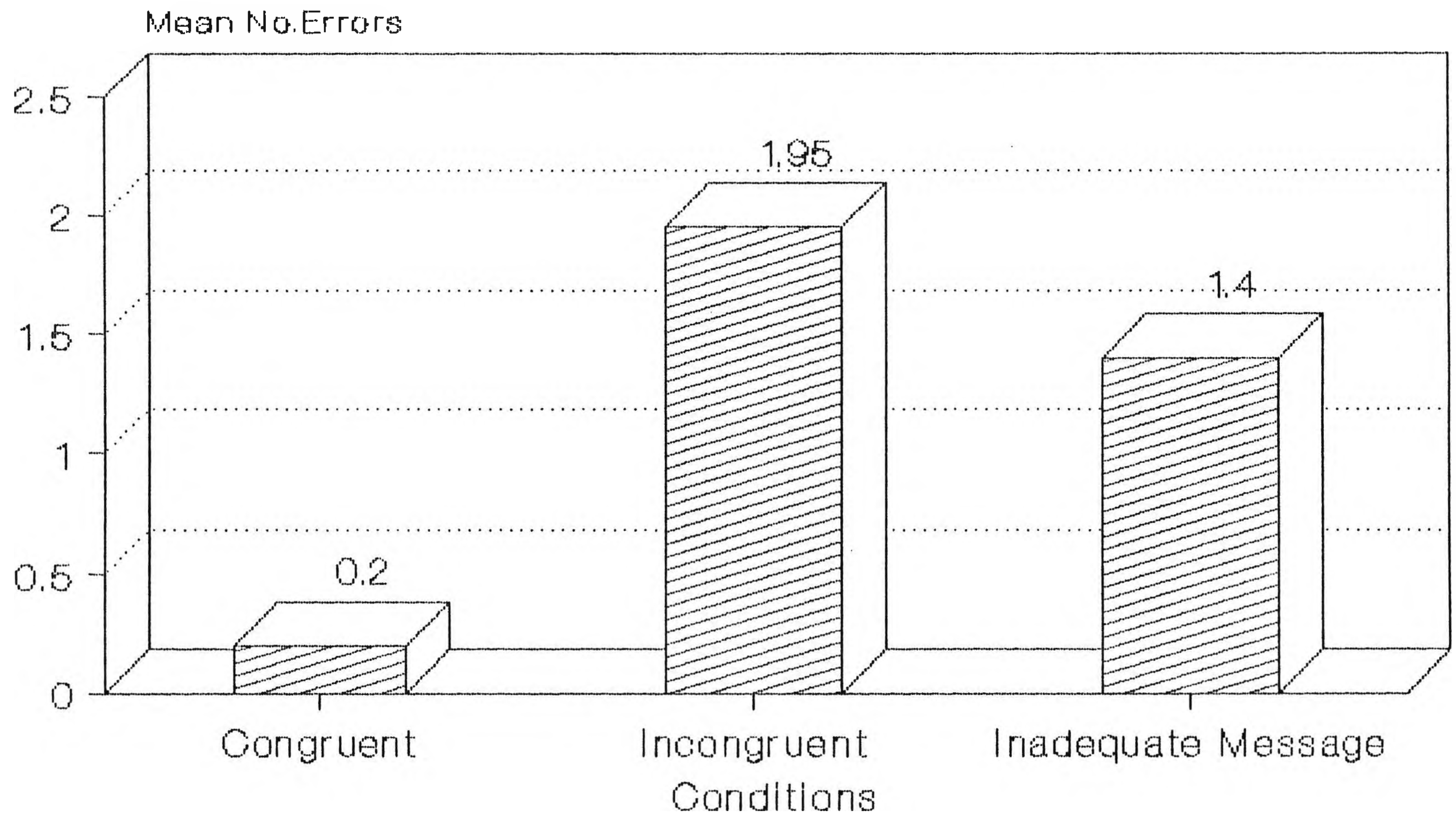
There was no significant difference, yet again, between the incongruent condition and the inadequate message condition.

It must also be noted that no significant difference was found between the performance of the two subject groups. Furthermore, no significant interaction was found.

9.7.3 Language Handicapped Subject Group

A small group of 6 language handicapped children was compared with a matched sample of 6 mentally handicapped children and 6

Figure 9:4
Main Effect between Conditions in Exp.V.
(Mentally Handicapped x Normal Controls)



F=15.308, df=2/36, p<0.001

normal children from the 3;0-3;11 year old age level group.

The analysis of variance consisted of one between subject variable, which had three levels:

i. language handicapped (dysphasic) subjects

ii. mentally handicapped subjects

iii. normal subjects

There was one within subject variable, which was condition, and also had three levels:

i. semantically congruent

ii. semantically incongruent

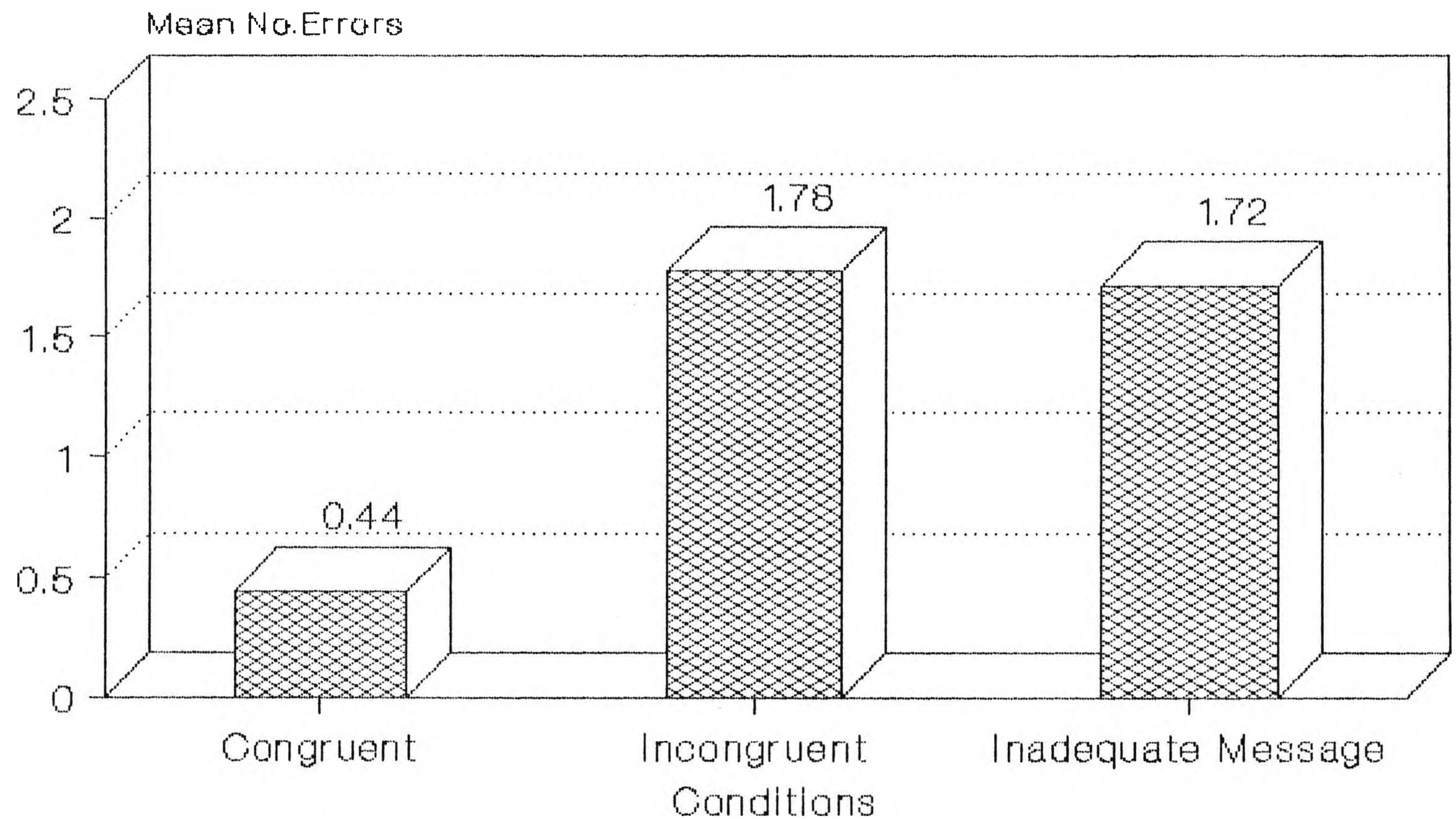
iii. inadequate message.

9.7.3.1 Main Effects for the ERROR Scores

There was a main effect between conditions ($F=10.635$, $df=2/30$, $p<0.001$), but not between the three subject groups. A graphic representation of the main effect between conditions may be seen in Figure 9:5. Since this subject group was so small, the results were not further analyzed with planned comparisons. However, the following trend was observed:

1. There appeared to be a difference between the semantically congruent and the semantically incongruent conditions, in favour of the former.

Figure 9:5
Main Effect between Conditions in Exp.V.
(Lang.Hand. x Ment.Hand. x Norm.Control)



F=10.635, df=2/30, p<0.001

2. There also appeared to be a difference between the congruent condition and the inadequate message, again in favour of the former.

3. There did not appear to be a difference between the incongruent condition and the inadequate message condition.

These observations were similar to those for the mentally handicapped group.

9.7.3.2 Interactions

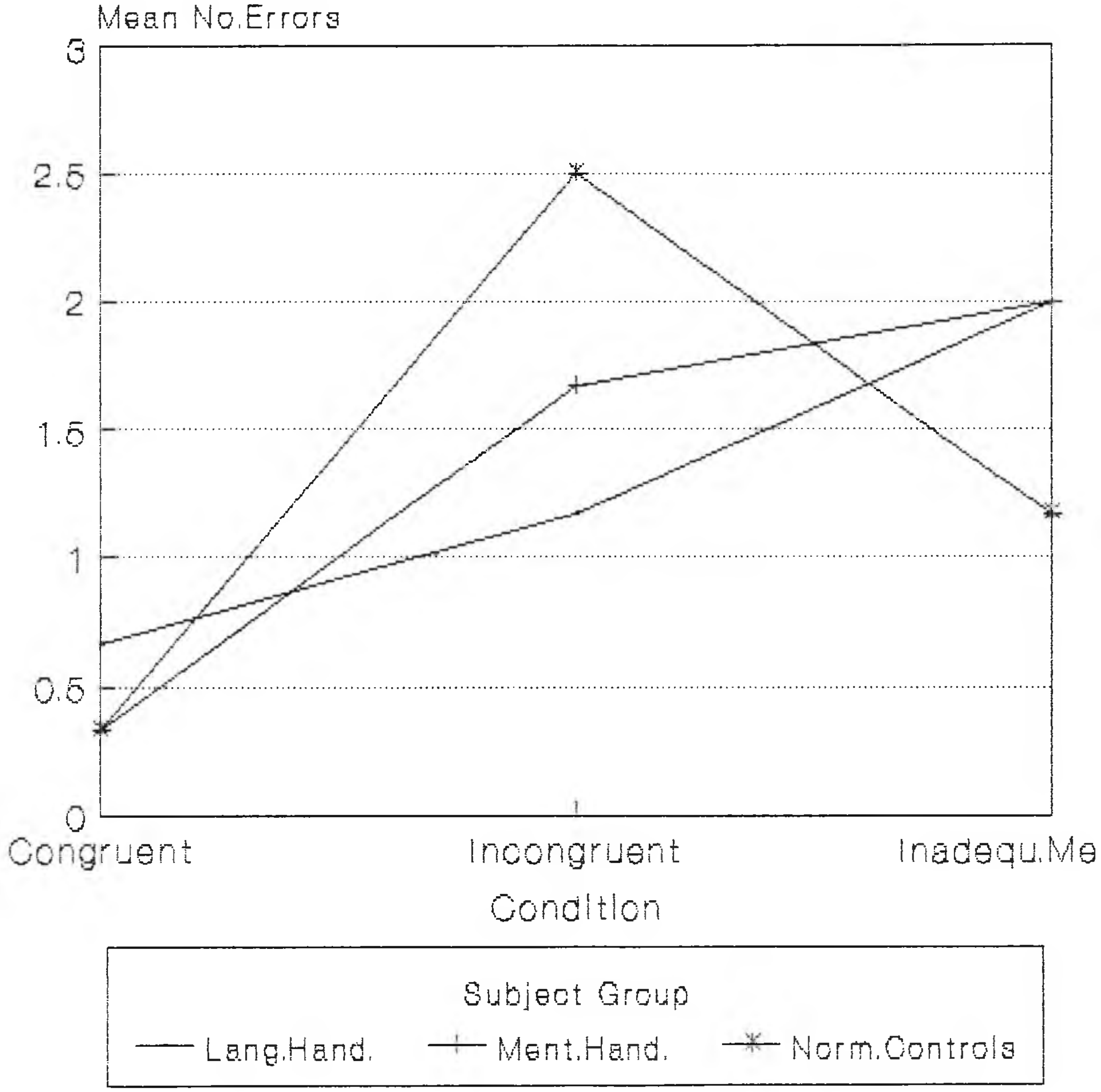
The interaction between subject group and condition was not significant, but, yet again, we considered it sufficiently close ($p=0.08$) to warrant our comments. These will be reserved for a later section. The graphic representation of the results of the three groups may be seen in Figure 9:6 and we believe, in a way, speak for themselves.

9.7.4 Result Summary

The following facts arise from the statistical analyses of the data in Experiment V:

1. Normal children over four years of age perform significantly

Figure 9:6
Mean Error Scores in Exp.V.
(Subject Group x Condition)



N.B. Analysis of Variance revealed no statistical significance in this interaction.

better at these tasks than do those between the ages of three and four years. In these two groups, there is also a significant difference between the ERROR scores for each condition. In the first condition, where the verbal instructions are semantically congruent, the children of both groups make almost no errors. However, in the second condition, where the instructions are semantically incongruent, there is a sharp rise in errors in both groups. This difference is significant.

The surprising finding in these results is that there is also a significant difference between the ERROR scores for the semantically congruent condition and the inadequate message condition. For this latter condition, the ERROR scores are more like those of the semantically incongruent condition than like those of the congruent condition, as had been anticipated. It will be remembered that for the inadequate message, a non-canonical placement was counted as an error. It is therefore apparent that the subjects were making quite a few non-canonical arrangements of the toy items, when they were not able to discriminate the locative preposition in the verbal instruction given to them. This was contrary to our expectations: we had expected that, when in doubt, a child would prefer to make a canonical spatial arrangement, in accordance with their knowledge of reality. Such a preference for that which is semantically congruent was, however, seen in the increase in errors that were made in the semantically incongruent instructions. The different strategies, that the children may have been using in interpreting the instructions in each condition, will be discussed in some detail below.

One further suggestion, which this data offers, which is not however statistically significant, is that the older children tend to make more non-canonical placements in the inadequate message condition, whereas the younger childeren make less non-canonical placements in the inadequate message condition, than they do in the semantically incongruent condition! Since this has interesting developmental implications, it will be further discussed in the following section.

2. There was no significant difference in the ERROR scores between the mentally handicapped group and the control group, which consisted of children of normal intelligence, aged between three and four years old. Yet again, the same pattern of results as for the normal groups was observed: there was a significant difference between the semantically congruent and incongruent conditions (less errors were made when the instructions were semantically congruent), and there was also a significant difference between the congruent condition and the inadequate message condition (again, less errors for the congruent condition). Yet again, both of the groups were making almost as many non-canonical arrangements with the toy objects in the inadequate message condition, as they were making canonical

arrangements in the semantically incongruent condition. Both the former and the latter counted as errors.

3. Finally, the language handicapped group´s data results did not appear to be significantly different from either the mentally handicapped group´s nor the normal group´s. Exactly the same pattern for the conditions was observed, as in the previous groups´: in other words, they made less errors in the semantically congruent condition than in either the semantically incongruent or the inadequate message conditions.

Although a significant interaction was not found between group and condition, it was close enough (p=0.08) to call for a more detailed inspection. In Figure 9:6, which represents these results, it may be seen that the normal children appeared to be having the most difficulty with the semantically incongruent instructions and the language handicapped group the least difficulty with that same condition; however, in the inadequate message condition, the normal children were making the fewest non-canonical arrangements. In contrast, the language handicapped group and the mentally handicapped group are making quite a lot of non-canonical arrangements in the inadequate message condition. With respect to the language handicapped group, this result seems to represent an oxymoron: on the one hand, they seem to be paying more attention to the verbal instructions than their normal counterparts, thus performing better than them in the semantically incongruent condition, and on the other hand, when given an inadequate message, they perform according to some other strategy, which leads them into making quite a few non-canonical arrangements of the objects.

This interesting fact will be further analyzed and discussed in a following section, and it will be proposed that these results are not as confounding as they appear to be at first sight.

In the next section, a descriptive analysis of the data will be undertaken, since this might offer some vital information about the different strategies used by the children for the execution of these verbal instructions. This will, it is hoped, lead to a more comprehensive discussion of the results of this experiment.

9.8 Descriptive Analysis of the Data

It was felt that a statistical analysis of the present experiment's data was not sufficient to explain its results. It was therefore necessary to analyze several aspects of this experiment separately, and to corroborate our hypotheses with descriptive data. Finally, an attempt was made to amalgamate these findings with the statistical results, in order to draw our conclusions.

In this section, each condition will be treated separately and several questions will be posed for each. Some of the questions we will attempt to answer with respect to the data are:

1. What role does semantics play in young children´s understanding of verbal instructions?

2. How do children respond to different toy materials and how and to what degree does this influence the data?

3. What strategies do children employ when faced with an inadequate message in this test situation?

4. Do children respond differently to different locative prepositions?

5. What differences are there in performance between children of normal intelligence at different age levels, and between mentally handicapped and language handicapped children?

9.8.1 Semantically Congruent Condition

It will be remembered that in this condition the children were asked to place two toy objects in a canonical spatial arrangement. We must mention at this point that, during the test trial, when the experimenter had introduced the toys to the subjects and allowed them to handle them for a few seconds, most of the subjects had automatically combined the toys in their canonical arrangement. In other words, they had put the doll in the cot, the train on the rail, the telephone on the table, the dress in the cupboard. However, this arrangement of the objects, according to their knowledge of where things are commonly located in the real world, was not observed to occur so often for the last two pairs: the boat/bridge pair and the shoes/bed pair. Both of these pairs consisted of a canonical arrangement where the first item should be **under** the second item.

During the test itself, it is interesting to note that, in the normal groups, only two children at the younger age level made errors. Both of these children were the youngest of the group, being just three years old. Furthermore, both made an error in the shoes/bed pair, one child putting the shoes on the bed and the other putting the shoes next to the bed. It seems probable that this latter child interpreted the locative preposition "under", which is "kato apo" (followed by a noun) in Greek, in its adverbial sense, "kato", which means "down" or "on the ground". This child also misinterpreted the semantically congruent instruction for the train/rail pair, by putting the rail on the train.

From the type of errors that these two children were making and from the fact that these two children were the youngest in the group, it may be assumed that these were indications of how children under three years old might perform in this task.

The older children of normal intelligence, as may be expected, made no errors in the congruent task.

In the mentally handicapped group, only one child made some errors: in one, she put the shoes **on** the bed and in the other, she put the telephone **under** the table. This subject behaved in rather idiosyncratic way throughout the whole test: she would repeat all the instructions correctly, but often made mistakes in their execution.

Finally, in the language handicapped group, the main bulk of errors (that is, three out of the four made by the subjects in this condition) was made by one child. Out of the three errors, the two involved the boat/bridge pair and the shoes/bed pair.

Our initial observation concerning these two toy pairs, appeared to be confirmed in that, out of the total of eight errors made in this condition, five consisted of errors in the spatial arrangement of these two pairs.

9.8.2 Semantically Incongruent Condition

Although all the subjects of all groups seemed to be managing excellently with verbal instructions, which were semantically congruent, the opposite seems to be true when they were faced with semantically incongruent instructions. In this condition, a sudden rise in errors is observed:

1. Normal children, aged 3;0-3;11 years, made 27 errors out of a possible 72, which is 37.5% of the total.

2. Normal children, aged 4;0-4;11 years, made 12 errors out of a possible 72, which is 16.7% of the total.

3. Mentally handicapped children made 18 errors out of a possible 60, which is 30% of the total.

4. Language handicapped children made 7 errors out of a possible 36, which is 19.4% of the total.

Since the subjects seemed to be quite adept at interpreting the locative preposition correctly, as long as the instructions were semantically congruent, as a first impression the reason for this sudden breakdown appears to be in the semantic-pragmatic element in the instructions, that is, whether the instruction was congruent or incongruent.

The younger normal children, it will be noticed, appear to be more concerned with whether what is being asked is feasible, in a pragmatic sense, whereas the older children appear to be paying more attention to the semantic-syntactic elements of the instructions given to them. They too, however, are still biased towards those instructions that are semantically congruent, and therefore pragmatically feasible. Presumably, as they grow older, children pay more attention to the actual words spoken to them, although, even as adults, we often respond to what we hear according to what we expect to be told, not to what is actually spoken to us.

However, at this point, we wished to understand what were some of the possible reasons why the children were having such difficulty with the semantically incongruent instructions in this experiment. It was necessary, therefore, to analyze some other aspects presented by the data, which may indicate what were some of the factors contributing to the difficulties in the task.

First of all, the errors were analyzed, according to how many there were for each toy pair. This analysis was performed, in order to confirm the observation made previously, that some of the toy pairs (such as, the boat/bridge pair and the shoes/bed pair) did not produce such "fixed" spatial arrangements as others. For instance, a young child has a very well-established concept in his knowledge representations that the proper place for a baby is **in** a cot, and not **under** it. On the other hand, he may not as yet have such a firm knowledge representation of boats and bridges: that is, that boats always go **under** bridges, and not

on top of them. This is, naturally, due to the degree of direct experience that the child has. In conclusion, it seems probable that some objects are more semantically (or, strictly speaking, pragmatically) connotive than others.

This hypothesis was initially tested for the two groups of normal intelligence. A tabulation of the results may be seen in Table 9:2.

An inspection of this table makes it apparent that there is a stronger influence of pragmatic factors in the arrangement of some of the object pairs than in others: that is, some of the object pairs consistently produce more errors in the semantically incongruent condition than do others. It appears, therefore, that some of the object pairs are indeed more semantically (and pragmatically) connotive than others. Those that are not, produced less errors in this condition.

TABLE 9:2 Analysis of the Data of the Semantic Incongruity Condition for the two Normal Subject Groups.

	Normal 3;0-3;11 yrs		Normal 4;0-4;11 yrs	
Instruction	Errors (poss. 12)	% total	Errors (poss. 12)	% total
shoes on bed	0	0	0	0
boat on bridge	2	7.4%	0	0
telephone under table	2	7.4%	0	0
baby under cot	7	25.9%	1	8.3%
train under rail	8	29.6%	8	66.6%
dress on cupboard	8	29.6%	3	25%
Total Number of Es.	27		12	

From the above table, it is apparent that both the shoes/bed pair and the boat/bridge pair produced less errors in this condition, as we had assumed they would. However, another toy set, the telephone/table pair, also produced very few errors.

It had been hypothesized that the less errors the children made on a paricular set the less semantically and pragmatically connotive was that set. In other words, in the case of the shoes/bed pair, the instruction "put the shoes on the bed " was not particularly incongruent to the normal children at both age levels, since none of the children made an error with this instruction. It may therefore be concluded that the shoes/bed pair did not automatically produce a knowledge representation consisting of a "fixed" spatial arrangement for these two objects.

To a lesser degree, this was also true of the boat/bridge and of the telephone/table pairs. It may be said that the children´s success in carrying out the instruction "put the boat on the bridge", was due to a lack of direct experience with boats and bridges, but can the same be said of their success with the instruction "put the telephone under the table"? It seems fairly improbable that the subjects would not have had direct experience with telephones and where they are normally placed. Yet, their knowledge representation of the canonical spatial arrangement of these two objects is not yet "fixed", much as that for the shoes/bed pair was not fixed.

The answer was also sought elsewhere through other factors: did the children perform certain actions, and in consequence respond in a particular way, because the action itself was motorically simpler than another? For instance, this may be said for the shoes/bed instruction, where it is simpler to put something on a bed than **under** it, as well as for the boat/bridge instruction, where it is simpler to put the boat **on** the bridge. But, this strategy does not hold up when we examine the response for the telephone/table instruction: for, it is indeed simpler to put a telephone **on** a table than **under** it. Could it be, then, that in this particular incongruent instruction, the children were actually listening primarily to what was being requested of them? Or were they responding according to some other strategy, which is as yet unidentified?

