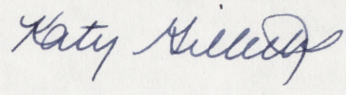
RESPONSES BY RATS TO COMPLEX GUSTATORY STIMULI: A STUDY OF CONFIGURATIONAL LEARNING

KATHLEEN A. GILLETTE

A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy of the Australian National University, Canberra.

July, 1980.

This thesis describes original research carried out by the author in the Department of Psychology of the Australian National University from January, 1978 to April, 1980.



Katy Gillette

ACKNOWLEDGEMENTS

This research programme has been supervised by a number of people at different stages. I wish to express my gratitude for their advice and encouragement which has been invaluable to me. In alphabetical order they are Dr. W.P. Bellingham, Professor R.F. Mark and Associate Professor G.N. Seagrim.

Steve Keleman and Fausta Parchi were always more than cooperative in attending to the technical requirements of this study. Gerard Martin, Julia Irwin, Luke Jones, Kurt Timmins and Ian Faulks provided friendship and assistance throughout the duration of the project. I would like to thank E.Johnstone, M. Connors and W. Kaveney for their care of the animals used in the experiments and I would particularly like to express my gratitude to Rhoni Stewart for her patient typing of my thesis. Finally, special thanks are extended to Bill, David and Elizabeth who put up with much more than a few late dinners.

ABSTRACT

Five experiments were conducted with a view to demonstrating configural conditioning and investigating its relation to other learning phenomena. The task used was flavour aversion learning where the complex stimulus was a NaCl-saccharin (N/S) solution and the conditioned aversive agent was LiCl. The preliminary finding was that after extended training with the complex stimulus, rats no longer generalised aversions from the complex to the individual component stimuli. It was shown that this could not be due to the synthesis of NaCl and saccharin into a unitary unique stimulus from the outset of training. Further research, using a latent inhibition procedure, revealed that the development of configuring over time could proceed in the absence of reinforcement. This was ascertained by testing for neophobia and latent inhibition to the component stimuli after varying amounts of nonreinforced exposure to the complex stimulus. The institution of moderate and severe partial reinforcement schedules during N/S exposure phases only marginally affected the degree of configuring shown. One known effect of partial reinforcement is to broaden the range of stimulus generalisation. The final experiment sought to show how stimulus configuring might underlie other learning phenomena, specifically sensory preconditioning. Past research has shown that sensory preconditioning emerges when CS_1-CS_2 has had only limited exposure. A configurational account of sensory preconditioning would predict that the phenomenon dissipates with further exposure. This was shown to be the

case when flavours serve as the CSs. The conclusion reached was that configuring of stimuli is a general phenomenon with a perceptual substrate. The implications for learning in general are discussed with a view to the dynamics of perceptual and associative processes.

CONTENTS

	Page
Statement	ii
Acknowledgements	iii
Abstract	iv
Contents	vi
Papers Published/Submitted	ix
Papers Presented	x
List of Tables	xi
List of Figures	xii
CHAPTER 1. Introduction	1
CHAPTER 2. THE EFFECT OF OVERTRAINING A COMPLEX GUSTATORY STIMULUS ON EXTINCTION OF FLAVOUR AVERSIONS TO COMPONENT STIMULI : EXPERIMENT 1	28
2.1 Equivalence of complex and individual component stimuli in supporting a conditioned taste aversion (Experiment 1a).	30
2.1.1 Experimental Method	31
2.1.2 Results	33
2.2 Taste aversion overtraining to a complex stimulus and its effects on responding to component stimuli (Experiment 1b).	35
2.2.1 Experimental Method	35
2.2.2 Results and Discussion	38
2.3 Training with spatial separation of component solutions (Experiment 1c).	49
2.3.1 Experimental Method	50
2.3.2 Results and Discussion	50
2.4 General Discussion	54

CHAPTER 3 ELIMINATION OF POST-CONDITIONING SENSITIZATION PRIOR TO EXTINCTION OF AVERSIONS FOR COMPONENT STIMULI: EXPERIMENT 2. 58

3.1 Interposition of a neutral solution between training and test phases (Experiment 2a). 59

3.1.1 Experimental Method 60

3.1.2 Results 61

3.1.3 Discussion 70

3.2 Verification of the nonselective effects of the neutral flavour on extinction of reference flavours (Experiment 2b). 71

