DISCOVERING INFANT LOGICS

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I hereby declare that this thesis is my own work, having been completed within the normal terms of reference and of supervision in the Faculty of Social Sciences, University of Edinburgh

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ABSTRACT

Adults have characterised infants as incompetent in action and cognition. An alternative interpretation which characterises infants as different rather than deficient is asserted. This alternative explanation is derived from an analysis using the formal categories of standard propositional logic. The analysis provides a structure within which all cognitive differences can be formally defined. The thesis suggests that formal characterisation is a necessity if progress is to be made from behavioural descriptions to cognitive explanations. The resultant interpretation is affirmed as an initial attempt towards a cognitive explanation of the mental world of the infant.

CONTENTS

CHAPTER 1

INTRODUCTION

1. METHODS The focus of psychology has always been the human being. The methods used to investigate this object of enquiry are myriad. Inferences have been made about human nature via the armchair, laboratory, society, ape, rat, crab and drug-induced state. The aetiology of these different inferences vary, but their purpose is uniform. Psychologists attempt to understand human nature by constructing systems of knowledge relevant to particular aspects of it, and this leads to a certain `reflective´ problem. Psychological accounts may explain how systems of knowledge relevant to perception, language, feelings, society, skills, identity, abnormality or indeed any aspect of humanity, originate and develop but these accounts must eventually account for themselves. Psychologists must then construct knowledge systems about systems of knowledge. The knowledge sought is often self-knowledge.

The systems of knowledge constructed by psychologists are said to be accepted or not depending on their parsimony; communicability; consistency; refutability; the final appeal always being to evidence rather than style. New theory assimilates old data while making predictions about `new´ data.

Some workers have suggested that psychology possesses few theories because of the unnecessarily rigorous criteria used in assessing theoretical adequacy.

> "What has happened, in fact, is that psychology has been asked to confront questions that are simply dismissed in the case of the natural sciences, where no one is much concerned with the fact that two samples might in principle be differently constructed, that theories are undetermined by evidence, and so on. This seems a strange state of affairs .....It is a fair rule of thumb that questions shall not be raised concerning the foundations of psychology if they cannot be answered in some measure at least in the case of physics. This reasonable principle has been drastically violated with the obvious consequences that nothing much comes of the discussion, even when confusions are eliminated." (Chomsky 1980)

Such criticisms, however telling in the abstract, are in practice misdirected. Psychologists have accepted that theories are underdetermined by evidence without generally being aware of the various formulations of `indeterminacy´. Descartes `Thesis of Indeterminacy´ is one of the most general and subsumes most others. For example, Quine´s `indeterminacy of translation´ thesis can be seen as the application of Descartes formulation to the linguistic domain. Descartes thesis is simply stated; no matter how much evidence is gathered, alternative interpretations must always be available. No one interpretation can ever be said to be unassailably correct or true. Descartes avoids heresy by including in his proof the point that the mind of the `great Artificer´ must always be opaque to the mind of man.

> "..so doubtless there is an infinity of different ways in which all things that we see could be formed by the great Artificer (without it being possible for the mind of man to be aware of which of these means he has chosen to employ)." (Descartes 1968, Descartes)

Acceptance of underdetermination rather than indeterminacy leads workers to the paradoxical conclusion that the proper task of psychology is data acquisition. The problem becomes not too many interpretations rather too much evidence. The diversity, complexity

and, most often, sheer bulk of `facts´ result in the judgement that no theory is adequate; indeed no theory could possibly assimilate the extant data.

For one hundred years, from James through Husserl to Fodor and Chomsky, doubts have been articulated about such a stance. These doubts are often rebutted by a curious inversion. Their undeniable power is ignored, apart from forcing an entry into faculty folk-lore, because the arguments are seen as eschatological and therefore irrelevant. When the revolution comes we may judge ourselves, but until then, any judgements are premature. This attitude has been variously defended; description precedes explanation; difficult questions may require unsatisfactory answers; psychology is a young science; theory not grounded in data remains armchair speculation; observation and experiment are the only starting points of the scientific method.

One may view these articulations as empirical or ostrich-like. What is clear is that in all the major areas of psychology (cognition, perception, developmental, social, language, abnormal, learning, skills) data exists without theory. The primacy of the data is accepted to the extent that data-acquisition is seen as an end in itself, as a worthwhile endeavour. Data is represented as facts obtained from reality and consistently available to all if the method of acquisition is identical. This representation of psychology as institutionally based, task-oriented and contextually bound may ironically be questioned because the appropriate studies have not been done. But few workers would deny that psychology is data-heavy. Psychology supports the weight of facts, figures, statistical analyses, situational descriptions and isolated experiments by transfer-

ring the burden back to the data. Data is granted primacy and autonomy. Further, where no theory exists, data stands as substitute. This view of the tasks of psychology is coherent and consistent with the belief that psychological theory is underdetermined by evidence.

Another view of the goals of psychology is compatible with the thesis of indeterminacy. This alternative view starts from the implications of indeterminacy. There is no such thing as an unambiguously correct interpretation and an inventory of the total contents of a thing would require an infinite process. Thus, there exists an infinite amount of data. Data collection can never be complete. Uncertainty about the status of the missing parts of the inventory means that all components must be allocated equal status. Summations or generalisations remain part of the inventory and are liable to incompleteness and uncertainty. Rational choice between part-inventories is misdirected because part-inventories cannot be in opposition. Interpretative fecundity changes the status of the data acquired. Ambiguity is accepted as necessary in all but formally constrained systems, but the data remains unambiguous. Data is represented as factual, existent, as a thing. Things are neither ambiguous nor unambiguous, they just are. Data is not an interpretation but something about which interpretations, inherently ambiguous, are made.

These two views are themselves only interpretations and are not in opposition. The status of theory in both cases is the same. The interpretation, theory or system of knowledge is seen as the end-point in the endeavour. It is in the construction of the theory that these two views differ.

The `underdetermined´ view assumes that most of the relevant data can be acquired; that unimportant data can be, somehow, excluded and that the data acquired will constrain or shape the possible interpretations until only a few, or ideally one, remain. This view delivers primacy and autonomy to data.

The `indeterminacy´ view accepts that all the data can never be acquired, that important data may not be illuminated and admits to different interpretations from any, even all, available data. This view asserts that data possesses no immanent guiding principles; may fit contradictory interpretations; has no scientific meaning outwith an interpretation and may be factual, because observed, but uninteresting.

The problem for both views is not one of data-acquisition, but one of choice. The investigators have chosen the strategy which will lead to construction of interesting knowledge systems, but what data is to be gathered remains unspecified. The underdetermined choice of interesting data is the result of a mix of historical accident, personal preference, intuition, formal necessity and practical considerations. The indeterminacy approach is extremely difficult to translate into practical action and construction. Very few analyses can be seen to have abandonned all value judgements with respect to data. Preferential treatment is inherent in both gathering and not-gathering.

The aim of this thesis is to show that when an `indetermininistic´ approach is applied, illuminating interpretations can be constructed. The phenomenon under analysis can be treated as theory-neutral. The choice of what data is to be gathered is dictated only by formal necessities. The explication of this shedding of very subtle preju-

dices is a preliminary to the construction of a value-free knowledge system. The domain for this application is cognitive development in infancy.

CHAPTER 2

DOMAIN

2.1. Research into the areas of development, cognition, infancy and the convergence of these areas, cognitive development in infancy, has been described as burgeoning, simply remarkable, mushrooming and of an ever increasing rate. The majority of this research is derived from only two theories, Behaviourism and Genetic Epistemology. These two theories have generated, often by dissent, the bulk of the research in this domain, but they remain the only systematic accounts of the cognitive development of the infant. They dominate the separate, but related attempts to account for the learning and development exhibited by the infant.

The theoretical content of behaviourism is deliberately minimal (operant, respondent, rate of response). Piaget's psychological, as opposed to his formal, theories are equally terse (assimilation, equilibration, accommodation). Their nomological content may be characterised as respond and equilibrate.

As a result of the recent research effort, the diversity and numbers of conditions and subjects has increased, but the structure of the various theories remains remarkably unaltered. The scope and depth of the research, and the criticism to which it has been subjected make this phenomenon of theoretical inertia very surprising.

It is apodictic that an increased research effort should produce a commensurate change in knowledge. If knowledge is regarded as theory, interpretation or knowledge-system and not description, then

the research effort in this domain has failed. An increase in research effort in the domain of cognitive development in infancy has resulted in few theoretical changes. Descriptions have multiplied; explanations have not.

2.2. Criticisms of these theories demonstrate the weakness of the investigative strategy. This invariably takes the form of producing experimental results which the particular theory cannot assimilate and has not predicted. Curiously, this provides support for the theory opposed. Piaget's work, in particular, has been reinforced by this cycle of misdirected opposition. To oppose, one needs an opposite not a vacuum. The bulk of research in this area is inadequate because alternative theories are not formulated and examined. Camus makes the point more lyrically. "The blasphemy is reverent since every blasphemy is ultimately participation in holiness." One must believe in two gods to oppose one. Thus a view which delivers primacy and autonomy to data and evidence rather than interpretations must act, albeit reluctantly, conservatively. The particular theory under analysis can never lose status because of the research effort; interpretations are never produced merely reinforced.

This implication of failure does not extend to the theories; their value is increased, but the problem for the worker engaged in theory-construction is to identify those aspects of the extant theories upon which a constructive contrast can be based. Once identified, these features can be analysed and productive reinterpretation can take place. This approach can only succeed if the investigator is explicit about the basic principles and assumptions accepted or rejected.

A basic assumption of this thesis is that a rational, coherent

explanation of the infants' cognitive development is possible. This assumption may not meet with universal approval. Entry into definitional debates can be avoided by noting that affirmation of the converse forces one to abandon the domain altogether. Acceptance of the assumption means that a story can be told; denial means that one cannot take psychology in the domain seriously.

Behaviourism and Genetic Epistemology probably owe their longevity to acceptance of this principle. Both provide serious explanations of cognitive development. Their theoretical structure is similar in three other important respects. They are both committed to a directional analysis of their subject; both accept a gap between theory proposed and empirical evidence; and inherent in each is the belief that the knowledge systems constructed must conform to formal rules.

2.3. Directionality Construction of schemas and learning of S-R chains are attempts to explain transitions in knowledge-systems. Analysis proceeds by a comparative procedure. The end point of the analysis - the rational adult - is kept in sight and the infant, at whatever stage, is modelled against the adult. This charting of the development of the infant with reference to a point of `maximum' development or `complete' learning is an explicit feature of both theories. The analysis is given direction and the direction is given a value.

> "It is clear that the model imputes a certain directionality, even a certain teleology, to ontogenetic development." (Flavell 1963)

> "Our problem is to explain how the transition is made from a lower level of knowledge to a level that is judged to be higher." (Piaget 1970b)

Directional or teleological analysis is essential to a complete explanation, but in isolation in this domain, it delivers a highly-charged value judgement which is necessarily pejorative. The cognitive history of the individual is written in identification of deficits, gaps or errors; learning and development is charted with respect to these errors.

The young infant is characterised as a poor survivor, immoral, vacant, unprogrammed, inadequate, egocentric, undifferentiated, illogical, elementary and incompetent. Piaget represents the psychic activity of the first few months of life as "simple, fixed, elementary, undifferentiated and chaotic." (Piaget 1955) The literature is replete with similar judgements.

> "When viewed through the eyes of a cognitive developmentalist, the child of five years or younger is remarkably inept." (Gelman 1978)

> "Genetic epistemology deals with both the formation and the meaning of knowledge - by what means does the human mind go from a state of less sufficient knowledge to a state of higher knowledge." (Piaget 1970a)

> "(The child) receives from (the Cooperation) the instruments necessary to extend the rational construction prepared during the first two years of life and to expand it into a system of logical relationships and adequate representations." (Piaget 1955)

The conclusions of this directional analysis are nearly always negative; the story of the infant is told in terms of failure not success. The established concepts of science (objects, space, time, causality, logic and numbers) are said to be beyond the cognitive grasp of the young infant.

The adult scientist is here displaying the egocentrism which is

judged pejoratively in the infant. The infant's conception of success and failure; adequacy and inadequacy; truth and falsehood may differ from the adult's so much as to render the above analysis inappropriate. The adult denies that other values or interpretations can exist. Analogously, one could judge pole-vaulters according to their singing ability. Neither judges nor pole-vaulters would be impressed.

Competence and incompetence are both valid objects of inquiry, but competence is the more revealing. Inquiry into incompetence may disguise a negative hypothesis but it cannot disguise the fact that analysis of the infant is directional. The cognitive structure of the infant may remain impenetrable to the adult until a causal analysis of the infant's competence is attempted.

2.4. Theory and Evidence. Most workers accept some form of the indeterminacy thesis. Theories are always going to deliver ambiguous predictions and one can never be certain about the status of undiscovered systems. The practical exigencies of working in a natural system means that this thesis must sometimes be ignored; the worker must act as if theories are underdetermined.

Similarly, the gap between empirical evidence and the predictions of the knowledge systems is accepted as a theoretical necessity, but often ignored through practical necessity. The empirical evidence may only adumbrate the theory, but the worker must act as if the evidence absolutely constrains the theory. The relationship between theory and evidence is ambiguous, uncertain and opaque, but practical science demands that it be unambiguous, certain and clear. These working assumptions are unavoidable, but they appear to generate two errors of judgement, one relevant to measurement, the other relevant

to the status of the evidence.

2.4.1. Measurement The questions: `How much learning?´: `How much development?´ have never been answered. It is an open secret among behaviourists that quantification is restricted to more and less. What is worse is that:-

> "Since the available measures are always measures of performance, these questions all involve the problems of transferring such measures into units appropriate to describe the degree of learning. At the present time, such units have not been developed. In fact, there is not even complete agreement as to exactly what constitutes a measurable response in the learning situation. For example, given the fact that with practice an organism can learn to respond rapidly, vigorously or persistently, is it appropriate to use speed, vigour and persistence as if they were quantitative reflections of the strength of some underlying process?" (Kimble 1961)

This candid statement accepts that the learning theorists do not know what to measure or how to measure. There is no base-line for learning apart from arbitrary or phenomenal limits imposed by the particular worker. In general, there is considerable agreement as to the phenomenal, developmental or macro measures (eg stages within the development of the object concept) and considerable disagreement as to the arbitrary, behavioural or micro measures (eg completion of the process of acquiring an instrumental response). But in both cases there is a danger that the measures will cease being regarded as measures of something and start being regarded as ends in themselves. Indeed, they can be treated as phenomena in their own right: for many behaviourists, learning is nothing more nor less than rate of response; for many Piagetians, development is nothing more nor less than temporal charting with regard to classic stage errors. But the process of reification is a manifest error if the underlying process or system of knowledge remains the overt object of inquiry. If the

system of knowledge retains its original status, then the measures remain measures and should not be treated otherwise.

2.4.2. Status If the research is directed towards the elucidation of the formal system underlying development, then the investigator seeks the best-fitting formal system, not the performance variables that operate on this system. There is general agreement that the status of any evidence is diminished because of performance variables.

> "Most theorists either assert or imply that the level of learning, itself, provides a hypothetical upper limit which performance would reflect directly under absolutely ideal conditions. Unfortunately, however, conditions never are completely optimal; and performance, therefore, always underestimates the level of learning to a degree which varies directly with the extent to which the training conditions depart from the ideal - it is very difficult to isolate the learning process and to study it alone in any given situation." (Kimble 1961)

Again the theorist must act as if the evidence acquired is more than an approximation to the knowledge system. An error of judgement occurs only if the investigative focus is transferred to the performance variables. The learning theorist or developmentalist may not know what or how to measure and must admit that any possible measures are approximations or indirect manifestations of the object of inquiry, but behaviour can deliver insights into the formal organisation of the mind. Unfortunately, psychology compiles an ever increasing list of performance variables which operate on behaviour and forgets that the formal system was the original research target.

> "Here stands an imposing system of logical propositions and their various transformations, elsewhere stands Piaget's body of empirical data on cognition at different genetic levels; and yet there is not the slightest attempt to effect any real liaison between them." (Flavell 1963)

Flavell's conclusion is revealing. The Theory - Evidence distinction, inherent throughout Piaget's work, is made explicit. But Flavell does not ask the more interesting question. If the empirical data on cognition is not relevant to a formal model, to what model is the data relevant? What theory is inferred from the assembled facts? If a psychological theory is necessarily informal, then a serious attempt to match the logical with the psychological will never succeed. The psychologist is reduced to collecting 'empirical' data with no theory in mind. This stance is coherent only if the psychologist accepts the descriptionist label and gives up the pretence of theory construction.

2.5. CONCLUSIONS Certain limitations are evident in learning and development research.

(1) Research has become fixed on two theories. Alternative theoretical constructions are rare.

(2) Inherent in a directional analysis based on incompetence are:

a) A fixation with adult values

b) Pejorative value-judgements

c) Negative hypotheses.

(3) The gap between theory and evidence generates two errors.

a) The instrumental means, the evidence or measures, may become a substitute for the terminal value, the system of knowledge.

b) The performance variables which operate on the evidence may become a substitute for the terminal value, the system of knowledge.

The worker who takes psychology seriously may not, however, be mislead. The first principle, seriousness, is not an abstract value. Being serious about the systems constructed means committing oneself to following formal rules rather than values created by other means whether historical, accidental or practical.

Being serious about the cognitive infant means explicating the formal rules relevant to the cognitive infant without regard to adult values or inflated evidence.

CHAPTER 3

THEORIES AND ASSUMPTIONS

3. The cognitive processes of the infant can be investigated by attempting to answer two questions.

a) What cognitive structure must the infant possess to exhibit observed behaviour?

b) What cognitive structure must the infant possess to allow development to later structures?

Theories can be compared and contrasted using their answers to these two questions.

3.1. Behaviourists claim that all observed behaviour and development can be satisfactorily explained by attributing to the infant the structure which allows a connection to be made between respondent and reinforcement or operant and reinforcement. The infant is said to possess the ability to make a connection between stimulus and response. Respondent reinforcement is seen in the infants response of sucking to the stimulus of the nipple. Operant reinforcement is seen in the infants response of crying to the stimulus of hunger.
Piagetians claim that all observed behaviour and development can be satisfactorily explained by attributing to the infant the capability for progressive evocation of conceptual structures through action. The conceptual structures, whose change constitutes development, emerge through the application of the functional invariant of

adaptation to extant organisations. The infant is said to possess the ability to make a connection between action and cognitive structure mediated by adaptation.

Both theories postulate an initial cognitive structure which is essentially impoverished compared to later structures. Both theories postulate an initial cognitive functioning restricted to a few, very general principles of application. Behaviourism states that function is a process best characterised by crude associationism; genetic epistemology states that function is a process best characterised by adaptation. Investigation proceeds by examination of the infant's progressive application of these principles. The interest moves from the function to its varied application in the world.

A serious attempt, dedicated to an alternative interpretation of the infant's cognitive processes, can only be made if the cognitive processes are open to investigation. The structure and function fixed by these two theories must be freed and the theoretical monoliths of reinforcement and equilibration given up. Only then can an alternative analysis proceed.

Assume that the infant is not a crude associator or a homeostat.

As an alternative, assume only that the infant can reason logically.

3.2. This alternative assumption implies that all observed behaviour and development can be satisfactorily explained by attributing to the infant the capability for logical thought. This imputation of infantile logic, until specified, will provide merely a translation of the answers already given by behaviourism and genetic epistemology. The specification of the logical processes must eventually differentiate this interpretation from any other. An interpretation

which is not thus distinguished cannot be said to make a valuable contribution to knowledge. By itself, a reformulation in terms of logical propositions, whether of stimulus and response or of schemas and actions is worthless.

Assume that the logical processes of the infant can be characterised by a specification of structure and function which distances this explanation from others. In terms of structure, differentiation can only be in one direction. A specification of the logic must produce an initial cognitive structure which is essentially rich compared to that proposed by preceding theories. A specification of the logic must produce an initial cognitive functioning restricted to logical rather than psychological, behavioural or dynamic principles. The logical principles proposed must operate on, or adumbrate, a structure different from those already proposed. The experimenter must ensure that a structural difference is generated and success, in this respect, is guaranteed if very specific logical principles are applied to the infant. Similarly, any comparison or contrastive may be clarified by consideration of the extreme conditions generated by the different components.

Treatment of the infant as "remarkably inept" will always produce a simple initial structure; treatment of the infant as remarkably adept will always produce a more complex initial structure. A genuine attempt at a reinterpretation of the psychic activity of the first few months of life must assume that the cognitive processes operating in these months are complex, differentiated and systematic. The best way of ensuring this is to assume that the infant has all the logical attributes displayed at all later levels of development. The level of logical development said to be most divergent from the

infant's level is that of the adult logician.

Assume that the logical infant is as adept as the logical adult. Then the laws and principles which characterise adult logic should also characterise infantile logic. Their application may change but their existence may not. Standard logic is a logic generated by the adult logician.

3.3. Classical logic is, as the name implies, generally accepted as a base from which other logics can be specified. There are three basic principles of classical logic which because of their fundamental nature have become know as the Laws of Logic.

a) The Law of Identity : If p then p.

b) The Law of Contradiction : Never [p and not-p].

c) The law of the Excluded Middle : Always [p or not-p].

These principles, can only be modelled in a two-value system, the two values being True(T) and False(F); no intermediate values are possible.

Thus:

From a) the Truth value of p is uniform in all its occurrences.

From b) p and not-p cannot both be true or both be false.

From c) since either p will be True or not-p will be True, it is always the case that the disjuction will be True.

If the infants logical structure can be characterised by classical logic then these principles and structure must also apply to the infant. But the behaviour of the infant has never been examined under the above assumptions.

3.4. Data acquisition has never been carried out for the basic questions generated by the above assumptions. Extant data has been produced with unspecified logical aims. The evinced object of inquiry, the formal system underlying behaviour, has been replaced by behaviour in a particular situation. Interest has been directed at the level of the behaviour, thus the categorisation of research interest by task. But these assumptions change the methodological alternatives.

The relationship between independent and dependent variables must be expressed propositionally and represented within a truth table using only the values True(T) and False(F). The truth table provides a convenient, exhaustive and value-free analysis of the formal structure of any situation and will eventually be used to define the logical structure of the infant.

Results must be relevant to the question of exhibited behaviour, no indirect speculations are allowed.

Results must be positive. Results must be relevant to competence not incompetence. Infant's observed competence will provide a base against which negative results, such as stage errors in object concept tasks, can be placed.

Results must be relevant to early logical structures.

Logical assumptions also change the interrogative alternatives.

3.5. Questions

1) Does the infant use a two-value system(True and False) ?

2) What is the infant's construction of negation?

3) Is the infant's logic synchronically fixed or flexible?

4) If flexible, is the logic reversible?

5) What is the import of propositional content?

6) What is the interaction between affirmation and negation at and between the different propositional categories?

   a) Behaviour

   b) External world

   c) Logical relationship between a) and b).

7) What characteristics of logic structure and function can be identified by asking:

   a) What conditions are optimal for learning(assimilation)?

   b) What conditions are optimal for development(accommodation)?

   c) Under what conditions does the infant find its own theories untenable(extinction)?

3.6. Conclusions Assumptions of differences between old and new theories lead to the following hypotheses:

a) The important learning and developmental mechanisms are in place from birth.

b) Logical structure and function can be characterised by classical logic.

c) This structure and function having been specified is open to investigation.

Data must be collected relevant to the questions raised in 3.5 The infant must be observed in a situation where behaviourism, genetic epistemology and logical representation can be applied.

Theoretical choice can then be made according to the accepted comparisons of parsimony, communicability, coherence and refutability.

The following experiment was used because it conforms to these demands. The experiment has been regarded as an operant learning situation. Behaviourism, by definition, makes specific predictions about the situation. Genetic epistemology makes specific predictions about the cognitive structure and function, particularly negation, used by the infant in such situations. Logical representation of the experiment is possible because logical representation of any independent-dependent variable design is possible.

CHAPTER 4

THE EXPERIMENT

4. The infant was observed in a simple learning situation. The basic components were a mobile, a photo-electric cell and the infant. Mobile movement was related to photo-electric cell activation. The photo-electric cell was placed so that activation was dependent on some specific limb movement of the infant. The infant was given the opportunity to determine that a connection existed between limb movement and mobile movement.

The independent variable was the causal connection between limb-movement and mobile movement. The dependent variables were the infant's pattern of limb-movement measured by number and type over time and affective reaction. Observations were made for both initial contingency conditions and changes from initial conditions.

The experimenter could infer whether the various subject reactions (perseveration, adaptation, extinction, denial) were consistent or inconsistent with the different interpretations.

4.1. Conditioning This type of experiment can be described as instrumental or free operant conditioning. There is no formal difference between pigeons pecking for food and infants moving for reward. In certain contingencies both creatures progressively increase specified behaviour. It does not matter, at this stage, that the nature of the reward for the infant is a mystery.

Thus, experimental results could be produced and analysed according

to accepted behavioural methods.

> "In choosing rate of responding as a basic datum and in recording this conveniently in a cumulative curve, we make important temporal aspects of behaviour visible." (Skinner 1956)

> "We may define learning as a change in probability of response, but we must also specify the conditions under which it comes about. To do this we must survey the independent variables of which probability of response is a function." (Skinner 1950)

Some independent variables so far surveyed include motivation; difficulty of response; environmental context and amount, delay and schedules of reinforcement.

These surveys or inventories enter the descriptivist category previously criticised. They deliver few insights into the nature of learning and their deliberate specificity combined with an infinite variety of possible context makes them endlessly uninteresting.

4.2. Contingency Analysis A more sophisticated analysis describes the experiment in terms of contingency detection. J.S. Watson in a series of papers points out the strengths of this approach. (Watson 1967, Watson 1972, Watson 1979, Watson 1984) Watson escapes from the barren descriptivism of radical behaviourism by basing his analysis on the infant's perception of control or contingency. This analysis differs from that of conditioning in several respects.

1) The infant's structuring of experience (rather than its behaviour) is seen as the focus of research.

2) The formal structure of contingencies, rather than the rate of response, provides the investigative impetus.

3) Non-behavioural contingencies are included within the analysis.

> "Perfect contingency would exist if R were a necessary and sufficient cause of S. Were that so, than every response would produce a stimulus ..... Now consider how this contingent relationship between R and S might be diminished. There are two ways. One is by having the stimulus fail to occur on some occasion when R has occurred. (Partial Reinforcement or Intermittent reward). The other way of reducing the contingency is by introducing the occurrence of the stimulus independent of the occurrence of the response. When this situation of reduced contingency is arranged, it is termed a condition of noncontingent or response-independent stimulation. Remarkably, these two ways of reducing the contingency of a stimulus on a response have received separate and very unequal attention in the experimental literature. There has been extensive study of intermittent, or partial, reinforcement particularly by Skinner and his colleagues. However, the second way of reducing a contingency, involving response-independent occurrence of the stimulus, has only recently received attention as an experimental variable in its own right." (Watson 1979)

4) Contingency Analysis assimilates a behaviouristic analysis; behaviouristic analysis cannot easily accommodate itself to contingency terms and findings, for example the role of response-independent reinforcement.

Watson´s work demonstrates that important aspects of information, previously ignored by investigators, are available to and are used by the infant in similar situations to the above experiment.

Watson´s analysis does display some enduring behaviouristic features. Much of his work can be interpreted as research on different schedules of reinforcement. The postulation of a new kind of reinforcement (non-contingent) makes certain that a probabilistic analysis must bifurcate. Thus the distinction between necessity probabilities, arrived at through analysis of non-contingent reinforcement, and sufficiency probabilities arrived at through analysis of partial reinforcement.

As for conditioning, the major preoccupation remains the temporal structuring of response and reinforcement. Analysis proceeds according to a temporal analysis of contingency relations.
Watson's analysis is clearly superior to an interpretation based on traditional conditioning views. But it is obvious that Watson does not succeed in telling the whole story. The approach needs to be expanded and neutralized by the application of a formal analysis to the phenomenon.

4.3. Formal Analysis Like contingency analysis, a formal approach focuses on the infant's experience within the experiment. Unlike contingency analysis, this approach is directed towards answering some of the questions raised in Chapter 3 and is constrained by the theoretical desiderata already outlined. The salient points of the formal analysis of the phenomenon are:-

1) The structure of the infant's logical experience (rather than behavioural experience) is the focus of investigation. Representation is logical not behavioural, psychological or mathematical. Non-logical terms (reinforcement; sufficiency; necessity; success; non-contingent) are avoided.

2) Few presuppositions are made about the infant's logic. Descriptions of 'perfect contingency' which can be reduced may be relevant to adult or later forms of logic, but their use here is unjustified. The infant may have a different idea of perfection. Any such labeling is seen as premature.

3) Logical structure is atemporal. Time is here just one of the many independent variables which may influence logical content.

Temporal analysis of contingency relations is empirically irrelevant to a formal approach.

4) Negation is clarified. Contingency analysis represents negation as success or failure thus:-

> "Apparently, if a subject, be he human infant or laboratory rat, fails to perceive a contingency between his behaviour and some recurrent stimulation, then his ability to perceive a contingency in later situations will be greatly impaired even if the stimulus is then perfectly contingent and seemingly obvious." (Watson 1979)

Formal analysis represents negation in terms of Truth and Falsehood, Logic Acquisition and Logic Justification. Contingency analysis has great difficulty in making the distinction between failure to perceive a contingency and success in perceiving a non-contingency. Watson above means the latter, but states the former. Something has been learnt because something successfully interferes with later learning. This and further distinctions are made explicit by a formal approach because:-

5) An exhaustive and value-free analysis of logical relations is possible:

Let proposition ´l´ be leg movement.

Let proposition ´m´ be mobile movement

´T´ means true and ´F´ means false

Then: l(T) means ´It is true that my leg moves´

l(F) means ´It is false that my leg moves´

m(T) means ´It is true that the mobile moves´

m(F) means ´It is false that the mobile moves´

Propositions ´l´ and ´m´ with their associated truth values are

elementary propositions. Their logical relationship can be defined using a logical proposition 'r'.

Let 'r' specify the logical relationship between 'l' and 'm'.

Thus; [l, m, r] means:- It is True that my leg moves
and the mobile moves

[l, m, not-r] means:- It is False that my leg moves and the mobile moves

[not-l, not-m, r] means:- It is True that my leg does not move and the mobile does not move.

etc.

These propositions define totally the formal structure of the phenomenon. The only information available to the infant must come from one or a combination of the defined logical relationships. There is no other information. There is no superfluous information. There is no preferred information. Formal analysis avoids the obvious choice [l, m, r];

'It is true that my leg moves and the mobile moves.'

to the mind numbing [not-l, not-m, not-r];

'It is false that my leg does not move and the mobile does not move.'

by giving them equal status in the investigation.

Table I (below) summarises all the information available to the infant.

TABLE I

	l	m	r
1.	T	T	T
2.	F	T	T
3.	T	F	T
4.	F	F	T
5.	T	T	F
6.	F	T	F
7.	T	F	F
8.	F	F	F

The formal approach is stronger than conditioning and contingency analysis because both emerge from it. This can be demonstrated by formal representation of the alternatives.

Conditioning starts from observed behaviour (l in Table I). Non-behaviour not-l is excluded from the analysis. Investigations are restricted to lines 1, 3, 5, 7 in Table I. Investigations are further restricted by the denial of a negative connection between l and m. There is either a (S R) connection or there is not. Alternatively stated; conditioning theory cannot differentiate between:

line 3 It is True that my leg moves and the mobile does not move.

and line 5 It is False that my leg moves and the mobile moves.

or

line 1 It is True that my leg moves and the mobile moves.

and line 7 It is False that my leg moves and the mobile does not move.

Conditioning Theory limits itself to lines 1 and 3 and designates them 100% reinforcement and Partial reinforcement respectively. All conditioning research has been directed at these two logical rela-

tions.

Contingency Analysis is explicitly interested in behaviour l and non-behaviour not-l. No lines are excluded from Table 1 under proposition 'l'. Likewise both mobile movement m and non-movement not-m are included in the analysis. No lines are excluded under proposition 'm'.

Like conditioning, Contingency analysis does not accept that non-connections can enter the analysis. Alternatively stated, Contingency Theory does not differentiate between:

line 3 and line 5

or

line 1, 6 and 7:-

line 1 It is True that my leg moves and the mobile moves.

and line 6 It is False that my leg does not move and the mobile moves.

and line 7 It is False that may leg moves and the mobile does not move.

Analysis is therefore limited to lines, 1, 2, 3, 4 and 8. Further restrictions result from a lack of concern for non-contingent not-l non-reinforcement not-m conditions. Lines 4 and 8 are excluded.