This problem cannot be solved at this point, but we can reiterate the observation that the increased number of errors in the last three toy pairs in Table 9:2 seems to point to the fact that these objects are more semantically connotive than the first three pairs of objects.

An analysis of the subjects responses in these last three toy pairs reveals the following interesting facts. First of all, the baby/cot pair produced many errors in the younger age range, but not in the older age range. For the younger children, therefore, the incongruent instruction "put the baby under the cot" was often misinterpreted, the response being that which was most familiar to the child: that is, to put the baby **in** the cot.
The older children, on the other hand, were able to overcome any pragmatic misgivings they may have had concerning the execution of this semantically incongruent instruction. Thus, most older

children responded correctly, by putting the baby under the cot. There is some evidence, furthermore, that this particular instruction represented an act which was semantically somewhat emotive for the children (Bennett, 1975). This may be seen in the behaviour of two of the younger subjects, on asked to perform this instruction. One little boy placed the doll underneath, slamming the cot hard on top of it. He then laughed mischievously and said: "I did what she (the tape) said: I put the baby under the cot!" Another thoughtful little girl, twice placed the doll correctly under the cot, but retrieved it both times, finally leaving it in the cot. This was an "incorrect" response, according to the test criteria.

The dress/cupboard pair of toy objects reveals almost the same trend: a tendency to make the canonical arrangement by the younger children, which decreases with increasing age.

The object pair which produced equal difficulty for both the younger and the older children was the train/rail pair. It seems that this incongruent instruction was quite inconceivable to the children. Three children responded by putting the train next to the rail, presumably because the closest they could get to understanding the instruction was to misinterpret the locative preposition "kato apo" (which means "under" in Greek), as the adverb "kato" (which means "down" or "on the ground"). Another child put the train on the rail and made it fall off, this being pragmatically feasible for him.

The truth is that this instruction was difficult for more than one reason: not only was it semantically incongruent and pragmatically inconceivable, but it was also something that one did not do even for fun in a toy situation. Therefore, the children may not have had any mental representation whatsoever of this non-canonical spatial arrangement. Add to this two further complicating facts: first, that it is fairly difficult to balance a rail on a train, making the task motorically complex; and second, that the instruction involved the locative preposition "under", which appears to be more complex syntactically than the preposition "on". The accumulative force of all these detrimental factors probably caused the errors in this particular incongruent instruction.

One further point must be mentioned, which concerns language-specific factors. One of them has already been mentioned before: the fact that some subjects misinterpreted the locative preposition "under" ("kato apo") as its adverbial meaning of "down" or "on the ground" ("kato"). Out of 37 incorrect responses, 5 involved a misinterpretation of these lexical items. This is probably due to the ambiguity of "kato" in the Greek language. However, we were not able to test this with cross-linguistic data: that is, whether English subjects would or would not make similar types of mistakes.

Another "linguistic" mistake made by two of the older children was that, when they were told to "put the dress on the cupboard", they deliberately put the dress in the cupboard, saying that they were putting it "on the top shelf". In Greek, the locative preposition "on" is "pano sto" followed by a noun. The adjective "top" is also "pano" (thus, "on the top shelf" is "sto pano rafi" in Greek). This probably causes a certain amount of confusion for young children.

We will now turn to evidence of how the mentally handicapped group responded to each pair of toys in the semantically incongruent condition. This data may be seen tabulated in Table 9:3 below. From this information, it emerges that the general overall pattern is the same for the mentally handicapped and the normal control groups. The sole difference is between their responses for the baby/cot pair, where the mentally handicapped group are producing relatively fewer errors. The answer to this is probably linked with some of the findings of the first three experiments: that is, that the mentally handicapped children are less able to wean information from semantic-pragmatic factors. This allows them to be "freer" when responding to semantically incongruent instructions.

The data for the language handicapped group is so restricted, due to the small number of the subject sample, that it seemed unfair to add information and to make generalizations, with respect to these subjects. We will restrict ourselves to one observation only: that out of the seven errors made by this group in this condition, four of the errors were made by one child. It would be interesting, in a further study, to see whether the language handicapped children are also less governed in their interpretation of verbal instructions by semantic-pragmatic

TABLE 9:3 Analysis of the Data in the Semantically Incongruent Condition of Experiment V (Mentally Handicapped Group versus the Normal Control Group).

	Normal Controls		Mentally Handicapped	
Instructions	Errors (poss. 10)	% total	Errors (poss. 10)	% total
shoes on bed	0	0	2	11.1%
boat on bridge	2	9.5%	4	22.2%
telephone under table	1	4.8%	1	5.6%
baby under cot	5	23.8%	1	5.65%
dress on cupboard	7	33.3%	5	27.8%
train under rail	6	28.6%	5	27.8%
Total number of Es.	21		18	

factors. The present, rather small group of language handicapped children seemed, surprisingly enough, to opt for a linguistically-, rather than a pragmatically-based strategy.

After analyzing the data, according to the errors made for each object pair, we proceeded to re-group the errors, according to whether they involved the interpretation of the locative preposition "on" or the locative "under". In this condition, it will be remembered, there was no instruction involving the locative "in". This new categorization of the errors was considered necessary, since we wished to investigate whether one or the other locative presented more difficulty to the subjects. There is a considerable amount of developmental data which suggests that the locative "under" is acquired later than the locative "on". Our present hypothesis was that instructions involving the locative preposition "under" would present more difficulty to the subjects. The following Table 9:4 shows a rearrangement of the data, according to the two locatives in question.

TABLE 9:4 Percentage of Errors in the Semantically Incongruent Condition for the Locative Prepositions "on" and "under".

	Normal 3-4 yrs.	Normal 4-5 yrs.	Mentally Handicap.	Language Handicap.
% of Errors for "on"	37%	25%	61%	57%
% of Errors for "under"	63%	75%	39%	43%

From the above table, one can see that both the normal groups appear to be having more difficulty with the locative preposition "under", whereas the reverse seems to be true for the mentally handicapped and the language handicapped groups. Although the two latter groups' sample sizes are too small for any real conclusions to be drawn, these results are definitely very suggestive. What could be the differences between the groups, which result in this cross-over effect? Could it again be, for instance, that the mentally handicapped group and the language handicapped group were less likely to be governed by pragmatic rules than their normal counterparts, and that, therefore, they were not deterred in their performance by this more "difficult" locative preposition? Conversely, it could be that, for the normal children, the interpretation of an instruction which was semantically incongruent, was even further complicated when the locative preposition was "under". If one looks at it mathematically, it may be that these two "negative" features in the instructions led to a "positive" response, that is, a canonical placement of the objects. Whatever the reason, it is a point which it would be interesting to investigate further in the future.

In conclusion, for the semantically incongruent task, the following points have been made:

1. More errors were made with some toy pairs than with others. The reason for this seems to lie in the unique features of the toy pairs themselves: some are more familiar to the children than others, others provide interesting features to be explored, others are charged with conventional sentiments. It is merely possible to speculate on these individual features at this point.

2. It seems that mentally handicapped and language handicapped children are not so influenced by these features as are normal children, and the reason for this is again open to speculation.

3. It does not seem that the relative difficulty or ease of the motoric response played a decisive role in the children's execution of the instructions.

4. There is evidence that the normal children had more difficulty in the correct interpretation of instructions involving the preposition "under" in the semantically incongruent condition,

than did either of the two handicapped groups. The reasons for this are, as yet, unclear.

9.8.3 Inadequate Message Condition

This condition was necessary in order to test, whether young children will automatically respond with a canonical arrangement, when they are not able to clearly discern the locative preposition in a verbal instruction. Alternatively, they might ask the experimenter what had been said, or respond by placing the objects according to other criteria, such as, what it is motorically simpler to do. There might also be other factors which might influence their responses.

The results of this condition were indeed interesting, if somewhat surprising: there was a large percentage of non-canonical responses for the inadequate message condition. These can be summarized in the following way:

1. Normal children, aged 3;0-3;11 years, made 19 "errors" (non-canonical responses), out of a possible 72, which is 26.4% of the total.

2. Normal children, aged between 4;0-4;11 years, made 15 "errors", out of a possible 72, which is 20.8% of the total.

3. Mentally handicapped children made 14 "errors", out of a possible 60, which is 23.3% of the total.

4. Language handicapped children made 12 "errors", out of a possible 36, which is 33.3% of the total.

From looking at the above results, it is apparent that one part of the question asked here can be answered decisively forthwith. That is, when faced with a verbal instruction in which the locative preposition is inaudible, children do not necessarily interpret it in such a way as to make the message semantically congruent.

There are, obviously, more factors that come into play in the interpretation, which we will try to unravel by making a close inspection of the children´s performances.

In Table 9:5, one can see the data for the inadequate message condition, arranged for each toy pair separately, for each age level of children of normal intelligence. This may be compared with Table 9:2, which shows the data for the semantically incongruent condition.

TABLE 9:5 Analysis of Data for the Inadequate Message Condition for the Two Normal Groups.

Canonical Arrangemt.	Inadequate Message	Normal 3;0-3;11 Subjects		Normal 4;0-4;11 Subjects	
		non-can. response	% total Es.	non-can. response	% total Es.
under^	shoes...bed	8	42%	7	47%
under^	boat...bridge	6	31.5%	5	33%
on*	telephone...table	0	0%	0	0%
in*	baby...cot	0	0%	0	0%
on*	train...rail	2	10.5%	0	0%
in^	dress...cupboard	3	16%	3	20%
Total N. Non-Canonical		19		15	

Key: ^ denotes complex motoric action
* denotes simple motoric action

In the Table 9:5 above, it may be seen that the normal children at both age levels did not make non-canonical arrangements for two of the toy pairs: baby/cot and telephone/table.

The first pair, baby/cot, produced consistent results with the semantically incongruent condition and, therefore, tends to confirm the belief that putting a baby **in** a cot is a well-established knowledge representation for young children. It is, in fact, so semantically connotative, that they tend to misinterpret semantically incongruous instructions, with regard to these particular objects.

However, in the previous condition, this was not the case for the telephone/table pair of toys: the results in the semantically incongruent condition for this pair had suggested that there was not such a strong semantic link with the canonical arrangement of these two objects. This was assumed because, in that condition, where the subjects were requested to "put the telephone under the table", most children were able to execute this rather incongruous instruction successfully (see Table 9:2). In the inadequate message condition, the apparently relatively weak semantic link of these two objects was strengthened by the fact that it was easier to place the telephone on the table, thus producing canonical responses by the children. This implies that the children´s responses were often a sum of various different factors, in this particular case a semantic-pragmatic element in conjunction with a simpler motoric action. This is a point to which we will return to later in the discussion.

Another factor, which seems to have influenced the children´s responses, was whether the inadequate message instruction for a particular toy pair was given **after** its semantically incongruent counterpart. It will be remembered that the instructions for all three conditions was randomly ordered. As a result, some of the inadequate message instructions followed the instructions for the semantically incongruent condition. Although none followed immediately after the other for a particular toy pair, it seems that two (the train/rail set and the dress/cupboard set) in particular, which followed after three or four other instructions, may have caused a perseverence effect in some of the children´s performance. Another strategy may be that the children attempted to correct the presented instructions, thus producing erroneous responses, which were not due to a lack of knowledge, as observed by Grieve, Hoogenraad and Murray (1977).

An analysis of the overall performance of those children, who made non-canonical responses, in the inadequate message condition for the toy pairs mentioned above, definitely points to a perseveration effect and not to an attempt to "correct" the instructions. In other words, they seemed to be repeating what they had already done in the semantically incongruent condition before it. It seems as if they were so impressed by what they had been asked to do in the former instruction, concerning that toy pair, that they wished to repeat it. Alternatively, they may have thought that the tape was saying such strange things, it was obvious that here too they were being asked to do something peculiar.

The point we are so laboriously trying to make is that one cannot often know what particular strategy children are using in their performances. However, there is considerable evidence that in the case of the two toy pairs mentioned above, the children's responses in this condition seem to have been biased by the test design.

The same, however, was not true of the toy pairs, which produced the most non-canonical responses: the shoes/bed and the boat/bridge pairs. Neither of the inadequate message instructions for these pairs was ranked anywhere near their semantically incongruent counterparts. Therefore, it cannot be said that the non-canonical responses were due to a perseverence effect.

However, the high number of non-canonical responses for these two toy pairs in this condition is consistent with our previous observations in the semantically incongruent condition for these two pairs. In other words, both of these pairs do not seem to have very strong semantic links, and that this fact was added to the fact that it was easier to place the one object on top of the other, rather than under it. The sum of these two factors produced a non-canonical arrangement of the toys, in both cases. In the telephone/table pair, it will be remembered that these same two factors caused a canonical arrangement.

With regard to the mentally handicapped group, the comparison, which may be seen in Table 9:6 below between this group's data with the normal control group's, reveals that the mentally handicapped group´s are more scattered than the normal group´s. This observation had again been made in Table 9:3 above.

The mentally handicapped group did not appear to perseverate as much in the train/rail set and they had less problems with the boat/bridge pair, confirming suggestions made above.

TABLE 9:6 Comparison between the Results of the Mentally Handicapped Group and the Normal Control Group in the Inadequate Message Condition.

Inadequate Message	Number of Non-Canonical Responses	
	Mental.Handicap.	Normal Controls
shoes...bed	6	6
boat...bridge	1	4
telephone...table	2	0
baby...cot	1	0
train...rail	0	2
dress...cupboard	3	2
Total N. Non-Canon.Resp.	13/60 poss.	14/60 poss.

Finally, because the sample is small for the language handicapped group, a cursory look at the data reveals a similar overall pattern with the mentally handicapped group´s.

One further question was asked, when designing this condition: this was whether, when requested to perform an instruction which was not fully audible, young children would ask for it to be repeated, whether they would look puzzled or whether they would behave as if the linguistic component missing from the instruction, was irrelevant to their understanding of the message.

The astonishing fact that emerged from these results was that, on the whole, the children totally ignored the fact that the locative preposition was missing from the instructions.

Looking at the data in closer detail, the following were noted:

1. The younger age group of normal children looked "slightly puzzled" only six times (out of a possible 72 times for this condition), however they did not proceed to ask the experimenter what had been said. Instead, they executed the instruction, as if they had understood whatever it was that they thought they had misheard. One child supplied the missing locative himself on two separate occassions, thus making the instructions semantically congruent.

2. The older normal children were no more insecure than the younger ones: again, there were only six "puzzled" expressions noted. This time, on two occassions only, these were followed by queries: one child asked whether the tape-recording had said "on the bed", concerning the shoes. When the experimenter made a non-commital response, the subject responded "correctly" by putting the shoes under the bed instead; the second child merely asked what the tape-recording had said, and after receiving a non-commital response from the experimenter, also proceeded to place the objects canonically.

3. The mentally handicapped children were even less puzzled by the inaudible message: there was only one "puzzled" expression noted. One of the subjects, however, behaved in such an idiosyncratic way that it is interesting to analyze her performance, in this condition, in greater detail. She repeated all of the instructions given correctly, but was not always correct in her execution of them. In the inadequate message condition too, she repeated the instructions, but, this time, supplied the missing locative. Her motor response, as can be seen below, did not match her verbal one:

Verbal Response	Motor Response
"the shoes under the bed"	*shoes on bed
*"the train in the rail"	train on rail

"baby in the cot"	*baby under cot
*"boat in the bridge"	boat under bridge
"telephone on the table"	*telephone under table
"dress in the cupboard"	*dress under cupboard

N.B. The asterisk * denotes semantic incongruence in the verbal response or non-canonical placement in the motor response.

4. In the language handicapped group, only one child appeared to be worried by the unintelligibility of the locative preposition in the instruction. Monolectically, she asked: "On?", for the shoes/bed instruction, and proceeded to put the shoes on the bed, since the experimenter did not elucidate the point. She repeated the procedure for the boat/bridge and for the telephone/table instructions. For these, she also made non-canonical placements and looked at the experimenter with what seemed to be a challenging expression. Apart from this subject, no other seemed puzzled by the inaudibility of the message.

In conclusion, the inadequate message condition did not evoke the expected results: on the whole, the children were not perturbed by the fact that a part of the message was inaudible and furthermore it did not stop them from executing the instruction. Their response was not necessarily to arrange the toys canonically; often, the children placed the toys in a non-canonical arrangement. An analysis of the children's responses, according to different variables, has revealed that many factors may have led to these rather unexpected performances. These will be discussed in the final section below.

9.9 Discussion

Most of the points, which are to be discussed, have already been raised above and some of them, for the sake of clarity, have already been analyzed. In this section, an attempt will be made to make a synopsis of these observations and to draw any implications from them, as seem appropriate.

This experiment was extremely interesting, in that it had several facets. It also dealt with an issue, which may be considered rather vast and unfathomable, but which, we believe, has fairly well-defined and regular rules. We are, of course, referring to semantics.

Semantic congruity plays quite an important role in our understanding of what is said to us. Some of the factors leading to our better processing of verbal input are: the context in which it is spoken, by whom, what we are being referred to and what we expect to be told about these things. These expectations are founded on our knowledge or mental representations of these things: in other words, what we know about the world we live and move in. Often, even as adults, we by-pass a linguistic analysis of what we are told, because we rely so heavily for our language comprehension on these knowledge representations. It must be noted that these pragmatic abilities, on the whole, do not let us down.

Young children's linguistic development, as far as their semantic-pragmatic abilities are concerned, is closely linked to their cognitive development, and continues right through childhood. Experience and learning, naturally, enhance these abilities.

There are, however, some handicaps, which may inhibit these abilities: for instance, clinicians have often reported impaired pragmatic abilities in the mentally handicapped. Some forms of language disability also lead to an impaired pragmatic ability, apart from the often severe forms of semantic disability that these individuals reveal. Similar effects are reported in other disorders, such as autism.

This experiment set out to investigate how important a role semantic congruity plays in our understanding and compliance with verbal instructions. Furthermore, how it influences different groups of children, whether normal or handicapped.

The data collected from this experiment seems to confirm the fact that children have a tendency to hear, and act on, verbal instructions which are semantically incongruous, as if they are semantically congruous. Younger children, that is, under four years of age, show more of such a tendency, than do children over four years old. However, between the ages of 4 and 5, children are still fairly likely to fall into this "trap". From the results of this experiment, it was not apparent that the mentally handicapped or the language handicapped children had, at this particular stage in their development, more difficulty in this area than did their normal counterparts.

It is possible, however, that at this linguistic age level, the handicapped groups were equal to the normal subjects, but that if they were to be tested at an older linguistic age level, there would be a developmental lag in their pragmatic abilities. This, of course, is mere speculation, in part triggered by the data seen in Figure 9:6. Here, although the samples for each group are very small, the trend in the inadequate message condition is quite clear: both of the handicapped groups were making more incongruous responses, whereas the normal groups were making less. Also, in the semantically incongruous condition, the handicapped groups were making less errors, that is, they were less influenced by pragmatic factors in interpreting the verbal instructions. Does this mean that both the mentally handicapped and the language handicapped groups are not able to glean as much vital information from pragmatic factors in the utterances that they hear? A suggestion of this sort was also apparent in the data from Experiments I-III, when the handicapped groups did not perform as well on the Concrete task, as they did on the Abstract task. This seemed to imply that they were not able to make positive use of contextual or pragmatic information in solving the Concrete task.

To return to Experiment V, another interesting point is that the older normal children were not paying that much more attention to the verbal instructions than were the younger children. However, it is possible that the demands of the test situation were partly to blame for some of the older children´s performances. In other words, they may have been trying to please the experimenter by arranging the toy items non-canonically, a strategy some children are likely to adopt during a test situation.

Part of the experiment´s analysis consisted of a description of some of the differential responses to the toy pairs and an attempt was made to account for them. A pattern was discerned, which may be due to several possible factors: the properties of the objects themselves, the degree of the subjects´ familiarity with them, how semantically "loaded" they were, what was the order of a particular instruction in the test items, how simple or complex the task was on a motor level, whether the locative preposition involved was "on", "in" or "under", or indeed other factors, which have not been identified, or which it is impossible to identify.

As the mentally handicapped and the language handicapped groups did not have as fixed a pattern in their responses as the normals, it was suggested that they are not so subject to at least some of the complexities of the above variables.

As for the normal children of this sample, it seems evident that some objects are definitely more semantically connotive than others; that instructions involving the locative "under" cause more misinterpretations, when they are in conjuction with semantically incongruent instructions; and finally, that when something is not very semantically loaded, they will respond with the least complex motoric action.

Do these findings aid, or add confusion to, the debate? Possibly, a little of both: it helps in that it attempts to quantify and qualify the different aspects of the semantic enigma and it confounds, in that it makes it even more apparent that quantification is almost impossible, with respect to something as volatile as the role of linguistic factors in young childrens´ actions.

The next experiment, described in the following chapter, was yet another attempt to qualify the sphynx´s parts.

CHAPTER 10

Semantic Congruity, Locative Prepositions and Word Order: Experiment VI.

10.1 Introduction

In the previous experiment, the role which semantic congruity plays in young children´s understanding of spatial instructions was investigated. In that experiment, it was seen that the canonical placement of objects according to pragmatic rules was given preference by the children in all the subject groups, to the extent that this tended to render them less able or less inclined to interpret correctly those verbal instructions, which required the non-canonical placement of the toy objects.

This tendency, which appeared in all the experimental groups, whether normal or handicapped, was not however carried over into a condition, which required children´s spontaneous placement of the objects, when faced with an incomplete verbal message. Here, other rules or strategies seemed to be at work, which led to the children making a considerable number of non-canonical or incongruous placements of the objects in question.

Furthermore, it was observed that the locative preposition "under" caused more problems than the locative "on", when it was combined with a semantically incongruous instruction.

All of the above observations had interesting implications, which it was decided to investigate further. The purpose of the present experiment, therefore, was to shed some light on the various factors, which are at work, when young children interpret or attempt to interpret instructions involving locative prepositions.

It is, of course, well-known that knowledge of syntax, as well as semantics and pragmatics are all necessary for the correct interpretation or understanding of verbal input. None of these variables alone can serve us reliably or consistently, and an impairment in one or more of these functions can lead to language breakdown. However, the learning of these rules is a gradual process over childhood and the gaps in this knowledge may lead to young children´s misunderstanding of what is being said to them.

This experiment represents an attempt to test some of these rules and to ascertain which are more informative to young pre-school children: is it syntax, semantics or pragmatics? Can we separate these three sufficiently, in order to test them?

Basing our test design on the previous experiment´s, four conditions were devised, which tested different aspects of the verbal instructions, given for the spatial arrangement of toy objects. These conditions attempted to represent the semantic-syntactic variations of the canonical or non-canonical placement of these objects.

1. The first condition requested the canonical placement of the objects, according to semantically congruent instructions, which were represented by a syntactically conventional form. For instance: "Put the chair on the carpet". All the instructions in this condition contained the preposition "on", since in the previous experiment, it had been observed that the toy pairs, whose canonical arrangement involved something being **under** something else, had been more difficult for the children. An attempt was made, this time, to choose object pairs which would not lead to this bias.

Thus, in this condition, we were testing semantic congruity, which we defined as a maximum convergence or agreement of semantic and pragmatic rules, accompanied by a syntactic form, which adhered to the conventional word order rules. Therefore, the instruction :"Put the chair on the carpet" is syntactically simple (that is, it is not ambiguous in any way), semantically patent by requesting something to be placed on something else canonically, and of course, for this reason, it fulfills pragmatic rules, by leading to a canonical spatial arrangement.

2. The second condition requested the non-canonical placement of these objects, again using the locative preposition "on". The

instruction consisted of a word order reversal of the verbal instruction of the previous condition, which led to a complex syntactic and semantic interpretation, plus a spatial arrangement which did not fulfil pragmatic rules. The verbal request was, for example: "Put the carpet on the chair".

3. The third condition added a further incongruence: not only was the instruction semantically incongruent, but the locative preposition in the instruction was "under". This locative, as has already been seen in the previous experiment, caused further ambiguity when connected with a semantically incongruent situation. It had been speculated that, in the previous experiment, it had led some children to a response based on the theory of "two negatives cause a positive": the "negatives" being the locative "under" and the semantic incongruence; and the "positive" being a canonical placement.