3.2.1 Experimental Method 72

3.2.2 Results and Discussion 72

3.3 General Discussion 75

CHAPTER 4 A DEMONSTRATION OF STIMULUS CONFIGURING IN THE ABSENCE OF REINFORCEMENT: EXPERIMENT 3. 77

4.1 Experimental Method 78

4.2 Results 79

4.3 Discussion 87

CHAPTER 5 THE EFFECTS OF PARTIAL REINFORCEMENT ON CONFIGURING OF COMPLEX GUSTATORY STIMULI: EXPERIMENT 4. 92

5.1 Experimental Method 93

5.2 Results 94

5.3 Discussion 98

CHAPTER 6 SUMMARY AND DISCUSSION OF CHAPTERS 2-5 (EXPERIMENTS 1-4) 100

6.1 Summary of Experiments 1-4 100

6.2 Discussion of Implications 105

CHAPTER 7 CONFIGURAL PRECONDITIONING: THE EFFECT OF VARYING NUMBER OF PRETRAINING TRIALS ON SENSORY PRECONDITIONING. 110

7.1 Experimental Method 114

7.2 Results 115

7.3 Discussion 123

CHAPTER 8 GENERAL DISCUSSION: COMPLEX STIMULUS PROCESSES IN RETROSPECT AND CONCLUDING COMMENTS 128

REFERENCES 151

APPENDICES 1a-1c DATA FOR EXPERIMENTS 1a, 1b & 1c 164

APPENDICES 2a & 2b DATA FOR EXPERIMENTS 2a & 2b 190

APPENDIX 3 DATA FOR EXPERIMENT 3 221

APPENDIX 4 DATA FOR EXPERIMENT 4 239

APPENDIX 5 DATA FOR EXPERIMENT 5 254

APPENDIX 6 SUPPLEMENTARY STATISTICAL ANALYSIS 271

PAPERS PUBLISHED/SUBMITTED

Publications:

Gillette, K., Bellingham, W.P., and Martin, G.M., Transfer of taste aversion from food to water under various states of deprivation. *Animal Learning and Behaviour*, 1979, 7, 441-446.

Gillette, K., Martin, G.M., and Bellingham, W.P., Differential use of food and water cues in the formation of conditioned aversions by domestic chicks *(Gallus gallus)*. *Journal of Experimental Psychology: Animal Behavior Processes*, 1980, 6, 99-111.

In submission:

Bellingham, W.P., and Gillette, K., Spontaneous configuring to a tone-light compound using appetitive training: A common element interpretation. *Learning and Motivation.*

Gillette, K., and Bellingham, W.P., Evidence for perceptual account of configural conditioning in a conditioned flavor aversion paradigm. *Journal of Experimental Psychology: Animal Behavior Processes.*

PAPERS PRESENTED

Differential use of food and water cues in the formation of conditioned aversions by domestic chicks. Australian Society for the Study of Animal Behaviour, Brisbane, Qld., May 1978.

Transfer of taste aversions from food to water under various states of deprivation. Experimental Psychology Conference, Melbourne, Vic., May 1978.

Differential use of food and water cues.... Experimental Psychology Conference, Melbourne, Vic., May 1978 and also in 4th Year Prizewinner Symposium of the Australian Psychological Society, Newcastle, N.S.W., August 1978.

A behaviouristic approach to dyslexia and word learning in rhesus macaque. Australian Society for the Study of Animal Behaviour, Narooma, N.S.W., May 1979.

Assessment of the roles of performance factors and response topographies in the asymmetrical use of visual and taste cues by chicks. Experimental Psychology Conference, Canberra, A.C.T., May 1979.

Configural conditioning using complex gustatory stimuli. Experimental Psychology Conference, Sydney, N.S.W., May 1980.