Contingency analysis limits itself to:-

	l	m	r	
1.	T	T	T	100% Reinforcement
2.	F	T	T	Non-Contingent Reinforcement
3.	T	F	T	Partial Reinforcement

There is no theoretical reason why the other contingencies (lines 4 -

8) could not be included within the contingency analysis. An exhaustive contingency theory is possible, but terminological difficulties quickly become apparent and make some sort of change essential.

	l	m	r	
4.	F	F	T	Non-Contingent Non-Reinforcement
5.	T	T	F	Non (Contingent Reinforcement)
6.	F	T	F	Non (Non-Contingent Reinforcement)
7.	T	F	F	Non (Contingent or Partial Non-Reinforcement)
8.	F	F	F	Non (Non-Contingent Non-Reinforcement)

Practical difficulties remain, but the advantages of the formal approach are apparent. Conditioning and Contingency Analysis exclude or fail to make distinct sources of information which the infant may use. Given that the epistemologist has no idea which learning categories or logical structure is infantile, any exclusions are premature. Results should be analysed with respect to behaviour and non-behaviour, stimulus occurrence and non-occurrence. So far this has not been done.

CHAPTER 5

EXPERIMENTAL ANALYSIS

5. The initial task at the logical level is clear. The epistemologist must deduce from subject reaction to experimental conditions, the minimum number of logical relations (lines 1-8, table I) used by the epistemic subject. This will define the limits of the logical structure of the infant. Once the limits of the logic are defined, the role of affirmation (T) and negation (F) at the various levels (l,m and r) may be investigated.

At this point, there is no divergence from conditioning or contingency analysis. All that is proposed is that the infant brings to the situation an ability to make some sort of connection between activity and external world. Interpretative divergence occurs as soon as the infant is presented as epistemic. As an active searcher for knowledge, the infant will scan the logical connections at his disposal and attempt to fill their propositional content. In this analysis, the important learning limitations emanate from the logic, not from what the world offers or motor development dictates.

5.1. Experimental Conditions Connection between mobile and photoelectric (PE) cell was made via a pre-programmed BBC micro-computer. The connection was defined by two number variables eg. (100,0).

The first variable defined the percentage time the mobile could be moved by PE cell activation. The second variable defined the percentage time the mobile was moving and could be stopped by PE cell

activation.

For example, in (100,0), the (100 -) means the mobile moves for every PE cell activation, the (-,0) means the mobile is static.

Observed state with no PE cell activation: Mobile static.

Observed state with continuous PE cell activation: mobile moving.

In (0,100), the (0,-) means the mobile never moves for any PE cell activation; the (-,100) means the mobile is moving and stops for every PE cell activation.

Observed state with no PE cell activation: mobile moving.

Observed state with continuous PE cell activation: mobile static.

Each variable could be varied between 0 and 100. The first variable (1st,2nd) was given precedence. Thus: In (100,10), the (100,-) means the mobile moves for every PE cell activation; the (-,10) means the mobile moves 10% of the total time given no PE cell activation.

Observed state with no PE cell activation: mobile moves 10% of the time.

Observed state with continuous PE cell activation: mobile moving.

Analysis was restricted to the following conditions:

EXPERIMENTAL DEFINITION	CONDITIONING DESCRIPTION
(100,0)	100% Reinforcement
(100,10)	Non-contingent Reinforcement
(0,0)	Extinction
(0,10)	Extinction
(0,50)	Partial Reinforcement/Extinction
(0,90)	Non-contingent Reinforcement
(0,100)	100% Reinforcement

Initially, the infant was exposed to one of the above conditions. Subsequently,a transfer from the initial condition to a different condition was made.

There may be no group or statistical base-line for measurement of

learning, but the transfer from one condition to another provided a crucial individual base-line through which the formal content of the knowledge constructed by the infant could be discovered. The experimenter can never say only this much has been learnt at any point; the transfer allows the experimenter to say that necessarily this much must have been learnt otherwise reaction to transfer would not be possible. Formally, reaction by change in rate or affect is much more interesting than lack of positive reaction. Inferences made from positive reactions have a higher status than inferences made from no overt behavioural change.

5.2. Experimental Environment A good enviroment for observing behavioural change was determined by trial and error in a number of pilot studies. The physical conditions were kept constant for all subjects. The important features of the experimental enviroment were:

1) Coloured back projection of mobile on screen

2) Distance from infants' eyes to screen - 30 inches

3) Placement of PE cell to ensure activation by full extension of either leg

4) Time between activation and mobile movement 0.25 seconds

5) Mobile movement time per activation - 2 seconds

5.3. Subjects The subjects were 25 infants aged between 13 weeks and 21 weeks. Subjects were restricted to two visits to facilitate balancing of conditions and decrease interference due to variable retention. Visits were arranged to be one week apart or as near to

this as possible.

The 25 infants provided a total of 47 visits. 5 of these were terminated with no data obtained.

5.4. Analysis of Results Three experimenter decisions exert an influence on the form of the learning curve. These directly effect representation of the curve before any interpretations are made.

1) CRITERIA FOR EXCLUSION/TERMINATION

For the infant, participation in the experiment involved separation from the parent, meeting strangers, a new and perhaps confusing environment, an impoverished visual field consisting of an illuminated mobile and being strapped in a strange chair in an upright position which made sleep difficult.

In spite of these difficulties, most infants were willing to spend some time visually examining the only salient feature of the enviroment, the mobile.

The problem for the experimenter is to decide which subjects should be excluded because of inattention to the mobile. Non-attention could be manifested as distress, finger chewing, parent-seeking, sleeping or, indeed, any behaviour such as chairfondling, bubble-blowing, vocalisation, motor-activity or inactivity.

Alternatively, all of these manifestations could be a result of the infant's interaction with mobile, with some infants habituating to the relationship and other infants failing to discover causal relationships and losing interest.

Experimental bias may be introduced by selective exclusion of subjects. Criteria for exclusion were therefore rigorous. Subjects were

excluded from the analysis only if they were very distressed (eyes shut, crying, very active), or had never looked at the screen throughout the experiment.

5 out of the 47 visits were excluded from the analysis using these criteria. Inclusion of infants more interested in chair-chewing or finger-sucking may make group trends much harder to discern, but the dangers of excluding subjects reacting to logical acquisitions are avoided. Positive individual results, the elimination of experimenter bias and minimal information loss compensate for submerged group results. Any positive group differences are enhanced using rigorous criteria.

2) CRITERIA FOR TRANSFER FROM CONDITION 1 to CONDITION 2

The theory behind the transfer is straight forward. Inferences can be made about the content and structure of the logic used by the infant by observing the infant's reaction to transfer in different conditions.

Interpretations made from differences to projected curves are only accurate if the projected curves are accurate. Thus the method is systematic only if the transfer is introduced at the same point for all subjects. Ideally, the experimenter should introduce the transfer where learning is complete, but before habituation has started. Practically, the experimenter has no way of knowing how much or how little the subject has learnt. The transfer will be introduced both before and after the learning curve reaches its maximum, introducing corresponding inaccuracies to projected differences.

Use of the transfer conditions appears to necessitate having the

answers to the very questions posed. What is learnt? When is it learnt? Thus the behaviourists use of extinction to investigate learning entails the utilisation of conditions already categorised as producing increments or decrements in learning. This may be a valid technique after base-line studies have produced categorical results. In the present situation, when there are no such results, this is unjustifiable. The experimenter has no idea what constitutes optimal or minimal learning conditions for the infants. In behavioristic terms, we do not know the difference between conditioning and extinction.

Behaviourists avoid the problem by denying it is a problem.

> "There is nothing gained in setting an arbitrary point at which conditioning shall be regarded as complete, for we are not interested in a qualitative statement of the sort. It is possible, moreover, that complete conditioning may only be approached as a limit". (Skinner 1932)

Complete learning cannot exist because learning is a continuous and orderly process which is represented quantitatively by rate of response. The course of the process is the obtained curve and nothing else.

There is nothing wrong with the behaviourists stance if they admit to a priori definitions of learning and extinction and deny that learning can be a discontinuous process.

An epistemological analysis vitiates the problem by accepting that learning may be discontinuous and denying that differences to the projected curve provide the important interpretation.

The logical structure either has a propositional content, which may be ambiguous, tautological or contradictory, or the logical structure has received no logical content. If there is a content to the struc-

ture, the transfer conditions will oppose a content-filled structure; if there is no content the transfer conditions will oppose a content-free structure. At this stage there is no way of telling whether the subject is acquiring or justifying the content acquired. The impossibility of practical temporal differentiation between acquisition and justification becomes an irrelevant problem when the projected curve is removed from the analysis. The transfer condition is an attempt to investigate the logic, not differences to a projected curve. Transfer results can be interpreted with reference to the logic already defined by analysis of initial condition results.

The problem of where to introduce the transfer becomes practical, not theoretical. It does not matter when the transfer is introduced as long as reaction to the transfer is observed. Thus, the transfer condition was introduced differentially depending on the stamina of the subjects. One initial condition (0,0) proved so aversive that an early transfer was initiated at 120 seconds; for all other conditions transfer was initiated between 210 and 780 seconds.

Reapplication of criteria for termination was necessary at the point of transfer. Criteria for termination at transfer were the reverse of the criteria for termination during the initial condition. Only infants who were content and looking at the screen were included in the transfer analysis. These criteria were an attempt to avoid including reactions due to fatigue; hunger, loneliness etc amongst genuine reactions to transfer conditions. 17 of the 42 visits which provided data for initial conditions were excluded from analysis using these criteria.

Once infants progressed to the transfer condition, termination was as for the initial conditions or at 15 minutes. Only 3 visits lasted 15

minutes.

3) MEASURES

The theoretical problem with measures have already been detailed. The produce their practical counterparts.

What to Measure?

The investigator wants to chart the logical content and structure of the infants' knowledge systems relevant to the interaction between leg-movement and mobile-movement. The adopted measures were leg-movement and affective reaction.

Doubts about bias against propositional content of no-leg movement and no-mobile movement are answered by pointing out that the important initial questions are not directed at propositional content, but at logical structure. More practically the propositions chosen make experimental conditions susceptible to logical representation. The experimenter can cope with affirmation and negation of leg-movement and mobile-movement at the various levels. Logical representation and manipulation of negative propositions is more difficult.

Doubts about bias against other propositions can be answered by pointing out that something must be measured; everything cannot be measured. Measures of smiling; vocalisation; eye-blinks; unilateral leg-movement; arm, head or bowel movements are all candidates for measurement. It is enough that the propositions chosen suit the infant. Infants can differentiate between a static mobile and a mobile and leg-movement is in the repertoire of very young infants.

How to Measure?

The propositional content decided upon can be variously represented. Rate of response was retained as a basic datum making a contrast with traditional learning interpretations easier. Rate can be represented as individual or as group data by:-

a) Rate of response by time

b) Rate of response by percentage time

c) Percentage rate of response by time

d) Percentage rate of response by percentage time

Each representation has advantages and disadvantages. The more obvious are:-

Group results may submerge interesting individual data.

Interesting trends may not be discernible in individual results.

Percentage rates may hide interesting differences in rate between conditions.

Percentage time may hide interesting differences in time between conditions.

Measurement of time necessitates arbitrary choice of time slots, too small and results are incomprehensible, too large and information is lost.

Measurement by rate may create bias either for or against low or high rates.

Because of these problems, results are represented using all of these measures. The time slots were by the minute, by centile time and by split time (50/50) in condition. Reasons for not attempting to account for any measures are presented where necessary. For example,

where time in conditions is very divergent, as between (0,0) and (100,0), rate by centile time is of dubious value. Conversely, a good guide to change in response within conditions is taken to be percentage mean rate by split times.

Consistency between different measures is noted.

As far as possible, the accepted behavioural maximum

> "When one asks which of the possible measures is best, it turns out that the answer is different for different situations, and that it depends in part upon practical considerations". (Kimble 1961)

...is ignored. Within the limits of the propositions chosen an attempt is made to account for all the above measures.

Theory and Evidence

The most persistent problem for the theorist is one of attachment. How can specific attachment of measures to theory be justified? The experiment appears to be straightforward; a neutral analysis produces a different conclusion.

The behavioural theorist may take a persistent increment in leg movement to be a sign of acquisition of a learned response.

The neutral theorist can point out that it is as reasonable to take a persistent increment in leg movement as a sign of non-justification of the logical relationship between activity and mobile-movement. Why should the infant who has acquired the relationship justify it persistently? Sporadic justification is just as likely. Similarly an infant who acquires the relationship very quickly may not display any increment in activity. This does not make the acquisition any less real.

The theorist can only be wary of a blinkered analysis of results. In the present case, whatever measures are adopted, results must be

examined for any change, not necessarily for increment. Any change is potentially revealing.

The use of affective reaction as a concurrent measurement delivers further justification to any interpretation. The assumption held throughout the analysis is that affective reaction will be positive (smiling, cooing gurgling, maintenance of interest) if informative content or structure is expanded; negative (frowning, crying, rage, loss of interest) if information loss or structural destruction occurs; neutral if no change in formation occurs.

CHAPTER 6

INTERPRETATION OF RESULTS

Results have been variously presented. (Appendices I to VI) Measures of speed, rigour, and persistence are available. Which should be taken as the most accurate reflection of learning? Even before interpretations from data are attempted, there are doubts about which data should be interpreted. One can sympathise with the behaviourist who believes solutions lie in the collection of more data.

The temptation in the above experiment is to go on working through different conditions using different or greater numbers of subjects. From the job-creation perspective, the experiment is ideal. The combinations and permutations of conditions; (0,100, 100/0) - (100,0, 0,100); combined with the classic psychological categories of age, sex, social class and handicap, guarantee that the single-minded application of the entire resources of every psychology department would fail to complete the task. A single experiment, deliberately restricted to two propositions, provides the source for an infinite number of observations.

The error, instigating this misapplication of resources, has already been explicated. The data has no priority even if the chapter heading tends to mislead. Interpretations should not be attempted <u>from</u> data. Missing or accidental observations make such attempts useless. Interpretations should be addressed <u>to</u> data. Data determines which of the many interpretations provides the best answers, but the initial construction of the interpretations remains entirely unaf-

fected by any possible data. The process of theory-construction in science is a mystery. Data is relevant to the process of theory validation not theory construction. The psychologists failure to differentiate between construction and validation is realised in the myth that data causes theory and subsequent complaints when no theory appears. There is no magical or mechanical concoction for theory building, nor do interpretations change because of data. Data specifies the scope of the theory, not the content of the theory. Data may direct the theoretical content to different targets.

The results from this experiment will be interpreted according to this process of progressive specification. At all stages of the analysis the infant will be regarded as epistemic. The early hypotheses will be extremely crude, where relevant, alternative interpretations will be presented. The minimum formal content and structure necessary for each interpretation will be progressively outlined.

6.1. The Infant Changes the Specified Behaviour in the Initial Condition of the Experimental Situation. This is the most general hypothesis. Individual and Group results validate this interpretation. 34 of the 42 infant visits display an increase in rate; 7 of the 42 infant visits display a maintenance in rate, only 1 of the 42 infant visits show a decrease in rate over the condition. (A. III.(1 to 7), c), d)). Diagrams 1, 2, 6, 7, 8, 10, 11 and 12 show this progressive change in the rate of leg movement. The change is incremental. Thus:

6.1.1. The Infant Progressively Increases the Specified Behaviour in the Initial Condition of the Experimental Situation. At this stage of the analysis, even before any attempts are made to answer why the infant acts, an extensive formal structure must be attributed to the epistemic infant to account for the capability for action.

There is something about the experimental situation that is identified by infants and is associated with increases in the specified behaviour. No systematic change in behaviour can occur unless the infant possesses the ability to identify and affirm something. The infant must possess a propositional capability. There are things.

Change in specified behaviour can not be maintained unless the infant possesses the ability to identify the thing propounded as continuing over time. The infant must possess a notion of permanence. There are enduring things.

Further, systematic change can not be consistently produced unless the infant possesses a notion of equality. The infant identifies something about the situation as being equal to another something in another situation. The infant must possess a notion of identity. There are equal things.

Finally, the observed change in the specified behaviour can never start or stop unless the infant possesses the ability to recognise things as being NOT other things. The infants reaction to the breast does not generalise to the mobile and vice-versa. The infant must possess a notion of negation. There are different things.

Propositional content involving p, q and r; permanence; identity (If p then p) and negation not-p are the cornerstones of formal logic. The results of the experiment indicate that the 13 to 20 week old infant possesses these powerful logical concepts. Indeed, any

creature which changes its behaviour in an operant situation must also possess these concepts. Logical divergence between such creatures and between adult and infant lies in the application of these basic notions, not as popular presuppositions exhort, in their presence or absence. It is curious that in an effort to separate man from the animals, the psychologist is unwilling to ascribe any capability to the infant. it is only for the adult that the world of the infant is a booming, buzzing confusion or simple, fixed, elementary, undifferentiated and chaotic. Investigations which start from this stance are not only pejorative, but useless, precisely because the established concepts of logic (objects, permanence, identity and negation) are manifestly not beyond the cognitive grasp of the young infant. The only profitable investigative stance is to interrogate the infant regarding the application of these established concepts.

6.2. A Causal Connection Between Foot Movement and Mobile Movement is the Permanent Object Identified by the Infant and Associated with an Increase in the Specified Behaviour in the Initial Condition of the Experimental Situation

> "In the last 20 years following Papousek's classic work (PAPOUSEK 1959), laboratory studies of infant learning have provided ample evidence that the human infant is capable of perceiving and engaging instrumental contingencies very possibly from birth, but surely by the end of the second month of life." (Watson 1984)

That the infant in the experimental situation is engaged in some sort of contingency detection is not in dispute if 6.1 is accepted. What is in dispute, is the nature of the contingencies involved. Analysis, so far, indicates that the specified behaviour has

increased; this contingency is not a matter for debate.

6.2 demands that the thing associated with the increase be specified as the causal connection between foot and mobile. But the observed increase could be associated with any changing feature of the situation, either internal (fatigue, motivation, hunger, fear, elation, restlessness) or external (light, temperature, noise, movement, hardness of the chair). It appears that the strongest statement is restricted to the postulation of a causal connection between leg-movement 1 and an unknown proposition p. Any specification of p seems to be premature. Whatever p is posited, alternative interpretations are available.

The scientist should not be surprised at the availability of alternatives. The above argument stops the analysis only if rational choice between interpretations is rejected. There are three sources of evidence supportive of 6.2.

Naive Observation

Casual observation of the infant in the experimental situation supports the hypothesis that the infant is interested in the mobile. Infants appeared content when the mobile was present, distressed when it was not. Infants' gaze was directed at the screen for long periods. Initial restlessness and random activity in many cases developed into a happy, observant stance and specific activity.

These characteristic signs combined with an absence of the characteristic signs of hunger, fear and fatigue make other interpretations unlikely.

Reaction to Different Initial Causal Connections

All aspects of the situation were kept constant for all subjects. The independent variable, the causal connection between leg-movement

and mobile movement, is the only source of different reactions.

Two initial conditions (0,0) and (0,10) proved very aversive to subjects (see A. IV.3 and A.IV.4.) Six out of the eight subjects became very distressed, and the other two subjects produced a very low rate of response.

Different conditions elicited very different rates and patterns of behaviour. (Diagrams 3, 4, 5, 9, 10, 11, 12 and 13)

It is impossible to ascribe these observed differences in reaction to anything but the nature of the causal condition. Infants' reactions to these different conditions could only be elicited if the focus of attention was indeed the mobile.

Reaction to Different Transfer Conditions

The differences in reaction to various transfer conditions provides the strongest evidence that the other contingency involved in the learning situation is the mobile.

Reaction to initiation of transfer conditions (0,0) and (0,90) was affectively spectacular. (see A.IV. 1.3; 2.1 and 7.1) Five out of the seven subjects displayed violent antipathy to initiation of these transfer conditions.

Other transfer conditions produced consistent reactions in both affect and changes in rate. (see A.IV. 2.2; 6.1 and 2.3)

These very different reactions to different transfer conditions can either be attributed to the different causal connections or to accidental influences.

Analysis, so far, has paralleled more conventional representations of the infant's interaction with the world; the infant responds with foot movement to the stimulus of the mobile. 6.1 and 6.2 have not been presented in this abbreviated form for two reasons.

The mutually supportive myths of infantile incompetence and intervening variables have been destroyed. The infant has a logical competence and is capable of directing it. Intervening variables do not make a formal analysis impossible either for the infant or the scientist.

Secondly, an abbreviated analysis which takes rate as the basic datum loses vital evidence. The infant's response is not limited to changes in rate. Vigorous and definitive responses to different causal connections were observed which were not reflected in analysis of rate. An epistemic analysis does not remove hunger, restlessness, depression, ecstasy and tantrum from the analysis; it treats them as different responses to different conditions. It is no accident that the infant is disinterested and progressively restless in some conditions, ecstatic or antipathetic in others. Thus as a corollary to 6.2:

6.2.1. The Infant Responds Differently to Different Causal Connections These different responses will provide clues as to how the infant structures its experience. Again, the temptation for the experimenter is to attempt to elicit different responses in different conditions. But the behaviour is not of direct interest, the structure remains the investigative focus.

Accepting 6.1 and 6.2 means accepting that the infant is an epistemic agent who acquires and justifies knowledge. This process of acquisition and justification previously ignored by most investigators, can now be explicated.

CHAPTER 7

ACQUISITION

The infant and the adult are formally equivalent in several respects. They show an ability to identify and affirm propositional content and an ability to affirm and negate relationships between propositions. There are a limited number of ways the propositions involved can be related. These have already been listed in Table I.

Table I

	l	m	r
1.	T	T	T
2.	F	T	T
3.	T	F	T
4.	F	F	T
5.	T	T	F
6.	F	T	F
7.	T	F	F
8.	F	F	F

Formal or standard or adult logic has names for 16 causal relationships. These relationships are defined by analysis of only four out of the eight lines listed in Table I. The subset of named relationships is obtained by restricting the possible truth values in (r) at any specific truth-value in l and m to either TRUE or FALSE, but not both. Thus if Line 1) is affirmed, Line 5) is negated. If Line 7) is affirmed, Line 3) is negated. This restriction is a necessary consequence of allowing no contradictions to exist at the level of the causal relationship r. The causal relationships are always restricted to four lines and defined by the truth values under (r).

Thus, where the four lines are:

	l	m	r
1)	T	T	
2)	F	T	
3)	T	F	
4)	F	F	

the causal relationships between these propositions are defined under r as follows:

Table II

	r				In words
Lines	1	2	3	4	
1.	T	T	T	T	TAUTOLOGY
2.	F	T	T	T	Not both l and m
3.	T	F	T	T	If m then l
4.	T	T	F	T	If l then m
5.	T	T	T	F	l or m
6.	F	F	T	T	not m
7.	F	T	F	T	not l
8.	F	T	T	F	l or m, but not both
9.	T	F	F	T	If l then m and if m then l
10.	T	F	T	F	l
11.	T	T	F	F	m
12.	F	F	F	T	neither l nor m
13.	F	F	T	F	l and not m
14.	F	T	F	F	m and not l
15.	T	F	F	F	l and m
16.	F	F	F	F	CONTRADICTION

Previous investigations have concentrated on one or two parts of these causal relationships (See Chapter 4) and have tended to ignore the others. The very words used to describe the relationships tend to give some a priority over others. Thus, 'strict implication' is often ascribed more 'value' than 'neither l nor m'. Formally all the relationships from 1. to 16. in Table II are equivalent and the infants acquisitive capability with regard to them is an empirical matter. They are all causal relationships.

Unfortunately, there is a strong bias inherent in Table II. There is no evidence that the infant shares the adult notions of contradiction and negation. Indeed, given the spectacular failure of adult investigations into the mind of the infant there is every reason to suppose that the infant´s notion of contradiction and negation are very different from the adult´s.

The unbias investigator can do nothing else but assume that the infant is capable of asserting and affirming Lines 1) to 8) in Table I. This leads the analysis to the uncomfortable conclusion that the adult investigator will have no names for the causal relationships used by the infant. Even more disturbing, is the speculation that the causal relationships discovered may be beyond the cognitive grasp of the investigator. The restricted logic of the adult being unable to assimilate the more general logic of the infant.

Apart from the appeal for impartiality, there are formal grounds for giving up the standard notions of causal relationships in the case of the infant. Strong logic can never emerge from weak. Adult logic uses all eight lines from Table I, but only four at any time, to define causal relationships. Simultaneous denial of spontaneous creation and assertion of logical differences between adult and infant delivers a direction to the differences. At some stage in the process of acquiring or justifying knowledge the infant can utilise the entire contents of Table I to define causal relationships between propositions.

Secondly, if the causal relationship is treated like any other proposition, like (l) or (m) for example, there is no obvious reason why it can not be held to be both TRUE and FALSE.

The infant can cope with contradiction at the level of the behaviour:

	l	m	r
1)	T	T	T
2)	F	T	T

and at the level of the stimulus:

	l	m	r
1)	T	T	T
3)	T	F	T

so why not at the level of the causal relationship:

	l	m	r
1)	T	T	T
5)	T	T	F

Somehow, the logician has placed the relationship in a privileged propositional position. Truth and Falsehood in r are not the same as Truth and Falsehood in l and m. Implicit in the rejection of contradiction at the level of r is the distinction between elementary propositions and logical propositions. This distinction may be an analytic artifact unused by the infant. Assuredly, for the infant, there are things. It remains to be proved whether, for the infant, there are logical things and other things. Rather than accuse the infant of a similar propositional bias, the impartial investigator must assume that the infant regards the causal relationship like any other proposition.

The experimenter may have no vocabulary for the causal relationships used by the infant and may have great difficult in acquiring such relationships. Fortunately, any relationships are easily defined by the particular configuration of propositional relationships affirmed and their various truth values.

Using only Table I the analysis can progress from a representation of the formal relationships investigated by conditioning theory:

From Table I

	l	m	r	
Line 1)	T	T	T	100% Reinforcement
Line 3)	T	F	T	Partial Reinforcement

to a representation of the focus of contingency detection:

From Table I

	l	m	r	
Line 1)	T	T	T	100% Reinforcement
Line 2)	F	T	T	Non-Contingent Reinforcement
Line 3)	T	F	T	Partial Reinforcement

to a formal analysis of standard logic:

From Table I

			(r)		
	l	m	1)----------	16)	(From Table II)
Line 1)	T	T	T	F	
Line 2)	F	T	T	F	
Line 3)	T	F	T	F	
Line 4)	F	F	T	F	

to the object of inquiry, the epistemic infant.

The infants utilisation of causal relationships can be defined using any or all of the lines from Table I.

For example, the formal relationship defined by lines 1) to 5) from Table I:

	l	m	r		
Line 1)	T	T	T		
Line 2)	F	T	T	Tautology	
Line 3)	T	F	T		Not both l and m
Line 4)	F	F	T		
Line 5)	T	T	F		

although virtually incomprehensible could be expressed in words as a combination of Tautology and Not both l and m.

If

Line 6)	F	T	F	

is added, the following standard logic descriptions are involved in the definition.

From Table II

Line 1	T	T	T	T	Tautology
Line 2)	F	T	T	T	Not both l and m
Line 3)	T	F	T	T	If m then l
Line 6)	F	F	T	T	Not m

and the words lose all value.

The analysis appears to have generates a paradox. Justification of the logical relationships used by the infant can be done by the adult by defining the relationships as above. But the adult is incapable of acquiring the relationships defined, the words collapse under the weight of apparent contradictions. Justification appears to precede acquisition.

A paradox is generated only if the adult denies his own infancy. The epistemic infant becomes the epistemic adult, acquisition precedes justification. The apparent gap in this case provides more evidence that there is a reversible symmetry between acquisition and justification. Late acquisitions are justified early, early acquisi-

tions are justified late. The acquisitions in question, causal relationships between things, are very early and we should not perhaps be surprised that we have, for practical purposes, forgotten them just as we are learning that their justification is a possibility.

Interestingly, attempts to justify the epistemologically prior question about the existence of things runs into similar, but greater difficulties. Heidegger's entire output can only be understood as an attempt to justify the earliest acquisition, that of being itself. Heidegger was aware that his question and subsequent analysis; "Why are there things rather than nothing?" can only be interpreted at the very end of the justificatory process.

> "But this question may be asked expressly, or, unrecognised as a question, it may merely pass through our lives like a brief gust of wind, it may press hard upon us or, under one pretext or another, we may thrust it away from us and silence it. In any case, it is never the question that we ask first in point of time."

> "But it is the first question in another sense - in regard to rank. This may be clarified in three ways. The question "Why are there things rather than nothing?" is first in rank for us, first because it is the most far reaching, second because it is the deepest and finally because it is the most fundamental of all questions." (Heidegger 1953)

The first acquisition for the majority will never be justified and Heidegger proves his case.

This metaphysical interlude has provided the analysis with a hierarchy of questions.

Question 1 Why are there things?

Question 2 What things are involved here?

Question 3 Why are there relationships between things?

Question 4 What relationship between things are involved here?

Question 1 is best left with Heidegger. Questions 2, 3 and 4 can now be answered with regard to the infants acquisitions.

The things involved here are propositions. The particular propositions involved are leg-movement l and mobile-movement m. The infant possesses the ability to affirm (T) or negate (F) these propositions.

Question 3 can be answered on various levels. Relationships exist between things because the existence of things necessitates a relationship between something and something else or nothing. Relationships exist because development demands them. Relationships exist because we observe them. None of which are satisfactory answers. It is, perhaps, more likely that "Why" questions about acquisitions are inappropriate.

A definitive answer to question 4 is available. The relationships between propositions are defined by the truth values expressed in Table I.

Summary

The infant's acquisition of causal relationships is very different from the adult's, differences are directional, for the infant there are no restrictions on the acquisition of causal relationships.

The infant posits l and m, projects a relationship and inserts the propositions into the logical structure. All lines in Table I receive a propositional content. The infant does not abandon adult notions of contradictios, tautology or paradox because it has never restricted itself by acquiring them.

Future acquisitions become impenetrable to the experimenter immediately initial acquisitions are diminished.

> "But what is great can only begin great. Its beginning is in fact the greatest thing of all. A small beginning belongs only to the small, whose dubious greatness it is to di-

minish all things; small are the beginnings of decay, though it may later become great in the sense of the enormity of total annihilation". (Heidegger 1953)

CHAPTER 8

JUSTIFICATION

To complete the epistemic process, the infant must attempt to justify the logical content and structure acquired. Justification can only be done by observation. The different conditions provide the infant with the opportunity to observe and justify different relationships. The experimenter, in turn, can attempt to map the logical content and structure acquired by interpretation of the infant's observed behaviour onto the logical content and structure justified by the formal attributes of the different conditions involved. The end point of the analysis is the infant's justification.

8.1. The following interpretations were made to account for the observed behaviour of the infant in the different conditions.

8.1.1. The infant acquires a propositional content for (r) in all conditions.

8.1.2. The infant acquires a propositional content for (l) and (m) in Conditions (100,0); (100,10); (0,10); (0,50); (0,90); and (0,100).

The infant does not acquire a propositional content for (l) and (m) in Condition (0,0).

8.1.3. The propositional content acquired in 8.1.1 is justified in conditions (100,0); (100,10) and (0,100).

Justification in incomplete in conditions (0,0); (0,10); (0,50);

and (0,90).

8.1.4. The epistemic process is completed in conditions (100,0); (100,10) and (0,100). Completion of the process leads to adoption of a particular nexus of relationships. This relationship constitutes knowledge.

8.1.5. The knowledge thus constructed is different for each condition. In each case the infant learns something different.

8.1.6. Knowledge thus constructed is resistant to change, but open to negation.

8.2. The formal attributes of the different conditions depend on the stance of the observer. An initial analysis can be attempted which treats the infant as an interested observer testing hypotheses on the basis of the observed behaviour of the mobile.

This analysis assumes that the infant treats the leg movement as the independent variable and the mobile movement as the dependent variable. In this analysis, the causal agent is the infant; given this stance, the following relationships are observed per condition.

(0 = observed)

Table 8.2

				CONDITION				
	l	m	r	100,0	100,10	0,10 0,50 0,90	0,0	0,100
1.	T	T	T	0	0			
2.	F	T	T		0	0		0
3.	T	F	T			0	0	0
4.	F	F	T	0	0	0	0	
5.	T	T	F			0	0	0
6.	F	T	F	0	0	0	0	
7.	T	F	F	0	0			
8.	F	F	F		0	0		0

Condition (100,0) is defined by Lines 1, 4, 6 and 7.