The verbal instruction in this condition, therefore, was: "Put the chair under the carpet", which, although syntactically simple as far as conventional word order rules, was semantically incongruent, and since it led to the non-canonical placement of the objects, did not comply with pragmatic rules.

4. In the fourth condition, the canonical placement of the objects was again the final result, but the verbal instruction concerned a word order "reversal" and the locative preposition

"under", which combine in causing syntactic and semantic obtuseness.

The instruction for this condition, therefore, was: "Put the carpet under the chair". It may be seen that, even for an adult, the mental image evoked by this statement is laboriously related to its canonical form. It was hypothesized that this would be the most difficult condition for the children to execute correctly.

Furthermore, the hypothesis was that these conditions would produce different results, when analyzed, and that possibly this would enlighten us concerning the different factors, which made children´s understanding of semantically incongruous instructions so inconsistent.

10.2 Subjects

The subjects tested in this experiment were the same as those tested in Experiment V. The groups were:

1. 12 Greek children of normal intelligence, with chronological ages between 3;0 and 3;11 years (mean chronological age of 3;6 years), with mean Peabody Picture Vocabulary Test (PPVT) score (language level) of 3;7 years. This group was compared with 12 older Greek normal children, aged between 4;0 and 4;11 years (mean chronological age of 4;5 years), with a mean PPVT score of

4;6 years.

2. 10 Greek mentally handicapped children, with a mean chronological age of 7;11 years and a mean PPVT score of 3;8 years, matched with a control group of 10 normal subjects, who had a mean chronological age of 3;7 years and a mean PPVT score of 3;8 years.

3. 6 Greek language handicapped (dysphasic) children, with a mean chronological age of 5;6 years and a mean PPVT score of 3;5 years, matched with two control groups:

   i. 6 Greek mentally handicapped subjects, with a mean chronological age of 8;9 years and a mean PPVT score of 3;5 years.

   ii. Greek children of normal intelligence with a mean chronological age of 3;6 years and a mean PPVT score of 3;5 years.

No English subjects were used for this experiment, since the aim of this study was not to test any cross-linguistic differences.

10.3 Materials

For this experiment, as in the previous one, the materials used were toy objects, which were however different from the ones used in Experiment V. These toy pairs were carefully chosen to fulfill the following criteria: that they should be familiar to young children, that the toy pairs would have a canonical spatial arrangement known to the children, that this canonical arrangement would be with respect to the locative preposition "on", that the toy would be as neutral as possible in an emotive sense, that is, they would not consist of babies, mothers, etc.

The object pairs chosen were:

1. pencil and paper
2. chair and carpet
3. cup and saucer
4. table and tablecloth
5. road and car
6. lid and saucepan

As can be seen, the toy pairs have an unequivocal canonical spatial arrangement, where one of the objects is **on** the other one, this being reversed when the "on" locative is replaced by "under": that is, i. the chair is on the carpet

ii. the chair is under the carpet.

The word order was also reversed, therefore there were no Fixed Objects in the toy pairs: all of them could be manipulated by the child, since the grammatical relations of the sentences meant that all of the objects could be either the subject or the predicate of a statement.

A tape-recording was made, once again, containing a random series of instructions concerning these toy pairs. There were four conditions for each object pair, and since there were six toy pairs, the instructions given to each subject were 24.

10.4 Conditions

In Table 10:1, the four conditions and the expected spatial arrangement for each object pair, according to these conditions, can be seen. It will be remembered that the instructions were given in random order to each subject. Furthermore, since the subjects were all Greek-speaking, the instructions were in Greek. The full set of instructions in Greek may be seen in the Appendix.

Briefly, the conditions contained the following characteristics, which were determined by three dimensions: what locative preposition was given in the instruction; whether the word order was familiar, that is, whether the subject of the sentence was also the expected subject of the sentence; finally, whether the ensuing spatial arrangement of the toys was canonical or non-canonical.

Table 10:1
Verbal Instructions for the Conditions (Exp.VI).

Condition 1	Condition 2	Condition 3	Condition 4
1. Semantic congruity. 2.Locative "ON" 3.Canonical Spatial Arrangement.	1. Semantic incongruity. 2.Locative "ON" 3. Word-order reversal. 4.Non-canonical Arrangement.	1. Semantic incongruity 2. Locative "UNDER". 3.Non-canonical Spatial Arrangement.	1. Semantic incongruity 2. Locative "UNDER". 3. Canonical Arrangement
pencil on the paper	paper on the pencil	pencil under the paper	paper under the pencil
chair on the carpet	carpet on the chair	chair under the carpet	carpet under the chair
cup on the saucer	saucer on the cup	cup under the saucer	saucer under the cup
tablecloth on the table	table on the tablecloth	tablecloth under table	table under tablecloth
car on the road	road on the car	car under the road	road under the car
lid on the saucepan	saucepan on the lid	lid under the saucepan	saucepan under lid

Condition	Locative	Word Order	Spatial Arrangement
1	on	subject-object	canonical
2	on	object-subject	non-canonical
3	under	subject-object	non-canonical
4	under	object-subject	canonical

The first condition was congruent, in every respect. For instance, the instruction "Put the chair on the carpet" consisted of the following features:

i. the locative preposition "on"

ii. a canonical word order, where the grammatical subject of the sentence was also the perceptual "subject".

iii. a resulting canonical spatial arrangement, that is, the chair was put on the carpet.

The other three conditions consisted of varying degrees of incongruity, with respect to these three dimensions. For instance, the instruction for the second condition, "Put the carpet on the chair", consisted of the locative "on", but the word order with respect to the subject and the object of the sentence was reversed, thus making the perceptual subject the grammatical object of the sentence. Furthermore, the ensuing spatial arrangement was non-canonical.

Both the third and fourth conditions consisted of the locative preposition "under". The third condition, where the instruction was "Put the chair under the carpet", consisted of a canonical word order: the grammatical subject was also the perceptual subject of the sentence, but the resulting spatial arrangement was non-canonical. On the other hand, the verbal instruction for the fourth condition, "Put the carpet under the chair", may have had a non-canonical word order, but the spatial arrangement was canonical.

10.5 Procedure

Each subject was tested for this experiment a few days after he had completed the task for Experiment V.

The child was again seated at a low table facing the experimenter. The tape-recorder was also placed on the table. The toy pairs were in a compartmentalised box, placed discretely out of the subject's view.

The experimenter told the child that they were going to play a new game, where he would have to listen carefully to what the tape asked him to do. First, however, the subject was shown each toy pair separately: the objects were named by the experimenter and the subject was allowed to handle them for a few seconds. After this was done for all object pairs, the experimenter told the child to listen carefully to the instructions on the tape-recording and try to follow them. She then placed the first pair of objects in the taped sequence, side by side, in front of the subject and switched on the tape-recorder. After the child performed the instruction for this toy pair, the experimenter removed the object pair and replaced it with the next one in the sequence of instructions. Meanwhile the tape-recorder had been switched to PAUSE. This procedure was repeated for all twenty-four instructions on the tape.

10.6 Test Criteria

The experimenter scored each subject´s performance on a score sheet, which contained all 24 instructions in the sequence presented on the tape-recording. When each instruction was completed by the child, the experimenter noted whether the spatial arrangement made by the subject was correct and, if it was not, drew a pictogram representing the spatial arrangement made by the child. These were as follows:

Score Pictograms (for the Errors)		
Spatial Arrangement	Score Pictogram	Pragmatic Status
1. pencil on paper		canonical
2. paper on pencil		non-canonical
3. chair on carpet		canonical
4. carpet on chair		non-canonical
5. cup on saucer		canonical
6. saucer on cup		non-canonical
7. tablecloth on table		canonical
8. table on tablecloth		non-canonical
9. car on road		canonical
10. road on car		non-canonical
11. lid on saucepan		canonical
12. saucepan on lid		non-canonical

In this way, the experimenter knew by counting these pictograms how many incorrect responses had been made and also, more importantly, what exactly these responses were.

After the test was completed, the experimenter rearranged the responses on the score sheet, according to those made for each condition and for each object pair.

10.7 Results

Three analyses of variance were conducted on three group comparisons:

1. Greek children of normal intelligence at 2 age levels:
   - i. 12 children aged between 3;0-3;11 years/months
   - ii. 12 children aged between 4;0-4;11 years/months

2. Ten Greek mentally handicapped subjects, compared with a matched control group of ten Greek normals.

3. Six Greek language handicapped subjects, compared with six matched mentally handicapped subjects and six matched normal subjects (two control groups).

10.7.1 Greek Subjects of Normal Intelligence

The analysis of variance for this comparison had one between subject variable, which was age (at two levels), and one within subject variable, which was the conditions. This had four levels, distinguished according to the characteristics of the instructions:

1. congruent "on", canonical spatial arrangement
2. incongruent "on", non-canonical spatial arrangement
3. incongruent "under", non-canonical spatial arrangement

4. incongruent "under", canonical spatial arrangement.

The groups consisted of equal numbers of subjects, which were 12 in each age group.

10.7.1.1 Main Effects for the ERROR Scores

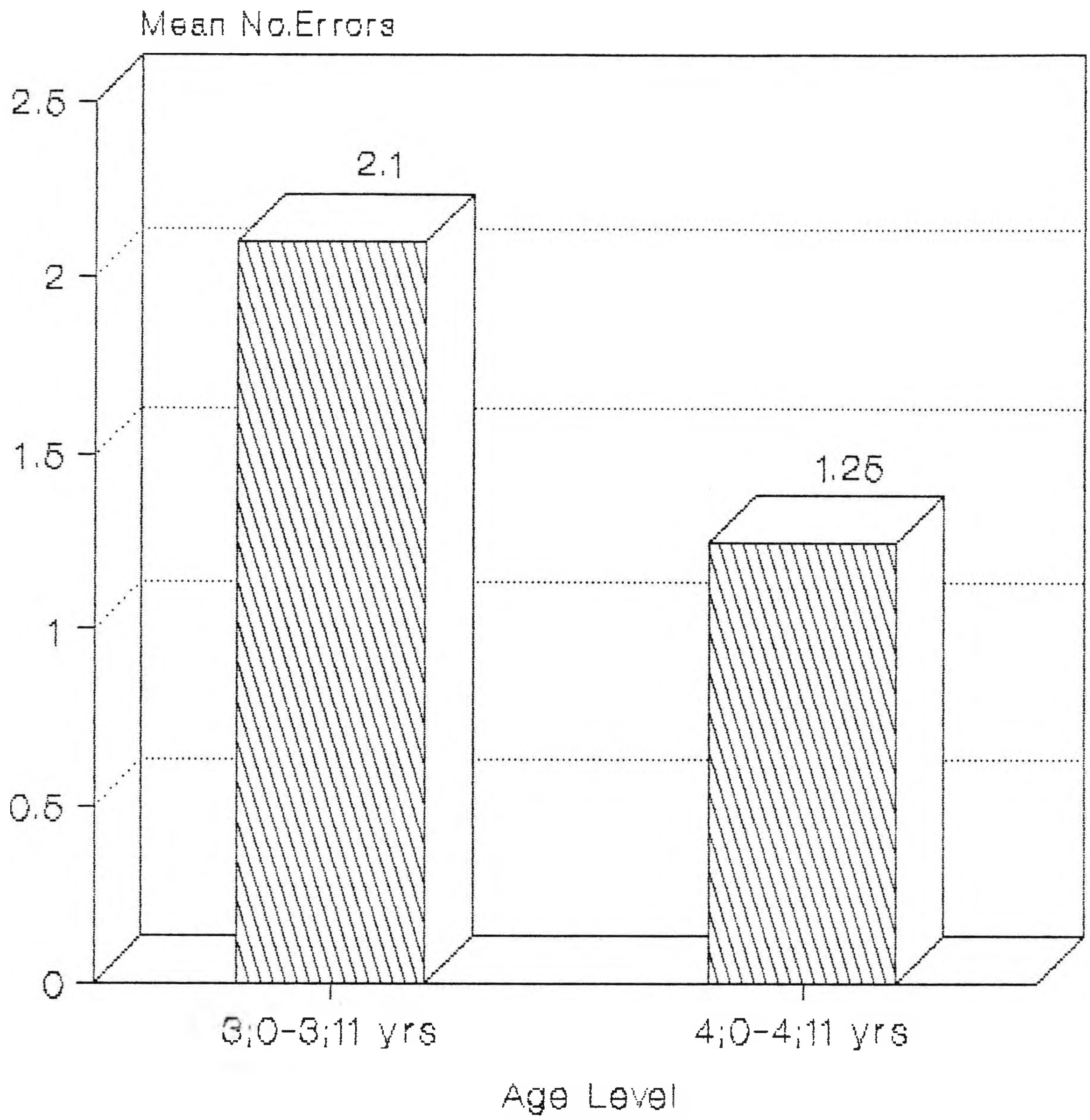
Two main effects were found for these results:

1. There was a significant difference between the overall scores of the children at each age level ($F=6.141$, $df=1/22$, $p<0.02$). This is represented graphically in Figure 10:1. From this, it is obvious that the older children were making fewer errors. No further analysis of this was necessary.

2. A main effect was also found between conditions ($F=11.684$, $df=3/66$, $p<0.001$). This main effect may be seen depicted in Figure 10:2.

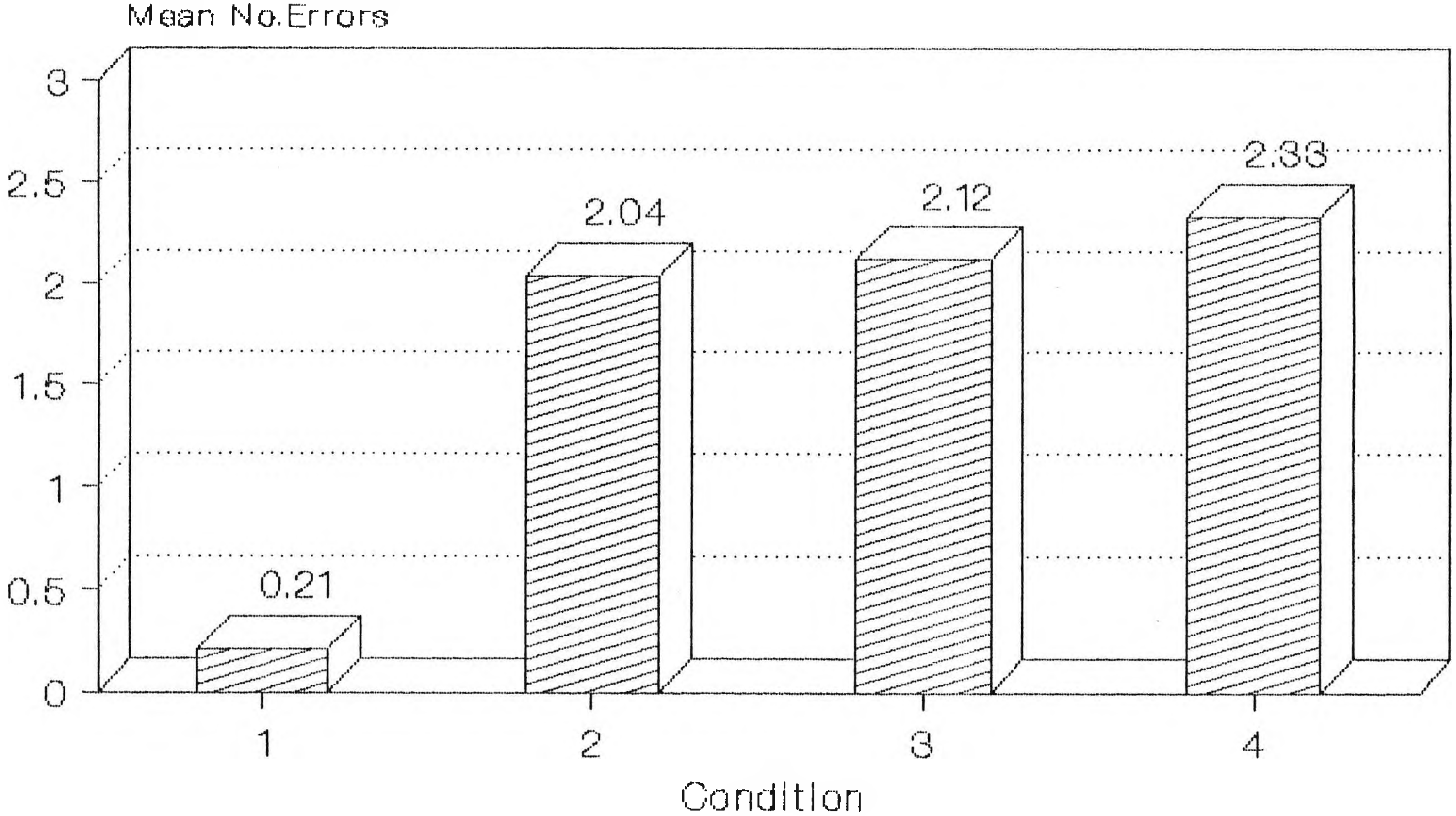
Since there were four conditions and since it had already been hypothesized that a difference would be found between the semantically congruous condition (1) and the other three conditions, which showed varying degrees of semantic incongruity, a planned comparison was performed on these results, to ascertain which conditions differed significantly from which others.

Figure 10:1
Main Effect between Age Levels in Exp.VI
(Normal Subject Groups)



$F=6.141$, $df=1/22$, $p<0.02$

Figure 10:2
Main Effect between Conditions in Exp.VI
(Normal Subject Groups)



F=11.684, df=3/66, p<0.001

Thus, it was ascertained that the children were making significantly fewer errors in the semantically congruous condition (1) than in any of the other three conditions ($F=15.66$, $df=1/54$, $p<0.001$).

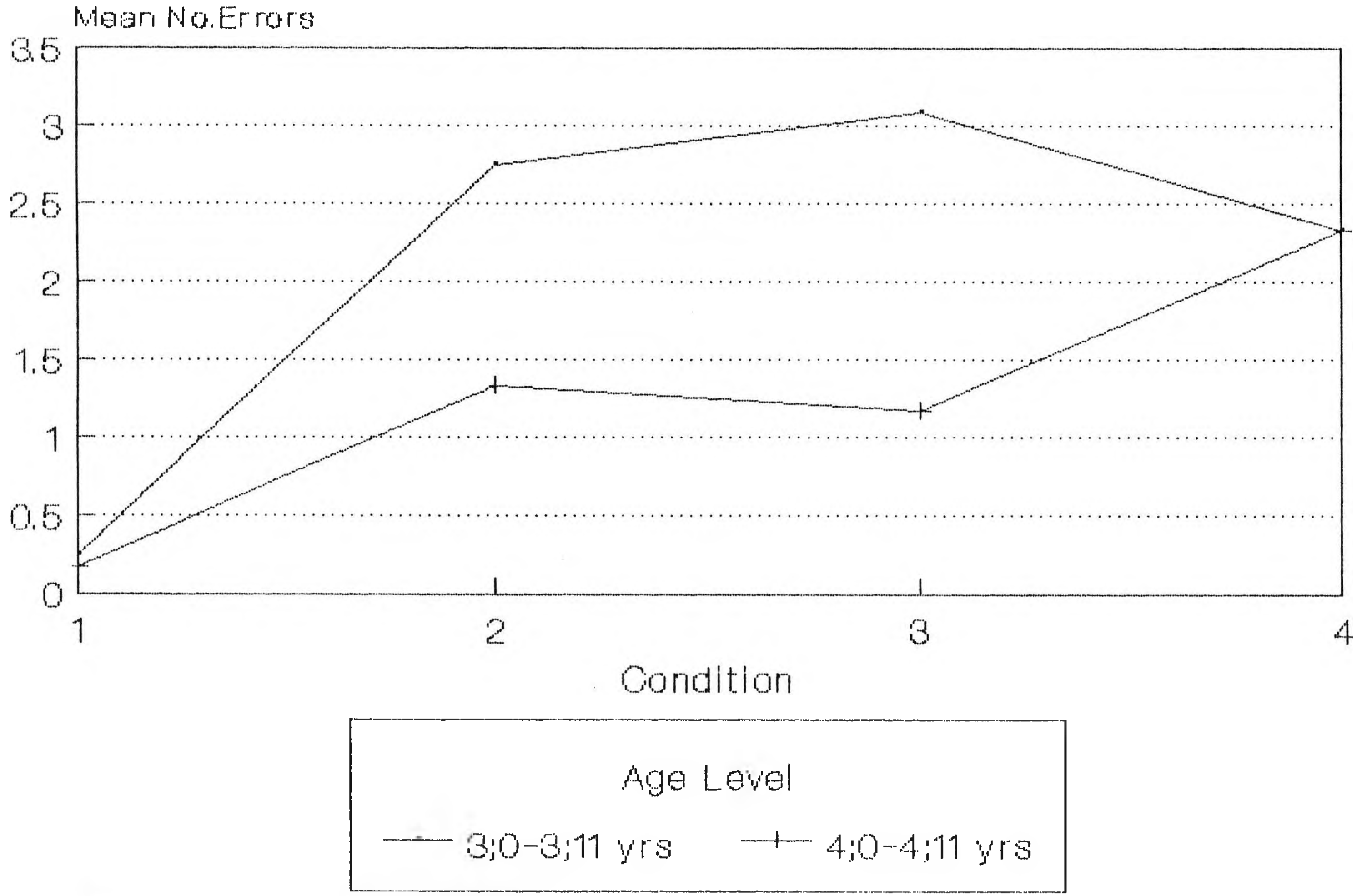
As can be seen from Figure 10:2, conditions 2, 3 and 4 did not seem to differ significantly, so this was not tested any further.

10.7.1.2 Interactions

An interaction was found between age level and condition ($F=2.769$, $df=3/66$, $p<0.05$). This interaction is graphically represented in Figure 10:3. From this, it may be observed that, although within both groups of children, there are approximately the same number of errors in conditions 2 and 3 (the younger children were of course making many more errors in these two conditions), the younger children made less errors in condition 4, whereas the reverse was true for the older children, who made more errors in condition 4. Consequently, both groups were now averaging the same overall number of errors in condition 4.

The differences between the two age levels in conditions 2 and 3 were tested with t tests and both were found to be significant, the subjects in the younger age level making significantly more errors in both cases ($t=1.87$, $df=22$, $p<0.05$ in condition 2; $t=2.9$, $df=22$, $p<0.005$ in condition 3). It was, of course, not

Figure 10:3
Interaction betw. Age Level & Condition
(Normal Subject Groups)



F=2.769, df=3/66, p<0.05

necessary to test conditions 1 and 4, since both age groups, younger and older, were making the same number of errors.

The possible reasons for this finding will be discussed again at a later point.

10.7.2 Greek Mentally Handicapped Group

This group was compared to a group of Greek normal controls. Each group had ten subjects.