LIST OF TABLES

TABLE		PAGE
1	ANOVA Summaries of Flavour Group within Overtraining Group Extinction Tests.	41
2	ANOVA Summary Table of Post-extinction N/S Consumption by Overtraining Groups in Experiment 1b.	45
3	Summary of Scheffé Multiple Comparisons for Postextinction N/S Consumption in Experiment 1b.	47
4	ANOVA Summary Table of Post-extinction N/S Consumption by Overtraining Groups in Experiment 2a.	69
5	Summary of Trend Analysis Comparing Effects of Increased N/S Exposure on Sensory Preconditioning in Experiment 5.	122

LIST OF FIGURES

FIGURE		PAGE
1	Mean consumption of N/S, N and S by experimental and saline control groups on training and test days from Experiment 1a.	34
2	Summary of acquisition and extinction means from the five Overtraining groups in Experiment 1b.	39
3	Summary of mean consumption of N/S, N or S, on the tenth extinction trial, and of N/S alone, on the eleventh and twelfth post-extinction trials from Experiment 1b.	43
4	Mean consumption of N and S from two simultaneously presented bottles, during acquisition, and consumption of N/S, N and S, during extinction, in Experiment 1c.	52
5	Comparison of patterns for consumption of N/S, N and S during extinction in Experiment 1c with those for the two-trial conditioning group of Experiment 1b.	53

FIGURE		PAGE
6	Summary of acquisition, desensitization, and extinction phase means for Overtraining groups receiving four, six, ten or ten no-drug conditioning trials with the complex solution, N/S, in Experiment 2a.	62
7	Comparison of N/S, N and S consumption patterns during extinction as a function of level of training in Experiment 2.	65
8	Summary of mean consumption of N/S, N or S, on the tenth extinction trial, and of N/S alone, on the eleventh and twelfth post-extinction trials, for Experiment 2a.	68
9	Results of Experiment 2b during acquisition, desensitization, and extinction test phases for groups conditioned with N/S, N or S.	74
10	Results of Experiment 3 during latent inhibition pretraining, differential conditioning, desensitization and extinction phases for groups receiving two, ten or twenty pre-exposures to N/S.	81

FIGURE		PAGE
11	The left panel represents differential neophobia for N/S, N or S after two, ten or twenty pre-exposures to N/S alone. The rate to acquire an aversion for N/S, N or S in each pre-exposure condition is shown in the right panel.	83
12	Comparison of N/S, N and S consumption patterns during extinction for groups receiving differential conditioning after N/S pre-exposure in Experiment 3.	85
13	Results of Experiment 4 showing acquisition by groups under 1:1 and 2:1 schedules of nonreinforcements to reinforcements and subsequent extinction to N/S, N and S as a function of partial reinforcement schedules.	95
14	The left panel compares N/S, N and S consumption during extinction for groups receiving 0:1, 1:1 and 2:1 partial reinforcement schedules for tests 1-5. The right panel depicts the results of tests 6 - 10.	97
15	Results of Experiment 5 during N/S preconditioning and sensory preconditioning test phases for groups receiving one, four, seven or ten N/S exposures.	117

FIGURE		PAGE
16	Differential neophobia for N or S after one, four, seven or ten exposures to N/S alone is shown in the left panel. The right panel depicts summed consumption of N or S over the second and third conditioning trials as a function of prior N/S exposures.	118
17	Comparison of test results for conditioned aversion groups versus preconditioned aversion groups.	120
18	Schematic representation of the postulated reduction in the number of elements attributable to a stimulus presentation via neural inhibition.	136
19	Mean changes in body weights as measured on pretraining days for animals in Experiments 1b and 2a.	216

CHAPTER 1

INTRODUCTION

It can hardly be overstated that any sentient animal in any learning situation is faced with a multiplicity of stimuli in spite of experimenters' efforts to eliminate all but those specified by procedural traditions. The focus of configural conditioning is to determine whether and how an animal comes to integrate this multiplicity of stimuli over time. Although single stimulus manipulations contribute to an understanding of the basic behavioural mechanisms, extrapolation of the dynamics of complex stimulus integration from single stimulus principles is limited. Reports of configural conditioning by Western psychologists are conspicuously absent from the literature concerned with abstract principles of learning.

The general concern of configuring studies is to determine how training to a complex stimulus, e.g. CS_1 + CS_2, affects subsequent responding to the individual component stimuli which went to make up the complex. Configural conditioning is said to have occurred when, with increased training, the components of a complex stimulus become progressively less effective in evoking a response conditioned specifically to the complex stimulus. As with so many of the behaviour phenomena investigated by animal learning psychologists, Pavlov and his students

* This literature is not reviewed here since none of it has been translated nor has it been made available outside Russian archives. Gregory Razran collected and reviewed the studies during a stay in Moscow. He serves as the only source for these materials. Although he treated the studies as highly suggestive od configural conditioning, he did point out that they do not use orthodox Western methodology.

were the first to study configurational processes in the laboratory. Although relatively little space is devoted to complex stimulus processes in his book, *Conditioned Reflexes*, Pavlov marvelled at the fact that two stimuli acting together could come to evoke an 'excitatory' process while only one of the two acting alone seemed to evoke an 'inhibitory' process. The problem is indeed a perplexing one and is the focus of this thesis.