Condition (100,10) is defined by Lines 1, 2, 4, 6, 7 and 8.

Conditions (0,10); (0,50); (0,90) are defined by Lines 2, 3, 4, 5 6 and 8.

Conditions (0,0) is defined by Lines, 3, 4, 5 and 6.

Condition (0,100) is defined by Lines 2, 3, 5 and 8.

8.3. A mapping of 8.1 onto 8.2 produces the following interpretations.

8.3.1. The infant attempts to justify the acquired knowledge by analysis of all relationships. The three conditions (100,0); (100,10) and (0,100) are justified using different groups of relationships which span the entire contents of Table I.

The four conditions unjustified span six out of the eight lines in Table I.

Therefore it is the particular nexus of lines observed and not any line which leads to justification of a relationship between l and m.

When logical content and structure is acquired and justified, the infant acts as a causal agent.

When logical content and structure is acquired but not justified the

infant does not act as a causal agent, rather as an interested observer.

When logical content and structure is neither acquired nor justified the infant acts neither as a causal agent nor as an interested observer.

8.3.2. Simpler interpretations are available. The complexity of the infant's initial acquisitions need not be reflected in justification. Indeed, acceptance of a reversible symmetry between processes implies that if acquisition goes from complex, contradictory and unspeakable to simple, two-valued and communicable, then justification reverses the course. Thus the behaviourist may be able to save his approach by accepting the proof that a purely behavioural stance is too restricted to account for acquisitions. Subsequent to this acceptance the behaviourist can assert that since we have proved we cannot really speak about acquisitions, we must pass over them in silence and enter the behavioural domain - justification.

This claim is intuitively attractive and deserves analysis.

A behavioural interpretation states that Lines 1. and 3. are the only relationships used by the infant to justify acquired knowledge. The other relationships may be observed, but are irrelevant to the learning process.

This interpretation accounts for several of the positive findings. Conditions (0,0), (0,10), (0,50) and (0,90) all lack Line 1.. The infant will fail to learn because the crucial component of the learning process is absent. These conditions reflect this failure in the infants behaviour; progressive restlessness, discontent and not one observed positive reaction to transfer.

Conditions (100,0) and (100,10) are identical with respect to Lines

1. and 3. The crucial component (Line 1) is present and learning occurs; affective reaction to these conditions and to transfer from these conditions is similar. The violent aversive reaction to transfer to (0,0) can be interpreted as instantaneous extinction. Further evidence that these conditions are similar is the lack of reaction to transfer from (100,10) and (100,0).

The observed learning in (0,100) and positive reaction to transfer from (100,0) to (0,100) appears to be a problem. Line 1 is absent in condition (0,100). this problem is solved by noting that reinforcers are not fixed. If a new reinforcer (mobile-stops) is substituted for the old (mobile-moves), condition (0,100) possesses Line 1. Alternatively, the reinforcer can be regarded as the change in state, not the state per se, rendering condition (0,100) and (100,0) identical. This simplest of all interpretations appears to account for much of the observed evidence. Unfortunately, this interpretation is severely embarrassed by other evidence.

Conditions (0,0), (0,10), (0,50) and (0,90) did indeed produce similarities in the infant's behaviour. There were also distinctive differences in behaviour between these conditions. The most distinctive difference being between (0,0) and the others. Condition (0,0) produced instant aversion in both initial and transfer conditions. Aversion was much more progressive in the initial conditions of (0,10), (0,50) and (0.90). The justification for these observed differences cannot come from differences in Lines 1. and 3.. The behavioural interpretation cannot account for these observations and must classify them as incidental to the learning process.

Likewise, there are positive differences between behaviour in (100,0) and (100,10). Affective reaction is similar, but (100.10) produces

a much higher rate than (100,0). Most interesting was the definitive positive reaction to transfer from (100,0) to (100,10) compared to the neutral reaction to transfer from (100,10) to (100,0). Again (100,0) differs from (100,10) only in Lines 2. and 8. and the behavioural account must classify these observations as accidental.

The reformulation of (0,100) by changing the reinforcer or the assertion of a shared reinforcer with (100,0) creates several formal problems.

If a new reinforcer (mobile-stops) is substituted for the old (mobile-moves) some ad hoc mechanism must stop this substitution in conditions (0,10), (0,50) and (0,90). If substitution takes place in these conditions then the formal attributes become identical to (100,10) and learning should occur; since there is no obvious manifestation of learning, there can have been no such substitution. Similarly, if (0,100) and (100,0) share reinforcers (change in state), then (100,10) and (0,90) share the same reinforcer even with respect to rate of reinforcement. There are undeniable differences between behaviour in (100,10) and behaviour in (0,90).

A behavioural interpretation which relies only on Lines 1. and 3. cannot give a systematic account of these phenomena.

A more sophisticated behavioural approach could be attempted using contingency detection terms. Contingency detection utilises Lines 1., 2. and 3. and successfully differentiates between (100,0) and (100,10); (0,0) and ((0,10), (0,50), (0,90)). It fails to differentiate between; (0,100) and ((0,10), (0,50), and (0,90)). Contingency detection theory decreases, but does not eliminate the amount of incidental phenomena.

8.4. The epistemic interpretation appears superior with respect to internal consistency, formal coherence and assimilation of phenomena. The formal differentiation inherent in the interpretation appears to reflect the distinctive behavioural categories observed.

The interpretation, apparently successful, is implicitly paradoxical and further specification is necessary. The paradox becomes apparent by noting that the interpretation accounts for the most distinctive behavioural difference between conditions, (contentment of the infant in (100,0), (100,10) and (0,100) and discontentment in (0,0), (0,10), (0,50) and (0,90) by claiming that the epistemic process in the unhappy conditions is incomplete. The infant objects because of boredom or frustration. This seems to be a reasonable explanation until we note that incomplete justification implies that no knowledge has been constructed. The analysis appears to have worked itself back to the problem raised in Chapter 4; if no knowledge has been gained, if the subject has remained static with regard to knowledge of relationships, then the subject's ability to perceive a contingency in later situations should not be greatly impaired. Yet the above results indicate impairment in the relevant conditions. Secondly, if justification is incomplete and no knowledge has been constructed in conditions (0,0), (0,10), (0,50) and (0,90) the subject has no way of differentiating between these conditions. Yet (0,0) produces a distinctive behavioural category. The interpretation successfully isolates (0,0) on the formal level (8.2), but not on an epistemic level (8.3).

The epistemic interpretation must solve this problem. The interpretation must explain the distinctive behavioural differences between conditions and at the same time account for any subsequent impairment

to learning after exposure to 'non-learning' conditions. These two tasks are apparently irreconcilable at the behavioural level and no behavioural analysis offers a systematic solution.

Since there is no such thing as contradictory facts or behaviour, the solution must be brought about at the theoretical level. The problem requires re-examination before a decision can be made as to what part of the theory requires specification.

8.5.

FACT The epistemic process consists of acquisition and justification.

FACT Completion of the epistemic process leads to adoption of a particular nexus of relationships.

FACT This relationship constitutes knowledge.

FACT Something has been learnt in condition (0,0), (0,10), (0,50) and (0,90). Something interferes with later learning.

FACT Something has been learnt in conditions (0,0), (0,10), (0,50) and (0,90). Something interferes with earlier learning.

FACT The something that has been learnt is different in (0,0) from the something that has been learnt in (0,10), (0,50) and (0,90).

These facts are not irreconcilable:

FACT In condition (100,0), (0,100) and (100,10) the infant has learnt something different from the something that is learnt in conditions (0,0), (0,10), (0,50) and (0,90).

AND

The interpretation of this difference is 8.1.3. The process of acquisition and justification is incomplete in conditions (0,0), (0,10), (0,50) and (0,90).

Unlike the infant, the epistemologist cannot allow the epistemic process to be simultaneously complete and incomplete. The only

solution to the problem is to posit two different processes. One is complete. One is incomplete.

The immediate reaction to this bifurcation is to point out that knowledge is either possessed or not possessed. It can only be held and not held if the individual is disintegrating.

From the psychologist's causal viewpoint, this may be so, but the infant is not a psychologist and from a teleological viewpoint knowledge can be constructed on as many levels as there are purposes. An ethologist would argue that the image so far presented of the infant as a neutral knowledge acquirer is hopelessly impoverished. Nothing about the infant is neutral. The infant is a demanding, purposeful agent determined to discover and use his capabilities in manipulation of all relationships whether with objects or organisms. The infant does not blandly inquire after knowledge, he seeks it out as if his life depends on it.

The emotive and ethological arguments against the concept of neutral one- dimensional knowledge are strong, but the formal arguments are overwhelming. The object of inquiry was the logical content, structure and processes of the infant. There are very many different logics. Each has its distinctive features. Some logics will share many features. Some logics will share few features. There are logics relevant to being, learning, causation, language, self, fear, freedom, hunger and many others. The above analysis attempts to explicate fragments from at least three different logics; being, learning and causation. The analysis would fail if it did not specify the different logics involved.

The apparent paradox is solved. The terms causal and logical, up to now, have been interchangeable. We must now be more careful with

the terminology. There are at least two logics involved; the Logic of Learning (Logic) and the Logic of Causation.

In 8.1 the logic of causation was the object of inquiry, but 8.2 introduced distinctions relevant to the logic of learning. In condition (0,0), (0,10), (0,50) and (0,90) the process of acquisition and justification was completed with regard to the logic of learning, but not completed with regard to the logic of causation.

This solution to the 'non-learning' paradox and specification of the epistemic interpretation came about because of theoretical specification. It can now be seen that justification must always have an object not just in the sense of an acquisition to be examined. Justification also has a purpose. The potential of the knowledge about to be constructed lies not merely in the fact of its existence. Potential knowledge also has a direction. All of the infant's behaviour can be interpreted as a reaction to different projections and expectations.

Like the epistemic infant, this analysis does not disintegrate with the introduction of these different logics. Their introduction means that the relationships between them can be examined.

8.6. The epistemic processes under investigation are closely related. The logic of being, the process whereby the infant comes to attribute existence to objects, remains in the metaphysical domain. This logic cannot therefore be ignored. An inquiry which does not treat this logic as epistemologically prior to every other logic is unsound. The logic of being must be affirmed at every stage of the analysis.

The logic of learning, the process whereby the infant comes to attribute relationships to objects, is in the psychological domain.

Acquisition and justification relevant to this process have already been detailed. If the logic of being is epistemologically first in order of rank, then the logic of learning is second. No other logic can receive a content or structure until being and relationships are discovered. Chapter 7 shows why the infant must have at its disposal the contents of Table I. 8.2 shows how the infant justifies these acquisitions by observation. The description of the infant as a causal agent must be retracted; logical must be substituted for causal.

The logic of causation, the process whereby the infant comes to attribute personal efficacy to self, is also in the psychological domain. The ontogenetic relationships between personal efficacy, other efficacy and egoity are complex. Although resolution of the debate may not be achieved by empirical means, this analysis provides the means for a reformulation. The logic of egoity can be seen as a subset of the logic of being. Egoity emerges with the acquisition and justification of a particular enduring existent.

The logic of other efficacy can be defined as identical to the logic of learning. The infant as observer of an infant in the experimental situation could attribute other efficacy to either the mobile or the observed infant. Thus other efficacy emerges before, or at least with, personal efficacy. The logic of personal efficacy cannot be constructed without the logic of learning. The infant must be able to analyse situations and categorise them as causal or not-causal, but they are all learning situations. In one category, the infant discovers personal efficacy. The other category allows learning; the infant learns that personal efficacy does not apply; many infants object to this observed lack of command and control.

Thus there is only one 1, the efficacious self, in the logic of causation. There are myriad 1's in the logic of learning. Apart from this difference and one other, the logics are identical. The acquisitions necessary for their construction are the same. The infant requires the contents of Table I to construct a logic of causation. It is also apparent that the relationships defined by the logic of causation as causal are a subset of the relationships defined by the logic of learning. All causal relationships have been learnt; not all learnt relationships are causal.

Again, the temptation is to attempt an inventory of causal relationships. the analysis has only investigated seven learning relationships and three causal relationships. No doubt there are many more in both categories. Any findings would be original, but not confirmatory because no attempt has been made to answer the interesting question. Why are relationships justified? Why are relationships defined as causal or non-causal? A listing of relationships is not a serious attempt to answer this interesting question. From the epistemological point of view it is a displacement activity, nothing more than a description of the output of the different logics.

An analysis of the differences between the logics is the only way into the question. There is a minor difference in the propositional content allowed in 1), but this does not explain why some logical relationships are causal and some are not. The logic of causation obviously possesses a criterion for excluding logical relationships. Thus the crucial difference between the two logics lies at the level of negation. Negation in the logic of learning is different from negation in the logic of causation. This difference demands specification, without which, the analysis is incomplete. The infant's

justification of the acquisitions relevant to the logic of causation has been reached but is no longer the end point of the analysis.

CHAPTER 9

NEGATION

9.1. For every affirmation, there is, presumably at least one negation. Psychologists make extensive use of these many forms of negation. The use of extinction as an investigative procedure in conditioning theory; interference in memory tasks; separation in mother-infant bonding investigations; hiding in object-concept tasks and indeed, any dependent-independent variable design are permeated at every level with negation. Psychologists feel comfortable using this notion, but for some mysterious reason do not regard negation as a psychological phenomenon worthy of any but accidental investigation. Negation has been left to the philosophers and has produced a remarkable consensus from disparate sources.

> "The learning of 'p' is essentially bound up with the learning of 'not-p'. 'I do not hope you are better' - must be, understood if 'I hope you are better' is understood."

> "Language is rule-governed utterance and conventions of affirmation and negation are the indispensable minimum of rules. The difference between a language and a practice of making arbitrary noises is that the former embodies a concept of negation." (Quinton 1973)

> "Freedom begins as an act of negation." (MacQuarrie 1982)

> "All possibility of things must therefore be regarded as derivative, with only one exception, namely the possibility of that which includes in itself all reality. This latter possibility must be regarded as original. For all negations

> (which are the only predicates through which anything can be distinguished from the thing in itself) are merely limitations of a greater, and ultimately of the highest, reality, and they therefore presuppose this reality and are, as regards their content, derived from it." (Kant 1933)

Analysis of a particular form of negation, nothingness or non-being, has been attempted by a succession of philosophers from Heraclitus onwards. The obscurity of their attempts is often matched by the attractiveness of the resultant aphorisms.

Nothing abides, everything changes; Becoming shot through with Being; Nothingness haunting Being, have been remembered where the detail has been dismissed. When Sartre questions:

> "But where does nothingness come from? If it is the original condition of the questioning attitude and more generally of all philosophical or scientific inquiry, what is the original relation of the human being to nothingness? What is the original nihilating conduct?"

there is little disagreement as to the validity and power of the question. Similarly, Heideggers parody of a positivist's reaction to his inquiry remains burlesque.

> "He who speaks of nothing does not know what he is doing. In speaking he speaks against what he intended. He contradicts himself. But discourse that contradicts itself offends against the fundamental rule of discourse, against "logic". To speak of nothing is illogical. He who speaks and thinks illogically is unscientific. But he who goes so far as to speak of nothing in the realms of philosophy, where logic has its very home, exposes himself most particularly to the accusation of offending against the fundamental rule of all thinking. Such a speaking about nothing consists entirely of meaningless propositions. Moreover: he who takes the nothing seriously is allying himself with nothingness. He is patently promoting the spirit of negation and serving the cause of disintegration. Not only is speaking of nothing utterly repellent to thought, it also undermines all culture and faith. What disregards the fundamental law of thought and also destroys faith and the will to build is pure nihilism". (Heidegger 1953)

The positivist may indeed question the clarity of the analysis, but not the impetus behind it. Negation appears to occupy a unique place in the history of philosophy. It is a focus of agreement. It transcends philosophical boundaries and its importance in logic, epistemology, metaphysics and ontology has never been questioned. Negation does not only make distinct language and arbitrary noises. It also appears to be the defining feature of all systems of knowledge. This is a fascinating phenomenon.

> "Nothing, in fact, has had a more direct power of persuasion than the error of being."

Astonishingly, one hundred years of psychology has produced not one direct attempt to investigate the psychological aspects of negation.

9.2. Piaget's Account of Negation

Piaget was well qualified to construct a psychological account of negation. He was an epistemologist, logician and psychologist. Piaget's treatment of negation is articulated in 'Experiments in Contradiction' which is an attempt to investigate the relations between contradiction and disequilibrium of action or thought. (Piaget 1980) The intricacies of his analysis (he proposes 19 different classes of contradiction; three forms of affirmation and three forms of negation) are not relevant. Two points are relevant to this analysis. Firstly, Piaget asserts the primacy of affirmation over negation.

> "We did indeed observe a systematic disequilibrium favouring affirmation, constituting the more natural and spontaneous behavioural reactions, over negations, which, being much more difficult to construct and handle, invariably lag behind affirmations until one reaches operatory levels".

> "At the perceptual level only positive characteristics are

perceived and negation is not a process occurring in perception".

Secondly, Piaget asserts that the most general form of contradiction is incomplete compensation between affirmation and negations.

> "In sum, any action, however positive its goal, is interdependent upon two systems of negations, one external, which sets it in opposition to that which is not itself when viewed as affirmatively characterised by that goal, and the other internal, rendering the positive character of the transfer in the direction of the goal interdependent upon a subtraction and moving away from the point of origin. Thus it is neglect of such negative aspects that engenders contradiction".

These conjectures are clear enough. Affirmations are constructed before negations and absence of negations generates contradictions, functional disequilibrium and development. These conjectures can be mapped onto the observed results.

Let affirmation be (T) and negation (F) in Table 8.2. Line 1 contains nothing but affirmations and according to Piaget should be constructed first, and, indeed, (100,0) and (100,10) both contain Line 1 and both produce similar behaviours. Unfortunately, so does (0,100) and it lacks Line 1. Piaget's hypothesis predicts more impetus in (100,0) where there is no negation observed at the behavioural level. Yet (100,10) produces a higher rate than (100,0). Both of Piaget's hypotheses do not easily map onto the observed data. Obviously there is something wrong with the mapping or something wrong with Piaget's analysis.

The mapping is trivial and arbitrary. A reversal of the propositional content of l and m will change the results. But the mapping is trivial because Piaget's analysis is trivial.

Piaget is unable to differentiate between affirmations and negations

beyond the distinction that affirmations are "more natural and spontaneous behavioural reactions". Are negations unnatural, premeditated behavioural reactions? In the above experiment the infant affirms, negates, acquires and justifies. Piaget can assert that leg-movement is a more natural behavioural reaction to mobile movement than to lack of mobile movement, but this assertion should be seen for what it is, a value judgement not the result of a systematic analysis. The analysis itself, is the final product of a value judgement which has consistently regarded the infant as deficient or impaired.

The philosophical consensus regarding negation includes Piaget:

> "the affirmative or positive character of an action is indiscernible from a negative aspect or exclusion, which sets that action (a) in opposition to that which is not itself".

But Piaget is not willing to extend this consensus to the epistemological activities of the infant. Piaget delivers his last and greatest insult to the infant. The infant is alone in the epistemological universe. Negation, the defining feature of knowledge systems, is absent in the infant. In Piaget's analysis there is no such thing as the epistemic infant. In this search for a motor of development the car appears to have been destroyed.

9.3. An objection to value-judgements does not constitute an argument against their justification. In addition to the problems of postdictive analysis, arbitrariness and pejoration, there are natural and logical objections.

Piaget's thoughts on negation can be summarised as:

ACQUISITION:	Affirmations are acquired before negations
JUSTIFICATION:	Negation is not a process occurring in perception
ACQUISITION:	The absence of negations generate contradictions
JUSTIFICATION:	Contradiction is incomplete compensation between affirmation and negation.

It is not always clear whether Piaget is speaking about natural systems or logical formal systems. The assertions can be questioned on both levels.

On the logical level all the assertions can summarily dismissed.

At every level of logic, acquisition of affirmations cannot be separated from acquisition of negations. Thus Wittgenstein "The positive proposition necessarily presupposes the existence of the negative proposition and vice versa". Logical negation and logical affirmation are not processes occurring in perception; they are processes generated by the logician. The presence not the absence of logical negation generates contradiction. Contradiction is complete compensation between affirmation and negation. Logical contradiction is the indiscriminate neutralisation of all TRUE statements because of absolute compensation between the opposing forces of affirmation and negation.

The arguments against these assertions at the natural level are equally compelling. For philosophers, anyway, the notion of a solo affirmation is absurd. Isolated affirmations are not a naturally occurring phenomenon in the natural world of the adult. Piagetians may point out that the assertion of the primacy of affirmation is not as philosophically isolated as has been claimed. Piaget appears to have acquired this assertion from Kant.

> "Negation and the mere form of intuition, in the absence of a something real, are not objects". (Kant 1933)

> "Now no one can think a negation determinately, save by basing it upon the opposed affirmation. Those born blind cannot have the least notion of darkness, since they have none of light. The savage knows nothing of poverty, since he has no acquaintance with wealth. The ignorant have no concept of their ignorance, because they have none of knowledge, etc. All concepts of negations are thus derivative; it is the realities which contain the data, and, so to speak, the material or transcendental content, for the possibility and complete determination of all things". (Kant 1933)

A decontextualised, shallow interpretation of Kant could be taken as support for the primacy of affirmation and the absence of negation in perception. A closer reading of Kant delivers another interpretation. Kant classifies Negation as one of "the list of all original pure concepts of synthesis that the understanding contains within itself a priori. Indeed, it is because it contains these concepts that it is called pure understanding; for by them alone can it understand anything in the manifold of intuition, that is, think an object of intuition". (Kant 1933)

Kant appears to hold negation as distinguishing and determining and as determined and derived. Piaget appears to have adopted the latter description while ignoring the former. He also got the wrong answer to the question: Determined and derived from what?

Kant´s meaning is clear although he omits Wittgensteins vice versa. Thus no one can think a negation determinately save by basing it upon the opposed affirmation and no one can think an affirmation (but one) save by basing it upon the opposed negation. This interpretation is articulated in the statement that negation "is the only predicate through which anything can be distinguished from the thing-in-itself". For Kant everything is derived from this one absolute affirmation, the thing-in itself, the ens realissimum. The thing-in-itself is a transcendental ideal and universal. It is the con-

cept of an individual being but it does not specify or separate individual beings. Negation allows this specification and separation. In Kant's analysis everything is derived from the thing-in-itself. Negation is the predicate which separates objects (all other affirmations) from the thing-in-itself.

The scale of the Piagetian misinterpretation becomes clear. Kant claims negation is derived from and determined by the thing-in-itself, but all other objects or affirmations are derived or separated from the thing-in-itself by negation. Piaget claims Kant as epistemological company and asserts that specific negations are derived from specific affirmations. Piaget asserts that negation is not a process occurring in perception. Kant asserts that negation is a process occurring before perception. Kant asserts that a blind infant has no notion of light or darkness. Piaget appears to assert that at some stage a sighted infant has no notion of the dark.

These philosophical objections have their naturalistic counterparts. From the moment of birth the infant acts as if it was aware of pairs of contradictory predicates. The infant cannot breathe and it cries; the infant is hungry and it cries; the infant is cold or hot or tired or afraid of the dark or lonely and it cries. Its behavioural response to these contradictory predicates is limited from the adult's point of view, but the infant's conception of a state of affairs with which it disagrees is crystalline. Every act by the parent can be seen as a transfer experiment; as an attempt to discover precisely what it is that the infant is negating. Most parents become adept at transference to affectively affirmative contingencies. Piaget may be correct when he asserts that negation is not a process occurring in perception; negation as Kant's analysis

suggests may be a process or acquisition occurring before perception; negation makes perception possible.

Piaget's second acquisition, the assertion that absence of negation generates contradiction, collapses if his first acquisition, isolated affirmations, is rejected. There are other problems.

The absence of anything can generate nothing. The presence of an absence can generate something. The analysis has returned to Chapter 4. How can non-learning influence learning?

The notion of incomplete compensation runs into similar difficulties. An imbalance between two acquisitions may lead to development. But there cannot be an imbalance between two acquisitions if only one is acquired. Acquisition of a Piagetian natural contradiction would necessitate disacquisition of a negation. The infant would have to know where it was going before it could forget its destination in order to get there.

Piaget appears to have created more problems than he solved by his natural and logical divisions of contradiction. It is unfortunate that his division was itself contradictory. Experimental evidence; formal analysis; naturalistic observation and the philosophical consensus of recorded history indicate that Piaget's assertions are unjustified. This investigation has not been iconoclastic. Piaget's misconjectures themselves carry out a negative function. They determine what can not be said about negation and in so doing limit the possibilities for what can be said. Piaget, at least, made an attempt. He realised the necessity for an attempt on negation. Paradoxically, his analysis does not deal with necessity, but with sequence and the problems generated can be traced to a predilection for temporal analysis. The impossibility of a valuable temporal

distinction between acquisition and justification was realised in the psycholinguists failure to differentiate linguistic transformations. Piaget's attempts provide more evidence that epistemological processes are not open, in any simple way, to temporal analysis.

An alternative approach is available. An attempt on negation may be atemporal and formal; the philosophical insights of 2,500 years need not be ignored and the behaviour of the infant whether naturalistically or experimentally observed should enter the analysis. However Piaget created his analysis, he did not systematise it to concur with these criteria.

9.4. A preliminary analysis can now be attempted.

In both the logical and the natural world the acquisition of affirmations cannot be separated from the acquisition of negations.

Negation is a process or acquisition constructed before perception. Negation makes perception possible.

The notions of verification (TRUTH) and falsification (FALSEHOOD) collapse without the prior acquisition of a pair of contradictory predicates; affirmation and negation.

Affirmation of p and negation of not-p can, and indeed must amount to the same thing. The infant can either affirm that the mobile moves or deny that the mobile does not move.

Neither affirmation nor negation can be regarded as more natural or more spontaneous than the other.

Negation has an object in addition to its corresponding affirmation. Negation has a purpose.

In the natural world the justification of negation depends on naturalistic observation. In the logical world the justification of negation depends on formal observation. Negation in the logic of

learning is different from negation in the logic of causation.
The purpose and nature of negation in any organism can only be inferred from its behaviour.
The self-evidence of these points is disputed by the only extensive analysis of negation in the infant. Piaget found no necessity for any of these conjectures.

9.5. As for justification the experimenter can only attempt to map the logical content and structure of negation acquired by interpretation of the infants observed behaviour onto the logical content and structure of negations justified by the formal attributes of the different conditions involved. The end point of the analysis is the infants construction of negation.

9.5.1. The following interpretations were made to account for the observed behaviour of the infant in the different conditions. In general, negation is manifested in all of the different behavioural categories already observed. The object, nature and structure of these negations is, at the moment, unknown, but the fact of their existence can only be disputed by rejecting the conjectures of 9.4 and denying that all determination is negation.
The analysis must attempt to account for the salient observations.

a) The distinct behavioural categories of (100,0), (100,10), (0,100) and (0,0), (0,10), (0,50), (0,90).

b) The distinct behavioural categories of (0,0) and (0,10), (0,50), (0,90).

c) The presence of a reaction (the infant by change in rate or affect appears aware that something different has happened) to

transfer conditions.

	FROM	TO
1)	100,10	0,10
2)	100,10	0,0
3)	100,0	0,0
4)	100,0	0,100
5)	100,0	100,10
6)	0,0	100,10
7)	0,100	0,90

d) The absence of a reaction (the infant appears unaware that something different has happened) to transfer conditions.

	FROM	TO
1)	100,10	100,0
2)	0,50	0,0
3)	0,90	0,100

9.5.2. The formal attributes of negation can be examined on three levels. The level of the infant's behaviour (l), the level of the external event (m) and the level of the relationship between the two (r). The following categories are involved:

Acquired propositions - TRUE or FALSE

Affirmed propositions and negated propositions

Observed (Justified) propositions and Unobserved (Unjustified) propositions.

The complete inventory of logical categories would therefore demand 24 different categories. Fortunately the analysis can reduce the categories.

The unjustified categories are relevant in that they provide the source for projections at each level. But because the analysis seeks to explicate justification through negation, only the justified

categories are of interest at each level.

Affirmation and negation must be able to say the same thing, therefore the truth value of the propositional content is irrelevant to the formal construction (although as will be seen it may play an important part in the formal mapping by the infant). Thus justified affirmed true propositions and justified affirmed false propositions can be defined together as justified affirmed propositions (JA). Similarly justified negated false propositions and justified negated true propositions can be defined together as justified negated propositions (JN).

The different conditions can therefore be examined according to the possible observations and projections of affirmation and negation at each level. Only three categories are required:

Relevant but unjustified propositions (R)

Justified affirmed propositions (JA)

Justified negated propositions (JN)

The preliminary analysis at 9.4 produces two further restrictions relevant to the formal analysis.

JA and JN at each level must provide pairs of contradictory predicates. Thus the formal analysis will project a specific JN from a specific JA or vice versa.

Negation has an object by which the corresponding affirmation is constructed and vice versa. The formal analysis can only proceed by specification of the object. The only object available is the truth value of the propositional content at each level. Thus the formal infant can justify relationships only by observation of TRUE propositions or by observation of FALSE propositions.

The formal analysis produced by the above specification; (Three

observable levels; behaviour (l), external event (m) and relationship (r). Three logical categories; relevant propositions (R), justified affirmed propositions (JA) and justified negated propositions (JN). Two objects of justification; TRUE propositions and FALSE propositions); is as follows for each experimental condition. See Table 9.5.2

Table 9.5.2

		Justification by Affirmation of True Propositions			Justification by Affirmation of False Propositions					
		l	m	r	l	m	r	l	m	r
100,0	1	T	T	T	JA	JA	JA	R	R	R
	2	F	T	T	JN1	R	R	R	JN4	JN6
	3	T	F	T	R	JN1	R	JN4	R	JN7
	4	F	F	T	R	R	JA	JA	JA	R
	5	T	T	F	R	R	JN1	JN6	JN7	R
	6	F	T	F	R	JA	R	JA	R	JA
	7	T	F	F	JA	R	R	R	JA	JA
	8	F	F	F	JN7	JN6	JN4	R	R	R
100,10	1	T	T	T	JA	JA	JA	JN2	R	R
	2	F	T	T	JN1	JA	JA	JA	JN4	R
	3	T	F	T	R	JN1	R	JN4	R	JN7
	4	F	F	T	R	JN2	JA	JA	JA	R
	5	T	T	F	R	JA	JN1	JN6	JN7	R
	6	F	T	F	R	JA	JN2	JA	R	R
	7	T	F	F	JA	JN5	R	JN8	JA	JA
	8	F	F	F	JN7	JN5	JN4	JA	R	R
0,10 0,50 0,90	1	T	T	T	R	R	R	JN2	JN3	JN5
	2	F	T	T	R	JA	JA	JA	JN4	R
	3	T	F	T	JA	R	JA	JN4	JA	R
	4	F	F	T	JN3	JN2	JA	JA	JA	R
	5	T	T	F	JA	JA	R	JN6	JN7	JA
	6	F	T	T	JN5	R	JN2	JA	JN8	R
	7	T	F	F	R	JN5	JN3	JN8	JA	R
	8	F	F	F	R	R	JN4	JA	JA	R
0,100	1	T	T	T	R	R	R	JN2	JN3	JN5
	2	F	T	T	R	JA	JA	JA	R	R
	3	T	F	T	JA	R	JA	R	JA	R
	4	F	F	F	JN3	JN2	R	R	R	JN8
	5	T	T	F	JA	JA	R	R	R	JA
	6	F	T	F	JN5	R	JN2	R	JN8	R
	7	T	F	F	R	JN5	JN3	JN8	R	R
	8	F	F	F	R	R	R	JA	JA	JA

0,0	1	T	T	T	R	R	R	R	JN3	JN5
	2	F	T	T	R	R	R	R	JN4	JN6
	3	T	F	T	JA	R	JA	JN4	JA	R
	4	F	F	T	JN3	R	JA	JA	JA	R
	5	T	T	F	JA	R	R	JN6	JN7	JA
	6	F	T	F	JN5	R	R	JA	JN8	JA
	7	T	F	F	R	R	JN3	R	JA	R
	8	F	F	F	R	R	JN6	R	JA	R

Table 9.5.2 defines the formal attributes at each level. A specific analysis at every level would be very cumbersome. A preliminary analysis can be attempted by making a formal comparison between conditions.

When justification is by observation of true propositions:

a) At the level of the behaviour:

(100,0) and (100,10) are identical

(0,0), (0,10), (0,50), (0,90) and (0,100) are identical.

b) At the level of the external event:

(100,0) is unique

(100,10) is unique and contains (100,0), (0,0), (0,10), (0,50) and (0,90).