Analysis of variance consisted of one between subject variable, which had two levels:

i. mentally handicapped

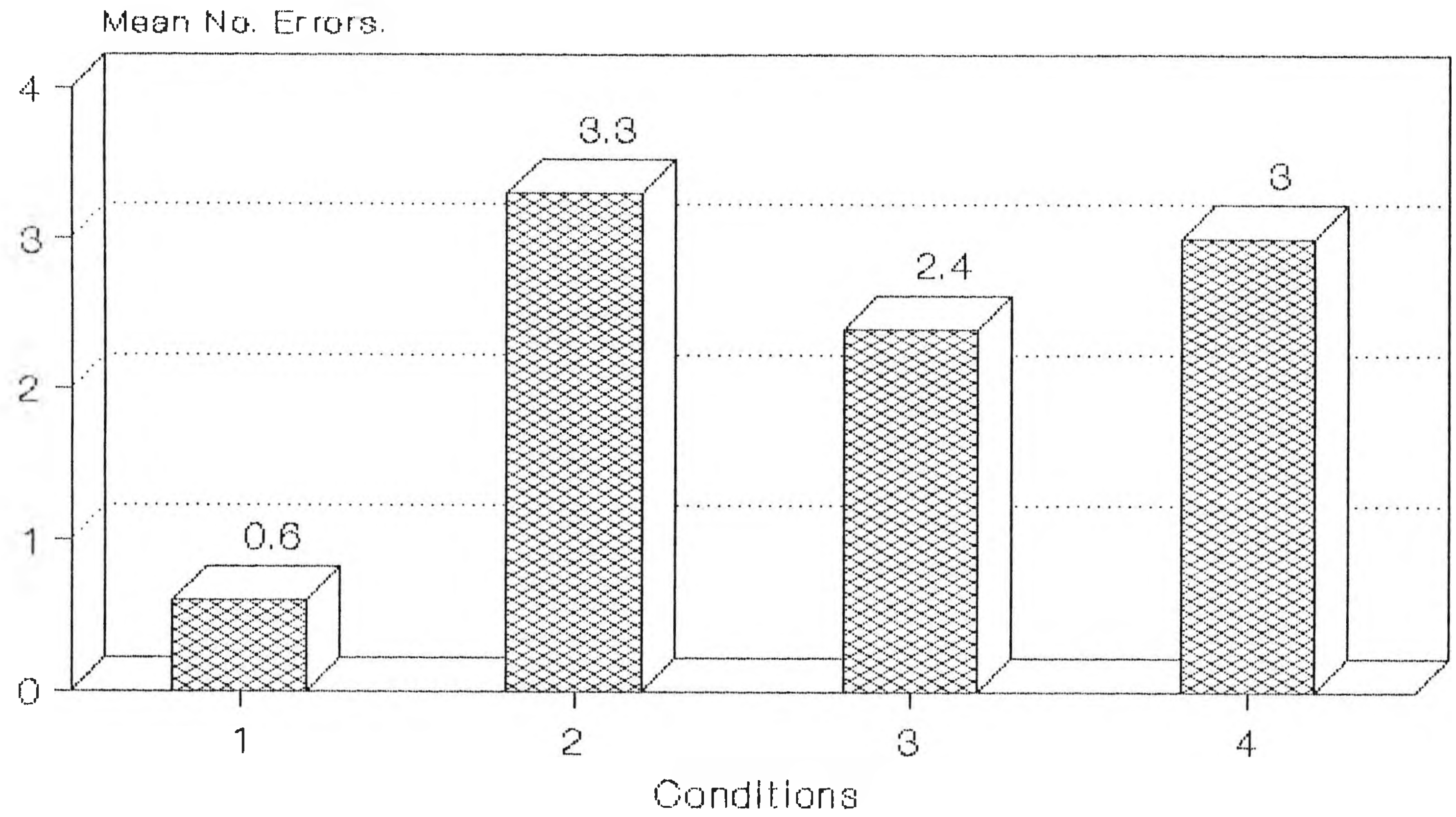
ii. normal intelligence

There was also one within subject variable, which was condition. This had four levels, as described above.

10.7.2.1 Main Effects

There was no main effect of groups. There was, however, a main effect between conditions ($F=11.504$, $df=3/54$, $p<0.001$). A graphic representation of this may be seen in Figure 10:4. This was further tested using planned comparisons between condition 1, on the one hand, and conditions 2, 3 and 4, on the other. This revealed a significant difference ($F=17.33$, $df=1/66$, $p<0.001$). In

Figure 10:4
Main Effect between Conditions in Exp.VI
(Gk.Ment.Hand. x Normal Controls)



F=11504, df=3/54, p<0.001

other words, the children performed significantly better at the semantically congruent condition 1.

Unplanned comparisons, using the Newman-Keuls method, were then conducted between all the conditions and these revealed that although each condition 2, 3 and 4 was each separately significantly different from condition 1, none of the three incongruent conditions were significantly different from each other. This may be seen tabulated in the Appendix.

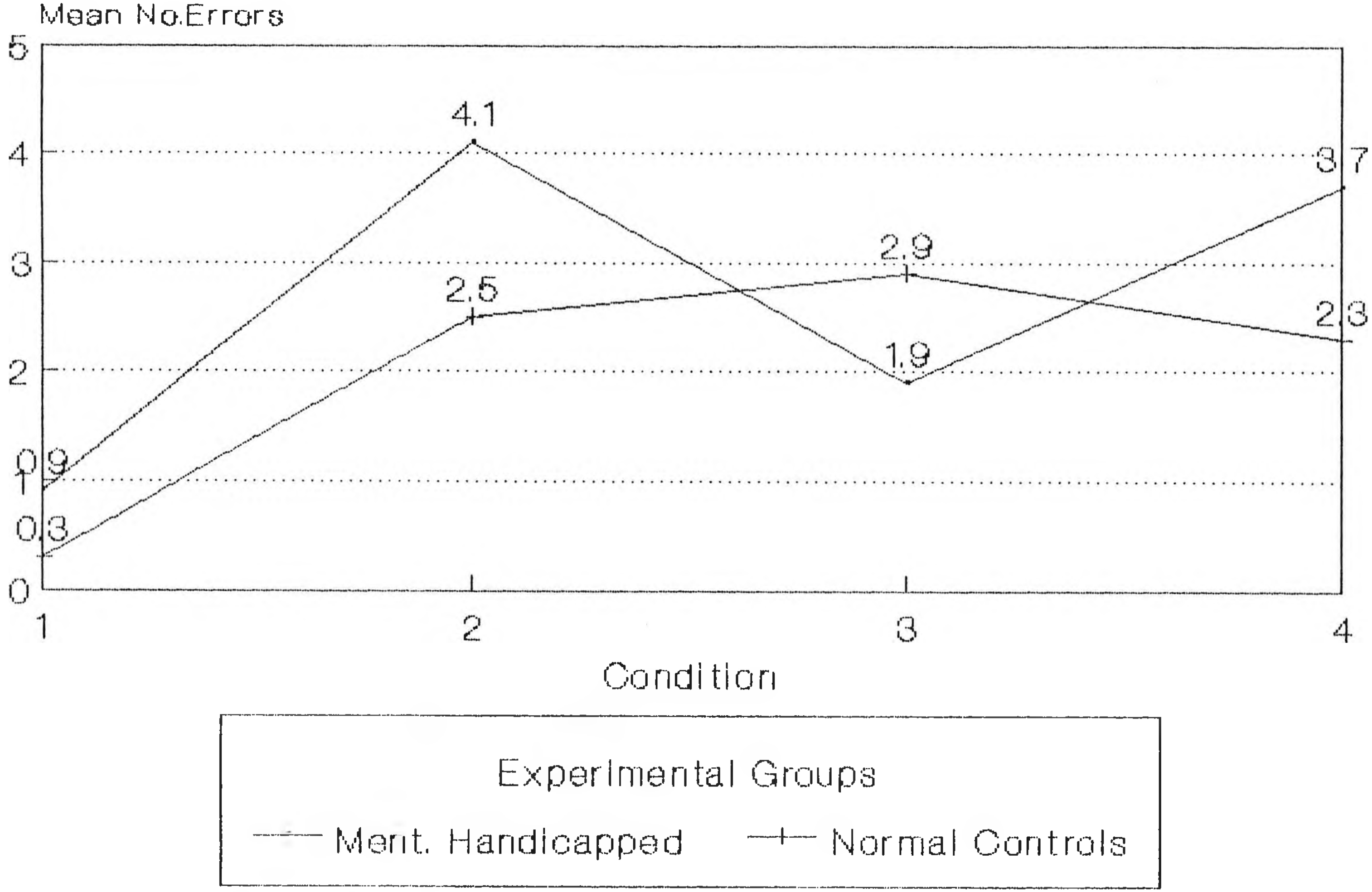
10.7.2.2 Interactions

A significant interaction was found between groups and conditions ($F=2.747$, $df=3/54$, $p<0.05$). In Figure 10:5, a graphic representation of the scores makes it apparent that the mentally handicapped group were making less errors in condition 3, than they were making in conditions 2 and 4. This was tested with t tests and a significant difference was found between conditions 3 and 4 (and therefore by implication between 2 and 3) in the mentally handicapped group ($t=4.0$, $df=9$, $p<0.01$). This will be discussed further in a later section.

10.7.3 Greek Language Handicapped Group

This small group of six dysphasic children was compared with an equal number of normal controls and an equal number of matched

Figure 10:5
Interaction between Group and Condition
(Gk.Ment.Hand. x Normal Controls)



F=2.747, df=3/54, p<0.05

mentally handicapped children.

Thus, the analysis of variance had one between subject variable, which was group and had three levels:

i. language handicapped

ii. mentally handicapped

iii. normal intelligence.

There was also one within subject variable, which was condition. This had 4 levels, as described above.

10.7.3.1 Main Effects for the ERROR Scores

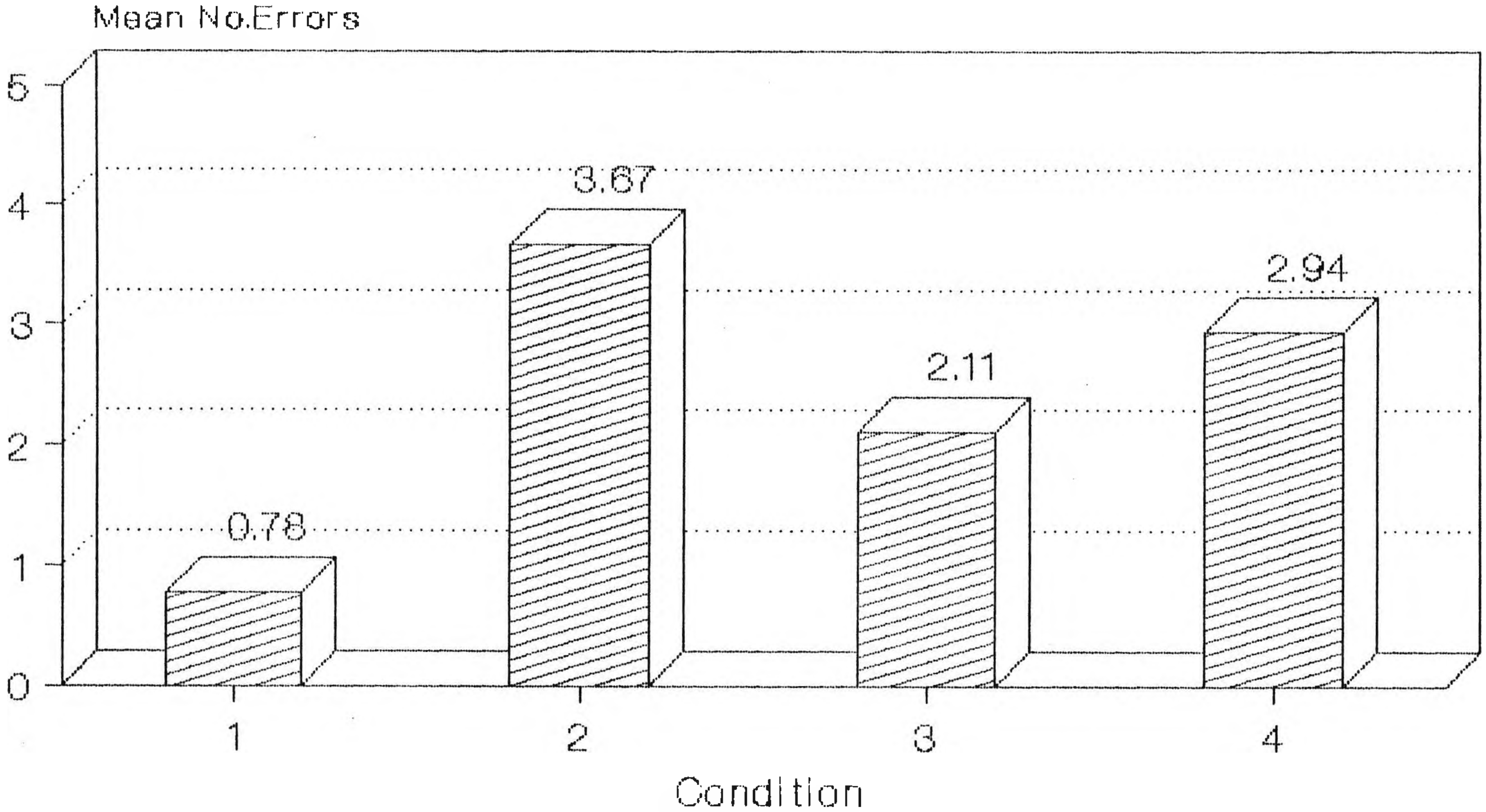
There was no main effect of groups. There was however a main effect difference between conditions ($F=13.376$, $df=3/45$, $p<0.001$). A graphic representation of these results may be seen in Figure 10:6.

Since this group was so small, it was not further tested with planned and unplanned comparisons.

10.7.3.2 Interactions

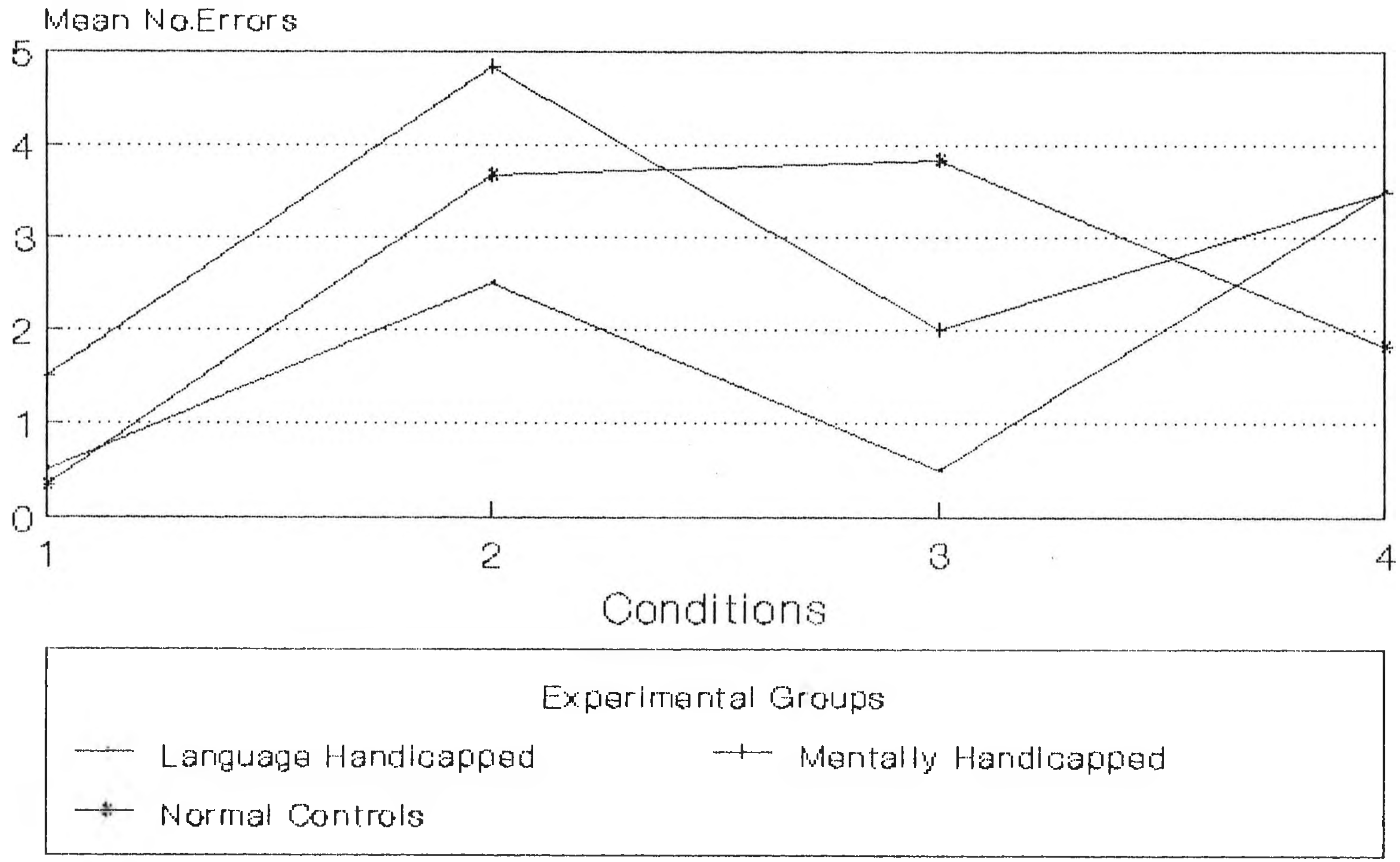
There was an interaction between groups and conditions, which may be seen in Figure 10:7 ($F=3.872$, $df=6/45$, $p<0.01$). From this it appears that the overall pattern of results found for the mentally handicapped is the same as that found for the language

Figure 10:6
Main effect between Conditions
(Lang.Hand.x Ment.Hand.x Normals)



F=13.376, df=3/45, p<0.001

Figure 10:7
Interaction between Groups & Conditions
(Lang.Hand.x Ment.Hand.x Normals)



F=3.872, df=6/45, p<0.01

handicapped, that is, both groups were making less errors in condition 3, than in condition 2 and 4. However, this is not true of the normal control group.

This phenomenon had already been observed during the analysis of variances of the mentally handicapped group and the normal groups, and here serves to re-confirm these findings. The Greek normal controls were again making less errors in condition 4: it will be remembered that this control group consisted of children from the younger age level group of normal intelligence.

Although the sample sizes are quite small, the pattern is definitely apparent, and must be taken into account, since it confirms previous observations. This will be discussed at greater length later on.

10.7.4 Results Summary

The following is a synopsis of the main results, according to the statistical analysis:

1. The older age group of children with normal intelligence performed, on the whole, significantly better at this task than did the younger normal children. However, the significant interaction between age level and conditions for these two groups, reveals that this difference stems from conditions 2 and

3, for in conditions 1 and 4, both groups made a similar number of errors. In condition 1, where the instructions were semantically congruent and led to a canonical placement of the objects, both age groups made a negligible number of errors. Conditions 2 and 3 both involve semantically incongruent instructions, both leading to a non-canonical placement of the toy objects. The difference with condition 4 is that, although the instructions were also semantically incongruent, they led to a canonical placement of the objects.

Below can be seen examples of the verbal instructions for each condition:

Condition 1: "Put the chair on the carpet."

Condition 2: "Put the carpet on the chair."

Condition 3: "Put the chair under the carpet."

Condition 4: "Put the carpet under the chair."

It seems that condition 4, owing to its unique characteristics, which will be discussed later, led to the younger normal children making less errors than the previous two conditions, and conversely to the older normal children making more errors than in conditions 2 and 3.

2. There was no significant difference in the overall ERROR scores between the mentally handicapped, language handicapped and normal groups. Again, it may be seen that the semantically

congruent condition (1) produced the least errors, which was significantly less than the remaining three semantically incongruent conditions (2, 3 and 4). These three, on the whole, produced an approximately equal number of errors.

A look at the interaction between conditions and groups in the comparison between the mentally handicapped and the normal groups (Figure 10:5), reveals the following interesting facts: that the mentally handicapped group made significantly less errors in condition 3, than in conditions 2 and 4.

Condition 3 involves the semantically incongruent instructions, which are, for instance:

"Put the pencil under the paper"

"Put the chair under the carpet".

By comparison, examples for the other two conditions are:

Condition 2: "Put the paper on the pencil"

"Put the carpet on the chair"

Condition 4: "Put the paper under the pencil"

"Put the carpet under the chair".

Condition 3´s characteristics are that the instruction involved a canonical word order, the locative preposition "under" and an ensuing non-canonical spatial arrangement. The only consistent difference, between this condition and conditions 2 and 4, is that of the canonical word order: for, condition 3 is similar to condition 2 in requesting a non-canonical spatial arrangement of the items; and it is similar to condition 4 in having the same locative preposition "under".

The above phenomenon was corroborated by data from the language handicapped group, who were actually making as few errors in condition 3 as they did in condition 1 (Figure 10:7).

What are the reasons, which could lead to these disparate results between the two handicapped groups and the normal groups? In order to seek the answers, one must turn to a descriptive analysis of the results.

10.8 Descriptive Analysis of the Results

It is necessary to consider several aspects of the results, in order to gain a better understanding of the possible strategies, which were being used by the children in their responses. These include the following features:

10.8.1 Canonical versus Non-canonical Spatial Arrangements

Half of the instructions in this experiment involved the canonical spatial arrangements of the objects, that is, for example, putting the chair on the carpet. These were represented by conditions 1 and 4. The other half involved the non-canonical arrangement of the toy objects, for example, putting the chair under the carpet, seen in conditions 2 and 3.

One of the questions raised by this experiment was whether, when the children of these experimental groups were in doubt, did they respond by making a canonical spatial arrangement? That is, did they screen out syntactically confusing or semantically incongruent input, and respond with that which is pragmatically consistent with their knowledge of the real world?

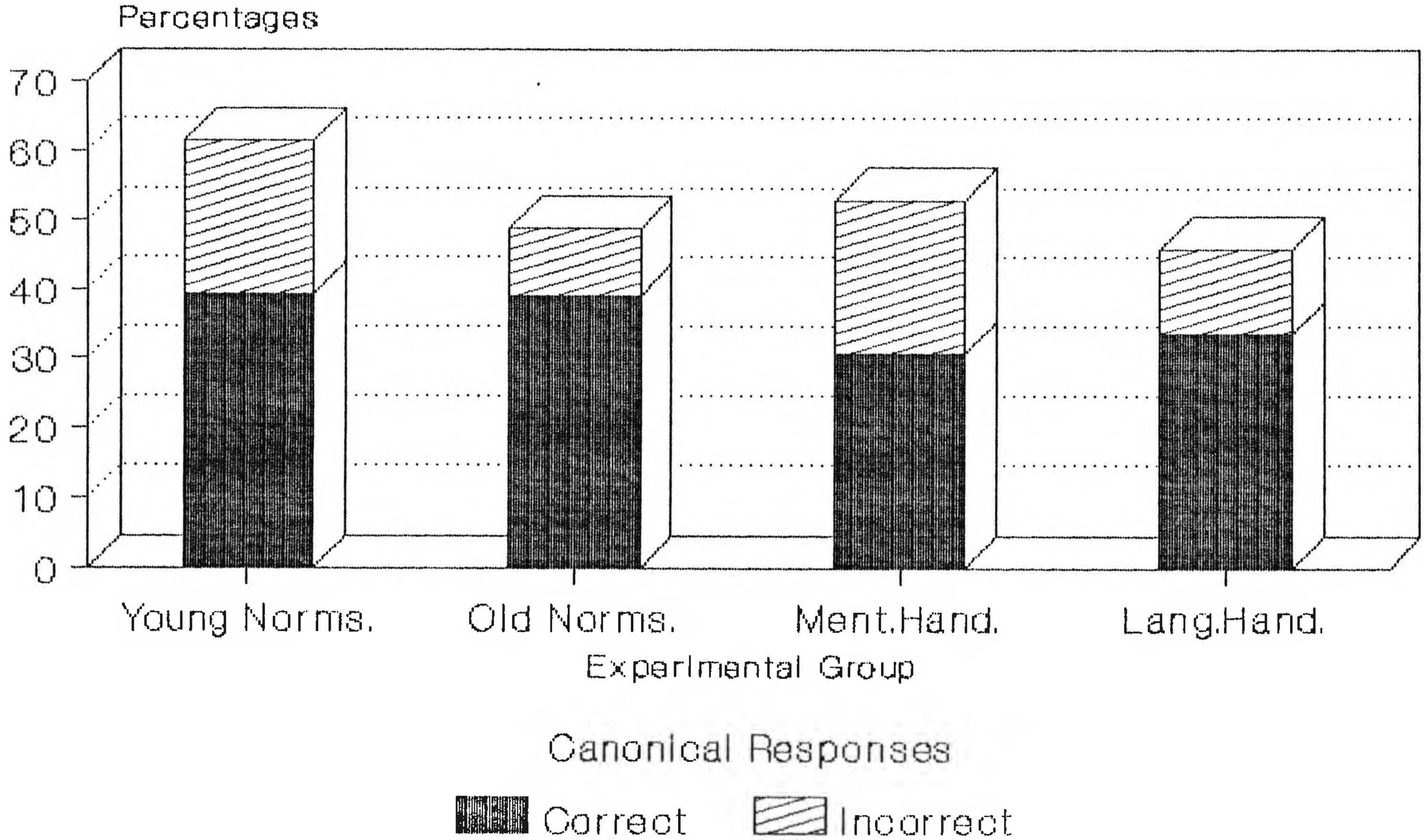
With this in mind, all canonical responses for each experimental group separately were counted. The following frequencies emerged for each group, which may also be seen in Figure 10:8:

1. For the 3;0-3;11 year old normal subject group, out of the total responses, 61.5% were canonical arrangements. Out of these, 64% were correct, that is, in accordance with the instructions. The rest, 36%, were incorrect.

2. For the 4;0-4;11 year old group of normal intelligence, 49% of the total responses were canonical arrangements, out of which 80% were correct.

3. For the mentally handicapped group, 53% of their total responses were canonical arrangements of the toy objects. However, only 58% of these were correct and 42% were incorrect.