EMPIRICAL FINDINGS:

Although several reviews of configural conditioning have been written by Western psychologists (e.g. Baker, 1968; Kehoe & Gormezano, 1980; Razran, 1965 & 1971) very little research has been specifically directed at this issue in the West. Razran (1971) claimed that over 750 Russian studies have been devoted to the configuring process.* He quite reasonably requested that, methodological and statistical considerations aside, the results of these studies be taken into account when discussing complex stimulus processes.

Configural effects were first demonstrated in Pavlov's (1927, pp. 144-147) laboratory. Essentially he and his colleagues used differential reinforcement techniques by which either a complex stimulus was always followed by reinforcement while presentations of component stimuli were never reinforced, or *vice versa*.

When an animal under these conditions comes to differentiate between the complex stimulus and component stimuli, it is said to have demonstrated patterning. In the case where the complex stimulus is reinforced, positive patterning is expected while when the components, rather than the complex, are reinforced, negative patterning is expected. Positive and negative patterning have been demonstrated in a variety of paradigms by both Russian and Western researchers (e.g. Hull, 1940; Whitlow & Wagner, 1972; Woodbury, 1943).

Often overlooked, however, is the fact that Pavlov's colleagues demonstrated spontaneous configuring in an indirect fashion. Pavlov described an experiment where dogs were conditioned to salivate after the presentation of a four-component sequential complex, say A-B-C-D, and not to salivate to A-C-B-D. Apparently the discrimination was difficult to establish but the interesting outcome, as reported by Pavlov, was "So soon as complete differentiation between such compound stimuli had been established, the individual components when tested singly were found to have lost all their initial positive conditioned effect." (1927, p.147) In other words, not only did the animals come to discriminate between the two complex stimuli but also between the complex and its constituent components even though the components had never been presented alone. Although this particular experiment is not a direct test (nor a necessarily good one) of the notion that animals can eventually discriminate between a 'whole' and its 'parts'

without explicit discrimination training, it is nevertheless suggestive that configuring can occur spontaneously.

To reiterate, spontaneous configuring (or spontaneous patterning) refers to the situation where responsiveness to the components of a complex stimulus decline as a function of increased training with the complex alone. Based on the Russian literature, Razran (1939; 1965) concluded that there was sufficient evidence to conclude that while the complex stimulus gains strength, the components lose their ability to control responding with continued training to the complex alone. This conclusion was not accepted by Baker (1968) who objected to it on two grounds.

Baker's (1968) first concern was with methodology. Specifically, he noted that the Russian studies typically used within-subject designs wherein nonreinforced tests of the components were interposed after various levels of conditioning. In a sense, then, the animals were being differentially reinforced to the complex and components. Any increased differentiation between complex and components could then be seen as a patterning effect rather than as spontaneous configuring. As Baker pointed out, patterning is easily and frequently demonstrated.

Baker's second objection seems somewhat less clear-sighted. He argued that any claim for configural conditioning must be accompanied by a demonstration of *absolute* decrements in responding to component stimuli as a function of increased conditioning to the complex. As

* All these studies tested after various levels of training in between-subjects designs. The first three used instrumental conditioning procedures while the latter was a classical conditioning study using a conditional discrimination task.

he saw it, *relative* decrement did not distinguish configuring from stimulus generalisation decrement. He did not state why absolute decrements could not simply represent a steepened generalization gradient. Presumably he adopted Hull's (1943) notion that there was a constant degree of generalisation decrement from a complex to a component. In any case, one wonders why configural conditioning would be a less important phenomenon if it was shown to be a special case of stimulus generalisation.