(0,0) is unique

(0,10), (0,50) and (0,90) and (0,100) are identical

c) At the level of the relationship:

(100,0) is unique

(100,10) is unique and contains (100,0)

(0,0) is unique

(0,10), (0,50) and (0,90) are identical and contain (0,0) and (0,100)

(0,100) is unique.

When justification is by observation of false propositions:

d) At the level of the behaviour:

(100,0) and (0,0) are identical

(100,10), (0,10), (0,50) and (0,90) are identical and contain (0,0), (100,) and (0,100)

(0,100) is unique.

e) At the level of the external event:

(100,0) and (100,10) are identical

(0,0), (0,10), (0,50) and (0,90) are identical and contain (100,0), (100,10) and (0,100)

(0,100) is unique.

f) At the level of the relationship:

(100,0) is unique and contains (100,10)

(100,10) is unique

(0,0) is unique and contains (0,10), (0,50) and (0,90)

(0,10), (0,50) and (0,90) are identical

(0,100) is unique and contains (0,10), (0,50) and (0,90).

9.6. A mapping of 9.5.1 onto 9.5.2 is considerably complicated by the possibility of a justificatory imbalance between affirmation and negation at different levels. For example, justification could be carried out by the infant by an analysis of affirmation at one level and negation at a different level.

A further complication arises from the possibility of a further imbalance between the objects of the justification. Thus justification could be carried out by the infant by analysis of affirmation at one level for one truth value and analysis of negation at another level for the other (or possibly the same) truth value.

The infant must indeed have acquired the affirmation if the negation is acquired and vice versa, but the infant is under no compulsion to give these acquisitions equality in justificatory importance. The necessity for a formal balance between affirmation and negation is reflected in acquisition, but not in justification. However it has been noted that affirmations and negations can only exist as matched pairs. This must apply in both acquisition and justification. Thus in the natural world any affirmation once acquired may be matched with a negation once acquired. For the purposes of justification, affirmations and negations may not be fixed.

The greatest complication is the possibility that two types of

negation are involved; one from the logic of learning; one from the logic of causation. The analysis would be made easier if indeed one negation was merely a stricter version of the other. For example, negation from causation could contain negation from learning plus some other restriction on justification. There is no guarantee that this is the case. The acquisition of the two logics may be identical, but negations may be very different. The different conditions justified may reflect this difference.

In spite of these considerable complications the mapping can be attempted with the aid of the observed behaviour, formal necessities and the processes already discovered. The analysis can move from the simplest interpretation of negation to the more complex.

9.6.1. The simplest construction of negation is its placement at the level of the behaviour or at the level of the external event when true propositions are affirmed.

Conditioning theory could assimilate either construction, but the choice would have to be consistent.

These interpretations are quickly refuted by the observed evidence. 9.5.2 a) and b) do not make the necessary distinctions between conditions. For example, 9.5.2 a) cannot explain the presence of a transfer reaction from (100,0) to (100,10). 9.5.2 b) cannot explain the transfer reaction from (0,100) to (0,90).

In summary;

9.5.2 a) accounts for 9.5.1 c) 1) to 4) and 9.5.1 d) 1) to 3). It does not account for 9.5.1 a); 9.5.1 b) and 9.5.1 c) 5) to 7).

9.5.2 b) accounts for 9.5.1 b); 9.5.1 c) 3) to 6) and 9.5.1 d) 1) to 3). It does not account for 9.5.1 a) and 9.5.1 c) 1) and 2).

9.6.2. Negation constructed only at the level of relationships when true propositions are affirmed contains the formal differentiation necessary for specification of different conditions. 9.5.2 a) accounts for 9.5.1 b); 9.5.1 c) 1) to 7) and 9.5.1 d) 1) to 3). It does not account for 9.5.1 a) in any obvious manner.

9.6.3. Negation constructed as for 9.6.1, but when false propositions are affirmed does not map onto the observed evidence any better than 9.6.1.

9.5.2 d) accounts for 9.5.1 c) 4) to 7) and 9.5.1 d) 1) to 3). It does not account for 9.5.1 a); 9.5.1 b) and 9.5.1 c) 1) to 3). 9.5.2 e) accounts for 9.5.1 c) 1) to 4), 7) and 9.5.1 d) 1) to 3). It does not account for 9.5.1 a); 9.5.1 b) and 9.5.1 c) 5), 6).

9.6.4. Negation constructed at the level of the relationship when false propositions are affirmed contains the formal differentiation necessary for specification of different conditions. 9.5.2 f) accounts for 9.5.1 b); 9.5.1 c) 1) to 4), 6) and 7). It does not account for 9.5.1 a) in any obvious manner; 9.5.1 c) 5) and 9.5.1 d) 1) to 3).

9.7. The Logic of Learning

If negation is constructed only at one level, the interpretation provided by construction at the level of the relationship when True propositions are affirmed and False propositions are negated produces the best account of the observed data. 9.6.2 accounts for all but 9.5.1 a). But the account of negation relevant to the Logic of Learning need not account for this observation. The interpretation offered in Chapter 8 places 9.5.1 a) as an observation relevant to the Logic of Causation.

9.6.2 therefore accounts for all the data relevant to the logic of learning. Negation and justification are constructed on this level. Now that the level has been identified, the details of this construction can be examined.

Table 9.7

Justification by Affirmation of True Propositions and Negation of False Propositions at level (r) for experimental conditions.

				CONDITION				
	l	m	r	100,0	100,10	0,10 0,50 0,90	0,100	0,0
1	T	T	T	JA	JA	R	R	R
2	F	T	T	R	JA	JA	JA	R
3	T	F	T	R	R	JA	JA	JA
4	F	F	T	JA	JA	JA	R	JA
5	T	T	F	JN1	JN1	R	R	R
6	F	T	F	R	JN2	JN2	JN2	R
7	T	F	F	R	R	JN3	JN3	JN3
8	F	F	F	JN4	JN4	JN4	R	JN4

Table 9.7 shows in detail how the infant differentiates between conditions. The questions about negation in the logic of learning can now be specified.

1) Is it presence or absence of justification which differentiates learning conditions.

2) Are affirmations and negations inextricably bonded or is there primacy of one over the other.

The first question has already been answered. Two symmetrical observations provide strong evidence that it is the presence of justified observations which differentiates conditions.

The infant reacts to transfer from (100,0) to (100,10) and from (0,100) to (0,90). The infant does not react to transfer from (100,10) to (100,0) and from (0,90) to (0,100).

The infant differentiates the conditions in the first case and fails to differentiate in the second. From Table 9.7 it can be seen that (100,0) is implied by (100,10); (100,10) contains all the justifications that define (100,0), plus two more. Likewise (0,100) is implied by (0,90); (0,90) contains all the justifications that define (0,100), plus two more. The infant does not react to transfer to (100,0) and (0,100) because no new relevant lines have been justified. The implication is that constructed justifications are retained, they do not fall back into relevance as an 'out of sight out of mind' hypothesis would predict. It is the presence of justification which differentiates conditions in the logic of learning.

The second question concerns the bonding and primacy of affirmation and negation. On the observational level the analysis does not appear to offer an answer. By definition every affirmation has a corresponding negation. Observed differentiation may be attributed to either but no evidence is forthcoming.

A teleological and formal analysis delivers a veridical answer. The infant in order to develop later adult acquisition must have in its logical repertoire all eight lines of Table I. The infant in order to develop later adult acquisition must possess a notion of negation. But where can this notion of negation be applied in the logic of learning? To make learning possible the infant must categorise all relationships as logical. For the infant there are no non-logical relationships. The notion of negation cannot therefore be applied

outwith the level of the logic. The logic of being and the logic of learning appear to be similar and different from all other logics in this respect. Negation for both is always directed within the logic. Only with these two logics is there this imbalance between affirmation and negation. In the logic of being the infant must affirm that an object has being or non-being. In the logic of learning the infant must affirm that a relationship is affirmed or negated. In both cases outwith the level of the logic there is no negation present. In all other logics, negation transcends the construction of the content of the logic. Thus the infant affirms and negates causal relationships or affectionate relationships or fearful relationships.

It appears that the logic of being and the logic of learning are the only logics where affirmation and negation are not inextricably linked. For the infant there are no not-being or non-logical relationships.

But negation must enter the analysis somewhere, otherwise the infant will affirm everything and deny nothing. In the logic of learning the only possibility for this negatory input is at the level of the relationship r. There can be no imbalance at this level. All justified affirmations have a corresponding negation. At the level of the relationships defined within the logic of learning, affirmation and negation must be inextricably bonded. One cannot be prior to the other in any sense; thus one cannot be acquired before the other, or justified before the other. Piaget's assertion is formal nonsense. Because there is no primacy to affirmation or to negation in the logic of learning the infant must regard both as being of equal value within the epistemic process. In effect, the infant sheds the

affirmation or negation label with its attendant value judgements. Any affirmations or negations observed are justified.

This raises the fascinating possibility that infants operate from what appears to the adult to be a perpetually contradictory state of affairs.

Every time the infant justifies,

Line 1) T T T

the infant also justifies

Line 5 T T F

Every time the infant justifies

Line 2) F T T

the infant also justifies

Line 6) F T F

Much infant behaviour from the investigators point of view is consistently perplexing. But contradictory behaviour is not contradictory within a contradictory logic.

9.8. The Logic of Causation

Causation can be treated as a special form of learning; personal efficacy rather than general efficacy. There is, of course, no guarantee that this is the case. Justification in the logic of causation could be carried out at any of the levels outlined in 9.6. A quick examination of justification constructed by affirmation of true propositions eliminates levels 1 and m. In both cases (0,100) is formally identical to (0,0), (0,50) and (0,90).

As a working assumption causation can be initially treated as a special form of learning. The level for analysis is therefore the relational level when true propositions are affirmed. Even with the advantage of the insight that it may be irrelevant to justification

whether construction is by affirmation or by negation, no obvious differentiation is available. The behavioural categories are clear. All the behavioural evidence indicates that:

Something about (100,0), (100,10) and (0,100) justifies the construction of a causal relationship.

Something about (0,0), (0,10), (0,50) and (0,90) justifies the construction of a non-causal relationship.

The simplest interpretation would point to the presence or absence of a particular justification as definitive for causation.

(100,0) and (100,10) do differ from (0,0), (0,10), (0,50) and (0,90) in that justification at Lines 1) and 5) is present, at Lines 3) and 7) is absent in the causal condition. But (0,100) does not display these differences. Lines 1) and 5) are not justified and Lines 3) and 7) are justified in (0,100).

Neither will the analytic problem be solved by projection of a change in propositional content in (0,100). If propositional content is changed in (0,100), then why not in (0,0), (0,10), (0,50), (0,90) and eventually (100,0) and (100,10)? Such an explanation may produce a coherent interpretation, but the inclusion of an ad hoc theoretical specification cannot be denied.

A more complex interpretation is that definition of causation is brought about by analysis of a particular nexus of justifications. This interpretation is easily refuted by the unassailable fact that (0,100) is contained within (0,10) (0,50) and (0,90). Whatever nexus is present within (0,100) is also present in the non-causal conditions.

The analysis has come to an end for the question about the presence or absence of justification. It is neither the presence nor the

absence of justification which differentiates causal from non-causal conditions. The question can be reformulated.

Is it present or absence of relevant categories which differentiates causal from non-causal conditions?

Table 9.7 shows that there is a consistent difference between causal and non- causal conditions. All eight lines are relevant between the three causal conditions. Only Lines 1, 2, 5 and 6 are relevant between the non-causal conditions. The analysis appears to offer two answers. (100,10) and (100,0) are differentiated from non-causal conditions by the presence of relevance at Lines 3) and 7). (0,100) is differentiated from non-causal conditions by the presence of relevance at Lines 4) and 8).

But Lines 3, 4, 7 and 8 have something in common. They are the complete set of lines produced by observation of the mobile at rest. It is not the absence of justification which defines causation, it is the presence of relevance at the relational level for a restricted category. The infant defines relationships as causal when relevant observations are made of non-mobile movement. The infant defines relationships as non-causal when no relevant observations are made of non-mobile movement.

This interpretation is coherent, systematic, accounts for all the observations and is entirely implausible to most adults and all behaviourists. In behavioural terms, the infant appears to observe the presence of an absence (Relevance without justification) of the non- occurrence of a reinforcement (Non-mobile movement).

Are there any other interpretations? All of the information available to the infant is contained within Table 9.5.2. Justification of causation by affirmation of false propositions has not yet been

examined.

Level l cannot provide an interpretation. (100,10) is identical to (0,10, (0,50) and (0,90).

Level m does provide an interpretation. The non-causal conditions at level m display justification of all lines.

(100,0) and (100,10) have justification present at lines 2, 4, 5 and 7.

(100,0) and (100,10) have relevance present at lines 1, 3, 6 and 8.

(0,100) has justification present at lines 1, 3, 6 and 8.

(0,100) has relevance present at lines 2, 4, 5 and 7.

Because of this symmetry between (0,100) and (100,0), (100,10) the presence or absence of any particular justification or relevance cannot be the differentiating feature in causation. But the complete justification in the non-causal condition means that the causal condition could be defined either by the presence of any relevance or the absence of any justification.

Level r provides an interpretation. Non-causal conditions have justification present at lines 1, 2, 5 and 6 and relevance present at all lines. Causal conditions have justification present at all lines and relevance present at all lines. Differentiation could therefore be achieved by the presence of justification at lines 3, 4, 7 and 8.

There is an obvious symmetry with the first interpretation. This symmetry is a product of the formal construction of Table 9.5.2. They are, however, very different interpretations. All three interpretations account for the observed behavioural categories. Can a choice be made between them?

INTERPRETATION 1 : Justification in the logic of causation is con-

structed at the relational level by observation of the relationships defined as m(F) when true propositions are affirmed.

INTERPRETATION 2 : Justification in the logic of causation is constructed at the level of the external event by observation of complete or incomplete justification when false propositions are affirmed.

INTERPRETATION 3 : Justification in the logic of causation is constructed at the relational level by observation of the relationships defined as m(F) when false propositions are affirmed.

9.8.1. All three interpretations concur in the absolute categorisation of conditions as causal and non-causal. Choice between interpretations cannot be made by using contrastive predictions. Choice can be made using other evidence.

Interpretations 1 and 3 are implied by 2. Interpretations 1 and 3 are more restrictive. They make specific claims about particular relationships. Thus they are more open to falsification. Interpretations 1 and 3 are superior with respect to refutability.

Interpretation 1 is easier to understand. Most adults find it easier to affirm true propositions and negate false propositions. Interpretations 2 and 3 affirm false propositions and negate true propositions. Interpretation 1 is superior with respect to communicability.

Interpretations 1 and 3 are supported by the observed differences in behaviour in (0,0) and other non-causal conditions. Something about (0,0) allows easy construction of a non-causal connection. Interpretation 2 does not differentiate (0,0) from other non-causal conditions. Interpretation 1 assimilates this observation by stating that the only justified relationships observed in (0,0) are non-

causal. Interpretation 1 is superior with respect to observed evidence.

Interpretations 1 and 3 are more consistent than 2. It is a theoretical inconsistency to claim that infants learn logical connections by observation of specific logical relationships, but abandon this particular observation for an absolute in causal relationships. Interpretations 1 and 3 are superior with respect to consistency.

The theory acquired by learning can be transferred direct to causation only in Interpretation 1. Just one specification is required, the role of content in not-m relationships. Interpretation 1 is superior with respect to parsimony.

Interpretation 1 is affirmed.

9.9. Summary

The unique status of negation was explicated. Negation produces consensus in thinkers as diverse as Neitzsche and Spinoza. For both "All determination is negation". Piaget's treatment of negation was analysed and dismissed.

A preliminary analysis and mapping using formal structure and observed evidence produced veridical results for the logic of learning. Only one interpretation is available. Justification is constructed by the observation of relationships produced by the affirmation of true propositions and the negation of false propositions. The differentiating categories are justification and relevance. The presence of justification has differentiating primacy. Within the logics of being and learning, affirmation and negation are inextricably lined.

Justification in the logic of causation is constructed by a specified negation applied to the logic of learning. Causal relationships are

defined by observation of relevant categories in m(F). Non-causal relationships are defined by observation of justified categories in m(F). The presence of relevance differentiates causal from non-causal conditions.

CHAPTER 10

SUMMARY AND IMPLICATIONS

The infant at the beginning of this study was characterised as inadequate. This prejudice is inherent in every "What children cannot do" approach. The very few positive statements about infant's cognitive capacities are couched in patronising or cautious language.

> "I hold that recent work supports the view that the preschooler possesses some cognitive capacities, capacities that might be less complex than, or even different from, those of the older child, but which are nevertheless very real." (Gelman 1978)

The infants' behaviour in this experimental situation can be interpreted as simple, chaotic, accidental, random or reflex. These interpretations are parsimonious, coherent and communicable. They are also irrefutable; they ignore the experimental evidence, the necessities of formal analysis and teleology; they do not therefore qualify as scientific interpretations. An approach which concurs with the restraints produced by the necessities of formality, teleology and observed behaviour produces a very different characterisation. This epistemological analysis indicates that the cognitive capacities of the infant have been underestimated. The following facts are asserted from the preceding analysis. They apply to 13 to 20 week old infants.

The infant possesses notions of propositional capability, permanence, identity and negation. The infant uses these notions to acquire and justify knowledge.

The infants acquisitive capability is different from the adults. The infant can acquire any logical relationship acquired by the adult. The converse is not true. The adults' acquisitive capabilities are inadequate when compared to the infants'. The infant justifies knowledge for a particular purpose. Justification varies with logics. Justification in the logic of learning is different from justification in the logic of causation. Justification in the logic of learning is constructed at the relational level by observation of logical categories when true propositions are affirmed. Justification in the logic of causation is constructed as for the logic of learning, but with one added specification. It is not the presence of justified relationships, but the presence of relevant relationships which defines causal conditions.
The questions asked in Chapter 3 can now be answered.

10.1. The Logic of Learning

1) Does the infant use a two-valued logic or a different system?

The infant uses a two-valued system both in acquisition and justification. The infant uses a two-valued system which generates matched pairs of predicates. These pairs are not contradictory to the infant. They are inherently contradictory to the adult. The infant appears to learn through construction of contradiction. The adult cannot learn with contradiction.

2) The infants' construction of negation has been explicated.

3) Is the infants' logic synchronically fixed or flexible?

The infants' logic is flexible for relevant categories and fixed for justified categories. Justified categories once constructed are held; they do not fall back into relevance.

4) The logic is not reversible.

5) What is the import of propositional content?

The system is content free. Any propositional content may be acquired. The relationships generated by affirmation and negation differentiate conditions. The content itself is irrelevant.

6) The interaction between external world and behaviour is balanced. The infant delivers primacy to neither behaviour nor external event. Analysis up to the relational level is neutral. Thus behaviour is not epistemologically more useful than non-behaviour. Mobile movement is not epistemologically more useful than non-movement. Justification is constructed at the relational level.

7a) There are no optimal conditions for learning. All conditions are learning or logical conditions.

7b) The analysis cannot answer the developmental question, but it does provide the method whereby the question can be answered. Paradoxically, veridical observations from adults in learning situations may be harder to achieve because of the different influence of other logics, especially language.

7c) The infant never finds its learning theory untenable. The infant does not verify or falsify the application of the logic of being and the logic of learning. These two logics are

inherent in and essential for all other constructions. They can only be applied.

10.2. The Logic of Causation

1) Does the infant use a two-value logic or a different system?

The infant uses the same system already outlined in the logic of learning.

2) The infants' construction of negation has been explicated.

3) Is the infant's logic synchronically fixed or flexible?

The logic of causation appears remarkably inflexible. Causal constructions are not given up quietly. Primitive denial or violence appears instead of reversibility. Likewise, non-causal constructions are not easily superceded by causal constructions. In some respects the infant is an absolute optimist or an absolute pessimist.

4) The logic if not reversible.

5) What is the import of propositional content?

The system is content bound at 1. The necessary content at 1 is the efficacious self. The system is content free at m and r.

6) The interaction between event, behaviour and non-behaviour is balanced.

The infant delivers primacy to the non-event not-m. The non-event is epistemologically more important than others. It provides the defining category for causation.

7a) The optimal conditions for discovering causal conditions are those which are defined by the presence of relevance at Lines 3, 4, 7 and 8.

The minimal conditions for discovering causal conditions are those which are defined by the presence of relevance at Lines 3 and 7 or at Lines 4 and 8.

The optimal conditions for discovering non-causal conditions are those which are defined by the presence of justification at Lines 3, 4, 7 and 8 and the presence of relevance elsewhere.

The minimal conditions for discovering non-causal conditions are those which are defined by the presence of justification at Lines 3, 4 7 and 8 and the presence of justification elsehwere.

7b) Again the analysis cannot answer the developmental question.

7c) The infant never finds it causal theory untenable. Things are in a non-causal relationship or Things are in a causal relationship.

10.3. Implications

10.3.1. CAUSALITY : The theory makes specific predictions about untested conditions.

	NON-CAUSAL	CAUSAL	
TESTED	0,0	0,100	TESTED
TESTED	0,50	100,0	TESTED
UNOBSERVED	50,0	100,100	UNOBSERVED
UNOBSERVED	50,50	100,50	TESTED
UNOBSERVED	50,100		

The unobserved causal condition (100,100) is not a causal condition for the adult. The adult would certainly not impute any personal

efficacy to a condition which exhibits constant movement regardless of behaviour. The fact that the infant may impute a personal efficacy to such a situation does not make the infants' analysis defective or inadequate or out of touch with reality. Formally, the infants' analysis is perfect and from the point of view of survival there are obvious advantages in maintaining an interest in moving things.

The point is open to empirical investigation.

10.3.2. Extension The theory is content free at all but 1 in the logic of causation and has considerable potential. It can be extended to all situations and experiments which can be represented in terms of components or propositions. Because all experiments are represented in terms of indpendent variables, by definition all experiments can be represented propositionally. Thus the theory provides the means whereby a unifying theory can be constructed. This theory will assimilate findings from diverse experimental situations whether natural, logical, social, abnormal or object concept.

Several well known phenomena are theoretically illuminated.

The infant fascinated by repetition of toy-throwing from the pram and recovery of the toy by the adult has been explained by use of "the out of sight out of mind" hyypothesis. This hypothesis is redundant in other object concept situations but the phenomenon remains.

This phenomenon is better explained epistemologically. The infant wants to acquire logical content and structure for at least three logics; being, learning and causation. The infant learns that throwing is observed with object disappearance and reappearance. If the proposition m at the level of the external event is object appearance then the efficacious infant will be more interested in

object non-appearance not-m. But the infant is never allowed to justify Lines 3, 4, 7 and 8 as long as the adult is playing the game. Therefore the infant observes relevance at these lines and defines the situation as causal. The infant's anger at the end of the game is not assuaged by the toy. The infant's anger is the same anger observed in transfer from (100,0) to (0,0). The theory predicts that at termination of the game the adult should not give the infant the toy. At least this disappearance (m(F)) will provide the infant with the required content at lines 3, 4, 7 and 8. The reaction to change from causal to non-causal condition will still emerge, but the anger may be ameliorated because the infant has got some of what it wants. Its logical structure has been completed. Another well-documented phenomenon is the 'AAB' error.

> "The Stage IV infant, though, still seems to have a peculiar concept of objects. The infant will look for an object if the object is hidden under a cloth. If, however, the infant is allowed to find an object under the same cloth two or more times, and then, the object is hidden within the infant's view, but under a different cloth in a different place, the infant will look for the object in its original place under the first cloth - totally ignoring the actual location of the object. This happens even if the hidden object is quite large; the infant will still pick up the flat cloth that had previously covered the object. This error implies that the infant does not yet really understand that an object that has been covered by a cloth is under the cloth. The infant seems to think that an object that has been hidden will always be found in the same place". (Bower 1982)

The epistemological theory delivers a totally different implication. There has been no error. The infant understands that an object that has been covered by a cloth is under the cloth. The infant, in an attempt to fill in the logic of learning and causation must observe not-m or where the object is not. In the eyes of the adult; the infant makes an error because the adult assumes the infant is looking

for the object. In the epistemology of the infant there is no error. The infant gains more information by observation where the object is not; not-m; then by repetition of observation of where the object is; m. Again the infants anger and surpise is manifested because lines 3 and 4 have been justified. The infant looks 1 and does not look not-1 and the object is gone not-m; justification by observation is complete and a causal situation is redefined as non-causal. The infants subsequently apparently random search activities are not random; they are successful attempts to justify lines 3, 4, 7 and 8. The infant is learning.

The epistemological analysis predicts that given two cloths and consistent hiding under one cloth, the infant will attempt to look under the other cloth. This behaviour, of course, is easily explained away by the ad hoc descriptivists as boredom. It is at best an inconsistency that the same behaviour should be simultaneously seen as an interesting error and as totally irrelevant.

The theory can similarly encompass all other relevant propositionally represented phenomena.

10.3.3. Interaction The analysis makes absolute statements about the interaction between the logics. Learning emerges from Being; Causation from Learning. There will be no point in development where the infant ascribes efficacy to self and not to others. The infant may indeed attribute all external events to personal activity, but self and others are defined as personal. This view is diametrically opposed to Piagetian interpretations.

> "Causality consists in an organisation of the universe caused by the totality of relations established by action and then by representation between objects as well as between object and subject. Hence causality presupposes at all levels an

> interaction between self and things, but if the radical eqocentrism of the beginnings first leads the subject to attribute all external events to personal activity, the formation of a permanent universe subsequently enables the self to be located among things and to understand the totality of the sequences which it sees or in which it is engaged as cause and effect."

> "Just as people doubtless constitute the first permanent objects recognised by the baby, so also they are very probably the first objectified sources of causality because, through imitating someone else, the subject rapidly succeeds in attributing to his model's action an efficacy analogous to his own". (Piaget 1955)

In Piagets view, observation or construction of the efficacious self is a necessity for observation or construction of efficacious others. An opposing analysis is offered. The efficacious other is a necessity for the efficacious self. Piaget sees the infant as a megolomaniac with delusions of cosmic omnipotence. The opposing analysis suggests that the infant is a logician.

In addition to the argument that gods don't cry, but logicians do; an interesting empirical approach could contrast the constructions of the infant as causal participant and as causal observer.

10.3.4. Development The analysis does not offer an answer to the why of development, but it imples an answer to the 'how'. Some of the important features of the infant's logics have been determined. Similar features of the adult's logics are also said to be known. A contrast between the two should indicate what specifications the infant must make to acquire later logics.

The logics of normal infants appear to be surprisingly alike and surprisingly unlike the logics of normal adults. Infants appear to use an absolute, two- valued but contradictory reasoning ability combined with a very abstract notion of negation. Adult logic can be

characterised as probabilistic, two-valued and actualised with regard to negation. Many adults find it very difficult to even think about negation in the abstract.

A change from infant to adult logic can be brought about by one structural change. The developing human must eventually apply the law of contradiction at the relational level. This application will restrict the infant's acquisition (Any combination or permutation of Table I) to the adult's acquisition (Table II).

It is clear that the infant is aware of the law of contradiction. The infant's reaction to non-causal transfer conditions after causal initial conditions can only be explained by the possession of 'never p and not-p'. The infant projects the non-existence of the causal condition from the existence of the non-causal condition. The puzzle is why should the infant possess a logical distinction (contradiction) but not use it in some of its constructions. The infant uses the distinction to separate causal from non-causal conditions but the infant does not make use of the distinction during justification at the relational level. T T F is not contradicted by T T T. There are a number of ad hoc answers to this puzzle. Contradiction may be action based, content free or content bound. An answer, consistent with the preceding analysis, is produced by the insight that being and learning are always applied. It is impossible for these applications to be negated. The application of being and learning is always appropriate. Negation exists only within these two logics. In all other logics negation exists both within and outwith all applications. Thus the law of contradiction may only be applied if the logic itself can be affirmed and negated. The law of contradiction can therefore be applied to causation, there are causal rela-

tionships and non-causal relationships, but not to learning, there are only learning relationships.

This interpretation implies that at the point where the infant asserts, adult-like, the existence of learning and non-learning relationships, the infants logical values will collapse and the adult values emerge. This assertion is itself constructed by the application of negation to the logic of learning. In effect, the infant's logic of learning collapses into the adult's formal justification of causation (Table II). This collapse could explain why certain categories have generated the bulk of research on learning and causation. Because learning has become causation, causation itself may be pushed into the more restricted categories of Lines 3, 4 and 9 Table II. Investigators consider that there is something 'naturally' causative about these relationships, because these are undeniably the relationships investigated. They are partial reinforcement; non-contingent reinforcement and 100% reinforcement. All the other relationships are ignored. They are not considered learning or causal relationships even although the adult possesses the formal proof that they are precisely what they are said not to be.

The infant is not the only one who may possess the law of contradiction but fail to apply it.

10.3.5. Problems

The analysis has produced a consistent theory. Several important questions remain unanswered.

The infant's acquisition and justification of propositional content is a process which may require a separate explanatory logic. Empirical isolation of this process may be very difficult.

Propositional content is linked to the major unresolved problem. If

indeed, the infant's logics are absolute and situations are defined as causal or non-causal, the infant must learn to abandon this analysis. Reassessment of the situation must be made before adaptive change can occur. Thus different propositional content can inhabit identical logical structures and identical propositional content can inhabit different logical structures. The infants analysis cannot be content bound and it cannot be permanent. The world changes and the infant must change with it.

The analysis has been deliberately restricted to logical structure. Time and content have been intentionally removed. A full analysis must eventually cope with changes in content and changes in analysis over time. The infants application of reversibility to content and structure over time is the major logical feature undetermined by the preceding analysis.

10.3.6. Conclusions A theory directed at the epistemological processes of the infant has been produced. Empirical evidence was collected and collated with respect to theory. Invigoration of the theoretically static domain of cognitive development in infancy was the result.

The analysis shows that data collection emanating from one simple experimental situation yields unlimited procedural possibilities. No progress can be made without a theoretical framework.

> "It is we alone who have fabricated causes, succession, reciprocity, relativity, compulsion, number, law, freedom, motive, purpose; and when we falsely introduce this world of symbols into things and mingle it with them as though this symbol-world were an 'in itself', we once more behave as we have always behaved, namely mythologically". (NIETZSCHE)

The infant is different from us and not a mythological creature.

LIST OF APPENDICES

APPENDIX I.

Group Results

Initial conditions

24 infants aged between 13 and 20 weeks provided 42 visits for initial conditions. The conditions for which data was obtained were:

CONDITION	NUMBER OF SUBJECTS
100,10	12
100,0	8
0,0	4
0,10	4
0,50	5
0,90	5
0,100	4

Group Results

(Table I.1) Mean rate of response by centile time in condition.

(Table I.2) Mean percentage rate of response by centile time in condition.

(Table I.3) a) Mean time in condition;

b) - g) Mean rate, percentage mean rate and mean rate per minute by split time in condition.

h) Total mean reponses in condition.

i) Mean rate per minute in condition.

Table I.1 Mean rate of response by centile time in condition

	CENTILE									
CONDITION	1	2	3	4	5	6	7	8	9	10
100,10	8.2	9.3	10.1	11.6	13.4	16.1	18.2	18.0	20.3	18.4
100,0	6.6	5.6	5.4	6.8	10.5	9.5	12.8	13.6	16.4	21.1
0,0	1.5	2.25	1.25	3.0	3.5	4.25	2.25	4.5	2.0	3.0
0,10	3.75	2.0	4.0	5.5	6.75	5.0	6.0	11.0	13.5	14.75
0.50	1.4	1.6	1.4	5.2	7.8	8.2	9.2	17.0	20.2	16.0
0.90	3.8	7.4	5.6	5.4	8.0	4.6	5.4	6.2	7.6	6.2
0,100	3.8	5.7	13.3	16.5	12.5	14.5	21.2	28.0	31.0	33.3
OVERALL	5.1	5.8	6.5	8.2	9.9	10.2	12.2	14.6	16.6	16.8

Table I.1.1 Difference and percentage difference in rate from 1st to 10th centile by condition

	CENTILE			
CONDITION	1st	10th	DIFFERENCE	PERCENTAGE DIFFERENCE 10th/1st
100,10	8.2	18.4	10.2	224
100,0	6.6	21.1	14.5	320
0,0	1.5	3.0	1.5	200
0,10	3.75	14.75	11.0	393
0,50	1.4	16.0	14.6	1143
0,90	3.8	6.2	2.4	163
0,100	3.8	33.3	29.5	876
OVERALL	5.1	16.8	11.7	329

Table I.1.2 Ranking of condition by difference in rate from 1st to 10th centile

	CONDITION	DIFFERENCE
1)	0,100	29.5
2)	0,50	14.6
3)	100,0	14.5
4)	0,10	11.0
5)	100,10	10.2
6)	0,90	2.4
7)	0,0	1.5

Table I.1.3 Ranking of condition by percentage difference in rate from 1st to 10th centile

	CONDITION	DIFFERENCE
1)	0,50	1143
2)	0,100	876
3)	0,10	393
4)	100,0	320
5)	100,10	224
6)	0,0	200
7)	0,90	163

Overall results from Table I.1 show a steady increment in rate of response from 5.1 in the 1st centile to 16.8 in the 10th centile. Leg movement increases by a factor of (x 3) from 1st to 10th centile. (Diagram 1)

Breakdown of centile results by condition indicates different contri-

butions to the overall increase. (Diagrams 3, 4 and 5)

Conditions which show the highest rate at the 10th centile are (0,100), (100,0) and (100,10). Both (0,90) and (0,0) do not show any major increase in mean rate of response. (0,50) and (0,10) show an intermediate mean rate of response.