Figure 10:8
Canonical Responses for Each Group across All Conditions (Percentages)



N.B. Young Norms. = 3;0-3;11 yrs.
Old Norms. = 4;0-4;11 yrs.

4. For the language handicapped group, 46% of the total responses involved the canonical arrangement of the objects, out of which 73% of these were correct.

From this, we can conclude that none of the groups appeared to adopt an exclusively canonical arrangement strategy, irrespective of the verbal instructions given to them. The younger normal children did appear to be making more canonical spatial arrangements than the other groups, but not to an overwhelming degree (61.5%). It seems that all of the groups were making an effort to decipher the verbal instructions being given to them.

<u>10.8.2 The Locative Prepositions: "On" versus "Under"</u>

It may be seen that the locative "under" was causing more confusion than the locative "on". Was this truer of some subject groups, than for others?

The locative preposition "on" was in the verbal instructions of conditions 1 and 2. In condition 1, this involves a semantically congruent instruction, such as, "Put the chair on the carpet". In condition 2, it involves a semantically incongruent instruction, such as, "Put the carpet on the chair".

We proceeded to pool the responses for both of these conditions and the ensuing percentages for the errors for these two conditions for each experimental group were:

1. For the younger normal group (3;0-3;11 years), 25%.
2. For the older normal group (4;0-4;11 years), 12.5%.
3. For the mentally handicapped group, 42%.
4. For the language handicapped group, 25%.

The locative preposition "under" was contained in conditions 3 and 4, both of which were semantically incongruent. In condition 3, the verbal instruction was, for example: "Put the chair under the carpet" and in condition 4, it was "Put the carpet under the chair".

When the errors for both of these conditions were pooled together, the percentages for each group were as follows:

1. For the younger normal group (3;0-3;11 years), 45%.
2. For the older normal group (4;0-4;11 years), 29%.
3. For the mentally handicapped group, 47%.
4. For the language handicapped group, 33%.

Comparing the percentages for the two locative prepositions, we conclude that neither the mentally handicapped nor the language handicapped children were particularly influenced by whether the locative preposition was "on" or "under". However, in both of the normal groups, there appears to be a bias towards the locative "on", in other words, both normal groups were making less errors where the preposition "on" was concerned. Yet again, it must be said that this is a biased comparison in that condition 1 contained semantically congruent instructions, and only condition 2 had semantically incongruent instructions, as both of the "under" conditions, 3 and 4, had.

These results do indicate, nevertheless, that the locative "under" does seem to present more problems than the "on" to the normal children at these age levels and at this type of task. Similar results were noted by Huttenlocher and Strauss (1968) in their experiments.

10.8.3 Word Order: Canonical versus Non-canonical.

This experiment involved another element, which was to be investigated: canonical versus non-canonical word order. The hypothesis was that, just as there is a canonical spatial arrangement of objects, there is also, as it were, a canonical word order. This latter may actually mirror the canonical spatial arrangement of objects and represent a verbal counterpart of the mental image that this spatial arrangement evokes. Thus, the mental representation of a chair on a carpet is immediately described in these terms: "the chair is on the carpet". A carpet on a chair is non-canonical as a spatial arrangement, and the word order used to described it mirrors this, by also being reversed. This instruction may take longer to process, because the mental image is reversed. However, the verbal instruction may be interpreted in reverse by young children. Thus, the instruction, "Put the carpet on the chair", is often interpreted as "Put the chair on the carpet", which leads to a canonical placement of the objects. Grieve, Hoogenraad and Murray (1977) also observed this phenomenon in their data.

For condition 2, therefore, the following ERROR frequencies were found for each experimental group:

1. For the normal 3;0-3;11 year olds, 46%.
2. For the normal 4;0-4;11 year olds, 22%.
3. For the mentally handicapped, 68%.
4. For the language handicapped, 42%.

From this, it may be seen that this word order "reversal" is best handled conceptually by the older normal children, although they too are still making quite a few mistakes, that is, putting the toy objects into their canonical arrangement.

Both the younger normals and the language handicapped children were having considerable problems with the word reversal feature of this condition, but by far the least able to comprehend this verbal instruction were the mentally handicapped children.

In condition 4, we also have word order "reversal", but it is far more complicated to analyse, since it involves other features as well. The instructions in this condition were, for example: "Put the carpet under the chair". This is, of course, a highly irregular way of saying: "Put the chair on the carpet", the ensuing result being the same.

In this condition, therefore, we are not only confronted with a non-canonical word order, but also with a semantically unusual way of requesting a canonical spatial arrangement. In addition, the locative preposition "under" may be assumed to further confuse the issue.

The errors provoked by this condition obviously stemmed from these various ambiguous linguistic features and not merely from word order "reversal". The frequencies of the errors for each subject group in condition 4 were as follows:

1. For the normal 3;0-3;11 year olds, 39%.
2. For the normal 4;0-4;11 year olds, 39%.
3. For the mentally handicapped, 62%.
4. For the language handicapped, 58%.

It is interesting to compare these figures to those for condition 2 (that is: "Put the carpet on the chair"). Younger normal children seem to be making less errors for this more complicated instruction than they were for condition 2 (that is, 39% errors in condition 4 as opposed to 46% in condition 2). On the other hand, the older normal children were responding in condition 4 (that is: "Put the carpet under the chair") as was to be expected: they were making more errors in this condition than they were in condition 2.

If one keeps in mind that a correct response in condition 4, is to make a canonical arrangement of the toys, then it seems reasonable to conclude that, in the face of condition 4´s highly confounding and ambiguous instructions, the younger normal subjects often resorted to a canonical arrangement of the objects, not because they were able to decipher what was being asked of them, but because they were <u>unable</u> to decipher the verbal instruction. The older subjects, however, did not resort to an easy problem-solving strategy, as the one mentioned above. Instead, they bravely struggled to understand the verbal message, and quite often interpreted it wrongly.

On the other hand, since both of the handicapped groups made considerably more errors than the two normal groups, they apparently neither resorted to canonical arrangements nor were successful at deciphering the verbal instruction. When comparing the percentage of errors that the mentally handicapped group made in conditions 2 and 4 (that is, 68% and 62% respectively), one concludes that word order is quite a crucial source of information for this group of children. They may make assumptions about the verbal content of a message through this particular linguistic feature.

This may be made clearer, when comparing the ERROR frequencies in condition 3, where the word order was canonical. The verbal instruction for this condition, it will be remembered was, for example: "Put the chair under the carpet".

1. For the normal 3;0-3;11 year olds, 51%.
2. For the normal 4;0-4;11 year olds, 21%.
3. For the mentally handicapped, 32%.
4. For the language handicapped, 8%.

In order for these figures to illustrate the point that we are trying to make apparent, they must be compared to the other conditions. This will be done for each group separately, beginning with the older normal children, who were 4;0 to 4;11 years old.

Condition 2	Condition 3	Condition 4
"carpet on chair"	"chair under carpet"	"carpet under chair"
22% errors	21% errors	39% errors

This appears to show that, where word order reversal alone is concerned, as in condition 2, or the locative preposition "under" alone, as in condition 3, the older children of normal intelligence make approximately the same number of errors. However, when both of these features, that is, word order "reversal" and the locative "under", are contained in the same verbal instruction, then there is a sudden rise in the ERROR rate. This difference was statistically significant between conditions 3 and 4 ($t=3.76$, $df=11$, $p<0.01$).

For the normal 3;0-3;11 year olds, the corresponding error percentages were:

Condition 2	Condition 3	Condition 4
"carpet on chair"	"chair under carpet"	"carpet under chair"
46% errors	51% errors	39% errors

Here a different pattern from that of the older normal group is apparent, but again it seems that word order "reversal" alone does not cause added confusion to these children; if anything, it seems to be the locative "under" which caused the main problems here. The difference between condition 2 and 3 in this age group were tested with related t tests and it was not found to be significant. However, the difference between conditions 3 and 4 was found to be significant ($t=5.16$, $df=11$, $p<0.001$).

As can be seen, these younger children made most of their mistakes in conditions 2 and 3, where the verbal instructions, though containing different linguistic elements, resulted in a non-canonical placement of the toys. Thus, it may be seen that in both of these conditions, approximately half of the children responded by making a canonical arrangement of the objects, which was considered an incorrect response.

Paradoxically, in condition 4, which we have already described as being the most difficult instruction to decipher from a linguistic point of view, the younger children were making significantly fewer mistakes than in the other two conditions. It must be mentioned that the ensuing correct response for these difficult verbal instructions was a canonical placement of the toys. We would, therefore, like to put forward the following theory for the children´s surprising results in this condition: that the strategy they were using to solve this problem was to respond according to their knowledge of the canonical spatial arrangement of these objects in the real world. This led to, what one could consider as "false" correct responses.

Turning now to the language handicapped and the mentally handicapped groups, we are faced with different patterns of results, yet again.

The following are the ERROR frequencies for the mentally handicapped group for the three conditions of interest:

Condition 2	Condition 3	Condition 4
"carpet on chair"	"chair under carpet"	"carpet under chair"
68% errors	32% errors	62% errors

The following are the ERROR frequencies for the language handicapped group:

Condition 2	Condition 3	Condition 4
"carpet on chair"	"chair under carpet"	"carpet under chair"
42% errors	8% errors	58% errors

In both these groups, one observes that in condition 3 (containing the locative "under"), they both make considerably fewer errors than in either of the other two conditions ($t=4.64$, $df=9$, $p<0.01$ between conditions 2 and 3 for the mentally handicapped group; $t=2.85$, $df=5$, $p<0.05$ between conditions 3 and 4 in the language handicapped group. Note 1.).Since word order is the sole factor which changes in conditions 2 and 4 and not the locative preposition or whether the response is a canonical

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1 The difference between conditions 2 and 3 in the language handicapped group almost reached significance, but not quite, probably due to the small sample of subjects.

arrangement of the objects or not, we would like to suggest that the mentally handicapped and the language handicapped were confused by the word order "reversals" in these instructions. They tended to focus their attention on the last element of the sentence and to process the sentence backwards, that is:
The verbal instruction "Put the carpet on the chair" is processed as "Put the chair on the carpet", which is also the more usual verbal form in pragmatic terms.

But, why was this strategy not also used in condition 3, where they were instructed to "put the chair under the carpet"? Could it be due to a reason which has already been identified in previous experiments in this study: that is, that semantic incongruence does not play such a definitive role in the mentally handicapped´s and the language handicapped´s understanding of locative instructions, as it does for the normal children? This seems to be a fairly reasonable explanation, in view of the facts, of the apparent discrepancies in the results of these two experimental groups. So, it may not actually be the non-canonical spatial arrangement which is causing the problem, but their inability to process sentences, which have an unusual word order in the correct sequence. In this case, it would mean that these children seem to resort to syntactic cues rather than to semantic or pragmatic ones, as do normal children, in their linguistic problem-solving.

10.8.4 Comparison between Object Pairs

In Experiment V, it had been observed that some of the object pairs in that experiment had provoked more responses, which led to canonical spatial arrangements, than other object pairs. It had been suggested that some of these object pairs had stronger links with meaningful spatial arrangements than others. The data supported this view by revealing such a systematic pattern in the results of the normal children.

In the present experiment, an effort was made to find object pairs, which did have such a clear meaningful canonical spatial arrangement, while an "opposite" spatial arrangement would be irregular and non-canonical.

The procedure followed in order to test whether the object pairs were equal in this respect, was the same as that followed in Experiment V. The canonical preferences or responses made in the three conditions (2, 3 and 4), where the instructions were semantically incongruent, were counted for each group. This may be seen in Table 10:2 following.

Table 10:2 Canonical Responses made by Each Subject Group in Conditions 2, 3 and 4 (according to Each Object Pair).

Canonical Spatial Arrangement	Gk.Normals 3-4 yrs.		Gk.Normals 4-5 yrs.		Ment.Hand.		Lang.Hand.	
	Rs.*	%	Rs.*	%	Rs.*	%	Rs.*	%
car on road	21	58%	18	50%	19	63%	10	55%
chair on carpet	20	55%	13	36%	13	43%	3	17%
cup on saucer	19	53%	15	42%	8	27%	4	22%
lid on saucepan	19	53%	7	19%	14	47%	6	33%
pencil on paper	17	47%	9	25%	12	40%	6	33%
tablecloth on table	13	36%	10	28%	11	37%	4	22%

* Rs.= Responses. Each subject group has a different number of possible canonical responses according to the number of subjects in each group. Thus, The two normal groups have a possible 36 canonical responses in conditions 2,3 and 4 for each object pair, whereas the mentally handicapped group have a possible 30 and the language handicapped group have a possible 18. For this reason, percentages are given next to the response numbers.

From this table, the following observations may be made:

1. Every subject group makes the most meaningful canonical

spatial arrangements in conditions 2, 3 and 4, with the car/road object pair. As can be seen, it ranks first in all groups (the younger normal group also has the chair/carpet object pair, the cup/saucer pair and the lid/saucepan pair very closely following the first position).

2. Overall, even taking the car/road pair into account, the canonical arrangements vary between 17% and 63% over all groups. Thus, all children make relatively frequent responses which, though these vary between groups and between pairs, are nevertheless in accordance with the incongruous verbal instructions.

Below, in Table 10:3, one can see the total number of canonical responses made by all of the subjects for each object pair (only conditions 2 - 4). This table simplifies the results of Table 10:2 above and allows us to conclude that, apart from the car/road pair, there are no great differences between the other object pairs.

Table 10:3 The Total Number of Canonical Responses made by the Total Number of Subjects for Each Object Pair In Conditions 2-4.

Canonical Arrangement of Toy Objects	Total Number	Total Poss.	Rank
car on road	68	120	1
chair on carpet	49	120	2
cup on saucer	46	120	3.5
lid on saucepan	46	120	3.5
pencil on paper	44	120	4
tablecloth on table	38	120	5

As already noted, most canonical preferences refer to the car/road pair, and least for the tablecloth/table pair. Thus the canonical preferences, which the subjects showed for each object pair did not form such a regular pattern as had been observed in Experiment V. The exception was the car/road pair, which in all groups seemed to bias towards a canonical spatial arrangement.

Referring back to the similar train/rail results of the previous experiment, it is suggested that the car/road object pair is highly inconceivable to children in its non-canonical spatial arrangement, due to the fact that even in play, a road on a car may never have been used or seen.

With this possible exception, we do not believe that any of the object pairs led to an undue bias in this task.

10.9 Discussion

The questions, which this experiment attempted to elucidate, had already been identified in the previous experiment: that is, what were the influences of syntactic, semantic and pragmatic rules in young children's understanding of verbal instructions, containing locative prepositions?

It had already been ascertained that semantically incongruent instructions, which do not request the familiar canonical spatial arrangement of a pair of objects, produce many more errors in the understanding of locative instructions, than those that are semantically congruent. It was suggested that syntactic, semantic and pragmatic factors were interacting and were responsible for the obtained results.

Thus, it was necessary to design an experiment following the previous one, which would attempt to discriminate to what degree each of these factors contributed to the understanding of verbal locative instructions. The present experiment, therefore, was designed in order to test the following questions:

1. To what degree does syntax play a role in young children's understanding? This was tested through word order, which is a

syntactic form reflecting man´s knowledge of the perceptual world. For instance, the visual image of a chair on a carpet is described: "the chair is on the carpet", not "the carpet is under the chair".

2. To what degree does semantics play a role? This was tested with the meaning of the instructions changing, according to the two locative prepositions used, "on" or "under". For instance, the sentences "Put the carpet on the chair" and "Put the carpet under the chair" are different because the change in locative prepositions make the former semantically congruent and the latter semantically incongruent.

3. Finally, to what degree does pragmatics play a role, in the form of canonical versus non-canonical spatial arrangements of the objects. For instance, the instruction "Put the carpet under the chair" may be incongruent, but the ensuing response is a canonical spatial arrangement. Are children likely to ignore the linguistic elements of a verbal instruction, which is somewhat ambiguous, and to respond according to their knowledge representations of the way things are ordered in the world?

The second feature of interest in this experiment was whether mentally handicapped children and language handicapped children responded differently from normal children to these instructions. It was seen that, on the whole, this was not the case, but that on some of the variables mentioned, there were nevertheless some group differences, owing to the different strategies being used and the subjects´ different capabilities.

Turning yet again to the individual features that we were testing in this experiment, after an analysis of each one individually, the following conclusions were reached:

1. Word Order Rules: the canonical word order, which reflects a canonical mental representation of the objects, may be a positive factor in children´s understanding of locative instructions. An instruction, such as, "Put the carpet on the chair" was confusing to all children of all groups.

2. Locative Prepositions: the locative preposition "on" seemed to be easier for normal children, but both the prepositions "on" and "under" produced an equal number of errors in the mentally handicapped and the language handicapped groups. The drop in the ERROR rate in both these latter groups in condition 3, where they were asked to "Put the chair under the carpet", suggests that the locative preposition "under" alone did not present any greater difficulty for the language handicapped group and only a slight difficulty for the mentally handicapped group. However, when this locative was combined with a word order "reversal", as it was in condition 4 ("Put the carpet under the chair"), the ERROR rate was quite high in both of these groups.

<u>3. Canonical Spatial Arrangements:</u> the younger normal group did appear to show a preference for the canonical arrangement of the objects, but none of the other subject groups did.

In order to see the strength of each of the above features, it was decided to count how many subjects in each group each particular feature seemed to influence in their interpretation of these particular verbal instructions. The following table, Table 10:3, is a summary of this exercise. An asterisk denotes that that particular feature seems to influence the particular subject group in question. If a feature was difficult for all of the subject groups, then it was assumed that it was the most influential one and conversely.

TABLE 10:4 Features Influencing Each Subject Group's Interpretation of the Verbal Instructions in Experiment VI.

Features	Subject Groups			
	Normal 3;0-3;11	Normal 4;0-4;11	Mental. Handicap.	Lang. Hand.
Word Order (Syntax)	*	*	*	*
Locative (Semantics)	*	*		
Canon. Arrange. (Pragmatics)	*			

The above table implies, therefore, that syntax (in the form of word order), then semantics (in the form of the specific locative preposition), and finally pragmatics (in the form of canonical spatial arrangements), in decreasing order, cause the misunderstanding of verbal instructions, which are incongruous. So, when hearing something that is incongruent or ambiguous, we suggest that children have the tendency to misjudge primarily the word order, since they turn to that aspect first for elucidating information. Secondly, they appeal to the semantic elements of the sentence, in this case, the locative prepositions, for information. Finally, as they grow older, they are least likely to resort to an "easy" solution to the problem, by ignoring the linguistic elements, and for instance, making a canonical arrangement of the objects, according to their mental representations.

This is true, in varying degrees for each subject group, as can be seen in the above Table 10:4. For instance, both the language handicapped and the mentally handicapped groups are more influenced by word order (or syntactic features) than by semantic or pragmatic ones. Does this mean that they tend to ignore semantic and pragmatic features in language, on the whole? Or could it be that in this particular task, they are more advanced in these than the normal control group, who were of course in the younger age range, and who had a more intuitive understanding of these features?

We believe that the answer is extremely complicated, and lies somewhere between these two extremes. In all of the previous experiments of this study, it has been shown consistently that semantic and pragmatic features are less fixed and influential, less connotative to these two subject groups. Because these features of the language comprehension process are less suggestive to them, they are also less confounding when they do not adhere to congruency rules, as they are for normal children. Thus, handicapped children are not, it seems, so put out when the semantic and pragmatic features of a sentence are not those that would be expected, for they appear to rely less on these aspects of language for information than do normal children. On the other hand, the influence of the role played by syntax seems similar for all the groups tested here.

The next chapter describes the last experiment in this series, Experiment VII, which returns to investigate some of the cross-linguistic aspects of locative acquisition, first raised in Experiments I-III.

CHAPTER 11

An Investigation into the Language Specific Properties of Different Locative Prepositions: Experiment VII.

11.1 Introduction

In this final experiment, we return again to some of the questions raised in the first section of this investigation. The experiments (I-III) in that section had been conducted, in part, with children from two different linguistic backgrounds, that is, Greek and English. The data from these experiments had led to some interesting questions, regarding the language specific properties of spatial cognition and their reflection on the acquisition of locative terms.

Of course, different languages map locative terms onto spatial perception in different ways. But, spatial perception itself seems to develop cross-culturally in a universal manner. This hypothesis was corroborated by the evidence from Experiment I, where both the English and Greek subject groups performed similarly in a non-verbal spatial sorting task. Spatial perception begins to be influenced, however, from the moment that more specific verbal instructions are introduced into the task, as seen in Experiment II. The difference in the results between the two linguistic groups now was significant and this seemed to be evidence of "linguistic contamination" of a primarily perceptual-conceptual spatial task.

In the present experiment, an attempt is made to further investigate these initial findings. The Greek and English languages have quite different ways of expressing location, as has been noted before.

In Greek, location is denoted chiefly with reference to general location, for instance:

the word "mesa" denotes the concept of "in-ness"

the word "pano" denotes the concept of "up-ness"

the word "kato" denotes the concept of "down-ness".

These terms are, in their principle form, adverbs which become locative prepositions only when a preposition is added to them.

Thus, "mesa" followed by the preposition "sto" means "in"

"mesa" followed by the preposition "apo" means "through"

"pano" followed by the preposition "sto" means "on"

"pano" followed by the preposition "apo" means "over"

"kato" followed by the preposition "apo" means "under".

It can be seen above, that the meaning changes according to the prepositional appendage. This is sometimes quite complex or ambiguous, because attention must be paid to the morpheme after the adverb, in order to interpret precisely the meaning of a phrase.

In English, almost the reverse is true. It will be noticed above that the English equivalents for the locatives consist of quite different lexical items, for concepts which belong to the same semantic category. For instance, although "on" and "over" belong to the same semantic category of "on-ness", the English language has two unrelated lexical items for these related concepts. Furthermore, there are many more words in each of the above semantic categories:

1. for "in-ness" we have: inside, indoors, interior, within, in.

2. for "on-ness" we have: up, on top of, over, above, on, top, upstairs, overhead.

3. for "down-ness" we have: down, underneath, below, downstairs, at the foot of, bottom, under.

This reveals a considerable linguistic diversity, which may impede young children from learning some concepts as quickly as children from other cultures, where these terms are classified more generally. On the other hand, it may lead to a greater perceptual and conceptual precision in spatial cognition, due to the preciseness of the linguistic terms.

Thus, the question is whether one can really speak of general developmental trends in spatial concept formation, which may at least in part be due to language-specific factors, such as linguistic differences in complexity or diversity. For instance, it may be that a particular locative preposition, which has a rather convoluted form, may take longer for the children of one particular language community to acquire, than another.

Such a hypothesis would allow that language-specific factors permit certain fluctuations in the acquisition of certain concepts or semantic terms in different languages, but nevertheless they will probably not determine the overall cognitive development of children, which appears to have a culture-independent nature.

It was decided that this supposition would be tested in the area, which is the concern of this study, that is, spatial cognition and locative terminology. Thus, the understanding of some locative terms was tested in the following experiment, in children from two linguistic backgrounds, Greek and English.

The locative terms chosen for this test were:

English Terms	Greek Terms
in	mesa sto
through	mesa apo
on	pano sto
over	pano apo

The task consisted of following an instruction to point to one of several drawings, according to an arrow´s spatial relation to a fixed abstract shape. In this way, the subject´s understanding of these four locative prepositions was tested.

The drawings consisted of abstract shapes and arrows, in order to eliminate any possible influence by pragmatic factors. It was presumed that the abstractness of the task would minimize experiential factors.

The locative terms, which were tested, were chosen for the following reasons:

1. The prepositions "in" and "on" are the first locatives normally acquired by young children, reflecting their practical or pragmatic preoccupations at this developmental phase of their concept formation. They are acquired usually by about three years of age.

2. These two locative prepositions contrast neatly with the more complex concepts of "through" and "over". "Through" implies movement from one end of an object to another. "Over", on the other hand, is not as clearly defined, but implies that the object is above and not touching another object, in contrast to "on", which is touching the object. Both of the above concepts

are developmentally quite advanced and are not acquired till later, that is, at about five years of age.

3. In Greek, the locative terms "over" and "through" are similar to the terms "on" and "in" respectively. The Greek language recognizes that, for instance, "over" belongs to the same semantic field as "on", by placing the distinguishing characteristic between them in the morphological feature. Thus, "on" is "pano sto" in Greek, whereas "over" is "pano apo". Similarly, the term for "through" is semantically linked to the term "in" in Greek, the difference being made primarily in the same way as above: that is, "in" is "mesa sto" and "through" is "mesa apo". However, there is one further distinction in that the term for "through" is always preceded by a verb, which denotes movement. This verb signifies that the locative "through" does not refer to something stationary, for instance:

Greek: /to toxo pernai mesa apo to milo/

English: /the arrow is passing through the apple/.

In conclusion, in English, these four spatial positions are distinguished by four quite separate locative terms, whereas in Greek, there is a categorization according to semantic field, which refers to the general location in space, that is "in-ness" or "on-ness". The term is made specific by the morphological appendage. Thus:

Semantic Field	Greek Term	English Term
"in-ness"	mesa sto	in
	mesa apo	through
"on-ness"	pano sto	on
	pano apo	over

The question, therefore, is whether these linguistic differences would result in a difference in locative acquisition rates between Greek and English children. Would a general developmental delay be apparent in one of the two language groups or would these differences merely result in a specific difficulty on some locatives in particular, compensated by a specific difficulty in another locative in the other language? This would be what one would expect if a "universality" hypothesis were correct, yet allowing for slight language-specific variations.

The second question addresses itself to language-specific properties and asks whether the fact that each spatial concept is, in English, mapped onto a different locative term is helpful to young children learning a language, even though there is a plethora of locatives in each spatial semantic field (which has already been named "linguistic diversity"), or whether the semantic over-simplification of the Greek language is more helpful, even though it means a linguistically complex system of adverbs and prepositions to distinguish each specific locative from the other?

A further subsidiary question was whether one would find cross-cultural differences in the childrens' mapping of these locative terms onto the spatial perceptual models provided. These were abstract shapes and could possibly evoke different responses from the children from different cultural backgrounds.

11.2 Subjects

The subjects of this experiment were all children of normal intelligence from either Greek or English linguistic backgrounds. They were all native speakers and monolingual.

Twenty-four subjects were tested in each linguistic group, each divided into two groups of equal numbers. This division was according to two age levels:

Age Level 1: 12 children between 3;0 and 3;11 years/months

Age Level 2: 12 children between 4;0 and 4;11 years/months.

The Greek children had already been used as part of the sample in Experiments V and VI. The English subjects were matched to the Greek group according to chronological age and language level, tested with the Peabody Picture Vocabulary Test (PPVT).

Table 11.1 below presents a summary of each subject group´s characteristics.

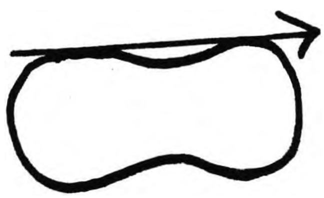
TABLE 11.1 Summary of the Greek and English Groups´ Characteristics at both Age Levels.

	Greek Group	English Group
Age Level 1	N=12 Mean C.A.=3;6 yrs. (SD=0.31) Mean PPVT=3;7 yrs. (SD=0.58)	N=12 Mean C.A.=3;5 yrs. (SD=0.32) Mean PPVT=3;8 yrs. (SD=0.36)
Age Level 2	N=12 Mean C.A.=4;5 yrs. (SD=0.34) Mean PPVT=4;6 yrs. (SD=0.24)	N=12 Mean C.A.=4;5 yrs. (SD=0.29) Mean PPVT=4;5 yrs. (SD=0.58)

11.3 Material

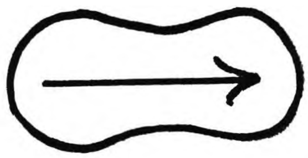
The material consisted of 7 cards, 8 cms. by 35 cms. wide. On each card, a specific abstract shape was repeated in a row five times. These were the Fixed Objects. The Moving Object was the same in all cases and was a red arrow. This arrow was placed in different positions in relation to each abstract shape, thus forming five different spatial configurations.

1. In one configuration, the arrow was **on** the shape, that is, horizontally placed and touching the top plane of the shape. It was either pointing to the left or to the right.
For example:



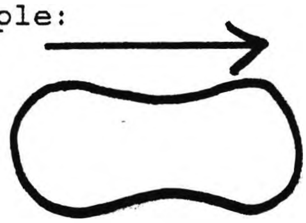
This represented the locative "on".

2. In another configuration, the arrow was horizontally placed **in** the shape, enclosed by it and again pointing either to the left or to the right. For example:



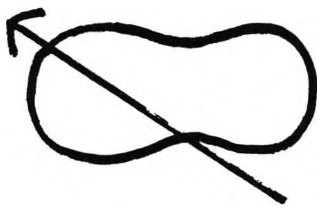
This represented the locative "in".

3. Another configuration consisted of a horizontal arrow vertically above the shape and suspended **over** it, that is, not touching it. Again, the arrow was pointing either to the left or to the right. For example:



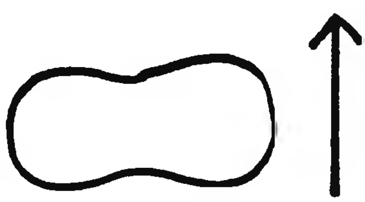
This represented the locative "over".

4. A fourth configuration consisted of an abstract shape with a diagonal arrow, running from one end to the other **through** the shape. The arrow had either a downward or an upward movement. For example:



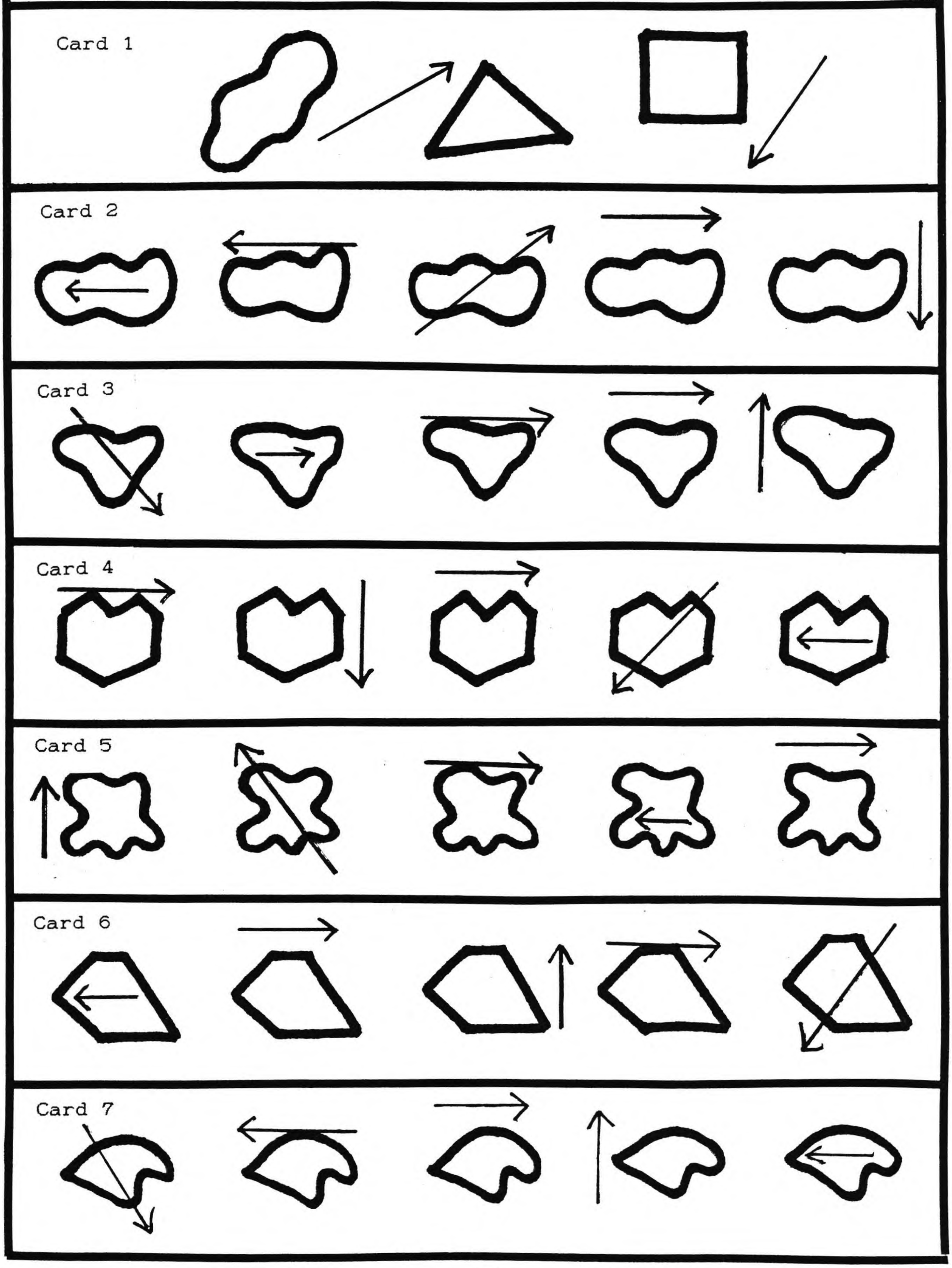
This represented the locative "through".

5. The last configuration was merely placed amongst the others as a "blind". None of the children were asked to point to this configuration. It consisted of a shape with an arrow either vertically to the right or to the left of it, pointing either up or down. For example:



In Figure 11:1, all the cards used for this experiment are shown. It will be seen that the first "training" card, consists of three shapes and two arrows in no particular configuration. This was used before the experiment began, to test whether the subject knew what a shape was or what an arrow was.

Figure 11:1
Test Material for Experiment VII.



It will also be noted that each set of cards had a Fixed Object, different to the others on each of the other sets. The configurations for each spatial location were presented in random order. Finally, the seven cards were held together with a ring binder.

After the experimental material was designed, it was trial tested on ten Greek adults. This was in order to ensure that, in Greek at least, the locative terms tested were fairly represented by the spatial configurations on the cards.

These adults all responded "correctly" to all of the questions asked of them, which meant that the correspondence between the Greek locative terms and the spatial configurations was accurate. It was not automatically assumed that this semantic-perceptual mapping would be the same in the English language, but this was to be revealed by the experimental results. The primary concern was that this correspondence should be consistent in one of the two languages.

11.4 Procedure

Each subject was tested individually. The child was tested sitting opposite the experimenter and was told that he was going to play a game, which involved pointing to some arrows on the drawings. The child was then shown the trial card, which consisted of the shapes and arrows. The experimenter said:

E: "Look at the shapes and arrows. Can you point to some shapes? Good! Now, point to some arrows. Good!"

In this way, the experimenter ensured that the subject knew what a shape and an arrow were. She then turned to the first test card (Card 2) on the ring binder and said:

E: "Now look at all these shapes. One has an arrow on it, another has an arrow passing through it, and another has an arrow in it..."

The experimenter did not point to specific configurations, but used this as an introduction in order to ask the first question, for instance:

E: "Can you show me an arrow **in** the shape?"

After noting the response on the score sheet, the experimenter proceeded to show the next card to the subject. This was repeated for twenty-four trials, because each locative preposition was tested 6 times. Since there were only six experimental cards (Cards 2-7 in Figure 11:1), after the first six trials were completed, the experimenter turned to Card 2 again and asked the subject to point to different configurations on the same cards. This procedure was done four times, in order to collect 24 responses (6 responses for each locative being tested). An example of a completed score sheet may be seen in the Appendix.

The requests made were as follows:

1. "Show me the arrow **in** the shape".
2. "Show me the arrow **on** the shape".
3. "Show me the arrow passing **through** the shape".
4. "Show me the arrow passing **over** the shape".

The locative preposition was stressed slightly. The experimenter repeated the instruction, if the subject requested it, though this was very rarely the case. In questions 3 and 4, it will be noted that the verb "passes" preceded the locative preposition. We are well aware that this is not necessary in English, but since it is necessary in Greek for the locative "through" ("mesa apo"), it was decided that it would also be used for the locative "over" and, of course, tested in this way in both languages.

The instructions for this experiment may be seen in Greek in the Appendix.

11.5 Test Criteria and Scoring

As can be seen in the previous pages, there were six cards, testing 4 locative terms. The subject was shown a card and asked to point to the required spatial configuration. His response was noted on the score sheet above, in the following way: each spatial configuration corresponded to a number (from 1 to 5, denoting the five configurations on each card). The experimenter merely circled the number on the score sheet, thus indicating the configuration which the subject pointed to in his response. No corrections were given.

The experimenter proceeded to the next card on the ring binder and asked the next question. This was continued, as already mentioned above, till all six cards were shown to the child. The experimenter then turned to Card 2 again, asking a different question this time. This was repeated, according to the order shown in the score sheet.

After the task was completed, the experimenter noted the following on the score sheet:

1. How many errors the subject had made.

2. What were the specific errors that the subject made.

11.6 Results

As previously described, the data obtained from each subject for this experiment were:

1. Overall ERROR score.
2. Specific error types for each locative preposition in each language.

The data was analyzed by analysis of variance and by chi square.

11.6.1 Analysis of variance

The overall ERROR scores were tested with analysis of variance. There were two between subject variables. The first was nationality, which had two levels:

1. Greek
2. English.

The second was age, which had two levels:

1. 3;0-3;11 years/months
2. 4;0-4;11 years/months

There was no within subject variable.

The results of the analysis showed that there was no significant difference between the two nationality or linguistic groups. More surprisingly, there was no significant difference between the age levels. The mean ERROR score across all subjects was 12.4 errors, out of 24 responses.

In Figure 11:2, a graphic illustration of the ERROR scores is represented for each group and at each age level.

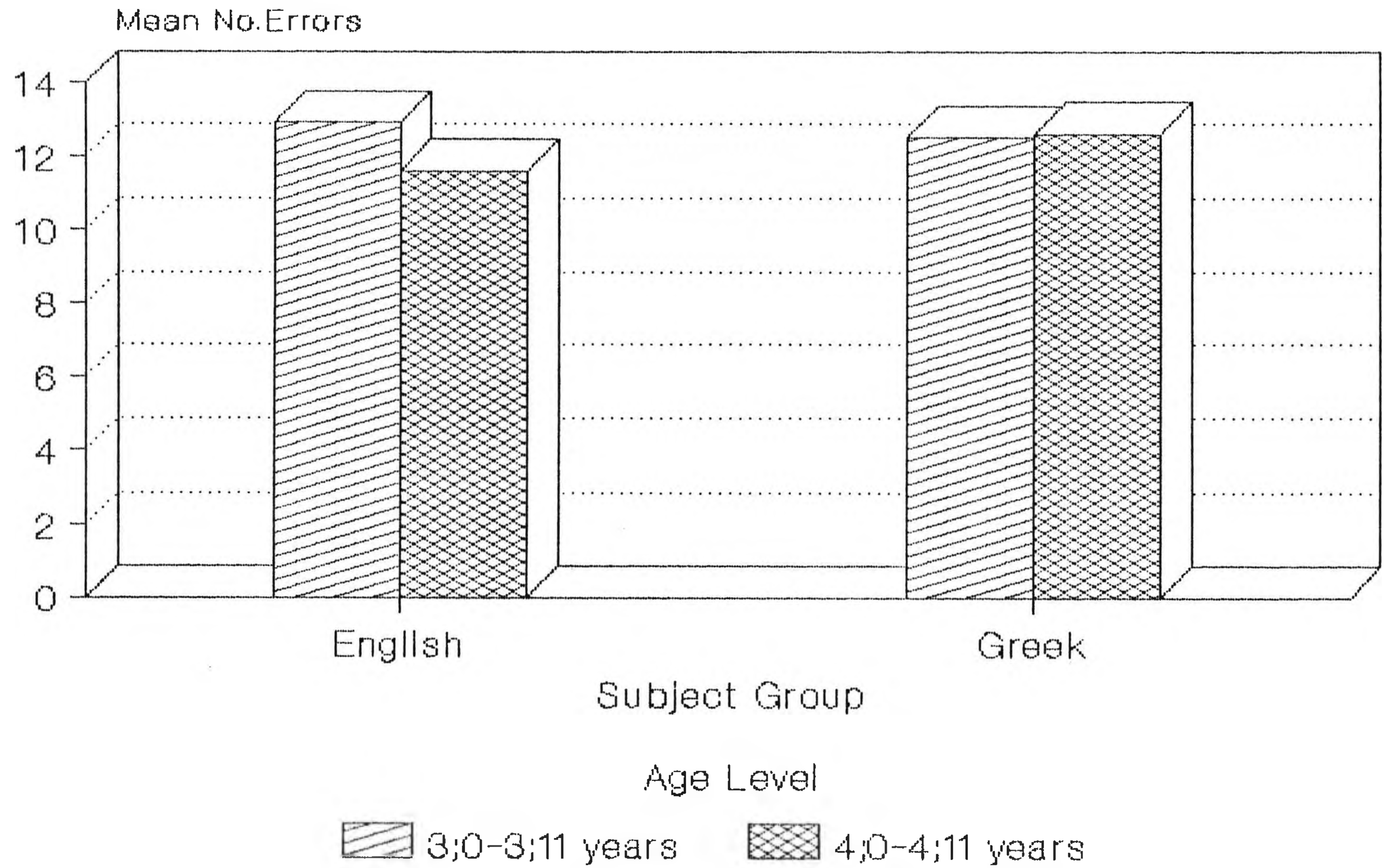
No significant interaction was present, though there appears to be a slight trend for the English children in getting slightly better with increasing age, while the reverse seems to be indicated for the English group. However, the differences are too small to lead to any statistical significance.

11.6.2 Chi Square

The error types for each locative preposition and for each linguistic group separately were analyzed by chi square. These may be seen in Table 11:2.

The erroneous responses for each preposition were counted separately for each locative preposition and these errors were classified according to what spatial configuration was shown by the child. Thus, if instead of showing the configuration for "on", the subject showed the configuration for "over", the response was put in that particular box.

Figure 11:2
Mean Error Scores for Each Subject Group at Each Age Level (Exp.VII).



No Statistical Significance found.

TABLE 11:2 Chi Square Results for the Four Locative Prepositions in Experiment VII.

A. Locative Preposition "ON"

Groups	Erroneous Responses: IN	THROUGH	OVER	NEXT	TOTAL
Greek	17	45	29	2	93
English	50	43	9	4	106

$x2 = 26.757$, $df = 3$, $p<0.01$

B. Locative Preposition "OVER"

Groups	Erroneous Responses: ON	IN	THROUGH	NEXT	TOTAL
Greek	33	4	59	9	105
English	23	13	70	6	112

$x2 = 7.871$, $df = 3$, $p<0.05$

C. Locative Preposition "IN"

Groups	Erroneous Responses: ON	THROUGH	OVER	NEXT	TOTAL
Greek	1	51	0	0	52
English	1	18	4	3	26

$x2 = 15.88$, $df = 3$, $p<0.01$

D. Locative Preposition "THROUGH"

Groups	Erroneous Responses: ON	IN	OVER	NEXT	TOTAL
Greek	5	46	1	2	54
English	4	26	10	7	47

$x2 = 15.397$, $df = 3$, $p<0.01$

Note: The individual scores for the age levels were pooled together for each nationality.

The chi square and the significance levels are given in the above Table 11.2. In summary, it was found that there was a significant difference in error types between the two nationalities for all four prepositions.

11.6.3 Statistical Result Summary

1. Analysis of variance showed that the overall data for the English and the Greek groups were not significantly different from each other. This result fits a universality of spatial concept and language acquisition theory.

2. Analysis of variance also revealed no significant difference between the younger and older age subject groups. This is contrary to developmental theory and was investigated further.

3. Chi square showed quite clearly that different types of errors were made by each linguistic group for each locative preposition. This fits the supposition that language-specific properties were responsible for specific variations in acquisition rate.

In order to understand the results of this experiment better, it was necessary to make a descriptive analysis of the data.

11.7 Descriptive Analysis of the Data

In Figure 11:3, the total number of correct responses which each language group made for each of the four locatives tested is shown.

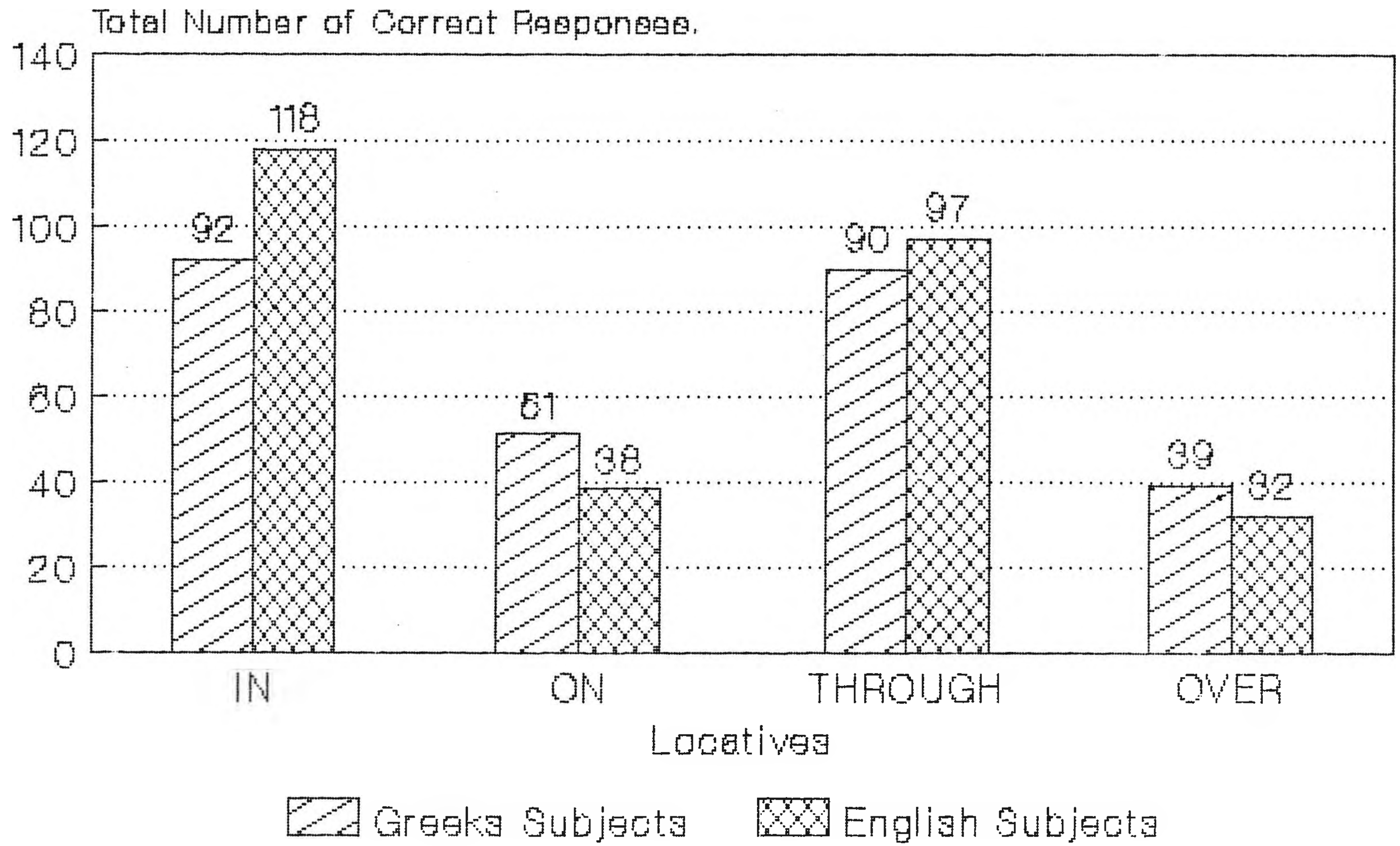
According to data from other sources, the developmental sequence of acquisition for these four locatives is:

"in" and "on" before "through" and "over"

Most researchers agree that by the age of three, most young children have acquired a good understanding of the locatives "on" and "in". The locatives "through" and "over" are acquired much later, at about the age of five.

The test design for this experiment precluded any pragmatic factors influencing the children in their responses. It was seen in the results from the previous experiments in this study, that semantic congruity and pragmatic factors influenced young children´s choice of locative placement considerably. In the present experiment, where the objects in question were abstract shapes, it was expected that the results would be "purer", in that they would not be contaminated by pragmatic factors. However, the task would be, for the same reason, more demanding in that the children would not be able to glean information from contextual cues.

Figure 11:3
The Total Number of Correct Responses*
for the Locatives: in, on, through, over



*out of a possible 144 correct responses
for each locative.