Table I.2 Mean percentage rate of response by centile time in condition

	CENTILE									
CONDITION	1	2	3	4	5	6	7	8	9	10
100,10	5.1	6.1	6.2	6.5	8.6	12.0	12.4	13.8	15.5	13.7
100,0	5.8	4.3	5.1	6.2	10.0	8.7	11.1	12.2	15.0	21.4
0,0	4.9	6.8	7.1	12.3	13.6	17.2	7.2	17.0	6.2	7.7
0,10	6.3	4.7	6.7	8.3	8.2	6.9	9.9	13.3	16.6	19.6
0.50	3.4	3.4	3.4	4.4	5.8	6.9	10.7	19.9	24.2	17.7
0.90	4.1	128.	7.5	6.1	12.9	7.4	9.2	8.9	16.6	10.0
0,100	1.6	2.7	7.5	9.8	8.0	8.0	12.4	14.7	17.6	17.6
OVERALL	4.9	5.9	6.2	7.2	9.3	9.7	10.9	14.3	15.9	15.6

Table I.2.1 Difference and percentage difference in percentage rates from 1st to 10th centile by condition

	CENTILE			
CONDITION	1st	10th	DIFFERENCE	PERCENTAGE DIFFERENCE
100,10	5.1	13.7	8.1	269
100,0	5.8	21.4	15.6	369
0,0	4.9	7.7	2.8	257
0,10	6.3	19.6	13.3	311
0,50	3.4	17.7	14.3	520
0,90	4.1	10.0	5.9	243
0,100	1.6	17.6	16.0	1100
OVERALL	4.9	15.6	10.7	318

Table I.2.2 Ranking of conditions by difference in percentage rate from 1st to 10th centile

	CONDITION	DIFFERENCE
1)	0,100	16
2)	100,0	15.6
3)	0,50	14.3
4)	0,10	13.3
5)	100,10	8.1
6)	0,90	5.9
7)	0,0	2.8

Table I.2.3 Ranking of conditions by percentage difference in percentage from 1st to 10th centile

	CONDITION	DIFFERENCE
1)	0,100	1100
2)	0,50	520
3)	100,0	369
4)	0,10	311
5)	100,10	269
6)	0,90	243
7)	0,0	157

Overall results from Table I.2 display the same pattern as Table I.1. Percentage mean rate of response increases by a similar factor (x 3) from 1st to 10th centile. (Diagram 2)

Percentage results disguise differences in overall rate by condition therefore contributions to the increase by different conditions are

not clarified using percentage rate representation. (Diagrams 6, 7 and 8)

Ranking of conditions by differences and percentage differences in rate and percentage rate between 1st and 10th centile produced the following resullts.

			RANK		
CONDITION	DIFFERENCE in rate	PERCENTAGE difference in rate	DIFFERENCE in % rate	PERCENTAGE difference in % rate	TOTAL
100,10	5	5	5	5	20
100,0	3	4	2	3	12
0,0	7	6	7	7	27
0,10	4	3	4	4	15
0,50	2	1	3	2	8
0,90	6	7	6	6	25
0,100	1	2	1	1	5

Overall ranking by difference bettween 1st and 10th centile is:

GREATEST DIFFERENCE - 1) 0,100
2) 0,50
3) 100,0
4) 0,10
5) 100,10
6) 0,90
LEAST DIFFERENCE - 7) 0,0

TableI.3 a) Mean time per condition; b) - g) Mean rate, percentage mean rate and mean rate per minute by split time in condition; h) Total mean responses in condition and i) Mean rate per minute in condition.

CONDITION	a) Mean time	b) mean rate in 1st half	c) percentage mean rate in 1st half	d) rate per minute in 1st half	e) mean rate in 2nd half	f) percentage mean rate in 2nd half	g) rate per minute in 2nd half	h) total response in condition	i) rate per minute in condition
100,10	355	52.7	32.7	17.5	90.8	67.3	31.7	143.5	24.6
100,0	442.5	33.4	31.4	9.5	73.4	68.6	20.3	106.75	14.9
0,0	120	11.5	46	11.5	15.25	54	15.25	26.75	13.4
0,10	360	22	34.1	7.3	52	65.9	17.3	74	12.4
0,50	348	17.4	20.54	5.9	70.6	79.5	23.9	88	14.9
0,90	424	30.2	44.7	9.0	30	55.3	10.5	60.2	9.8
0,100	457.5	51.75	29.6	15.4	128	70.4	34.4	179.75	24.9
OVERALL	367	35	33.5	11.9	70.5	66.5	23.4	105.7	17.6

Table I.3.1 Diffference and percentage difference in mean rate from 1st half (col b) to 2nd half (col e) by condition

CONDITION	1st HALF	2nd HALF	DIFFERENCE	PERCENTAGE DIFFERENCE
100,10	52.7	90.8	38.1	172
100,0	33.4	73.4	40	220
0,0	11.5	15.3	3.8	133
0,10	22	52	30	236
0,50	17.4	70.6	53.2	406
0,90	30.2	30	-0.2	99
0,100	51.8	128	76.2	247
OVERALL	35	70.5	35.5	201

Table I.3.2 Ranking of condition by difference in mean rate from 1st half to 2nd half

RANK	CONDITION	DIFFERENCE
1	0,100	76.2
2	0,50	53.2
3	100,0	40
4	100,10	38.1
5	0,10	30
6	0,0	3.8
7	0,90	-0.2

Table I.3.3 Ranking of condition by percentage difference in mean rate from 1st half to 2nd half

RANK	CONDITION	DIFFERENCE
1	0,50	406
2	0,100	247
3	0,10	236
4	100,0	220
5	100,10	172
6	0,0	133
7	0,90	99

Table I.3.4 Difference and percentage difference in percentage rate from 1st half (col c) to 2nd half (col f) by condition

CONDITION	1st HALF	2nd HALF	DIFFERENCE	PERCENTAGE DIFFERENCE
100,10	32.7	67.3	34.6	206
100,0	31.4	68.6	37.2	218
0,0	46	54	8	117
0,10	34.1	65.9	31.8	193
0,50	20.5	79.5	59	388
0,90	44.7	55.3	10.6	124
0,100	29.6	70.4	40.8	238
OVERALL	33.5	66.5	33	199

Table I.3.5 Ranking of condition by difference in percentage mean rate from 1st half to 2nd half

RANK	CONDITION	DIFFERENCE
1	0,50	59
2	0,100	40.8
3	100,0	37.2
4	100,10	34.6
5	0,10	31.8
6	0,90	10.6
7	0,0	8

Table I.3.6 Ranking of condition by percentage difference in percentage mean rate from 1st half to 2nd half

RANK	CONDITION	DIFFERENCE
1	0,50	388
2	0,100	238
3	100,0	218
4	100,10	206
5	0,10	193
6	0,90	124
7	0,0	117

Table I.3.7 Difference and percentage difference in rate per minute from 1st half (col d) to 2nd half (col g) by condition

CONDITION -	1st HALF	2nd HALF	DIFFERENCE	PERCENTAGE DIFFERENCE
100,10	17.5	31.7	14.2	181
100,0	9.5	20.3	10.8	214
0,0	11.5	15.25	3.75	133
0,10	7.3	17.3	10.0	237
0,50	5.9	23.9	18.0	405
0,90	9.0	10.5	1.5	117
0,100	15.4	34.4	19.0	223
OVERALL	11.9	23.4	11.5	197

Table I.3.8 Ranking of condition by difference in mean rate per minute from 1st half to 2nd half

RANK	CONDITION	DIFFERENCE
1	0,100	19.0
2	0,50	18.0
3	100,10	14.2
4	100,0	10.8
5	0,10	10.0
6	0,0	3.75
7	0,90	1.5

Table I.3.9 Ranking of condition by percentage difference in mean rate per minute from 1st half to 2nd half

RANK	CONDITION	DIFFERENCE
1	0,50	405
2	0,10	237
3	0,100	223
4	100,0	214
5	100,10	181
6	0,0	133
7	0,90	117

Table I.3.10 Ranking of condition by rate per minute

RANK	CONDITION	DIFFERENCE
1	0,100	24.9
2	100,10	24.6
3	100,0	14.9
4	0,50	14.9
5	0,0	13.4
6	0,10	12.4
7	0,90	9.8

FROM TABLE I.3

MEAN TIME IN CONDITION

Apart from condition (0,0), mean time in condition varied between 348 seconds for (0,50) and 457 seconds for (0,100). The (0,0) condition proved aversive to infants, necessitating a decreased time in condition. (Diagram 9)

FROM TABLE I.3.1 to I.3.6

Ranking of condition by differences and percentage differences in mean rate and percentage mean rate between 1st half and 2nd half produced the following results.

CONDITION	RATE Difference in rate	Percentage difference in rate	Difference in % rate	Percentage difference in % rate	Total
100,10	4	5	4	4	17
100,0	3	4	3	3	13
0,0	6	6	7	7	26
0,10	5	3	5	5	18
0,50	2	1	1	1	5
0,90	7	7	6	6	26
0,100	1	2	2	2	7

Overall ranking by difference between 1st half and 2nd half is:

GREATEST DIFFERENCE -	1)	0,50
	2)	0,100
	3)	100,0
	4)	100,10
	5)	0,10
	6)=	0,0
LEAST DIFFERENCE -	6)=	0,90

FROM TABLE I.3.7 to I.3.9

Ranking of condition by difference and percentage difference in mean rate per minute between 1st half and 2nd half produced the following results:

CONDITION	RANK Difference in mean rate per minute	RANK Percentage difference in mean rate per minute	Total
100,10	3	5	8
100,0	4	4	8
0,0	6	6	12
0,10	5	2	7
0,50	2	1	3
0,90	7	7	14
0,100	1	3	4

Overall ranking by difference in mean rate per minute between 1st half and 2nd half is:

GREATEST DIFFERENCE -	1)	0,50
	2)	0,100
	3)	0,10
	4)=	100,10
	4)=	100,0
	6)	0,0
LEAST DIFFERENCE -	7)	0,90

SUMMARY OF GROUP RESULT - INITIAL CONDITIONS

1) Over the 42 visits, the specified behaviour, leg movement, increased with time spent in condition. (Diagrams 1, 2, 6, 7 and 8)

2) Different conditions made different contributions to the observed overall increase. (Diagrams 3, 4, 5, 10, 11 and 12)

a) Ranking of condition by differences between 1st and 10th centile and 1st half and 2nd half, produced consistent results for rate, percentage rate and rate per minute. Condition (0,50) and (0,100) produced the greatest differences; condition (0,90) and (0,0) the least.

b) Tables I.3.2, I..3.5 and I.3.8 show that condition (0,90) and (0,0) produced no differences between 1st half and 2nd half in terms of rate, percentage rate or rate per minute. (Diagrams 10,11 and 12)

3) Different conditions produce different rates per minute of the specified behaviour. Condition (0,100) and (100,10) produced the highest rates per minute, condition (0,90) produced the lowest. (Diagram 13)

4) Condition (0,0) produced a decreased time to criteria for termination. (Diagram 9)

APPENDIX II

Group Results

Transfer conditions

14 infants aged between 13 and 20 weeks provided 25 visits for transfer conditions.

The conditions for which date was obtained were:

CONDITION		NUMBER OF SUBJECTS
INITIAL	TRANSFER	
100,10	100,0	2
100,10	0,0	3
100,10	0,10	2
100,0	100,10	3
100,0	0,0	2
100,0	0,100	2
0,0	100,10	4
0,10	0,0	1
0,50	0,0	1
0,90	0,100	3
0,100	0,90	2

Group results

Table II.1 a) Mean time in condition; b) - g) Mean rate, percentage rate and mean rate per minute by split time in condition; h) Total mean responses in condition and i) Mean rate per minute in condition.

Table II.1

CONDITION		a)	b)	c)	d)	e)	f)	g)	h)	i)
INITIAL	TRANSFER	Mean time	Mean rate in 1st half	Percentage mean rate in 1st half	Mean rate per minute in 1st half	Mean rate in 2nd half	Percentage mean rate in 2nd half	Mean rate per minute in 2nd half	Total response in condition	Mean rate per minute in condition
100,0	100,10	135	39	46	25.75	46	54	30	85	27.7
0,0	100,10	322.5	30.5	47	12.3	48	53	16	78.5	14.1
100,10	100,0	275	52	59.1	24	33.5	41	20.9	85.5	22.3
100,10	0,0	136.7	29.3	58.5	28.2	19.3	41.5	19.2	48.7	22.3
100,0	0,0	120	35	44.3	35	44	55.7	44	79	39.5
0,50	0,0	120	44	51.2	44	42	48.8	42	86	43
100,10	0,10	155	51	59.6	45	34	40.5	30.9	85	38
0,100	0,90	135	33	52	29.1	30.5	48	28.1	63.5	28.6
0,90	0,100	203	13.3	34.6	11.6	36	65.4	19.8	49.3	15.6
100,0	0,100	280	35.5	39.1	15.6	63.5	60.9	25.3	99	20.7
OVERALL MEAN		200.1	34.3	48.6	24.0	31.3	51.3	24.7	73.7	24.1

Table II.1.1 Difference and percentage difference in mean rate from 1st half (col b) to 2nd half (col e) by condition

CONDITION INITIAL	TRANSFER	b) 1st HALF	e) 2nd HALF	DIFFERENCE	PERCENTAGE DIFFERENCE
100,0	100,10	39	46	7	118
0,0	100,10	30.5	48	17.5	157
100,10	100,0	52	33.5	-16.5	64
100,10	0,0	29.3	19.3	-10	66
100,0	0,0	35	44	9	125
0,50	0,0	44	42	-2	95
100,10	0,10	51	34	-17	67
0,100	0,90	33	30.5	-2.5	92
0,90	0,100	13.3	36	22.7	271
100,0	0,100	35.5	63.5	28	179
OVERALL		34.3	31.3	-3	91

Table II.1.2 Ranking of condition by difference in mean rate from 1st Half to 2nd Half

RANK	CONDITION		DIFFERENCE
	INITIAL	TRANSFER	
1	100,0	0,100	28
2	0,90	0,100	22.7
3	0,0	100,10	17.5
4	100,0	0,0	9
5	100,0	100,10	7
6	0,50	0,0	-2
7	0,100	0,90	-2.5
8	100,10	0,0	-10
9	100,10	100,0	-16.5
10	100,10	0,10	-17

Table II.1.3 Ranking of condition by percentage difference in mean rate from 1st half to 2nd half

RANK	CONDITION		DIFFERENCE
	INITIAL	TRANSFER	
1	0,90	0,100	271
2	100,0	0,100	179
3	0,0	100,10	157
4	100,0	0,0	125
5	100,0	100,10	118
6	0,50	0,0	95
7	0,100	0,90	92
8	100,10	0,10	67
9	100,10	0,0	66
10	100,10	100,0	64

Table II.1.4 Difference and percentage difference in percentage mean rate from 1st half (col c) to 2nd half (col f) by condition

CONDITION		c)	f)		
INITIAL	TRANSFER	1st HALF	2nd HALF	DIFFERENCE	PERCENTAGE DIFFERENCE
100,0	100,10	46	54	8	117
0,0	100,10	47	53	6	113
100,10	100,0	59	41	-18	69.5
100,10	0,0	58.5	41.5	-17	71
100,0	0,0	44.3	55.7	11.4	126
0,50	0,0	51.2	48.4	-2.4	95.3
100,10	0,10	59.6	40.4	-19.2	68
0,100	0,90	52	48	-4	92
0,90	0,100	34.6	65.4	30.8	189
100,0	0,100	39.1	60.9	21.8	156
OVERALL		48.6	51.3	2.7	106

Table II.1.5 Ranking of condition by difference in percentage mean rate from 1st half to 2nd half

RANK	CONDITION		DIFFERENCE
	INITIAL	TRANSFER	
1	0,90	0,100	30.8
2	100,0	0,100	21.8
3	100,0	0,0	11.4
4	100,0	100,10	8
5	0,0	100,10	6
6	0,50	0,0	-2.4
7	0,100	0,90	-4
8	100,10	0,0	-17
9	100,10	100,0	-18
10	100,10	0,10	-19.2

Table II.1.6 Ranking of condition by percentage difference in percentage mean rate from 1st half to 2nd half

RANK	CONDITION		DIFFERENCE
	INITIAL	TRANSFER	
1	0,90	0,100	189
2	100,0	0,100	156
3	100,0	0,0	126
4	100,0	100,10	117
5	0,0	100,10	113
6	0,50	0,0	95.3
7	0,100	0,90	92
8	100,10	0,0	71
9	100,10	100,0	69.5
10	100,10	0,10	68

Table II.1.7 Difference and percentage difference in mean rate per minute from 1st half (col d) to 2nd half (col g) by condition

CONDITION		d)	g)		
INITIAL	TRANSFER	1st HALF	2nd HALF	DIFFERENCE	PERCENTAGE DIFFERENCE
100,0	100,10	25.75	30	4.25	117
0,0	100,10	12.3	16	3.7	130
100,10	100,0	24	20.9	-3.1	87
100,10	0,0	28.2	19.2	-9	68
100,0	0,0	35	44	9	126
0,50	0,0	44	42	-2	95
100,10	0,10	45	30.9	-14.1	69
0,100	0,90	29.1	28.1	-1	97
0,90	0,100	11.6	19.8	8.2	171
100,0	0,100	15.6	25.3	9.7	162
OVERALL		24	24.7	0.7	103

Table II.1.8 Ranking of condition by difference in mean rate per minute from 1st Half to 2nd Half

RANK	CONDITION		DIFFERENCE
	INITIAL	TRANSFER	
1	100,0	0,100	9.7
2	100,0	0,0	9.0
3	0,90	0,100	8.2
4	100,0	100,10	4.25
5	0,0	100,10	3.7
6	0,100	0,90	-1
7	0,50	0,0	-2
8	100,10	100,0	-3.1
9	100,10	0,0	-9
10	100,10	0,10	-14.1

Table II.1.9 Ranking of condition by percentage difference in mean rate per minute from 1st half to 2nd half

RANK	CONDITION		DIFFERENCE
	INITIAL	TRANSFER	
1	0,90	0,100	171
2	100,0	0,100	162
3	0,0	100,10	130
4	100,0	0,0	126
5	100,0	100,10	117
6	0,100	0,90	97
7	0,50	0,0	95
8	100,10	100,0	87
9	100,10	0,10	69
10	100,10	0,0	68

Table II.1.10 Ranking of condition by rate per minute

RANK	CONDITION		RATE PER MINUTE
	INITIAL	TRANSFER	
1	0,50	0,0	43
2	100,0	0,0	39.5
3	100,10	0,10	38
4	0,100	0,90	28.6
5	100,0	100,10	27.7
6=	100,10	0,0	22.3
6=	100,10	100,0	22.3
8	100,0	0,100	20.7
9	0,90	0,100	15.6
10	0,0	100,10	14.1

Table II.1.11 Ranking of condition by difference and percentage difference in mean rate; percentage mean rate and mean rate per minute produced the following results

Condition		Difference	Percentage	Difference	Percentage	Difference	Percentage	Total
Initial	Transfer	Rate	Difference Rate	Percentage Rate	Difference Percentage Rate	Rate per Minute	Difference Rate per Minute	
100,0	100,10	5	5	4	4	8	5	31
0,0	100,10	3	3	5	5	5	3	24
100,10	100,0	9	10	9	9	8	8	53
100,10	0,0	8	9	8	8	9	10	52
100,0	0,0	4	4	3	3	2	4	20
0,50	0,0	6	6	6	6	7	7	38
100,10	0,10	10	8	10	10	10	9	57
0,100	0,90	7	7	7	7	6	6	40
0,90	0,100	2	1	1	1	3	1	9
100,0	0,100	1	2	2	2	1	2	10

Table II.1.12 Overall ranking by difference between 1st half and 2nd half

RANK	CONDITION	
	INITIAL	TRANSFER
1	0,90	0,100
2	100,0	0,100
3	100,0	0,0
4	0,0	100,10
5	100,0	100,10
6	0,50	0,0
7	0,100	0,90
8	100,10	0,0
9	100,10	100,0
10	100,10	0,10

FROM TABLE II.1

1) Over the 25 visits there is no systematic change in the specified behaviour. (Diagrams 15 and 16)

2) Ranking of condition by difference between 1st and 2nd half in transfer conditions produced consistent results for rate, percentage rate and rate per minute. (See Table II.1.11)

3) Tables II.1.2, II.1.5 and II.1.8 show that differences by split times in transfer conditions are both positive and negative.

In the initial condition differences were insignificant or positive. In initial conditions specified behaviour increased with time in condition. (Diagrams 6, 7, 8, 10, 11 and 12)
This is not so in the transfer conditions. Some conditions in Tables II.1.2, II.1.5 and II.1.8 show a decrease in behaviour from 1st half to 2nd half. (Diagrams 15 and 16)

4) Different transfer conditions produce different rates per minute of the specified behaviour. Transfer condition (0,0) after initial condition (0,50) produced the highest rate per minute (43). Transfer condition (100,10) after initial condition (0,0) produced the lowest rate (14.1). (Diagram 17)

b) Differences between initial conditions and transfer conditions by condition

Group Results

Table II.2 :(cols (a-i Table I.3) minus (Cols (a-I) Table II.1)

		a)	b)	c)	d)	e)	f)	g)	h)	i)
INITIAL	TRANSFER	Difference mean time	Difference mean time 1st half	Difference percentage mean rate 1st half	Difference mean rate per minute 1stH	Difference mean rate 2nd half	Difference percentage mean rate 2nd half	Difference mean rate per minute 2nd half	Difference total response in cond	Difference mean rate per minute
100,0	100,10	220	13.7	-13.3	-8.25	44.8	13.3	1.7	58.5	-3.1
0,0	100,10	32.5	22.2	-14.3	5.2	42.8	14.3	15.7	65	10.5
100,10	100,0	167.5	-18.6	-27.2	-14.5	39.9	27.6	-0.6	21.25	-7.4
100,10	0,0	-16.7	-17.8	-12.5	-16.7	-4.05	12.5	-3.95	-21.95	-8.9
100,0	0,0	0	-23.5	1.7	-23.5	-28.75	-1.7	-28.75	-52.25	-26.1
0,50	0,0	0	-32.5	-5.2	-32.5	-26.75	5.2	-26.75	-59.25	-29.6
100,10	0,10	205	-29	-25.5	-37.7	18	25.4	-13.6	-11	-25.6
0,100	0,90	289	-2.8	-1.8	-20.1	-0.5	1.8	-17.6	-3.3	-18.8
0,90	0,100	254.5	38.45	-5.0	3.8	92	5.0	14.6	130.5	9.3
100,0	0,100	177.5	16.25	-9.5	-0.2	64.5	9.5	9.1	80.75	4.2
OVERALL		167	0.7	-15.1	-12.1	39.2	15.2	-1.3	32	-6.5

FROM TABLE II.2 col a)

There is a wide range (-16.7 to 289) in col a): Difference in mean time in condition. For all, but condition (0,0), differences are positive. Therefore, the infants' willingness to participate was decreased in the transfer conditions. The wide range in col a) makes cols d), g) and i) the most informative.

Table II.2.1 Ranking of transfer condition from cols d), g) and i)

CONDITION		Col d)		Col g)		Col i)			
INITIAL	TRANSFER	Rank	Difference	Rank	Difference	Rank	Difference	Total	Rank
100,0	100,10	7	-8.25	7	1.7	7	-3.1	21	
0,0	100,10	10	5.2	10	15.7	10	10.5	30	
100,10	100,0	6	-14.5	6	-0.6	6	-7.4	18	
100,10	0,0	5	-16.7	5	-3.95	5	-8.9	15	
100,0	0,0	3	-23.5	1	-28.75	2	-26.1	6	
0,50	0,0	2	-32.5	2	-26.75	1	-29.6	5	
100,10	0,10	1	-37.7	4	-13.6	3	-25.6	8	
0,100	0,90	4	-20.1	3	-17.6	4	-18.8	11	
0,90	0,100	9	3.8	9	14.6	9	9.3	27	
100,0	0,100	8	-0.2	8	9.1	8	4.2	24	
OVERALL			-12.1		-1.3		-6.5		

Overall ranking by difference between initial condition and transfer condition in mean rate per minute

RANK	CONDITION	
	INITIAL	TRANSFER
1	0,50	0,0
2	100,0	0,0
3	100,10	0,10
4	0,100	0,90
5	100,10	0,0
6	100,10	100,0
7	100,0	100,10
8	100,0	0,100
9	0,90	0,100
10	0,0	100,10

FROM TABLE II.2.1

Overall, rates per minute were higher for transfer conditions then for initial conditions. This is particularly evident in the col d): 1st half differences. Conditions (x) as a 1st half transfer condition elicits more behaviour than condition (x) as a 1st half Initial condition.

Only three transfer conditions ((100,0), 0,100)); ((0,90), (0,100)) and ((0,0), (100,10)) display an overall decrease in rate per minute compared with the same conditions presented as initial conditions. (Diagram 18)

c) Differences between initial conditions and transfer conditions within visits

Table II.3 Initial condition rate of response for time interval before transfer MINUS transfer condition rate of response for time interval after transfer

CONDITION		TIME INTERVAL FROM TRANSFER (Minutes)				
INITIAL	TRANSFER	0.25	0.5	1	1.5	2
100,0	100,10	6	7	15.5	17.5	10
0,0	100,10	2.25	2.25	6	8.25	4.75
100,10	100,0	1	2.5	6.5	11.5	10.5
100,10	0,0	1	0	5.3	8	17
100,0	0,0	-3	-3.5	0	-20	-38
0,50	0,0	-2	-11	-11	-8	-12
100,10	0,10	0.5	0	0	-15	-7.5
0,100	0,90	-4	7	7	3	1
0,90	0,100	-1.7	-4.3	-8	-6	-11.5
100,0	0,100	3.5	2.5	9	11.5	13.5
OVERALL		-1	-0.7	-3.6	-3	-2.4

FROM TABLE II.3

a) The overall differences between rate of response before transfer and rate of response after transfer are small for all time intervals analysed.

b) The following conditions produced a consistent decrease in rate of response for all time intervals after transfer:

1) 100,0 100,10

2) 0,0 100,10

3) 100,10 100,0

4) 100,10 0,0

5) 100,0 0,100

c) The following conditions produced a consistent increase in rate of response for all time intervals after transfer.

1) 100,0 0,0

2) 0,50 0,0

3) 0,90 0,100

d) Condition 100,10 0,10 showed an initial decrease in rate of response followed by an increase.

e) Condition 0,100 0,90 showed an initial increase in rate of response followed by a decrease.

Summary of Group Results - Transfer conditions

a) Within transfer conditions, changes in rate are a function of the particular condition.

b) Transfer conditions produced higher rates per minute than the same conditions presented as an initial condition.

c) Difference between rate after transfer and rate before transfer is a function of the initial and transfer conditions.

APPENDIX III

Individual Data

Date for each subject will be presented under the following headings:

INITIAL CONDITION: Condition (x)

a) Rate by centile time

b) Percentage rate by centile time

c) Split time results

TRANSFER CONDITION: Condition (x) to Condition (y)

a) Rate by centile time

b) Percentage rate by centile time

c) Split time results.