In Figure 11:3, it may be seen that the predicted pattern of acquisition was not confirmed. Both language groups, however, made a similar pattern of errors.

The pattern, in terms of fewest number of errors was instead:

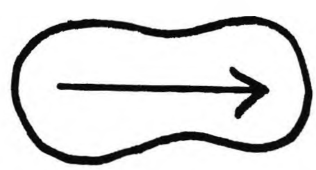
"in" and "through" before "on" and "over"

Furthermore, as can be seen, there was a considerable difference, in number of errors, between the former and latter prepositions. This was true for both language groups.

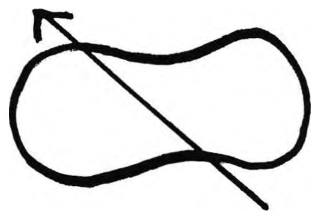
11.7.1 Error Types For the Locative "IN"

On the whole, children from both language groups made less errors for this category than for the others. The English group made less errors (26 out of a possible 144) than the Greek group (who made 52 errors). This was a significant difference, as seen earlier.

The locative preposition "in" in English ("mesa sto" in Greek) had to be mapped onto the following spatial perceptual representation in the test:



As may be seen in Table 11:3 following, the errors for both language groups consisted of mistaking this spatial representation and mapping it onto the one which represented the locative "through":

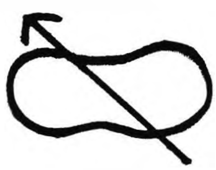
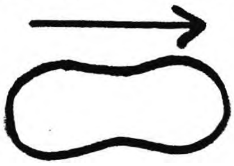
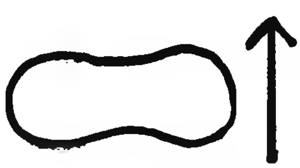


This may be due to the perceptually salient characteristics of diagonal lines, segments of which were indeed "in" the shape. However, how can it be explained that the Greek-speaking group made this mistake so much more often than the English group? Could it be due to a confusion with the locative preposition for "through", which is "mesa apo" and which has a shared linguistic feature with the locative preposition for "in", which is "mesa sto"? Such an explanation seems most likely.

Another interesting fact emerges when the results for each language group for the locative "in" are divided according to age level (Table 11:3). Here it may be seen that the Greek subjects were making an almost equal number of errors at both age levels, but, in contrast, the English group, were making the bulk of their errors at the younger age. The older English children were making minimal errors for the spatial locative "in".

TABLE 11:3 Error Types for the Locative Preposition "IN", according to Language Group and Age Level.

Display of
"IN" ("MESA STO")

	3;0-3;11 years		4;0-4;11 years	
Errors	Greek	English	Greek	English
"ON" ("PANO STO") 	0	1	1	0
"THROUGH" ("MESA APO") 	28	15	23	3
"OVER" ("PANO APO") 	0	4	0	0
"NEXT TO" ("DIPLA") 	0	2	0	1
TOTAL NO.ERRORS	28	22	24	4

11.7.2 Error Types for the Locative "THROUGH"

For this locative term, the overall number of errors for each language group was similar, that is, the English group made a total of 47 errors and the Greek group made a total of 54 errors. However, the pattern of errors made by each group was significantly different (see Table 11:2 above).

It is again interesting to note in Table 11:4 below, that 46 of the Greek subjects' 54 errors consisted of a confusion between "mesa sto" ("in") and "mesa apo" ("through"). In other words, what is apparent is a converse of what was observed in the error types for the locative "in" (see Table 11:3 above). This time, instead of pointing as instructed to "mesa apo" ("through"), they pointed instead to "mesa sto" ("in").

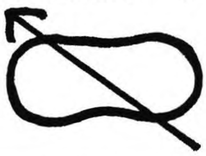
This seems to corroborate the hypothesis of a language-specific confusion, because the same pattern is not apparent in the English-speaking group. They, too, made a considerable number of errors with "through", pointing to the configuration, which designated the locative "in" (26 errors out of a total of 47 were of this type), but they also made frequent other types of errors.

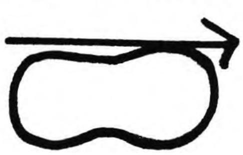
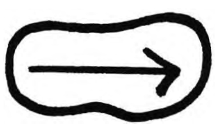
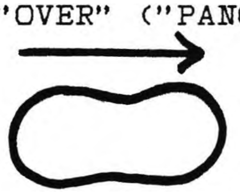
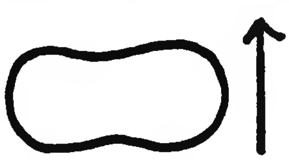
In Table 11:4, the data for the locative "through" is tabulated, according to language groups and by age levels. This shows that almost consistently, Greek children at both age levels are likely to point to the spatial configuration for "mesa sto" ("in") instead of that for "mesa apo" ("through"). This confusion does not appear to have resolved itself even for the older children, whereas the English group were making fewer errors at the older age level. If anything, the errors for this locative made by the Greek childen appear to increase with age. Could it be that a clearer conception of the spatial category "through", which the older age group has on a conceptual level, causes more confusion when this must be mapped onto an ambiguous language system?

The English groups´ error types were more varied, although they too more often substitute the locative "in" for the "through". This may, as has already been pointed out, have been due to a spatial configurational confusion. However, this is not a purely perceptual type of error, but also includes a conceptual confusion. In other words, both refer to the spatial category, earlier defined as "in-ness". This may cause some uncertainty at some developmental stage of locative acquisition.

TABLE 11:4 Error Types for the Locative Preposition "THROUGH", according to Language Group and Age Level.

Display for "THROUGH" ("MESA APO")



Errors	3;0-3;11 years Greek	3;0-3;11 years English	4;0-4;11 years Greek	4;0-4;11 years English
"ON" ("PANO STO") 	1	2	4	2
"IN" ("MESA STO") 	20	15	26	11
"OVER" ("PANO APO") 	0	7	1	3
"NEXT TO" ("DIPLA") 	1	4	1	3
TOTAL NO. ERRORS	22	28	32	19

11.7.3 Error Types for the Locative "ON"

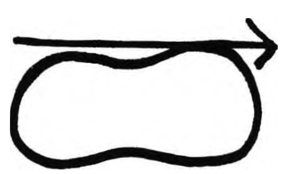
Referring back yet again to Table 11:2, we see that the locative preposition "on" provoked a considerable number of errors in both language groups, that is, 93 errors out of a possible 144 were made by the Greek-speaking group and 106 errors were made by the English group, again out of a possible 144. Also, no improvement was seen from the younger to the older age level in either language group (Table 11:5 below).

This, of course, does not mean that these subjects did not understand the semantic category of "on"; it merely means that when comparing this locative term with the spatial configurations presented to them to choose from, the subjects could not consistently map the locative onto one of the configurations.

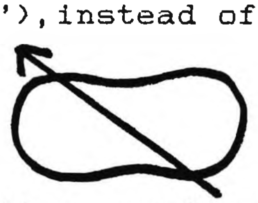
The configuration for "on" attracted 35% of the Greek group's responses and 27% of the English group's, when asked to point to the arrow, which was "on" the shape. Below are the percentages of responses attracted by each spatial configuration, for this locative term. It must be noted that only those responses that were for the configuration "on" were considered correct, the rest were considered incorrect.

Group	Spatial Configurations				
	ON (correct)	THROUGH (error)	OVER (error)	IN (error)	NEXT (error)
Greek	35%	31%	20%	12%	1%
English	27%	30%	6%	35%	3%

To explain this better, when the experimenter asked the subjects to show her the arrow which was <u>on</u> the shape, only 35% of the Greek children´s responses were for the experimenter´s version of "on", which was also the Greek adult´s version:



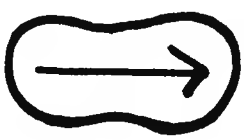
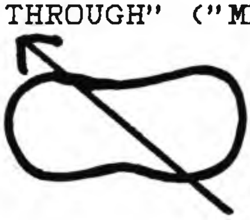
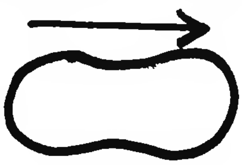
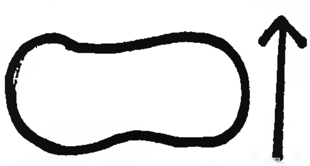
It was, however, their first choice. The next most popular choice made by the Greek children was the spatial configuration for "through" ("mesa apo"), instead of "on":



Moreover, this latter preference seemed to increase with increasing age. This may be seen quite clearly in Table 11:5, where the younger Greek children responded incorrectly to "on" by showing the configuration "through" in 18 of their 48 incorrect

TABLE 11:5 Error Types for the Locative Preposition "ON", according to Language Group and Age Level.

Display for "ON" ("PANO STO")

Errors	3;0-3;11 years		4;0-4;11 years	
	Greek	English	Greek	English
"IN" ("MESA STO") 	12	24	5	26
"THROUGH" ("MESA APO") 	18	25	27	18
"OVER" ("PANO APO") 	17	5	12	4
"NEXT TO" ("DIPLA") 	1	2	1	2
TOTAL NO. ERRORS	48	56	45	50

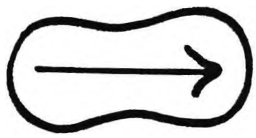
responses. At the older age level, they showed the configuration for "through" in 27 of their 45 incorrect responses.

The English children also made a considerable number of errors of this type, in other words, they showed the configuration for "through" instead of that for "on".

The second most popular choice made by the Greek children, when making an incorrect response for the preposition "on" ("pano sto"), was to show the configuration for "over" ("pano apo" in Greek). The younger children made 17, out of 48 errors of this type, and the older children made, 12 errors out of 45 total errors for this locative, which were of this type. In contrast, the English children at both age levels made very few errors of this type. In other words, they did not on the whole match the spatial configuration for "over" with the linguistic term "on".

The most popular incorrect choice to represent the locative "on", which was made by the English group, was that configuration which represented the locative "in". Almost half of both of the English groups´ responses were of this type (50 out of 106 incorrect responses).

The fascinating question, which arises at this point, is why did the two language groups show such considerable differences in their incorrect choices for this locative preposition? It appears, furthermore, to be a difference in the two language groups, which is not merely at a linguistic level, but which has repercussions on a perceptual level, as well. Many of the English children seemed to think that the spatial configuration for "in", represented the locative term "on":



Could it be that this was a perceptual difference in the two cultures? In other words, were the English children inclined to see the configuration as having a "top" (when seen aerially, that is), on which something like an arrow could be placed? Whatever the reason, we can merely speculate at this point and, of course, note the results, for future investigation.

On the other hand, it is likely that the Greek children's greater likelihood to match the spatial configuration for "over" with the spatial locative "on" has something to do with the possible confusion of these two terms in the Greek language. This seems probable, since the same is not apparent for the English group.

Finally, the fact that both of the language groups, when asked for "on", showed an attraction to the configuration for "through" (31% of the total responses made by the Greek group, 30% of the total responses made by the English group), may be due to the perceptual salience of an oblique line. This was also observed to occur for other locatives, for instance, for the locative "in", and the locative "over". It may also explain why the subjects made such a surprisingly few errors for the locative "through". This point will be returned to at a later stage.

11.7.4 Error Types for the Locative "OVER"

For this last locative term, there was again a significant difference between the children´s choices of the most representative models for this locative. However, both groups made a similar number of overall errors.

The following are the percentages of each language group´s responses to the locative "over", according to which spatial configuration was chosen to represent it:

Responses Chosen by the Subjects to Represent the Locative "OVER"

Groups	Spatial Configurations				
	OVER (Correct)	ON (error)	THROUGH (error)	IN (error)	NEXT TO (error)
Greek	27%	23%	41%	3%	6%
English	22%	16%	49%	9%	4%

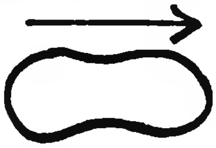
Thus, at first sight, it appears as if the spatial configuration for "through", was considered by both groups of children to be the most representative example of the locative preposition "over". However, let us not forget that at these age levels, it was not expected that the children would have a consistent knowledge of this preposition. The older normal children may be expected to be on the threshold of acquiring knowledge of this semantic category, though not as yet systematically (Table 11:6 below).

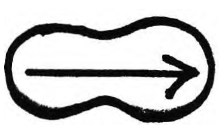
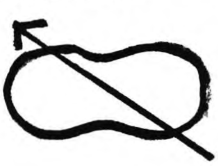
This probably explains why the children of both language groups selected the configuration for "through" as their first choice for the locative term "over": the diagonal line seems to have been the perceptually most salient of all the configurations.

In Table 11:6, another question arises: why did the English children choose the configuration for "through", for "over", more often as they grew older? We believe that the answer probably lies in the fact that the instruction requested the children to "show an arrow passing over the shape". The configuration for "through" certainly connotes movement, more so than the configuration for "over". Furthermore, if the English children had adopted a different viewpoint, that is, an aerial one, as had been suggested above for the locative "on", this would have been the natural choice to make for "over". Thus, this may be the reason why the English children appear to be making more errors

TABLE 11:6 Error Types for the Locative Preposition "OVER", according to Language Group and Age Level.

Display for
"OVER" ("PANO APO")



Errors	3;0-3;11 years		4;0-4;11 years	
	Greek	English	Greek	English
"ON" ("PANO STO") 	17	12	16	11
"IN" ("MESA STO") 	1	6	3	7
"THROUGH" ("MESA APO") 	31	27	28	43
"NEXT" ("DIPLA") 	6	4	3	2
TOTAL NO.ERRORS	55	49	50	63

of this type at the older age level than at the younger one.

On the other hand, it will be noted in Table 11:6 that the Greek children were making more errors of the "over" to "on" locative. This confusion arose probably for reasons which were language-specific (that is, "pano apo" was confused with "pano sto").

11.8 Discussion

This experiment has revealed some interesting results and also opens the way for more research in this fascinating aspect of cross-linguistic research.

First of all, in answer to the question whether children from different linguistic backgrounds master the semantic field of locative terms at the same rate, despite language-specific differences, the evidence from the results of this experiment is affirmative. This is shown by the fact that the Greek and English subject groups made similar numbers of errors in this task.

Secondly, in answer to the question whether there are language-specific differences, which may cause a different pattern of locative acquisition from one language group to the other, the data appears to confirm this supposition as well.

Finally, it had been supposed that an overall improvement in the performance of the task would have been noted from one age level (3;0-3;11 years) to the other (4;0-4;11 years). This, however, was not borne out by the data.

How can these superficially conflicting findings be reconciled?

To begin with, this experiment tested the subjects on their locative acquisition in a medium with which they were probably unfamiliar, that is, abstract drawings. Young children´s experiences consist of real objects in the real world, so knowledge is first applied to this real world. It is therefore quite reasonable to expect that a new medium, such as abstract drawings, would result in quite diverse results. It was not assumed that the child would automatically be able to transfer his real-world knowledge of locatives to this abstract task. However, it was proved by the data that the children successfully transferred some of this knowledge some of the time, and there was a certain amount of consistency among the experimental groups in the patterns, which were beginning to be formed.

Various factors are involved in children´s learning of locative terms, in particular in this study, three variables were observed, which were the chief causes for the subjects´ errors:

1. perceptual salience, such as diagonality.
2. perceptual ambiguity, which consisted of three-

dimensional instead of two-dimensional interpretation.

3. linguistic ambiguity, for example in Greek, "mesa apo" (through)/"mesa sto" (in) confusion.

11.8.1 Perceptual salience

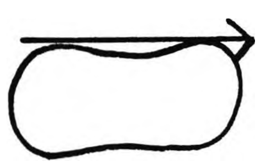
Many investigators have reported the phenomenon of the perceptual salience of diagonality (Bryant, 1974; Olson and Bialystok, 1983). It is, therefore, our belief that this phenomenon was also the reason why so many children responded by selecting the spatial configuration for "through" inappropriately. In fact, the "through" configuration was the most common wrong response for all of the locative prepositions.

It also accounts for the fact that, although quite an advanced concept, "through" produced such relatively few errors itself. (see Table 11:4). We conclude, therefore, that these results are not representative of these children's semantic knowledge of this term, but to the characteristics of the perceptual display which was used here. Thus, the task design must, unfortunately, be blamed for this confounding data.

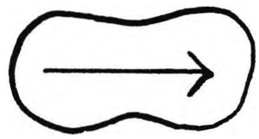
11.8.2 Perceptual Ambiguity

It had been suggested that slight variations would be expected between the two group's mapping of the locative terms onto the spatial models provided and that this would be due to cross-linguistic differences. It appears, however, that the fact that the task was designed, and controlled for, by a Greek population sample, accounted for a very specific difference between the English and the Greek subjects, in their different interpretations of locatives on a perceptual rather than on a linguistic basis.

When the drawings were shown to ten Greek-speaking adults, they reached an 100% consensus that, for this population at least, they were fair examples of the locative terms, which were to be tested. However, it appears that the models being used here did not represent identical prototypes of the locatives for the English sample. For instance, let us look at the evidence for the locative "on" (Table 11:5). Many more English children, than Greek children, were responding to the locative preposition "on", whose spatial configuration was:



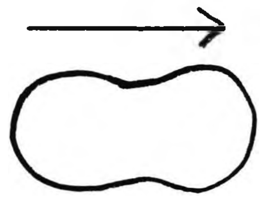
as if it was represented by the spatial configuration for "in":



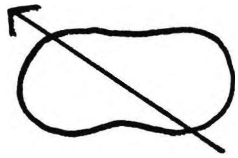
This leads us to conclude that, at least for "on", the English subject group were partly responding as if the abstract shape was being seen from an aerial viewpoint. This phenomenon has been observed by other investigators, which they suggest may be due to an attempt to make some sense of this unfamiliar abstract medium by putting some three-dimensionality into it, and may reflect the children's not yet completely acquired distinction between static and dynamic, as suggested by Grimm (1975) or, more simply, due to phonetic similarity (Grieve and Hoogenraad, 1978).

The next questions, of course, are: do these subjects behave in this way for other locatives as well? How generalized is this tendency and how consistent?

First of all, with regard to the confusion between "on" and "in" as a confusion between static and dynamic, or two-dimensionality and three-dimensionality, it must be said that though this phenomenon was often noted with respect to the locative "on", it was again noted, though not quite so frequently for the spatial locative "over", which was represented by the following spatial configuration:

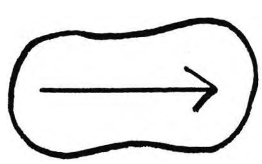


Here, in the older age group of English children, where one would be expecting a greater success at this semantic category, an increase in errors is noted, by substituting the configuration for "through":



Obviously, there was some confusion with the perceptually salient characteristics of the above configuration. However, one is again left with a difference between the Greek and the English responses in this respect. Thus it seems that, yet again, the confusion or ambiguity is perceptual, and not linguistic, and that "over" may be perceived as a moving line with an aerial aspect over the shape by the older English children.

This pattern of results observed for both the "on" and the "over" locatives in English children was not observed in the other two locatives tested: "in" and "through". For "in", the older age group of English children made considerably less errors than the Greek children, most probably due to the Greek language´s ambiguity with regard to this locative term. However, the English children´s results are rather bizarre in that the configuration representing the locative "in":



was often taken by the English children as representing the locative "on". It is considered likely, however, that young children are quite capable of interpreting the same pattern as one thing at one point and as another on another occassion (Herskovits, 1986).

Where could this cross-cultural difference in perception, specifically in the interpretation of abstract drawings, be stemming from? Perhaps, in a difference in educational experience or in a difference in exposure to visual materials? Whatever the reasons, it is only possible to speculate at this point and to hope for further elucidation on this matter through further research.

11.8.3 Linguistic Ambiguity

Our last consideration is the problem, which we had set out to test initially. Does differential linguistic complexity lead to ambiguity, when young children are learning their native language and could such a linguistic ambiguity lead to a developmental lag in the acquisition of some locative terms? It seems that an affirmative to the first question does not necessarily lead to an affirmative in the second.

This experiment produced sufficient evidence that the Greek children were often confusing two linguistically similar terms. Although these terms belonged to the same "conceptual" family, it was noted that the English children did not make such a conceptual confusion as often as the Greek subjects. In Table 11.7 below, we present the relationship between the spatial concept and the semantic terms in both Greek and English.

TABLE 11.7 The Spatial Concepts with their Relative Sematic Terms in both Greek and English.

Concept	Semantic Terms
A. "in-ness"	1. in (English)
	mesa sto (Greek)
	2. through (English)
	mesa apo (Greek)
B. "on-ness"	1. on (English)
	pano sto (Greek)
	2. over (English)
	pano apo (Greek)

It is obvious from the above tabulation of the terms used, that the English linguistic terms are quite different one from the other, although they may belong to the same conceptual family, that is, "on-ness" or "in-ness". The Greek terms, on the other hand, are similar and led to some confusion amongst those in the same conceptual family. This may be seen clearly in Tables 11:3, 11:4 and 11:5. Confusion was less marked, though to some degree still apparent, between "over" and "on" (Table 11:6).

Language-specific characteristics were, therefore, obviously responsible for some of the discrepancies between the English and the Greek group results. It was concluded that the linguistically similar terms for the spatial concepts resulted in linguistic ambiguity, which for Greek children of these ages led to some confusion in this task.

For the "over" to "on" ambiguity, seen in Table 11:6, it is possible to blame the English language as well (Washington and Naremore, 1978; Miller and Johnson-Laird, 1976). A not uncommon use of "over" in the English language is, in fact, "on", for instance, in the following sentence:

"Throw the coat over you"

This may have been the reason why the English children also made some more errors with regard to these locatives, though these were less frequent than those of the Greek groups.

Thus, in conclusion, every language has its specific complexities and ambiguities, leading to specific confusions for the language-learner of that particular language. This may be one contributing cause for the apparent "ups and downs" in developmental patterns. It may also cause a specific delay in generalizing the comprehension of a specific spatial term in one language as opposed to another. But, in spite of this, overall rate of locative acquisition appears to be the same, at least with respect to Greek and English children, even taking into account the individual language´s specific ambiguities.

CHAPTER 12
A Final Word

The experiments, which were conducted in this study, were all designed to test some aspect of spatial cognition, with regard to the acquisition of locative terms by young children. Spatial cognition, as we have already noted, concerns man´s knowledge about space and has traditionally been thought of as a non-linguistic function. Locative terms, on the other hand, are the linguistic forms used to talk about space. The locative terms must be matched onto both our perception of the "real" world, and our mental representations of the "real" world. Thus, a triangle is formed, which must be reconciled, between the "real" world, our cognitions and perceptions of this "real" world, and our linguistic expression of these two. For, what we express through the locative terms used by our respective languages is a combination of our culture´s historical view of space and our tendency as humans to form symbolic representations of space according to different personal, biological and environmental criteria.

These experiments, therefore, attempted to investigate at least two of these criteria, which lead to quite different directions concerning spatial cognition and the acquisition of locative terms. These consist of, first of all, the biological prerequisites necessary for the development of spatial cognition and, secondly, the unique properties of specific languages, which may influence or be influenced by the development of spatial cognition in the young language learner of a particular language.

Thus, two distinct lines of investigation were followed: the first involved the cross-linguistic comparison between two distinct groups of language learners, English- and Greek-speaking, in both their spatial cognitive development and their acquisition of the specific locative terms of their respective languages. The second involved the aspect of "biological" criteria in the development of spatial cognition and the acquisition of locative terms: this was investigated by testing groups of mentally handicapped and language handicapped children in these same tasks.

This methodological format gave us information, which was often complex and conflicting. Yet, these findings were able to contribute more global insights to our questions, since it was seen that they were in fact complementary aspects of the same issue.

In this final chapter, we will attempt to show the main line of this investigation in its complementary, rather than its conflicting aspect. How can the results of these experiments be reconciled?

First of all, we must remind ourselves that between the ages of two and five years of age, children are at the most demanding and also the most dynamic and creative stages of language acquisition. It is a period of semantic and syntactic rule extraction and rule generation, which often leads to a considerable amount of trial and error on the part of the young language learner. At this stage, too, the child is in the process of learning most of the locative terms, which he will need to describe and to understand how and where objects and people are located in space. Later, the foundations of this "locative" system will serve him in his ability for abstract logical thinking, but at the moment it is important to be able to manipulate and move around successfully in the "real" world.