INITIAL CONDITION: 100,10

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
12.1	2	8	3	7	13	14	23	27	22	24
13.1	11	4	20	34	31	19	27	28	28	30
15.2	4	5	2	1	2	6	8	12	14	15
20.1	0	3	6	6	10	15	24	13	12	5
14.2	0	0	8	1	0	12	7	13	16	21
11.1	4	2	1	4	19	18	27	25	25	8
10,1	10	3	0	0	9	14	1	13	19	9
42.1	24	16	15	29	19	25	28	16	14	22
44.1	12	21	27	26	20	19	22	5	30	30
21.1	0	16	9	10	10	16	5	14	14	13
27.1	18	22	23	15	24	26	26	24	20	14
32.1	13	12	7	6	4	9	20	26	29	30
M	8.2	9.3	10.1	11.6	13.4	16.1	18.2	18	20.3	18.4

b) Percentage rate by centile time

S	1	2	3	4	5	6	7	8	9	10
12.1	1.4	5.6	2.1	4.9	9.1	9.8	16.1	18.9	15.4	16.8
13.1	4.7	1.7	8.6	14.7	13.4	8.2	11.6	12	12	12.9
15.2	5.8	7.2	2.9	1.4	2.9	8.7	11.6	17.4	20.3	21.7
20.1	0	3.2	6.4	6.4	10.6	16	25.5	13.8	12.8	5.3
14.2	0	0	10.3	1.3	0	15.4	9	16.2	20.5	27
11.1	3.0	1.5	0.7	3.0	14.3	13.5	20.3	18.8	18.8	6.0
10.1	12.8	3.8	0	0	11.5	17.9	1.3	16.7	24.4	11.5
42.1	11.5	7.7	7.2	13.9	9.1	12	13.5	7.7	6.7	10.6
44.1	5.7	9.9	12.7	12.3	9.4	9	10.4	2.4	14.2	14.2
21.1	0	15	8.4	9.3	9.3	15	4.7	13.1	13.1	12.1
27.1	8.5	10.4	10.8	7.1	11.3	12.3	12.3	11.3	9.4	6.6
32.1	8.3	7.7	4.5	3.8	2.6	5.8	12.8	16.7	18.6	19.2
M	5.1	6.1	6.2	6.5	8.6	12	12.4	13.8	15.5	13.7

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
12.1	300	33	23.1	13.2	110	76.9	44	143	28.6	13
13.1	400	100	43.1	30.3	132	56.9	40	232	34.6	13
15.2	200	14	20.3	8.2	55	79.7	32.4	69	20.9	14
20.1	270	25	26.6	11.1	69	73.4	30.7	94	20.9	14
14.2	270	9	11.5	4.0	69	88.5	30.7	78	17.3	15
11.1	480	31	23.3	7.7	102	76.7	25.5	133	16.6	14
10,1	480	22	28.2	5.5	56	71.8	14	78	9.75	15
42.1	360	103	49.5	34.3	105	50.5	35	208	34.7	18
44.1	360	106	50	35.3	106	50	35.3	212	35.3	18
21.1	420	45	42.1	12.9	62	57.9	17.7	107	15.3	14
27.1	360	102	48.1	34	110	51.9	36.7	212	35.3	16
32.1	360	42	26.9	14	114	73.1	38	156	26	17
M	355	52.7	32.7	17.5	90.8	67.3	31.7	143.5	24.6	15.1

TRANSFER CONDITIONS : From 100,10

TO 100,0

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
10.1	6	3	26	18	18	12	0	5	3	4
11.1	5	10	9	4	5	5	9	12	8	9
M	5.5	6.5	17.5	11	11.5	8.5	4.5	8.5	5.5	6.5

b) Percentage rate of centile time

SUB	1	2	3	4	5	6	7	8	9	10
10.1	6.3	3.2	27.4	18.9	18.9	12.6	0	5.3	3.2	4.2
11.1	6.6	13.2	11.8	5.3	6.6	6.6	11.8	15.8	10.5	11.8
M	6	8.2	19.6	12.1	12.8	9.6	5.9	10.6	6.9	8

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
10.1	400	71	74.7	21.5	24	25.3	7.3	95	14.2	15
11.1	150	33	43.4	26.4	43	56.6	34.4	76	30.4	14
M	275	52	59.1	24	33.5	41	20.9	85.5	22.3	14.5

TO 0,10

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
42.1	9	10	6	8	9	7	10	11	5	4
44.1	12	12	12	14	10	14	7	0	2	8
M	10.5	11	9	11	9.5	10.5	8.5	5.5	3.5	6

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
42.1	11.4	12.7	7.6	10.1	11.4	8.9	12.7	13.9	6.3	5.1
44.1	13.2	13.2	13.2	15.4	11	15.4	7.7	0	2.2	8.8
M	12.3	13	10.4	12.8	11.2	12.2	10.2	7	4.3	7

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
42.1	120	42	53.2	42	37	46.8	37	79	39.5	18
44.1	150	60	65.9	48	31	34.1	24.8	91	36.4	18
M	135	51	59.6	45	34	40.5	30.9	85	38	18

TO 0,0

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
21.1	0	2	4	0	1	0	2	0	2	5
27.1	11	2	5	9	11	5	0	4	1	0
32.1	9	10	5	9	10	8	8	10	6	7
M	6.7	8	4.7	6	7.3	4.3	3.3	4.7	3	4

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
21.1	0	12.5	25	0	6.2	0	12.5	0	12.5	31.2
27.1	22.9	4.2	10.4	18.7	22.9	10.4	0	8.3	2.1	0
32.1	11	12.2	6.1	11	12.2	9.8	9.8	12.2	7.3	8.5
M	11.3	9.6	13.8	9.9	13.8	6.7	7.4	6.8	6.6	13.2

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks).
21.1	80	7	43.8	10	9	56.2	12.9	16	12.3	14
27.1	210	38	79.2	21.7	10	20.8	5.7	48	13.7	16
32.1	120	43	52.4	43	39	47.6	39	82	41	17
M	136.5	29.3	58.5	28.2	19.3	41.6	19.2	48.7	22.3	15,7

INITIAL CONDITION: 100,0

a) Rate by centile time

S	1	2	3	4	5	6	7	8	9	10
32.2	3	4	2	0	0	8	5	5	11	23
27.2	4	3	3	3	5	10	16	10	12	16
17.1	7	3	6	7	15	9	6	16	10	15
18.1	3	4	3	5	5	1	3	5	6	10
1.2	5	0	6	8	21	8	11	10	16	17
5.1	20	14	10	10	6	18	30	27	31	20
4.1	3	6	2	10	9	13	29	24	27	23
3.1	6	1	11	11	23	9	2	12	18	45
M	6.6	5.6	5.4	6.8	10.5	9.5	12.8	13.6	16.4	21.1

b) Percentage rate by centile time

S	1	2	3	4	5	6	7	8	9	10
32.2	4.9	6.6	3.3	0	0	13.1	8.2	8.2	18	37.7
27.2	4.9	3.7	3.7	3.7	6.1	12.2	19.5	12.2	14.6	19.5
17.1	7.4	3.2	6.4	7.4	16	9.6	6.4	17	10.6	16
18.1	6.7	8.9	6.7	11.1	11.1	2.2	6.7	11.1	13.3	22.2
1.2	4.9	0	5.9	7.8	20.6	7.8	10.8	9.8	15.7	16.7
5.1	10.8	7.5	5.4	5.4	3.2	9.7	16.1	14.5	16.7	10.8
4.1	2.1	4.1	1.4	6.8	6.2	8.9	19.9	16.4	18.5	15.8
3.1	4.3	0.7	8.0	8.0	16.7	6.5	1.4	8.7	13	32.6
M	5.8	4.3	5.1	6.2	10	8.7	11.1	12.2	15	21.4

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (Weeks)
32.2	360	9	14.8	3	52	85.2	17.3	61	10.2	18
27.2	480	18	22	4.5	64	78	16	8.2	10.2	17
17.1	240	38	40.4	19	56	59.6	28	94	213.5	17
18.1	480	20	44.4	5	25	55.6	6.2	45	5.6	13
1.2	360	40	39.2	13.3	62	60.8	20.7	102	17	20
5.1	540	60	32.3	13.3	126	67.7	28.2	186	20.7	16
4.1	480	30	20.5	7.5	116	79.5	29	146	18.2	14
3.1	600	52	37.7	10.4	86	62.3	17.2	138	13.8	14
M	442.5	33.4	31.4	9.5	73.4	68.6	20.3	106.7	14.9	16.1

TRANSFER CONDITIONS: From 100,0

<u>TO 0,0</u>

a) Rate by centile time

S	1	2	3	4	5	6	7	8	9	10
32.2	7	2	5	9	12	11	8	4	9	12

b) Percentage rate by centile time

S	1	2	3	4	5	6	7	8	9	10
32.2	8.9	2.2	5.6	10.1	13.5	12.4	9	4.5	10.1	13.5

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (Weeks)
32.2	120	35	44.3	35	44	55.7	44	79	39.5	18

TO 0,100

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
18.1	2	7	5	10	18	20	16	25	21	13
17.1	6	9	2	4	8	5	6	6	5	10
M	4	8	3.5	7	13	12.5	11	15.5	13	11.5

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
18.1	1.5	5.1	3.6	7.3	13.1	14.6	11.7	18.2	15.3	9.5
17.1	9.8	14.8	3.3	6.6	13.1	8.2	9.8	9.8	8.2	16.4
M	5.6	9.9	3.4	6.9	13.1	11.4	10.7	14	11.7	12.9

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
18.1	360	42	30.7	14	95	69.3	31.7	137	22.8	13
17.1	200	29	47.5	17.1	32	52.5	18.8	61	18.5	17
M	280	35.5	39.1	15.6	63.5	60.9	25.3	99	20.7	15

TO 100,10

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
4.1	6	11	5	5	8	7	14	5	7	5
5.1	1	3	3	15	13	8	5	11	13	17
M	7.5	7	4	10	10.5	7.5	9.5	8	10	11

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
4.1	8.2	15.1	6.8	6.8	11	9.6	19.2	6.8	9.6	6.8
5.1	9.3	3.1	3.1	15.5	13.4	8.2	5.2	11.3	13.4	17.5
M	8.7	9.1	4.9	11.1	12.2	8.9	12.2	9.1	11.5	12.2

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
4.1	150	35	47.9	28	38	52.1	39.4	73	29.2	14
5.1	220	43	44.3	23.5	54	55.7	29.5	97	26.2	16
M	135	39	46.1	25.7	46	53.9	29.9	85	77.7	15

INITIAL CONDITION: 0,0

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
20.2	4	4	0	7	3	6	1	6	4	1
42.2	0	0	0	0	0	0	0	0	0	0
44.2	2	5	2	3	8	3	7	9	4	11
43.1	0	0	3	2	3	5	1	3	0	0
M	1.5	2.2	1.2	3	3.5	4.2	2.2	4.5	2	3

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
20.2	11.1	11.1	0	19.4	8.3	16.7	2.8	16.7	11.1	2.8
42.2	10	10	10	10	10	10	10	10	10	10
42.2	3.7	9.3	3.7	5.6	14.8	5.6	13	16.7	7.4	20.4
43.1	0	0	17.6	11.8	17.6	29.4	5.9	17.6	0	0
M	6.2	7.6	7.8	11.7	12.7	15.4	7.9	15.2	7.1	8.3

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
20.2	120	18	50	18	18	50	18	36	18	15
42.2	120	0	50	0	0	50	0	0	0	19
44.2	120	20	37	20	34	63	34	54	27	19
43.1	120	8	47.1	8	9	52.9	9	17	8.5	21
M	120	11.5	46	11.5	15.2	54	15.2	26.7	13.4	18.5

TRANSFER CONDITION: FROM 0,0

TO 100,10

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
20.2	4	1	1	2	6	1	0	1	0	0
42.2	2	0	12	9	3	18	29	15	2	23
44.2	14	12	14	17	15	9	22	17	20	12
43.1	0	1	5	4	0	0	7	4	1	11
M	5	3.5	8	8	6	7	14.5	9.2	5.7	11.5

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
20.2	25	6.3	6.3	12.5	37.5	6.3	0	6.3	0	0
42.2	1.8	0	10.6	8	2.7	15.9	25.7	13.3	1.8	29.4
44.2	9.2	7.9	9.2	11.2	9.9	5.9	14.5	11.2	12.2	7.9
43.1	0	3	15.2	12.1	0	0	21.2	12	3	33.3
M	9	4.3	10.3	13.5	12.5	7.0	15.4	10.7	4.5	15.4

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
20.2	120	14	87.5	14	2	12.5	2	16	8	15
42.2	360	26	23	8.7	8.7	77	29	113	18.8	19
44.2	360	72	47.4	24	80	52.6	26.7	152	25.3	19
43.1	450	10	30	2.7	23	70	6.1	33	4.4	21
M	322.5	30.5	47	12.3	48	53	16	78.5	14.1	18.5

INITIAL CONDITION: 0,10

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
35.1	7	3	6	11	21	15	18	25	24	12
38.1	2	2	9	11	4	5	6	14	8	11
36.2	0	0	1	0	0	0	0	0	0	0
37.2	6	3	0	0	2	0	6	5	23	36
M	3.7	2	4	5.5	6.7	5	6	11	13.5	14.7

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
35.1	4.9	2.1	4.2	7.7	14.8	10.6	12.7	17.6	16.9	8.5
38.1	2.8	2.8	12.5	15.3	5.5	6.9	8.3	19.4	11.1	15.3
36.2	10	10	10	10	10	10	10	10	10	10
37.2	7.4	3.7	0	0	2.5	0	7.4	6.2	28.4	44.4
M	6.3	4.7	6.7	8.3	8.2	6.9	9.9	13.3	16.6	19.6

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
35.1	360	48	33.8	16	94	66.2	31.3	142	23.7	18
38.1	360	28	38.9	9.3	44	61.1	14.7	72	12	14
36.2	360	(1)	50	0.3	0	50	0	1	0.2	17
37.2	360	11	13.6	3.7	70	86.4	23.3	81	13.5	20
M	360	22	34.1	7.3	52	65.9	17.3	74	12.4	17.2

INITIAL CONDITION: 0,50

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
38.2	0	0	0	23	24	10	15	25	25	18
39.1	4	2	2	1	1	3	3	13	10	2
35.2	3	5	5	1	0	0	2	4	10	11
37.1	0	0	0	0	0	2	16	14	21	14
36.1	0	1	0	1	14	26	10	29	35	35
M	1.4	1.6	1.4	5.2	7.8	8.2	9.2	17	20.2	16

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
38.2	0	0	0	16.4	17.1	7.1	10.7	17.9	17.9	12.9
39.1	9.8	4.9	4.9	2.4	2.4	7.3	7.3	31.7	24.4	4.9
35.2	7.3	12.2	12.2	2.4	0	0	4.9	9.8	24.4	26.8
37.1	0	0	0	0	0	3	23.9	20.9	31.3	20.9
36.1	0	0.7	0	0.7	9.3	17.2	6.6	19.2	23.2	23.2
M	3.4	3.4	3.4	4.4	5.8	6.9	10.7	19.9	24.2	17.7

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
38.2	360	47	33.6	15.7	93	66.4	31	140	23.3	15
39.1	300	10	24.4	4	31	75.6	12.4	41	8.2	15
35.2	360	14	34.1	4.7	27	65.9	9	41	6.8	19
37.1	360	0	0	0	67	100	22.3	67	11.2	19
36.1	360	16	10.6	5.3	135	89.4	45	151	25.2	16
M	348	17.4	20.5	5.9	70.6	79.5	23.9	88	14.9	16.8

TRANSFER CONDITION: FROM 0,50

TO 0,0

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
38.2	8	10	9	10	7	10	4	9	9	10

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
38.2	9.3	11.6	10.5	11.6	8.1	11.6	4.7	10.5	10.5	11.6

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
38.2	120	44	51.2	44	42	48.8	42	86	43	15

INITIAL CONDITION: 0,90

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
15.1	5	0	0	1	9	3	4	14	22	12
14.1	0	2	1	1	8	4	5	11	3	2
13.2	14	23	22	23	22	14	15	6	2	11
11.2	0	0	0	0	0	0	0	0	1	2
10.2	0	12	5	2	1	2	3	0	10	4
M	3.8	7.4	5.6	5.4	8	4.6	5.4	6.2	7.6	6.2

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
15.1	7.1	0	0	1.4	12.9	4.3	5.7	20	31.4	17.1
14.1	0	5.4	2.7	2.7	21.6	10.8	13.5	29.7	8.8	5.4
13.2	9.2	15.1	14.5	15.1	14.5	9.2	9.9	3.9	1.3	7.2
11.2	10	10	10	10	10	10	10	10	10	10
10.2	0	30.8	12.8	5.1	2.6	5.1	7.7	0	25.6	10.3
M	5.3	12.3	8	6.9	12.3	7.9	9.4	12.7	15.3	10

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
15.1	240	15	21.4	7.5	55	78.6	27.5	70	17.5	13
14.1	500	12	32.4	2.9	25	67.6	6.0	37	4.5	14
13.2	420	104	68.4	29.7	48	31.6	13.7	152	21.7	14
11.2	480	0	50	0	(3)	50	0.7	3	0.4	15
10.2	480	20	51.3	5	19	48.7	4.7	39	4.9	
16										
M	424	30.2	44.7	9	30	55.3	10.5	60.2	9.8	14.4

TRANSFER CONDITION: FROM 0,90

TO 0,100

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
14.1	3	3	9	6	0	20	36	19	0	6
11.2	2	0	2	2	2	1	5	2	7	1
10.2	0	2	2	5	2	0	4	3	0	4
M	1.7	1.7	4.3	4.3	1.3	7	15	8	2.3	3.7

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
14.1	2.9	2.9	8.8	5.9	0	19.6	35.3	18.6	0	5.9
11.2	8.3	0	8.3	8.3	8.3	4.2	20.8	8.3	29.2	4.2
10.2	0	9.1	9.1	22.7	9.1	0	18.2	13.6	0	18.2
M	3.7	4	8.7	12.3	5.8	7.9	24.8	13.5	9.7	9.4

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
14.1	400	21	20.6	6.4	81	79.4	24.5	102	15.2	14
11.2	150	8	33.3	6.4	16	66.7	12.8	24	9.6	20
10.2	60	11	50	22	11	50	22	22	22	19
M	203.3	13.3	34.6	11.6	36	65.4	19.8	49.3	15.6	17.7

INITIAL CONDITION: 0,100

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
1.1	9	18	38	27	26	26	27	20	24	30
4.2	1	1	13	10	12	8	10	13	19	16
3.2	0	2	2	14	10	9	20	15	2	18
5.2	5	2	0	15	2	15	28	64	60	69
M	3.8	5.7	13.3	16.5	12.5	14.5	21.2	28	31	33.3

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
1.1	3.7	7.3	15.5	11	10.6	10.6	11	8.2	9.8	12.2
4.2	1.0	1.0	12.6	9.7	11.7	7.8	9.7	12.6	18.4	15.6
3.2	0	1.8	1.8	12.6	9	8.1	18	13.5	18.9	16.2
5.2	1.9	0.8	0	5.8	0.8	5.8	10.8	24.6	23.1	26.5
M	1.6	2.7	7.5	9.8	8	8	12.4	14.7	17.6	17.6

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
1.1	480	118	48.2	29.5	127	51.8	31.7	245	30.6	19
4.2	360	37	35.9	12.3	66	64.1	22	103	17.2	15
3.2	210	28	25.2	16.0	83	74.8	47.4	111	31.7	15
5.2	780	24	9.2	3.7	236	90.8	36.3	260	20	17
M	457.5	51.7	29.6	15.4	128	70.4	34.4	179.7	24.9	16.5

TRANSFER CONDITION: FROM 0,100

TO 0,90

a) Rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
1.1	7	3	8	3	6	11	4	10	5	7
4.2	7	8	4	9	11	8	9	2	3	2
M	7	5.5	6	6	8.5	9.5	6.5	6	4	4.5

b) Percentage rate by centile time

SUB	1	2	3	4	5	6	7	8	9	10
1.1	10.9	4.7	12.5	4.7	9.4	17.2	6.3	15.6	7.8	10.9
4.2	11.1	12.7	6.3	14.3	17.5	12.7	14.3	3.2	4.88	3.2
M	11	8.7	9.4	9.5	13.5	15	10.3	9.4	6.3	7.1

c) Split time results

S	Time In(Secs)	Rate 1stH	%R 1stH	RPM 1stH	Rate 2ndH	%R 2ndH	RPM 2ndH	Rate Overall	RPM Overall	Age (weeks)
1.1	120	27	42.2	27	37	57.8	37	64	64	19
4.2	150	39	61.9	31.2	24	38.1	19.2	63	63	15
M	135	33	52.1	29.1	30.5	48	28.1	63.5	63.5	17

APPENDIX IV

Summary of Individual Data

Individual results for each condition will be summarised under the following headings:

CONDITION (x)

SUBJECTS (n)

a) Time in condition.

b) Rate in first minute and maximum rate per minute.

c) Percentage rate by split time.

d) Rate per minute by split time.

e) Affective reaction to condition.

TRANSFER FROM CONDITION (x) TO CONDITION (y) SUBJECTS (n)

a) Time in transfer condition

b) Rate per minute by split time in transfer condition.

c) Change in rate for comparative time periods before and after transfer.

d) Affective reaction to initiation of transfer

e) Affective reaction to transfer condition.

IV.1 CONDITION (100,10)

SUBJECTS (13)

a) Time in condition varied between 200 and 480 seconds.

b) Rate in first minute varied between 2 and 33. Four subjects produced very high rates (20+) in the first minute. Maximum rate in any subsequent minute varied between 22 and 60.

c) Percentage rate in the 1st half varied between 11.5 and 50.

Percentage rate in the 2nd half varied between 50 and 88.5

11 subjects increased percentage rate from 1st half to 2nd half.

1 subject maintained the same percentage rate in both halves.

d) Rate per minute in the 1st half varied between 4 and 34.

Rate per minute in the 2nd half varied between 14 and 44.

11 subjects increased rate per minute between halves.

1 subject maintained the same rate per minute in both halves.

e) 1 subject was excluded from the analysis. 5 subjects were terminated before transfer because of sudden onset of distress, all 5 had previously appeared content and interested in the condition.

There was little vocalisation from all subjects (apart from crying from the 5 terminated).

7 subjects were successfully transferred to other conditions.

IV.1.1 TRANSFER FROM CONDITION (100,10) TO CONDITION (100,0)

SUBJECTS (2)

a) Time in transfer condition was 150 seconds and 400 seconds.

b) Rate per minute in the 1st half of the transfer condition was 21.5 and 26.4

Rate per minute in the 2nd half of the transfer condition was 7.3 and 34.4.

One subject increased rate per minute between halves.

One subject decreased rate per minute between halves.

c) Both subjects reaction to transfer was a decrease in rate from comparative preceding periods from 15 to 120 seconds.

Initiation of transfer in both cases changed a downward trend in rate into an upward trend in rate.

d) Neither subject showed any change in affective reaction to initiation of transfer.

e) Neither subject showed any change in affective reaction to continuation of the transfer condition.

IV.1.2 TRANSFER FROM CONDITION (100,10) TO CONDITION (0,10)
SUBJECTS (2)

a) Time in transfer condition was 120 seconds and 150 seconds.

b) Rate per minute in the 1st half of the transfer condition was 42 and 48.

Rate per minute in the 2nd half of the transfer condition was 37 and 24.8

Both subjects decreased rate per minute between halves.

c) Reaction to transfer by change in rate for comparative preceding periods was mixed up to a minute after transfer.

One subject increased rate, one subject decreased rate.

Between 90 and 120 seconds after transfer both subjects increased rate.

Initiation of transfer produced an initial improved tend and a dramatic downward trend.

d) On initiation of transfer one subject showed no change in affective reaction, the other subject after initial vocalisation became progressively restless and unhappy.

e) Both subjects were unhappy in the transfer condition and early termination was necessitated.

IV.1.3 TRANSFER FROM CONDITION (100,10) TO CONDITION (0,0)
SUBJECTS (3)

a) Time in transfer condition varied between 80 and 210 seconds.

b) Rate per minute in the 1st half of the transfer varied between 10 and 43.

Rate per minute in the 2nd half of the transfer varied between 12.9 and 39.

Two subjects decreased rate per minute between halves.

One subject increased rate per minute between halves.

c) Reaction to transfer by change in rate from comparative preceding periods was mixed, up to a minute after transfer. One subject increased rate, two subjects decreased rate.

Between 90 seconds and 120 seconds, all subjects decreased rate.

Initiation of transfer in all subjects produced a downward trend in rate.

d) One subject showed no change in affective reaction.

Two subjects displayed violent affective reaction to initiation of transfer, characterised by initial vocalisation followed by crying and random motor activity.

e) One subject was terminated after 80 seconds. Two subjects after reaching criterion for termination were transferred back to initial condition. Both subjects were willing to continue with the experiment after the re-transfer. The transfer condition itself, was aversive to all subjects.

IV.2 CONDITION (100,0)
SUBJECTS (10)

a) Time in condition varied between 240 and 600 seconds.

b) Rate in the first minute varied between 2 and 33.

Only one subject produced a very high rate (20+) in the first minute. Maximum rate in any subsequent minute varied between 28 and 44.

c) Percentage rate in the 1st half varied between 14.75 and 44.4

Percentage rate in the 2nd half varied between 55..6 and 85.25.

All 8 subjects increased percentage rate between halves.

d) Rate per minute in the 1st half varied between 3 and 19.

Rate per minute in the 2nd half varied between 6.25 and 29.

All subjects increased rate per minute between halves.

e) Two subjects were excluded from the analysis. One subject was terminated before transfer because of sudden distress. The remaining 7 subjects appeared content and interested in the condition.

There was little vocalisation from all 8 subjects.

7 subjects were successfully transferred to other conditions.

IV.2.1 TRANSFER FROM CONDITION (100,0) TO CONDITION (0,0)
SUBJECTS (2)

a) Time in transfer condition was 120 seconds and 30 seconds.

b) Rate per minute in the 1st half was 35

Rate per minute in the 2nd half was 44.

The subject increased rate per minute between halves.

c) Subjects initial reaction to transfer was mixed. One subject increased rate followed by termination, the other subjects decreased rate initially, followed by an increase.

Initiation of transfer in both cases continued an upward trend in rate.

d) One subject showed a very violent affective reaction on initiation of transfer best described as tantrum; this reaction necessitated immediate termination. The other subject after initial vocalisation and looking at mother became progressively restless. After reaching criterion for termination, this subject was transferred back to a control condition and settled down after the re-transfer.

e) The transfer condition, itself, was extremely aversive to both subjects.

IV.2.2 TRANSFER FROM CONDITION (100,0) TO CONDITION (0,100)
SUBJECTS (2)

a) Time in transfer condition was 200 and 360 seconds.

b) Rate per minute in the 1st half of the transfer condition was 14 and 17.1.

Rate per minute in the 2nd half of the transfer condition was 31.7 and 18.8.

Both subjects increased rate per minute between halves.

c) Both subjects initial reaction to transfer was a decrease in rate compared to preceding periods from 15 to 120 seconds.

Initiation of transfer produced a downward trend in rate followed by an upward trend.

d) Subjects showed similar affective reaction to initiation of transfer; cessation of all activity, vocalisation and raised eyebrows.

e) After 2 minutes in the condition, both subjects appeared content and were willing to continue with the experiment.

IV.2.3 TRANSFER FROM CONDITION (100,0) TO CONDITION (100,10)

SUBJECTS (3)

a) Time in transfer condition was 150 to 220 seconds.

b) Rate per minute in the 1st half of the transfer condition was 28 and 23.5

Rate per minute in the 2nd half of the transfer condition was 30.4 and 29.5.

Both subjects increased rate per minute between halves.

c) Both subjects reaction to transfer was a decrease in rate for comparative preceding periods from 15 to 120 seconds.

No clear trends in rate were discernible.

d) One subject displayed a violent affective reaction to initiation of transfer, this reaction necessitated termination.

Two subjects displayed a similar reaction; initial cessation of all motor activity and intent regard of the screen.

e) The two subjects successfully transferred appeared content and interested in the transfer condition.

IV.3 CONDITION (0,0)

SUBJECTS (4)

a) Time in condition was 120 seconds for all subjects.

b) Rate in the first minute varied between 0 and 20.

Rate in the second minute varied between 0 and 34.

Three subjects maintained the same rate between halves.

One subject increased rate in the second minute.

c) Three subjects maintained the same percentage rate in both halves.

One subject increased percentage rate between halves from 37% to 63%.

d) As for b)

e) One subject appeared content in the condition, this subject remained inert for all the initial condition. Three subjects were unhappy in the condition; two resorted to chair-chewing, one to tears.

All four subjects were transferred to another condition. Criteria for transfer were abandoned and initiation of transfer was at 120 seconds for all subjects.

IV.3.1 TRANSFER FROM CONDITION (0,0) TO CONDITION (100,10)

SUBJECTS (4)

a) Time in transfer condition varied between 120 and 450 seconds.

b) Rate per minute in the 1st half of the transfer condition varied between 2.7 and 24.

Rate per minute in the 2nd half of the transfer condition varied between 2 and 29.2.

One subject decreased rate per minute between halves.

Three subjects increased rate per minute between halves.

c) One subject increased rate compared to preceding periods from 15 to 120 seconds. This was the previously passive subject.

Three subjects maintained or decreased rate compared to preceding periods from 15 to 120 seconds.

In three subjects initiation of transfer produced no clear trends. In the passive subject, initiation of transfer produced an upward trend on rate.

d) One of the three subjects who had been restless in the initial condition became progressively more so and was terminated. The other two appeared content with the transfer condition. The previously passive subject displayed progressively greater interest in the transfer condition.

e) The three infants successfully transferred were happy, if not necessarily interested in the transfer condition.

IV.4 CONDITION (0,10)

SUBJECTS (4)

a) Time in condition was 360 seconds for all subjects.

b) Rate in the first minute varied between 0 and 9.

Maximum rate in any subsequent minute varied between 11 and 53.

c) Percentage rate in the first half varied between 13.6 and 50.

Percentage rate in the 2nd half varied between 50 and 86.4.

Three subjects increased percentage rate from 1st half to 2nd half.

One subject maintained the same percentage rate.

d) Rate per minute in the 1st half varied between 0.3 and 16.

Rate per minute in the 2nd half varied between 0 and 31.3.

Three subjects increased rate per minute between halves.

One subject remained passive throughout the condition (1 response).

e) Three subjects were terminated before transfer because of progressive onset of distress. Only one of these subjects appeared at any time to be happy and interested in the condition.

The passive subject was successfully transferred to a different condition.

There was no vocalisation, apart from distress, from any of the subjects.

IV.4.1 TRANSFER FROM CONDITION (0,10) TO CONDITION (0,0)

SUBJECT (1)

The subject was inert but awake for the 120 seconds duration of the condition.

IV.5 CONDITION (0,50)

SUBJECTS (5)

a) Time in condition varied between 300 and 360 seconds.

b) Rate in the first minute varied between 0 and 8.

Three subjects produced very low rates of response (0) in the first minute.

Maximum rate in any subsequent minute varied between 16 and 56.

c) Percentage rate in the 1st half varied between 9 and 34.1.

Percentage rate in the 2nd half varied between 65.9 and 100.

All five subjects increased percentage rate from 1st half to 2nd half.

d) Rate per minute in the 1st varied between 0 and 15.7.

Rate per minute in the 2nd half varied between 9 and 45.

All five subjects increased rate per minute between halves.

e) Four subjects were terminated before transfer because of progressive restlessness. Three subjects appeared initially content in the condition. One subject was initially restless, then settled down. After three minutes in the condition four

subjects showed all the signs of boredom, random motor activity; chair-chewing; and progressive restlessness.

There was little vocalisation from all subjects (apart from crying shortly before termination).

One subject was successfully transferred to another condition.

IV.5.1 TRANSFER FROM CONDITION (0,50) TO CONDITION (0,0)
SUBJECT (1)

a) Time in transfer condition was 120 seconds.

b) Rate per minute in the 1st half of the transfer condition was 44.

Rate per minute in the 2nd half of the transfer condition was 42.

There was a slight decrease in rate between halves.

c) Subjects reaction to transfer was in increase in rate from comparative preceding periods.

Initiation of transfer changed a downward trend in rate into an upward trend in rate.

d) There was no change in affective reaction to initiation of transfer.

e) There was no change in affective reaction to continuation of transfer or to re-transfer to a control condition (100,0).

IV.6 CONDITION (0,90)

SUBJECTS (5)

a) Time in condition varied between 240 and 500 seconds.

b) Rate in the first minute varied between 0 and 22.

One subject produced a very high rate (22) in the first minute.

One subject produced a very low rate (0) in the first minute.

Maximum rate in any subsequent minute varied between 2 and 41.

c) Percentage rate in the 1st half varied between 21.4 and 68.4

Percentage rate in the 2nd half varied between 31.6 and 78.6

Two subjects increased percentage rate between halves.

One subject decreased percentage rate between halves.

Two subjects maintained percentage rate between halves.

d) Rate per minute in the 1st half varied between 0 and 29.7.

Rate per minute in the 2nd half varied between 0.75 and 27.5.

Three subjects increased rate per minute between halves.

One subject decreased rate per minute between halves.

One subject maintained the same rate per minute between halves.

e) Two subjects were terminated before transfer because of progressive onset of distress. Three subjects were passive through the condition.

There was little vocalisation from all subjects (apart from crying from the two terminated).

Three subjects were successfully transferred to another condition.

IV.6.1 TRANSFER FROM CONDITION (0,90) TO CONDITION (0,100)

SUBJECTS (3)

a) Time in transfer condition varied between 60 and 400 seconds.

b) Rate per minute in the 1st half of the transfer condition varied between 6.4 and 22.

Rate per minute in the 2nd half of the transfer condition varied between 12.8 and 24.5

c) All three subjects reaction to transfer was a maintenance or increase in rate from comparative preceding periods from 15 seconds to 120 seconds.

Initiation of transfer in all subjects produced an upward trend in rate.

d) No subject showed any change in affective reaction to initiation of transfer.

e) One subject appeared happier and more interested in the continuation of the transfer condition.

IV.7 CONDITION (0,100)

SUBJECTS (4)

a) Time in condition varied between 210 and 780 seconds.

b) Rate in the first minute varied between 1 and 13.

Maximum rate in any subsequent minute varied between 35 and 55.

c) Percentage rate in the 1st half varied between 9.2 and 48.2.

Percentage rate in the 2nd half varied between 51.8 and 90.8.

All four subjects increased percentage rate between halves.

d) Rate per minute in the first half varied between 3.7 and 29.5.

Rate per minute in the 2nd half varied between 22 and 47.4.

All four subjects increased rate per minute between halves.

e) All four subjects appeared happy and interested in the condition. Two subjects vocalised in the 2nd half of the condition. There was very little displacement activity from any of the subjects in the 2nd half of the condition.

There was an intent regard of the mobile from all subjects.

All four subjects were successfully transferred to another condition.

IV.7.1 TRANSFER FROM CONDITION (0,100) TO CONDITION (0,90)
SUBJECTS (2)

a) Time in condition was 120 seconds and 150 seconds.

b) Rate per minute in the 1st half of the transfer condition was 27 and 31.2.

Rate per minute in the 2nd half of the transfer condition was 37 and 19.2.

One subject increased and one subject decreased rate per minute between halves of the transfer condition.

c) One subject reacted to transfer by a consistent decrease in rate compared to preceding periods from 15 to 120 seconds.

One subject reacted to transfer by an initial decrease in rate compared to preceding periods up to 60 seconds; followed by a slight increase in rate at 90 seconds.

Initiation of transfer in both cases produced a downward trend in rate.

d) Both subjects exhibited a dramatic affective reaction to initiation of transfer.

One subject produced an immediate tantrum which necessitated termination. One subject vocalised for the first time two seconds after initiation of transfer then abandoned his intent regard of the mobile.

e) Continuation of the condition proved aversive to the remaining subject, who became progressively unhappy. On re-transfer to another condition the subject settled down and was willing to carry on in the experiment for another four minutes.

(Two of the four subjects transferred to condition (0,90) from condition (0,100) were producing a very high rate of response (50+ per minute). This high rate made transfer impractical. Because the

mobile was nearly always stationary, the subject could not observe the mobile becoming stationary.)

APPENDIX V

Overall Summary

Initial Conditions

1) An increment in rate of response by centile time was observed both overall and in specific conditions. (Diagrams 1, 2, 6, 7 and 8)

2) Different conditions made different contributions to the observed overall increment.

   Conditions (0,0) and (0,90) made little contribution to the overall increment. Conditions (100,10) and (0,100) made the greatest contribution to the overall increment. (Diagrams 3, 4 and 5)

3) Condition (0,0) produced a decreased time to criteria for termination. (Diagram 9)

4) Split time results delivered consistent results for rate, percentage rate and rate per minute in differences between 1st Half and 2nd Half by condition.

   Conditions (0,50) and (0,100) produced the greatest differences; conditions (0,90) and (0,0) the least differences. (Diagrams 10,11 and 12)

5) Conditions (100,10) and (0,100) produced the highest rates per minute. Condition (0,90) produced the lowest rate per minute. (Diagram 13)

6) Affective reaction to initial condition varied. Three distinet affective categories were observed.

Affective reaction to (100,0); (0,100) and (100,10) was content and interested.

Affective reaction to (0,10); (0,50) and (0,90) was progressive restlessness.

Affective reaction to (0,0) was immediate antipathy.

TRANSFER CONDITIONS

1) Mean time in transfer conditions to criteria for termination was less than the mean time in the same condition presented as an initial condition. (Diagram 9 and 14)

2) Unlike initial conditions, split time differences in transfer conditions were both positive and negative. (Diagram 15 and 16)

3) Different transfer conditions produced different mean rates per minute. (Diagram 17)

4) Rates per minute were higher overall in the transfer condition. (Diagram 18)

5) Affective reaction to transfer conditions varied. Reactions to transfer conditions were more diverse than reactions to initial conditions. Transfer condition reactions do not fit easily into the three categories observed in initial conditions.

There was an affective reaction to initiation or continuation of the following transfer conditions.

	CONDITIONS	
	FROM	TO
a)	100,10	0,10
b)	100,10	0,0
c)	100,0	0,0
d)	100,0	0,100
e)	100,0	100,10
f)	0,0	100,10
g)	0,100	0,90

There was no affective reaction to initiation or continuation of the following transfer conditions.

	CONDITIONS	
	FROM	TO
a)	100,10	100,0
b)	0,50	0,0
c)	0,90	0,100
d)	0,10	0,0

APPENDIX VI

List of Diagrams

12. Difference in rate per minute, 1st Half to 2nd Half in initial conditions.

13. Mean rate per minute in initial conditions.

14. Mean time in transfer conditions.

15. Difference in percentage mean rate, 1st Half to 2nd Half in transfer conditions.

16. Difference in rate per minute, 1st Half to 2nd Half in transfer conditions.

17. Mean rate per minute in transfer conditions.

18. Difference in mean rate per minute between condition (x) as initial condition and condition (x) as transfer condition.

DIAGRAM 1: Mean rate of response by centile time for initial conditions.

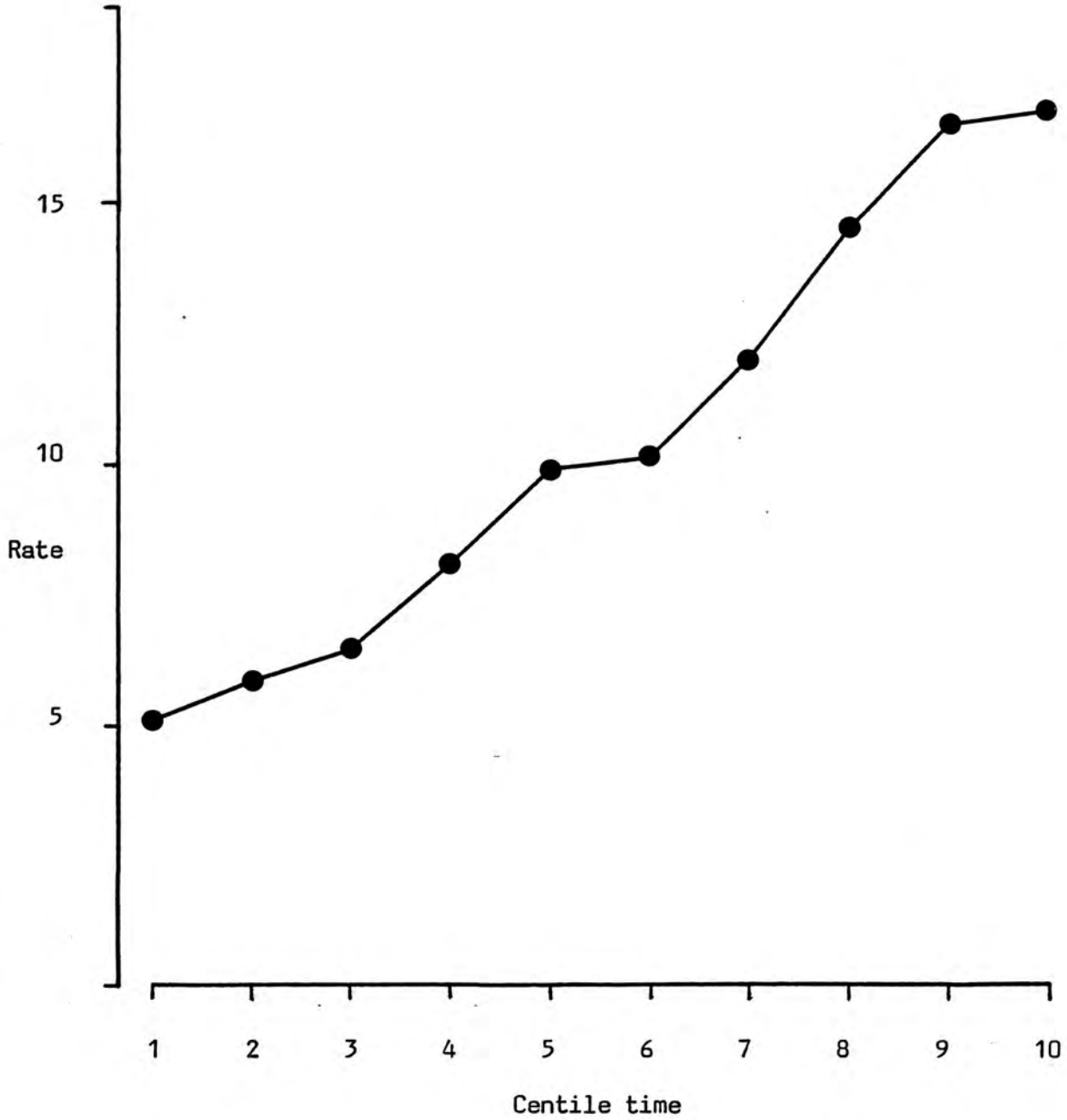


DIAGRAM 2: Mean percentage rate of response by centile time for initial conditions.

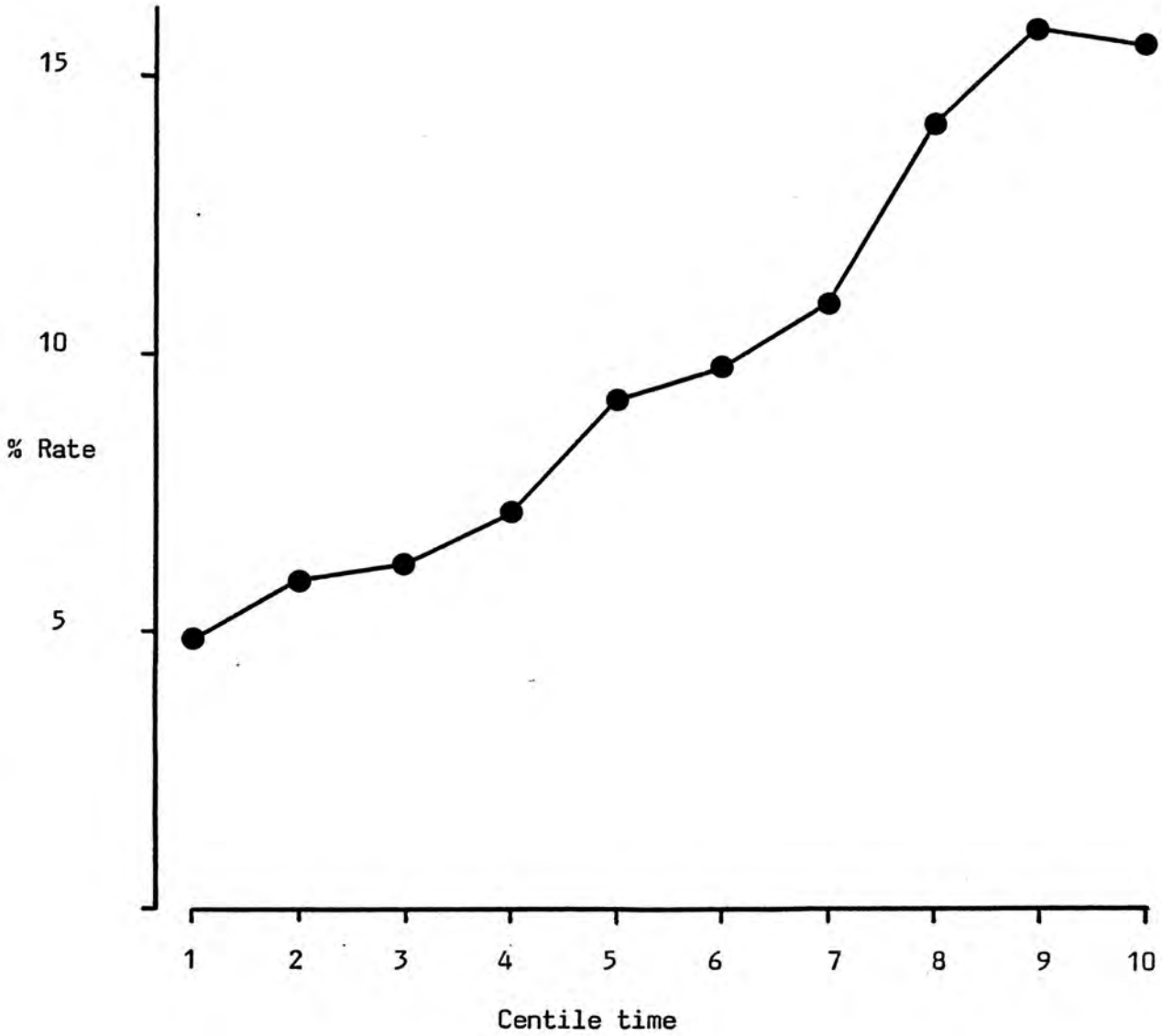


DIAGRAM 3: Mean rate of response by centile time for initial conditions (100,10) and (0,0)

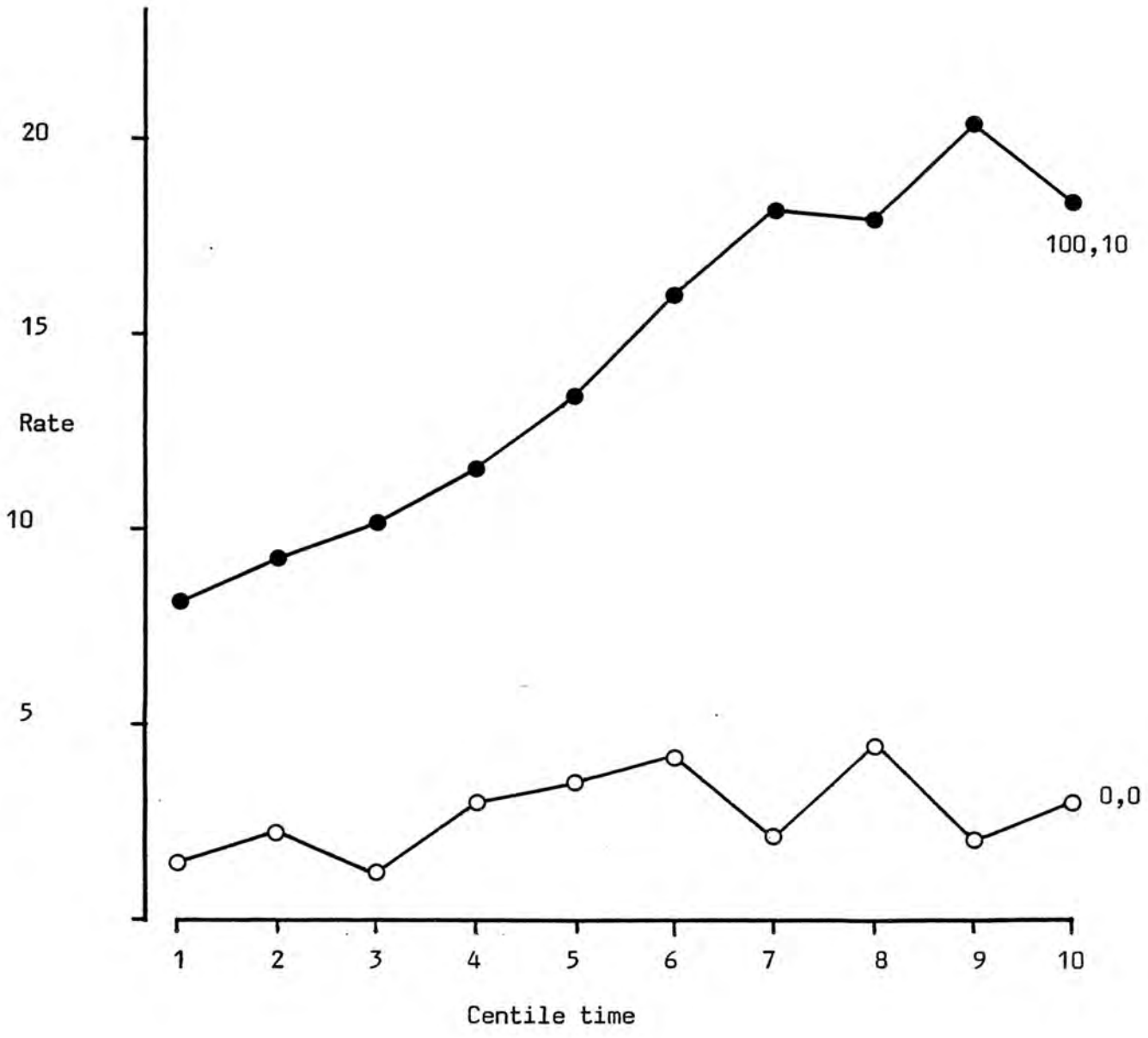


DIAGRAM 4: Mean rate of response by centile time for initial conditions (100,0); (0,10) and (0,50).

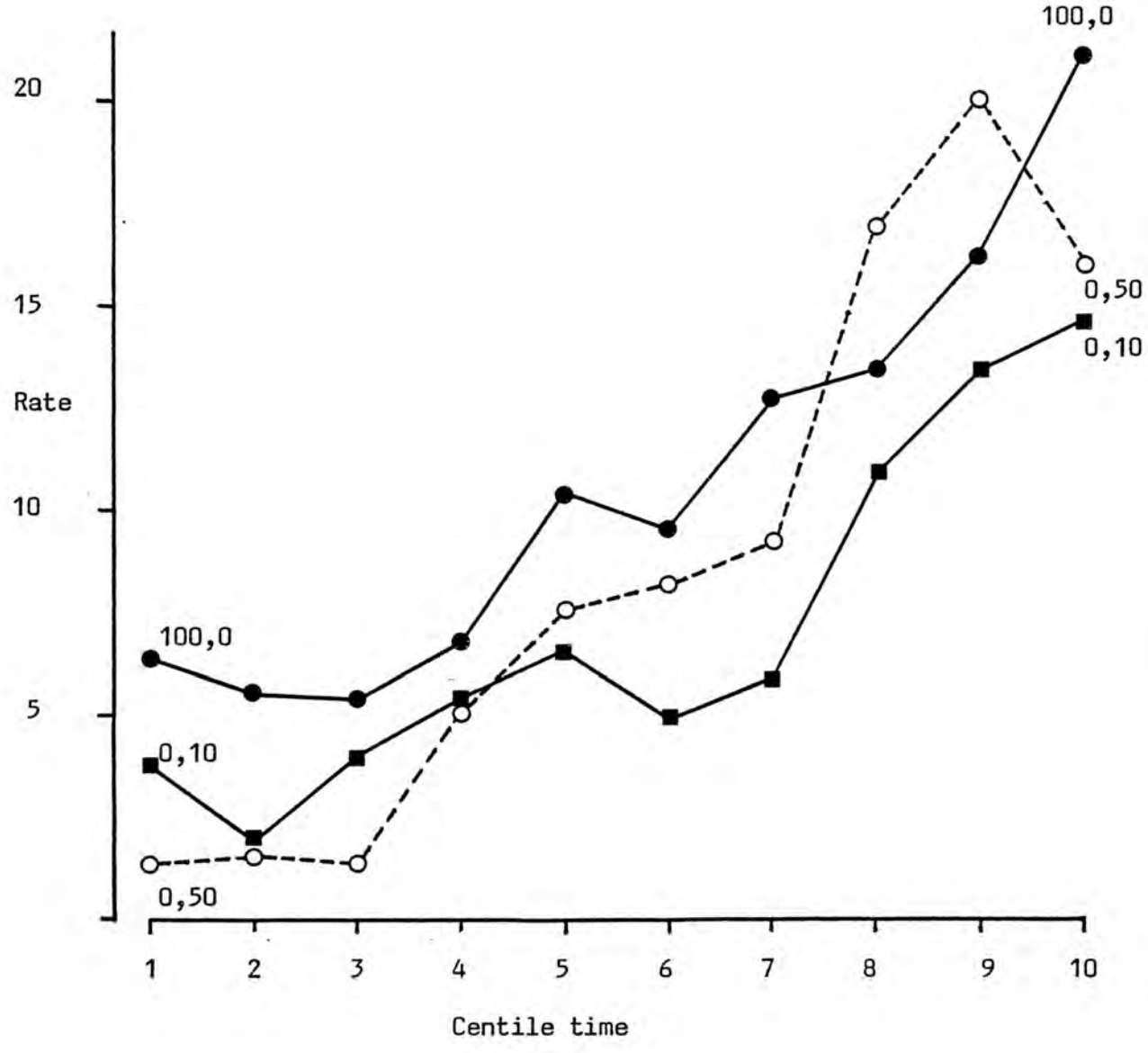


DIAGRAM 5: Mean rate of response by centile time for initial conditions (0,90) and (0,100).

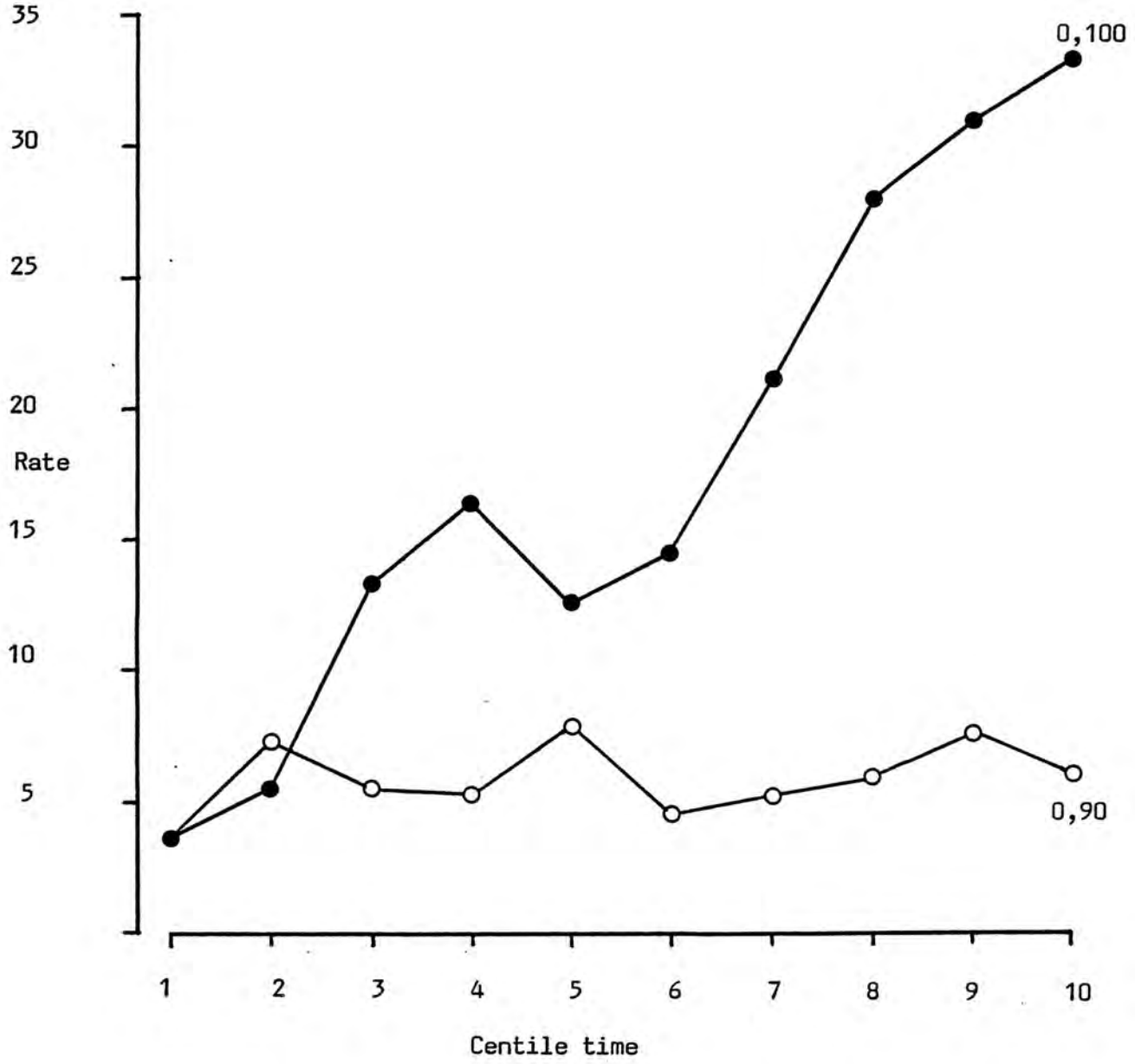


DIAGRAM 6: Mean percentage rate of response by centile time for initial conditions (100,10) and (0,0).

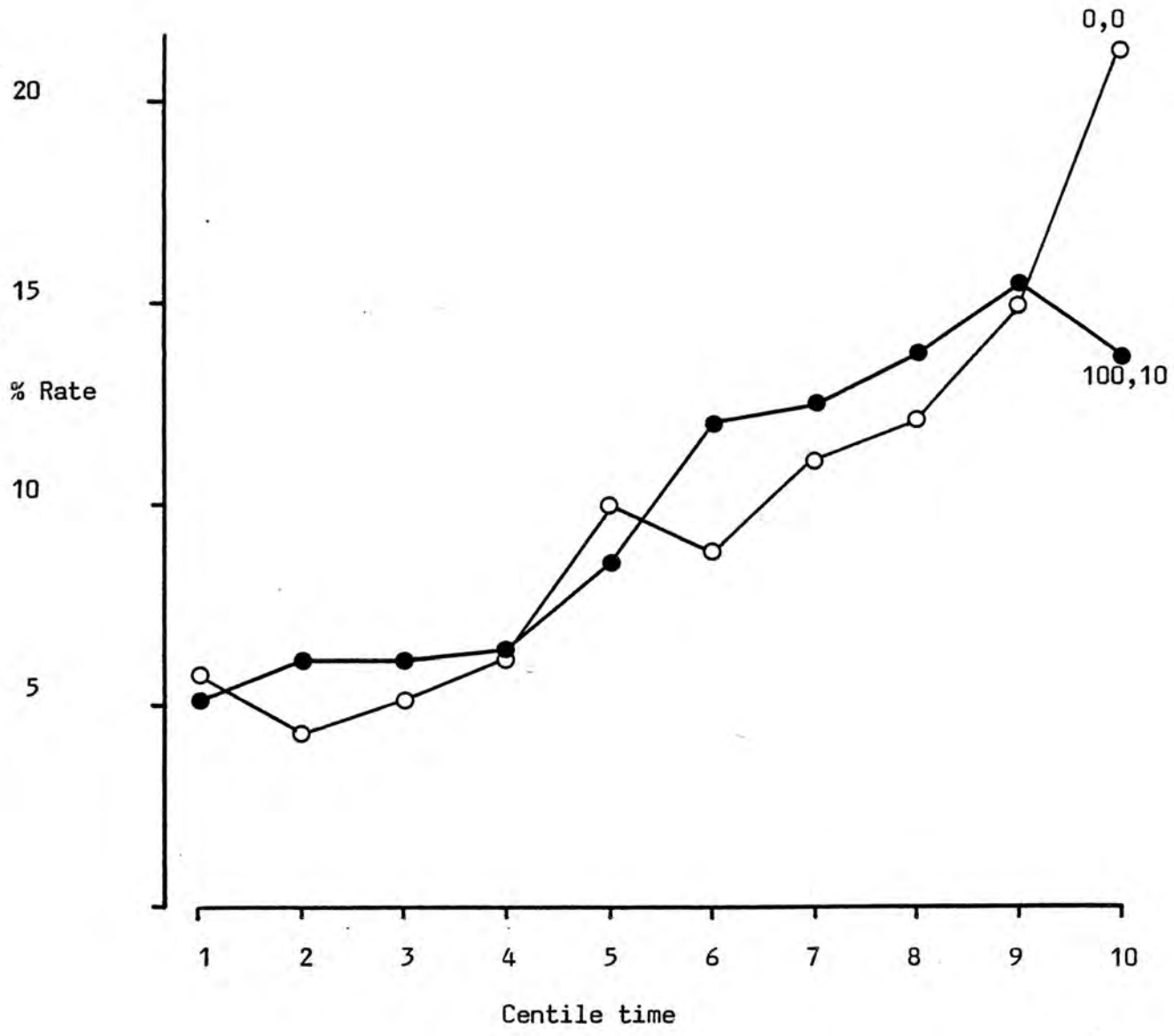


DIAGRAM 7: Mean percentage rate of response by centile time for initial conditions (100,0); (0,10) and (0,50).

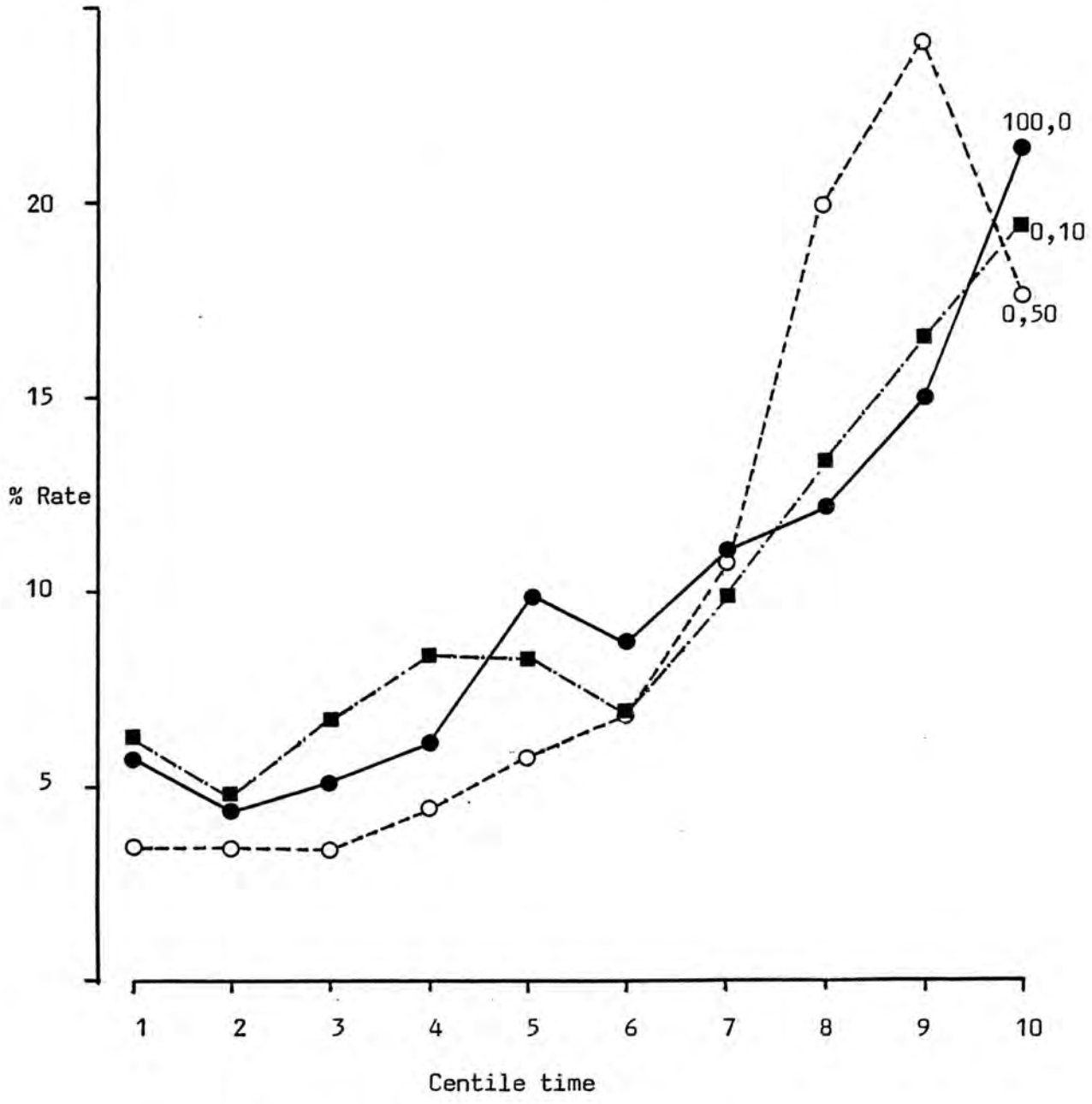


DIAGRAM 8: Mean percentage rate of response by centile time for initial conditions (0,90) and (0,100)

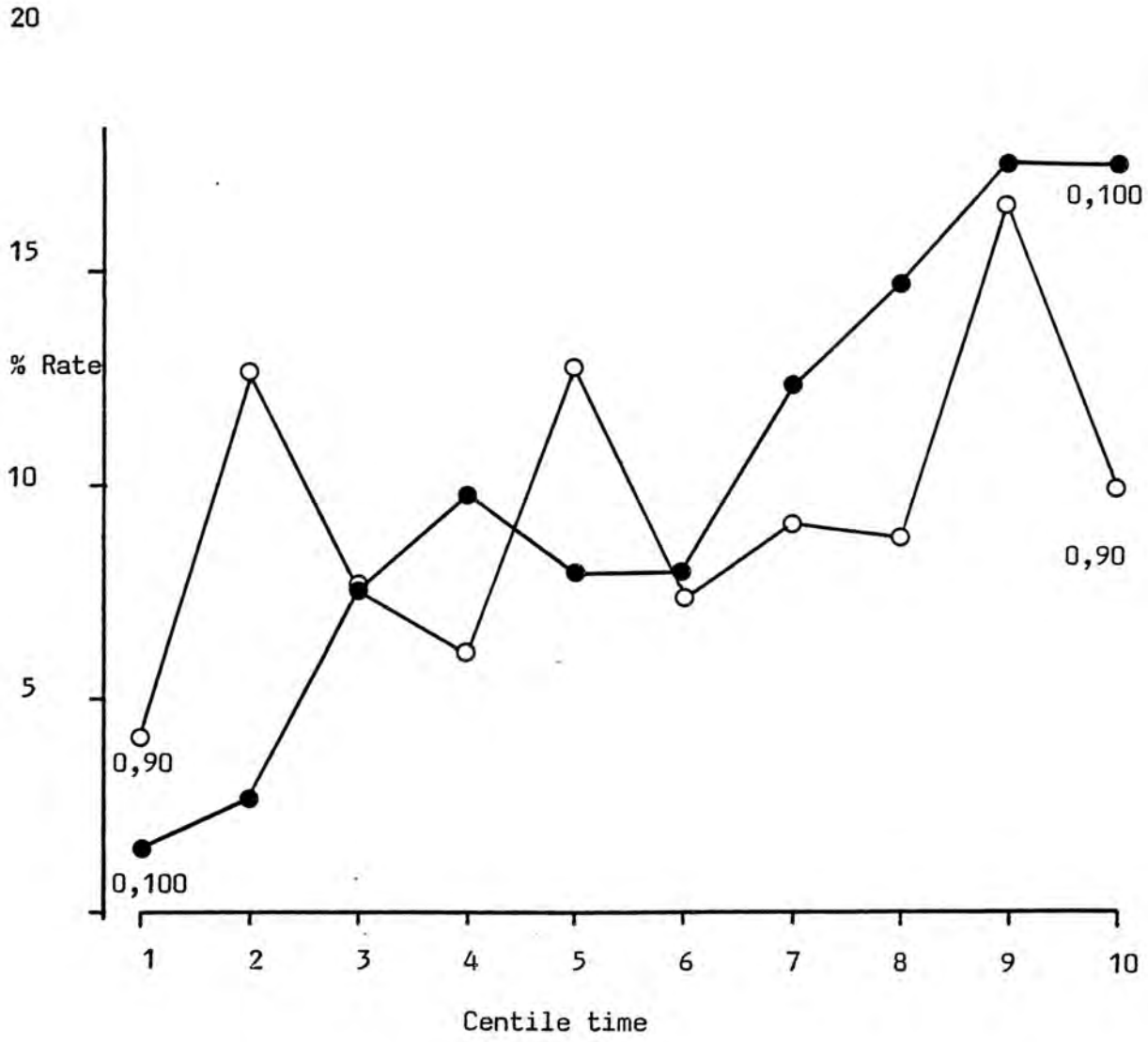


DIAGRAM 9: Mean time in initial conditions.