It may appear obvious, at this point, to say that this preoccupation with locative terms, is just a part of man's conceptual development: in other words, it is not an independent system, but grows directly out of man's need to explicate or to communicate that which he is aware of. The child's learning at this phase is directly connected with the way he views the universe, that is, as a biped, who moves and manipulates objects, with specific sensory, visual, auditory and tactile capabilities, and with specific aims and objectives. This child is an active participator in his environment: he is able to change the positions of objects and people, he is able to make new spatial arrangements. Yet, there are two vital reasons, why there are certain constraints to his movements. One reason has to do with the physical properties of the "real" world and matter: gravity the intransience of objects, etc. The other reason is much more difficult to define and has to do with man´s tendency to view the universe canonically, according to congruency principles. In this way he is able to categorize and classify and to make "sense" of things, which otherwise would take him a much longer time to learn, in that he would have to have an infinite number of direct experiences, if he were not able to assign it to some recognizable category.

The learning of locative terms uses classificatory information as well as knowledge of congruity, or pragmatic principles, in order to reach the consensus of their use by other speakers of the same language. The developmental sequence, in which the child learns these locative terms depends on both internal and external factors: his perceptual and cognitive abilities and the maturation of these abilities, and the specifics of the particular language which he must learn. The interplay of these factors leads to the gradual mapping of the locative terms onto the concepts.

In these experiments we chose to investigate these particularly active developmental phases of young children´s acquisition of locative terms. Between the ages of two and five, one could say that children are at a transitory stage where they are beginning to have some idea of the meaning of most locative terms, but are not yet consistently correct in their usage of them. The factors, which we described above, are activated unconsciouly to facilitate this task: thus, innate biological factors, combine with the conceptual functions, and with unique environmental and cultural factors, including the specific language to be learnt, to produce an inhabitant of this planet, who can communicate with his fellows in a common code.

Yet, it would be interesting to know the relative value of these factors, for in this way one could use information gained from the language development process to help remediate language breakdown. How does man learn to understand and communicate? Can anything be learnt by the investigation of the acquisition of locative terms by children from different linguistic backgrounds? Can we learn something about this process from the investigation of children with different cognitive and perceptual abilities, children who are considered "handicapped", because they have a different developmental pattern in these areas than other children?

Some tentative answers to these questions were brought up by these experiments, the significance of which will be discussed below. In order to do this, we will have to have recourse to the specific findings of the experiments conducted in this study.

First of all we will deal with the question of the influence of language or culture on conceptual development and on the acquisition of the specific locative terminology of each language. In Experiment I, where the task consisted of a non-linguistic spatial categorization task, we were not surprised to find that the children from two different linguistic backgrounds, Greek and English, showed no differences in their performance of the task. The developmental pattern was also identical within these two groups, at the different age levels.

In Experiment II, where general verbal instructions were added to the categorization task, a differentiation between the results of the two different language groups was, this time, observed. This difference was not seen in the overall performance or error rate of the the two groups, but specifically in their performance in the two conditions, depicting Abstract or Concrete spatial configurations. The fact that this differentiation was not seen between the two language groups, when the task was "non-linguistic" (Exp. I), seems to imply that there were now strong language-specific factors influencing the results of Experiment II. This was despite the fact that the instructions in this experiment were of a very general and non-specific nature. Yet, they were influential enough to cause the younger English children confusion in the Abstract condition (depicting shapes and dots), and conversely to facilitate the older English children´s performance significantly in the Concrete condition (depicting objects). Since the only parameter which changed between Experiments I and II was the instructions given to the subjects, it is suggested that these instructions were the cause of this discrepancy in the results.

Furthermore, it must be noted that this trend was not seen in any of the Greek-speaking groups, whether normal or handicapped. Could it, in fact, be that the "pragmatic" features in the English language were highlighted by the verbal instructions used for the English group, being a negative influence for the younger age group and a positive influence for the older age group? We have already made some suggestions why the "vocabulary" being used in these verbal instructions may have been the cause of these differences, but they are mere speculations. The debate is by no means resolved: the only observation worth noting at the moment is the significance of linguistic factors in the resolution of any task. This fact must be constantly kept in mind, not only in cross-linguistic research, but in any experimental task, which may involve the generalization of its findings.

In Experiment III, where the spatial locative was finally explicitly mentioned by the experimenter in the verbal instructions given to the subjects, there was no further differentiation between the two language groups: in fact, both groups, equally successfully, used the explicit verbal labelling of the spatial locatives in their respective languages, in order to improve their performance on this spatial categorization task. The performances of the two language groups were not significantly different, as may have been expected now that the task consisted of a specific linguistic element. However, the abrupt differentiation between the Abstract and Concrete conditions, which the general instructions of Experiment II caused in the English-speaking group's performance, was carried over into Experiment III, without causing any further differentiation. Thus, a difference between the two language groups was not seen, as expected, in their understanding of the spatial locatives per se, for reasons which were expounded in the hypotheses made for these experiments, but was observed to be due to some factors in the general verbal instructions of Experiment II.

With respect, therefore, to the cross-linguistic data in the first three experiments (I-III), we conclude that language-specific factors may influence children's performance, but that these factors may be non-specific rather than specific. Secondly, these factors may influence the perceptual-conceptual domain, for is it not true that the "pragmatic" factors, represented by the Concrete and Abstract in these experiments, are the linguistic expression of knowledge of the "real" world? If that is the case, we observed that the English children, for some reason which was due to the verbal instructions, differentiated their performance between the Abstract and Concrete conditions, something which was not observed in the normal group of Greek-speaking children.

Before turning to an analysis of the handicapped children's performance in Experiments I-III, we will close the evidence from the cross-linguistic data by looking at the results of Experiment VII, which was the only other experiment using subjects from the two language groups. The results of this last experiment highlighted the results of Experiments I-III and also brought up some new facts.

In Experiment VII, the spatial locatives tested were more complex than those in the first three experiments, including such complex notions as "through" and "over", as well as simpler ones such as "in" and "on". This design was followed because the Greek language, as described at length elsewhere, denotes these terms in such a way that they may be ambiguous to the young language learner. The English language, on the other hand, has quite a diverse vocabulary for these locative concepts, a fact which we hypothesized would make them simpler to acquire by the children of that language culture. The format through which the understanding of these locatives was tested was such that it precluded the use of any pragmatic cues being used by the child to add any information to his problem-solving: the spatial configurations were depicted in two-dimensional drawings of abstract shapes and arrows.

The astonishing fact brought to light by the results of this experiment was that, although there was not a significant difference between the overall error rate in this task of these two language groups, in all of the locatives tested, the Greek and English subject groups revealed a significant difference between themselves in their specific matching between the abstract spatial configuration depicted in the test material and the locative preposition, which the former was meant to represent.

We will not review again all the factors, which we assumed to be causing these differences, but will pick out the two, which seemed to be the most influential. For the Greek-speaking group, it appeared that, indeed, morphological complexity was causing a certain degree of confusion between the two "pairs" of locatives: "mesa sto"/"mesa apo" (in/through) and "pano sto"/"pano apo" (on/over). The English children, however, appeared to be viewing or "perceiving" the abstract configurations differently from their Greek peers, causing a difference in the perceptual matching of the configurations to their linguistic forms between the two groups. Yet again, we seemed to be witnessing the subtle way in which the interplay between language and perception works on conceptual development.

A possible answer to this would be if there was a common underlying mechanism, where all percepts are primarily coded in a modality-free abstract mode. This mechanism would be the primary encoding of experience of the "real world". The linguistic and visual functions could then dip into this deeper coding mechanism for information and help in their problem-solving tasks. The usefulness of the information given by this underlying mechanism or "common code" would depend on the efficiency of the coding which had previously taken place. Since this "common code" would also act as the interface between the linguistic and the visual modes, one can explain why different bits of information were being used to solve this task by the Greek or the English children, without this disrupting the overall developmental pattern. This implies that the interaction between the perceptual, cognitive and linguistic functions is very flexible and, in turn, less predictable. There appears to be a subtle mutual "borrowing" between the modalities according to the demands of the situation.

If we now turn to the evidence brought to light by the language handicapped and mentally handicapped groups in these experiments, we may see that they seem to corroborate the above hypothesis. In Experiment I, where the task was supposedly "non-linguistic", the mentally handicapped and the language handicapped groups behaved as if this task was in some way dependent on linguistic fuctions as well. For, both of the handicapped groups performed similarly to the normal groups, with which they were matched according to language level. It will be remembered with interest, that the language handicapped group had higher visual perception scores than all of the other groups, and conversely, the mentally handicapped group had lower visual perception scores than all of the other groups. Yet, a further confounding element to these results was that the two handicapped groups had a significant difference in this experiment between their results, indicating that perhaps, after all, perception did play some role in their performance. This pattern was continued in the other experiments. In Experiment III, for instance, the language handicapped group, although by definition "handicapped" linguistically, nevertheless performed significantly better than the two normal groups. In other words, they appeared to be most able to use the now explicit spatial locatives, and to match them onto the drawings of the spatial configurations, in order to most successfully complete the task. Paradoxically, in Experiments I and II, where the task was still primarily on a perceptual, non-linguistic basis, no significant differences were observed between the normal groups and the language handicapped group. This latter group, then, appeared to be functioning according to their language level, which was matched with that of the normal groups, since their visual perception level was much higher. Yet, astonishingly, their performance became significantly better than that of the normal groups only when the linguistic element in the task finally became explicit. This seems to imply that this group's higher perceptual abilities were only triggered off when the linguistic element matched the visual one. Would this only be possible if the "common code" or the modality-free abstract code used by both the visual and linguistic modalities was activated? It has been suggested that children with this type of disability are primarily impaired at a central cognitive level, which may influence both the understanding and expression of language. This means that they may have difficulty accessing the information which is available on a semantic, syntactic and pragmatic level, from a central type of coding system, which is neither visual nor linguistic, but leads to both types of information processing.

The mentally handicapped group, in contrast to the language handicapped group, had problems with the tasks in Experiments I-III, possibly due to their impaired ability to use perceptual or linguistic information, which meant that they were not facilitated by either the general verbal instructions of Experiment II, nor by the explicit ones of Experiment III. They were not able to reach that central level of processing, through which they would have been able to match the verbal input successfully to the depicted spatial configurations. Thus, their lower visual perception abilities did not allow their linguistic abilities to act positively, in order to solve the task. Both abilities together did not reach criterion level to further this group´s performance in the task.

The other two experiments in this series, Experiments V and VI, revealed one more aspect of spatial cognition, which was considered to be another determining factor in its development: that is, the role of the "real" world as a linguistic element in young children's understanding of spatial instructions. It has been noted by many investigators that not only young children, but also adults, often understand that which they **think** is being said to them, not what has actually been said to them. What they think has been said to them is usually seen to be determined by "reality" principles, that which we have named "semantic congruity". In our findings for Experiments V and VI, we observed that those instructions involving the placement of objects in semantically congruous positions were considerably easier for all children, whether normal, language or mentally handicapped. Other factors also were identified, however, which seemed to influence children's performance in these tasks, such as, the child's relationship and previous experience with the objects in question, his relationship with his interlocutor, his expectations from the task at hand and his general mood, as well as his actual understanding on a developmental level of the semantic and syntactic elements of the verbal input. The importance of the pragmatic, as well as the semantic and syntactic, elements necessary for language understanding were merely confirmed by the findings of these experiments. We were, however, surprised to note through all the experimental work in this investigation, a very distinctive trend shown by the mentally and language handicapped groups: this was their lesser ability to glean vital linguistic information from pragmatic factors. This trend was originally noticed in Experiments I-III, where it was seen that the handicapped groups performed significantly better in the Abstract condition, where there were no pragmatic cues for the task, than in the Concrete condition. This finding was reiterated through Experiments V and VI, where these subjects did not appear to be so hampered by "semantic congruity" or pragmatic factors, when performing the tasks. It has been suggested that language handicapped children, for example, have disrupted representational abilities, suggested by the poorer quality of their symbolic play. If this is a result of their inability to use pragmatic and semantic factors in symbolic functions, then according to our "common code" hypothesis, this could lead to generalized dysfunctions in conceptual growth patterns.

In conclusion, although this investigation has asked some of the fundamental questions concerning spatial cognition, they are questions which have been asked, using a slightly different format for several centuries. Despite our strenuous efforts, we have merely corroborated one hypothesis: to paraphrase Kant, nothing in the "real world" is perceptually given. Representational knowledge of space is formulated by each individual, according to many factors and criteria, using an extraordinary network of innate functions: the one common factor being that, miraculously, we are able, on the whole, to function and to communicate adequately amongst ourselves.

A P P E N D I X

TABLE 1

Instructions for the Abstract and Concrete Conditions in Exp. I
(Modern Greek Version)

ABSTRACT CONDITION

<u>Test trial:</u>

1. E:"Θα παίξουμε ένα παιχνίδι. Πρώτα θα σου δείξω εγώ, πως παίζεται και εσύ θα βλέπεις προσεκτικά. Μετά, θα παίξεις εσύ."

Translation:
1. E: " We're going to play a game. First, I' ll show you how we' ll play and you must watch very carefully. Then, you can do what i did."

2. E: " Κοίτα, σχήματα και μπαλίτσες! Τώρα, κοίτα αυτή τη κάρτα. Που να πηγαίνει; Α, ναι, πάει μ●αυτήν εδώ. Λοιπόν, θα τη βάλω εδώ πάνω."

Translation:
2. E: " Look, shapes and dots. Now, look at this card. I wonder where this goes? Oh, yes ! It goes with this one, so I' ll put it right here."

<u>Test Question</u>

E: " Που πάει αυτό; "

Translation: " Where does this go? "

CONCRETE CONDITION

<u>Test Trial</u>

First question is the same as in the Abstract Condition.

2. E: " Κοίτα αυτά τα ποτήρια και κουτάλια. Τώρα, κοίτα αυτή την κάρτα. Που να πηγαίνει; Α, ναι! Πάει μ● αυτήν εδώ. Λοιπόν, θα τη βάλω εδώ πάνω."

Translation:
2. E: " Now, look at this card. I wonder where this goes? Oh, yes! It goes with this one, so I'll put it on this pile."

Test Question is the same as in the Abstract Condition.

TABLE 2
Unplanned Comparisons between Subject Groups in Experiment I.
Newman-Keuls Test (Behrens-Fischer Approach).

Subject Groups

		Gk.Lang.Hand. N=19 Level 3	Gk.Norms. N=21 Level 2	Eng.Norms. N=23 Level 1	Gk.Ment.Hand. N=16 Level 4	
Means		8.66	10.52	10.89	11.97	
	3	-	2.21	2.51	4.08*	4
	2	-	-	0.52	2.37	3
	1	-	-	-	1.59	2
	4	-	-	-	-	1

* p=0.05

TABLE 3
Instructions for the Abstract and Concrete Conditions in Exp. II
(Modern Greek Version)

ABSTRACT CONDITION

Test Trial:

1. E: " Κοίτα που είναι αυτή η μπαλίτσα. Τώρα κοίτα αυτή τη μπαλίτσα... και τώρα αυτή εδώ."

Translation:
1. E: " Look at where this dot is! Now, look at that dot ... and now look at this last one."

2. E: " Κοίτα αυτή τη μπαλίτσα σ•αυτή τη κάρτα. Θα βάλω αυτήν τη κάρτα πάνω σ•αυτή εδώ, επειδή και οι δύο κάρτες έχουν μπαλίτσα στην ίδια θέση."

Translation:
2. E: " Look at the dot on this card. I'm going to put this card that I'm holding with this one here, because these two cards have got dots in the same place."

Test Question:

E: " Που πάει αυτό; "

Translation: " Where does this go? "

CONCRETE CONDITION

Test Trial:

1. E: " Κοίτα που είναι η γάτα. Είναι στην ίδια θέση μ•αυτό το κουτάλι. Ετσι, λοιπόν, θα τα βάλω μαζί. "

Translation:
E: " Look at where the cat is. It's in the same place as this spoon. So, I' m going to put the together."

TABLE 4
Unplanned Comparisons between Subject Groups in Experiment II.
Newman-Keuls Test (Behrens-Fischer Approach).

		Subject Groups				
		Gk.Lang.Hand. N=19 Level 3	Eng.Norms. N=23 Level 1	Gk.Norms. N=21 Level 2	Gk.Ment.Hand. N=16 Level 4	
Means		6.315	8.913	9.428	10.969	r
	3	-	2.97*	4.14*	6.64*	4
	1	-	-	0.58	2.44	3
	2	-	-	-	2.16	2
	4	-	-	-	-	1

* p=0.05

TABLE 5
Verbal Instructions for Abstract and Concrete Conditions in Exp. III
(Modern Greek Version)

ABSTRACT CONDITION

Test trial:

1. E: " Να ένα σχήμα με μια μπαλίτσα πάνω του. Να και ένα σχήμα με μια μπαλίτσα μέσα του. Αυτό, το σχήμα εδώ έχει μια μπαλίτσα από κάτω του. "

Translation:
1. E: " Here's a shape with a dot on it. Here's another shape with a dot in it. Now, this shape has a dot under it. "

2. E: " Σ' αυτή τη κάρτα, η μπαλίτσα είναι πάνω στο σχήμα. Είναι, λοιπόν, σαν αυτήν την κάρτα και θα τις βάλω μαζί. "

Translation:
2. E: " On this card, the dot is on the shape. So, it's like this card and they go together. "

Test Qustion:

E: " Που πάει αυτή η κάρτα; "

Translation: " Where does this card go? "

CONCRETE CONDITION

Test Trial:

1. E: " Κοίτα, εδώ το κουτάλι είναι μέσα στο ποτήρι, και εδώ το κουτάλι είναι κάτω απ' το ποτήρι. Εδώ το κουτάλι είναι πάνω στο ποτήρι."

Translation:
1. E: " Look, here the spoon is in the glass and here, the spoon is under the glass. Here, the spoon is on the glass. "

2. E: " Τώρα κοίτα αυτή τη γάτα. Είναι κάτω απ• το αυτοκίνητο. Σαν αυτό το κουτάλι ππου είναι κάτω απ•το ποτήρι. Λοιπόν, αυτές οι δύο κάρτες πάνε μαζί."

Translation:
2. E: " Now, look at this cat. It' s under the car. Just like this spoon, which is under the glass. So, these two cards go together."

TABLE 6

Unplanned Comparisons between Subject Groups in Experiment III.
Newman-Keuls Test (Behrens-Fischer Approach)

		Subject Groups				
		Gk.Lang.Hand. N=19 Level 3	Gk.Norms. N=21 Level 2	Eng.Norms. N=23 Level 1	Gk.Ment.Hand. N=16 Level 4	
Means		3.53	6.23	7.13	10.0	r
	3	-	3.80*	4.39*	9.80*	4
	2	-	-	1.11	5.16*	3
	1	-	-	-	3.45*	2
	4	-	-	-	-	1

* p=0.05

TABLE 7
Sequence of Taped Instructions (in Greek) for Experiment V

1. Βάλε τα παπούτσια κάτω απ' το κρεβάτι.
2. Βάλε το φόρεμα πάνω στη ντουλάπα.
3. Βάλε τη βάρκα ... γέφυρα.
4. Βάλε το τηλέφωνο κάτω απ•το τραπέζι.
5. Βάλε το φόρεμα ... ντουλάπα.
6. Βάλε τα παπούτσια πάνω στο κρεβάτι.
7. Βάλε το μωρό ... κούνια.
8. Βάλε το τραίνο πάνω στην ράγα.
9. Βάλε το μωρό κάτω απ• τη κούνια.
10. Βάλε τα παπούτσια ... κρεβάτι.
11. Βάλε την βάρκα πάνω στη γέφυρα.
12. Βάλε το μωρό μέσα στη κούνια.
13. Βάλε το τηλέφωνο ... τραπέζι.
14. Βάλε την βάρκα κάτω απ' τη γέφυρα.
15. Βάλε το τηλέφωνο πάνω στο τραπέζι.
16. Βάλε το φόρεμα κάτω απ' τη ράγα.
17. Βάλε το φόρεμα μέσα στη ντουλάπα.
18. Βάλε το τραίνο ... ράγα.

TABLE 8

Sequence of Taped Instructions (in Greek) for Experiment VII

Βάλε :

1. το μολύβι πάνω στο χαρτί
2. το φλυντζάνι πάνω στο πιάτο
3. την καρέκλα κάτω απ•το χαλί
4. το φλυντζάνι κάτω απ•το πιάτο
5. το τραπεζομάντηλο πάνω στο τραπέζι
6. τον δρόμο κάτω απ•το αυτοκίνητο
7. το καπάκι πάνω στη κατσαρόλα
8. τον δρόμο πάνω στο αυτοκίνητο
9. το χαρτί πάνω στο μολύβι
10. το τραπεζομάντηλο κάτω απ•το τραπέζι
11. το μολύβι κάτω απ•το χαρτί
12. το πιάτο πάνω στο φλυντζάνι
13. την κατσαρόλα κάτω απ•το καπάκι
14. το χαλί πάνω στη καρέκλα
15. την κατσαρόλα πάνω στο καπάκι
16. το τραπέζι πάνω στο τραπεζομάντηλο
17. το χαρτί κάτω απ•το μολύβι
18. το χαλί κάτω απ•τη καρέκλα
19. το αυτοκίνητο κάτω απ•τον δρόμο
20. την καρέκλα πάνω στο χαλί
21. το καπάκι κάτω απ•την κατσαρόλα
22. το πιάτο κάτω απ•το φλυντζάνι
23. το τραπέζι κάτω απ•το τραπεζομάντηλο
24. το αυτοκίνητο πάνω στο δρόμο

TABLE 9

Unplanned Comparisons between Conditions In Experiment VI.
Newman-Keuls Test (Behrens-Fischer approach).

	Conditions				
	Cond. 1	Cond. 2	Cond. 3	Cond. 4	
Means	6	24	30	33	r
1	-	18*	24*	27*	4
2	-	-	6	9	3
3	-	-	-	3	2
4	-	-	-	-	1

* p=0.05

TABLE 10
Instructions (In Greek) for Exp. VII

CARD 1:
E: " Κοίτα, σχήματα και βέλη. Δείξε μου μερικά βέλη. Μπράβο ! Τώρα, δείξε μου μερικά σχήματα. Μπράβο! "

Translation:
E: " Look at the shapes and arrows. Can you point to some arrows. Good! Now, show me some shapes. Good!"

CARD 2:
E: " Κοίτα, αυτά τα σχήματα. Ενα σχήμα έχει ένα βέλος πάνω του, άλλο έχει βέλος που περνάει μέσα απ•αυτό, άλλο έχει βέλος μέσα του ... "

Translation:
E: " Now, look at all these shapes. One shape has an arrow on it, another has an arrow passing through it, another has an arrow in it ... "

TEST QUESTIONS:

Δείξε μου το βέλος μέσα στο σχήμα.
Δείξε μου το βέλος πάνω στο σχήμα.
Δείξε μου το βέλος που περνάει μέσα απ•το σχήμα.
Δείξε μου το βέλος που περνάει πάνω απ•το σχήμα.

TRANSLATION:

Show me an arrow in the shape.
Show me the arrow on the shape.
Show me the arrow passing through_the shape.
Show me the arrow passing over the shape.

TABLE 11

Score Sheet for Experiment VII (English Version) FACSIMILE

Subject: S. P

Date of Birth: 2. 11. 83 Age: 4,7

Test Date: 7. 7. 88 Examiner: M.V.

School/Nursery: .... Nursery

Language: English monolingual

Peabody Picture Vocabulary Test, Raw Score: 47

M.A.: 4,8

Experimental Group Placement: English Age Level 2

Card	Spatial Concept	Response	Error Type	Correct
1	through	1 2 3 4 5		+
2	on	1 2 3 4 5	in	
3	over	1 2 3 4 5	through	
4	in	1 2 3 4 5		+
5	on	1 2 3 4 5	in	
6	through	1 2 3 4 5		
1	over	1 2 3 4 5	through	
2	in	1 2 3 4 5		+
3	through	1 2 3 4 5		+
4	on	1 2 3 4 5	in	
5	over	1 2 3 4 5	next	
6	in	1 2 3 4 5		+
1	in	1 2 3 4 5		+
2	over	1 2 3 4 5	through	
3	in	1 2 3 4 5		+
4	through	1 2 3 4 5		+
5	in	1 2 3 4 5		+
6	on	1 2 3 4 5	in	
1	on	1 2 3 4 5	in	
2	through	1 2 3 4 5		+
3	on	1 2 3 4 5	in	+
4	over	1 2 3 4 5	through	
5	through	1 2 3 4 5		+
6	over	1 2 3 4 5	through	
		TOTAL:	12	12

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