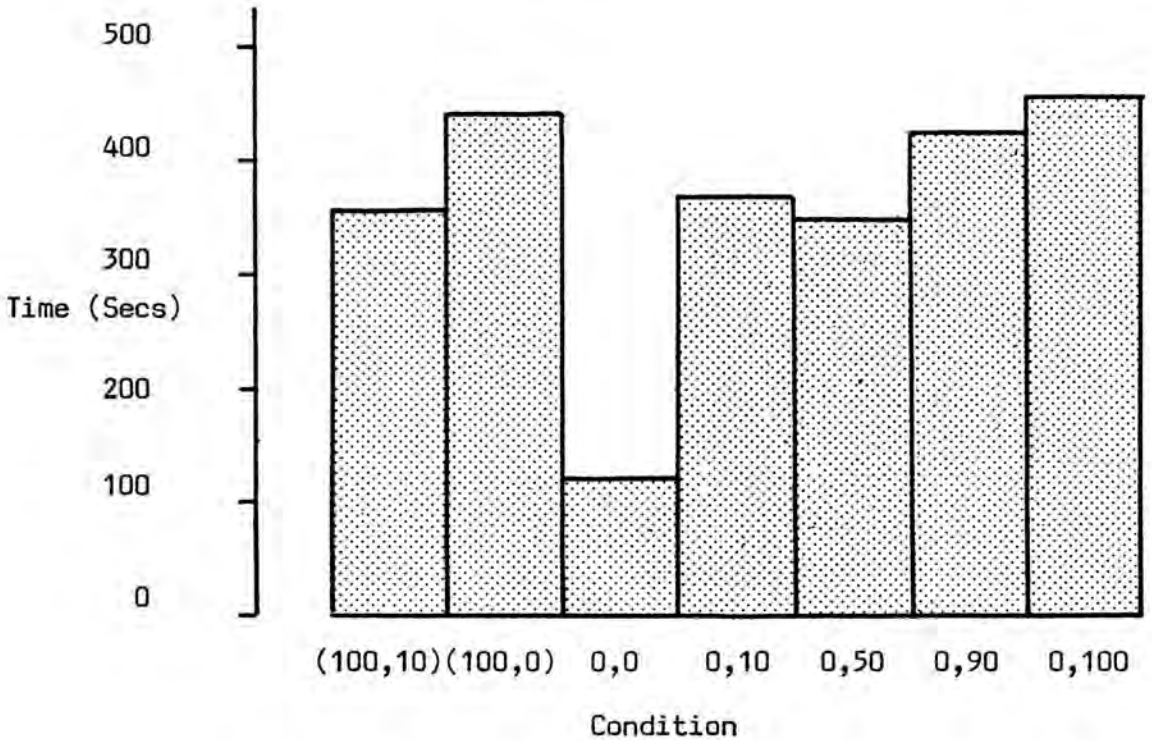


DIAGRAM 10: Difference in mean rate, 1st half to 2nd half, in initial conditions.

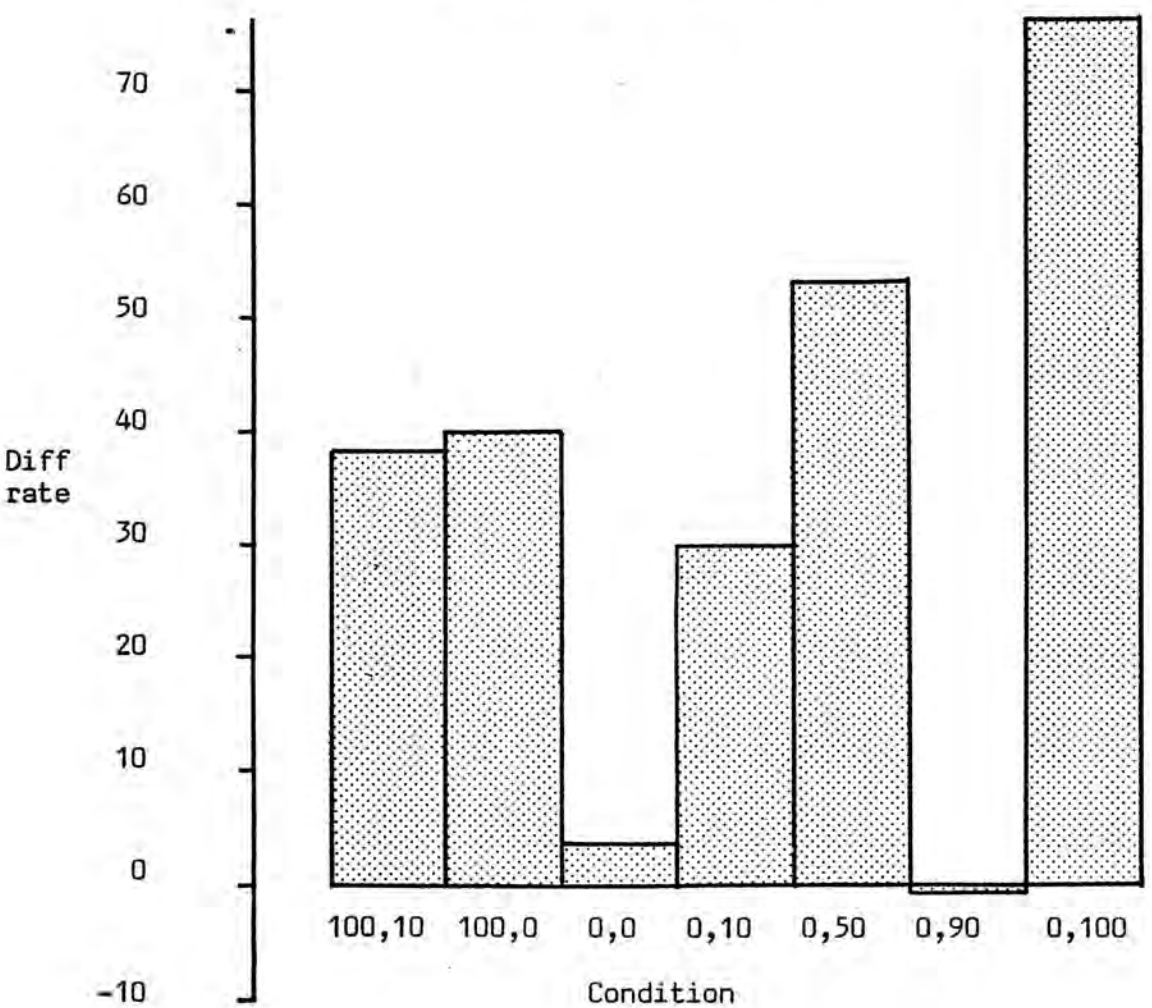


DIAGRAM 11: Difference in percentage mean rate, 1st half to 2nd half, in initial conditions.

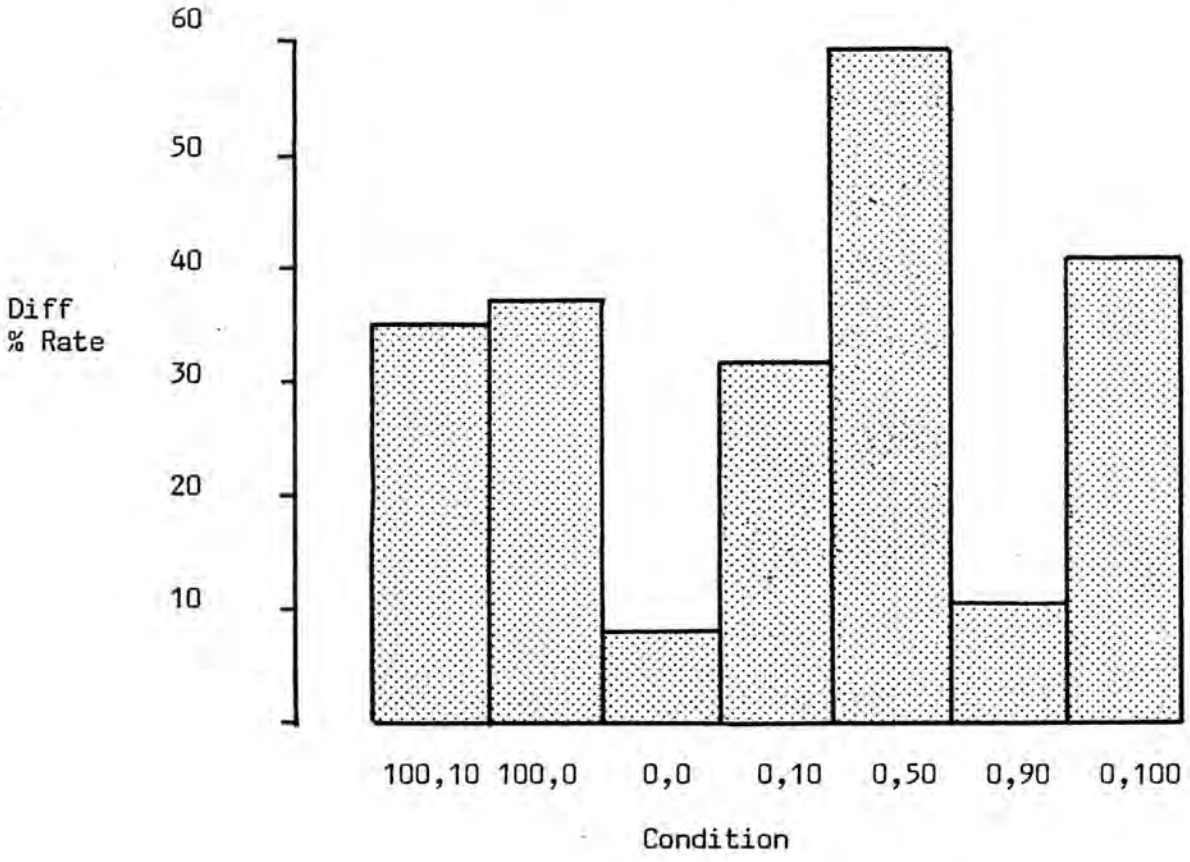
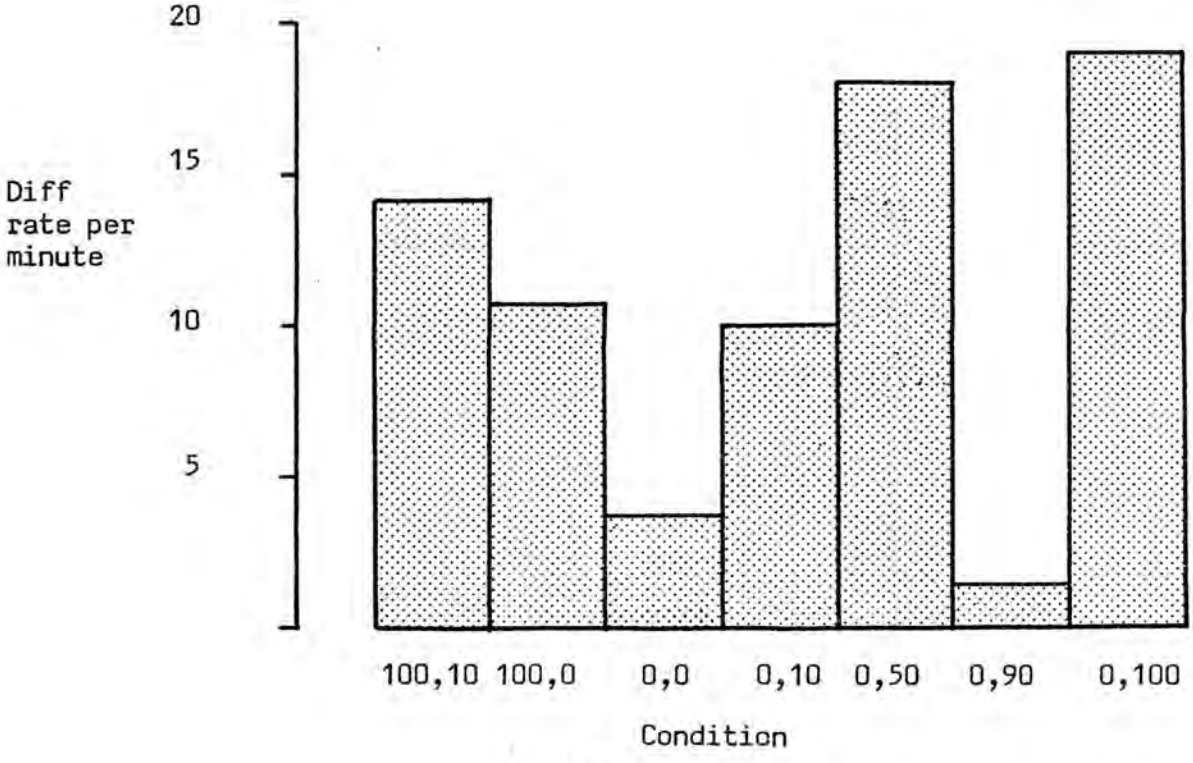


DIAGRAM 12: Difference in rate per minute, 1st half to 2nd half, in initial conditions.



DIAGRAMS 14 - 18.

COLUMN.	INITIAL CONDITION.	TRANSFER CONDITION.
1	100,0	100,10
2	0,0	100,10
3	100,10	100,0
4	100,10	0,0
5	100,0	0,0
6	0,50	0,0
7	100,10	0,10
8	0,100	0,90
9	0,90	0,100
10	100,0	0,100

DIAGRAM 13: Rate per minute in initial condition.

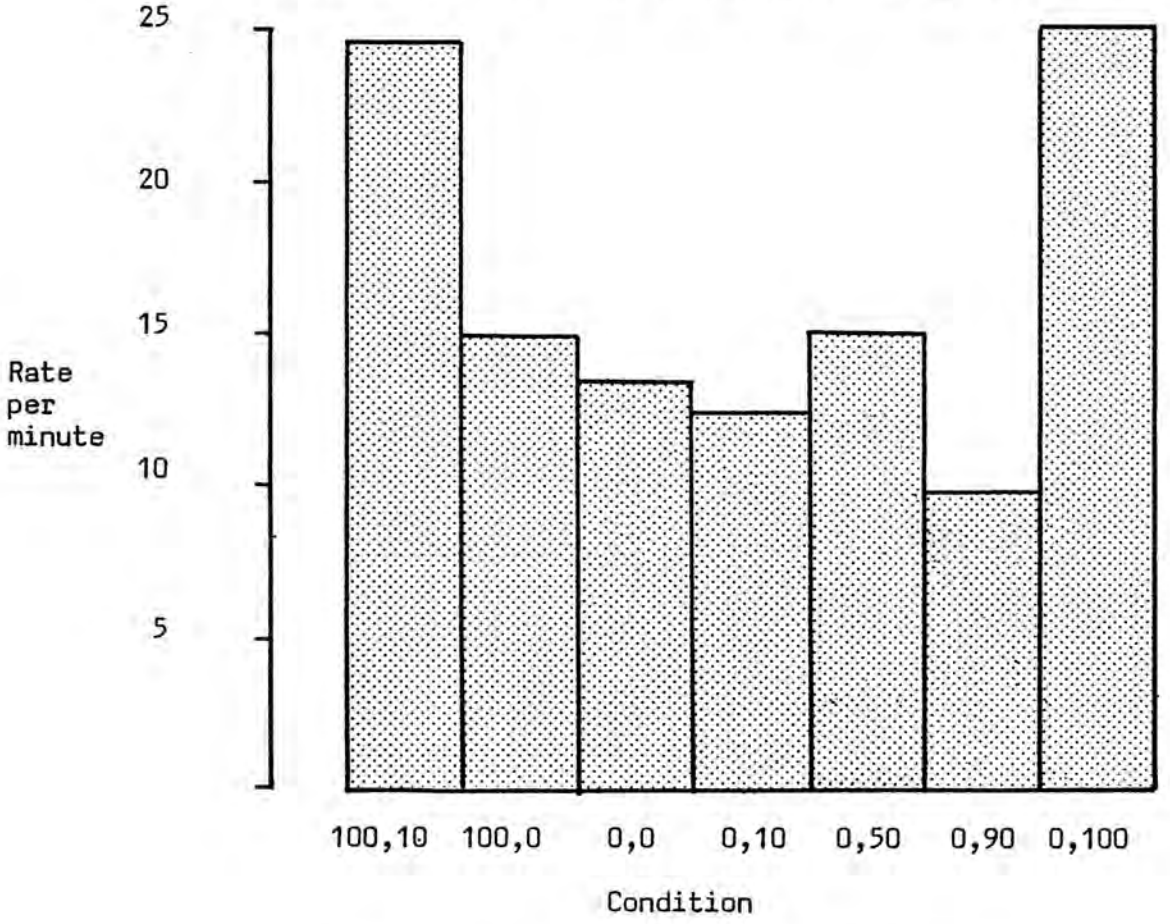


DIAGRAM 14: Mean time in transfer condition

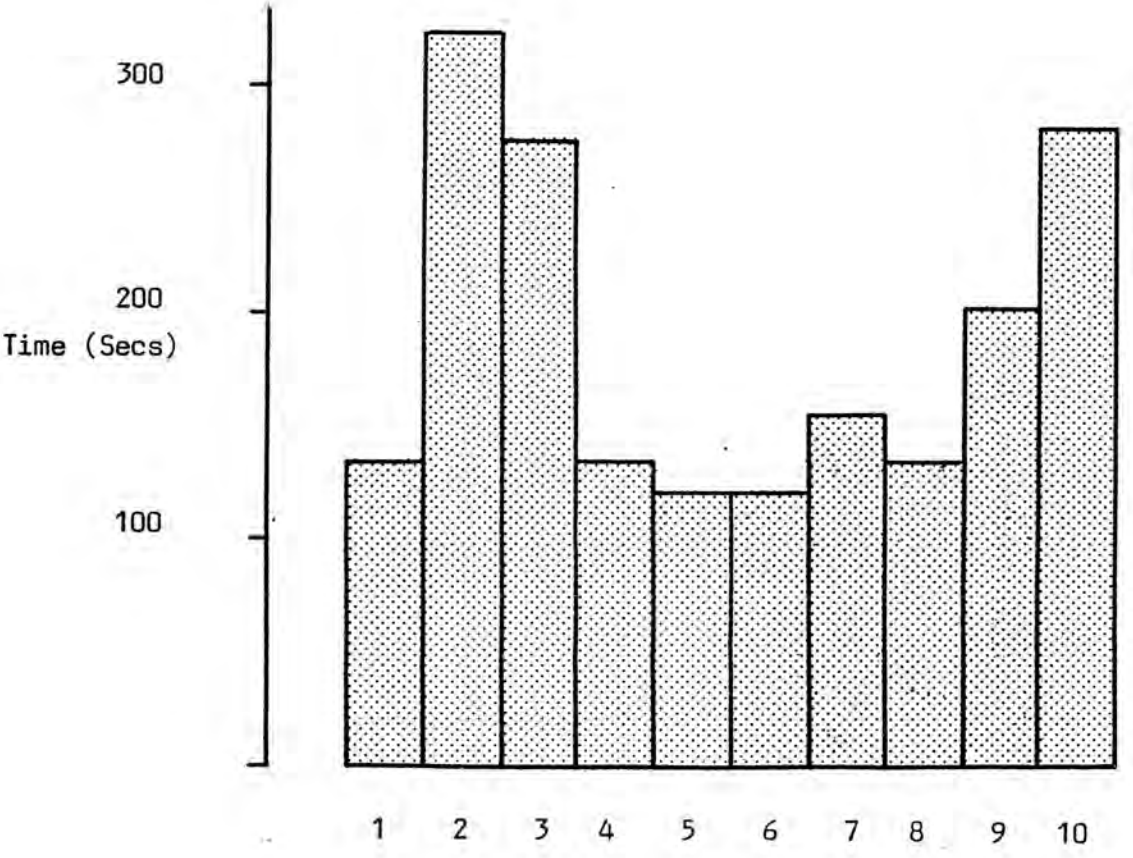


DIAGRAM 15: Difference in percentage mean rate, 1st half to 2nd half, in transfer conditions.

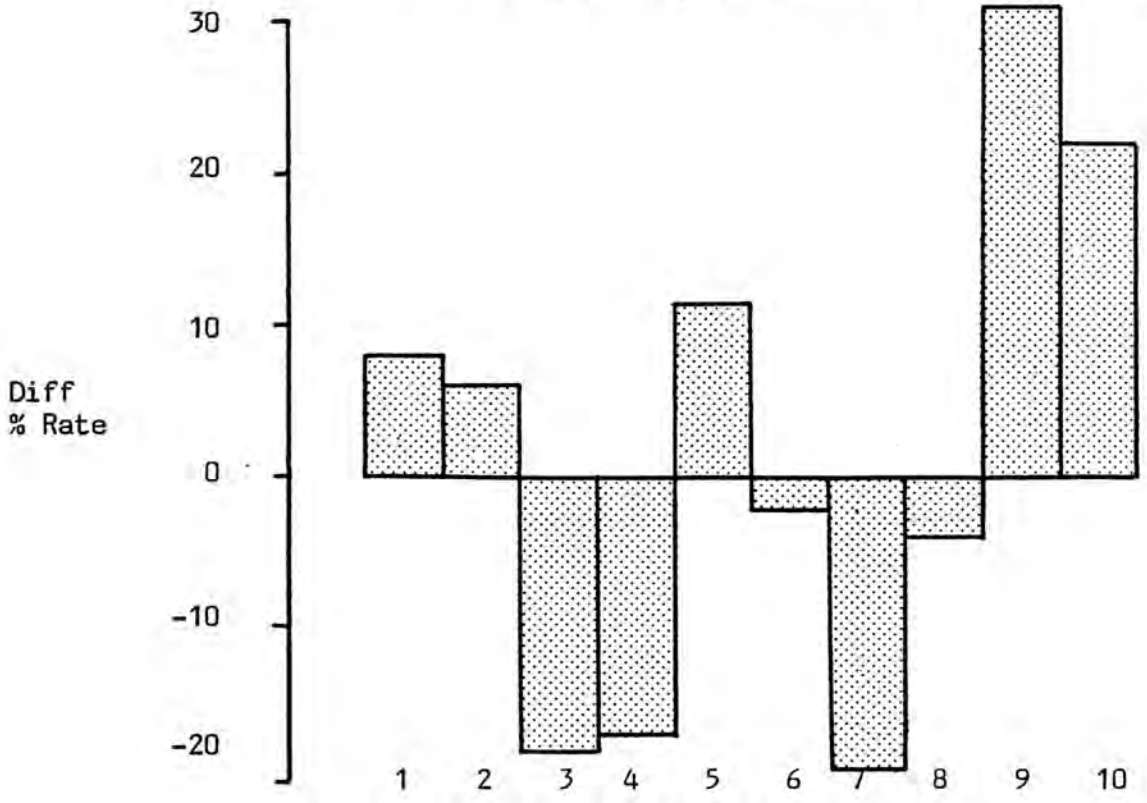


DIAGRAM 16: Difference in rate per minute, 1st half to 2nd half, in transfer conditions.

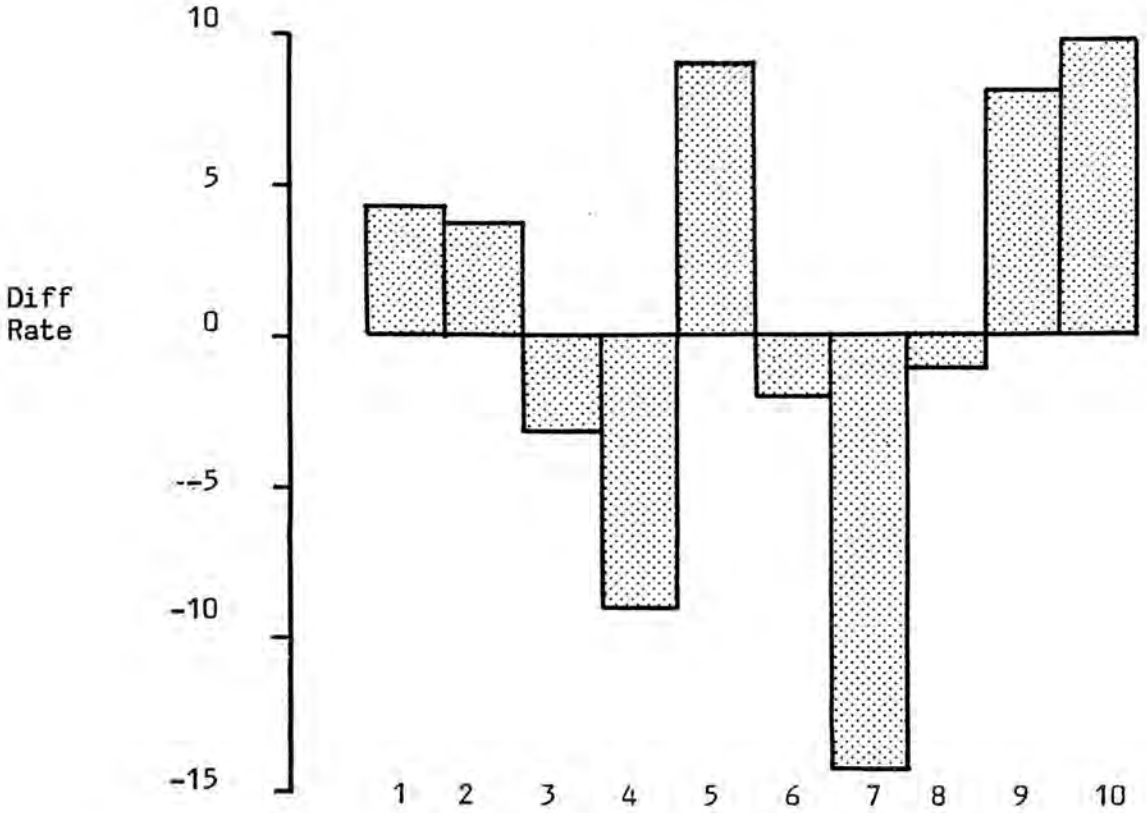


DIAGRAM 17: Mean rate per minute in transfer condition

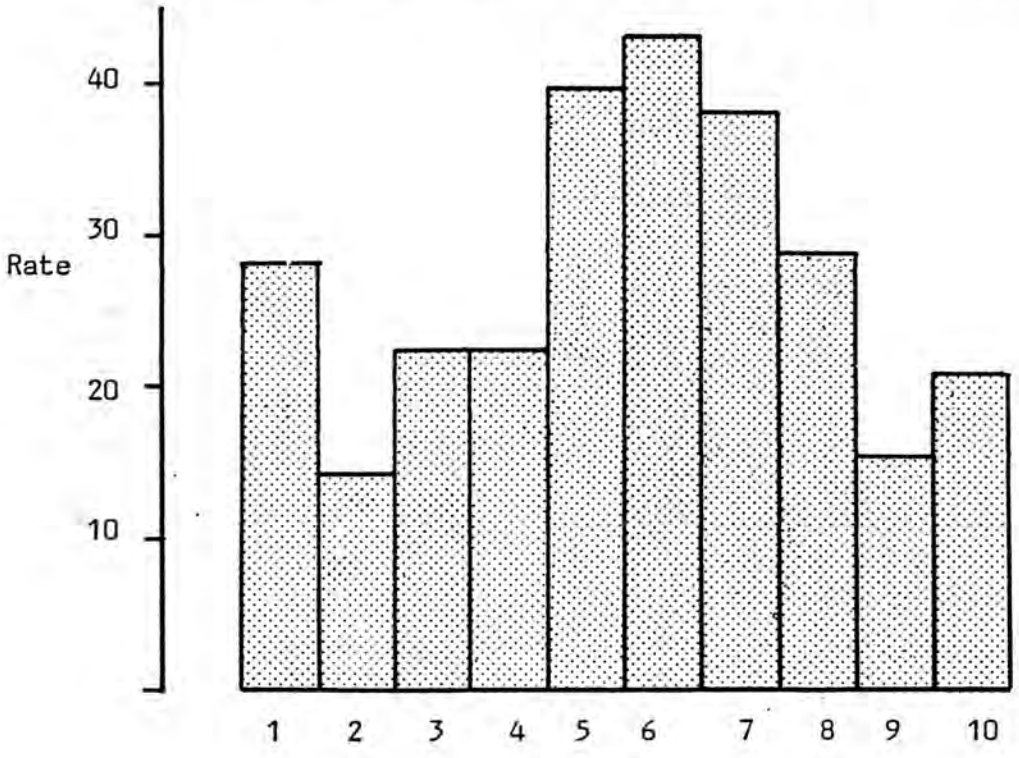
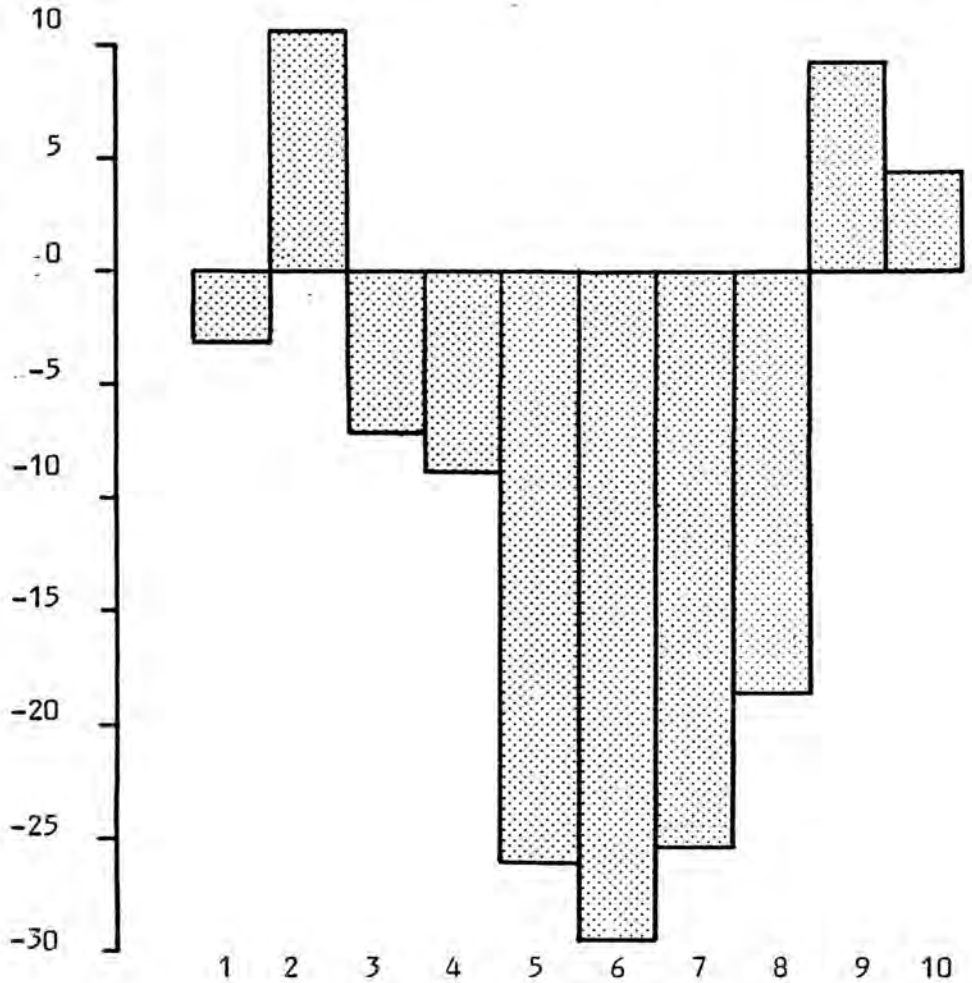


DIAGRAM 18: Difference in mean rate per minute between condition (x) as initial condition and condition (x) as transfer condition.



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