In the same year that Baker conveyed his misgivings regarding configural conditioning, Bellingham (1969) conducted a study which showed that configural conditioning could reasonably be seen as a special case of stimulus generalisation. It is interesting that he reached this conclusion having demonstrated absolute loss of associative strength by the components using a between-subjects design. Such a finding would have served to convince Baker that configuring was, indeed, distinct from stimulus generalisation decrement!

Using between-subjects designs in a variety of paradigms, most recent attempts to produce configuring have not been conclusive. Several studies have resulted in relative loss or no loss of associative strength by component stimuli (Baker, 1969; Rescorla, 1972; 1973; Saavedra, 1975).* Booth and Hammond (1971) found that only one component lost strength while the remaining component temporarily maintained its strength. They did

show, however, that there was no retardation in acquiring conditioned suppression to the components of a previously extinguished configural stimulus. In a sense this latter finding constitutes indirect evidence for spontaneous negative patterning. Nevertheless, Booth and Hammond's results have not been taken as positive evidence that configural conditioning is a general phenomenon.

Several other studies have examined the effects of prolonged complex stimulus conditioning on responsiveness to component stimuli. Using two sequentially presented visual stimuli in a conditioned reinforcement study, Thomas, Berman, Serednesky and Lyons (1968, Expt.2) found three characteristic stages of responding to the various stimuli. With relatively little training only the second stimulus was as powerful a conditioned reinforcer as the complex. After further training the first stimulus had acquired greater conditioned reinforcing properties than the second. After substantially more training neither the first nor the second were effective while the complex had powerful conditioned reinforcing properties. While the study seems a convincing demonstration of configuring to sequential stimuli, a within-subjects design was adopted. Other studies which have carried out component tests after extensive complex training have, unfortunately, not tested at earlier stages in training (e.g. Guth, 1967; Wickens, Nield, Tuber & Wickens, (1970). Nevertheless, in all cases responding to the complex was greater than to the components.

Recently, however, two studies have provided evidence for configuring where Baker's (1968) criteria have been met. The first was that of Gray and Lethbridge (1976) who used a tone-light complex in the conditioned emotional response (CER) paradigm. After only twenty-four trials they found that the suppression to component stimuli, which was marked after eight and twelve trials, had almost completely dissipated. This demonstration has been criticised by Kamin and Idrobo (1978) who claim that the effect is artifactual. Their criticism is based on fairly weak evidence that the complex stimulus also seemed to show some small loss of resistance to extinction as a result of overtraining.

Gray and Lethbridge (1976) conducted a companion experiment to that described above. The aim of the experiment was to show that the configuring effect could not be interpreted in terms of generalisation decrement or stimulus novelty effects. The procedure was to train rats with a component stimulus and then test suppression to the complex after various levels of training. They found complete suppression to the complex for all training levels. However, such a finding does not invalidate a stimulus generalisation account of configuring if a common-element model of stimulus generalisation is adopted. In stimulus generalisation studies, decrement is usually seen when testing is to a stimulus minus some elements. Gray and Lethbridge tested to a stimulus with all elements unchanged plus new elements. Such a procedure constitutes

an external inhibition rather than a stimulus generalisation design.

A second study demonstrating strong configural conditioning (Bellingham & Gillette, 1980) adopted a discrete-trial bar press procedure similar to that used by Rescorla (1972). They showed that the tone-light complex maintained associative strength for all levels of training while the components lost strength in a linear fashion over 300 - 3900 training trials. Further, it was shown that a common-element model of stimulus generalisation was compatible with configuring effects. This was demonstrated by training with a $tone_1$-light complex and testing with tones of different frequencies plus the light and with the light alone. The result was a continuous decrement along the $tone_1$-light to light-only continuum which increased with extended training.

THEORETICAL APPROACHES:

Despite the paucity of empirical findings regarding configural conditioning effects there has been substantial theorising regarding complex stimulus processes. This theorising is manifested at two levels. At the first level theoretical assumptions are made regarding the nature of a complex stimulus. At one extreme is the Gestaltist notion of an innate configure while at the other extreme is the notion that a configure is equal to the sum of its parts. The former position I will term configurationist, while the latter will be termed elementist. The second

level of theorising is not independent of the first but involves postulating mathematical rules regarding the interactive or combinatory effects of one component stimulus with the other. An extensive review of combination rule approaches has been written by Kehoe and Gormezano (1980) and will not be handled in detail in this introduction.

The Nature of a Configural Stimulus.

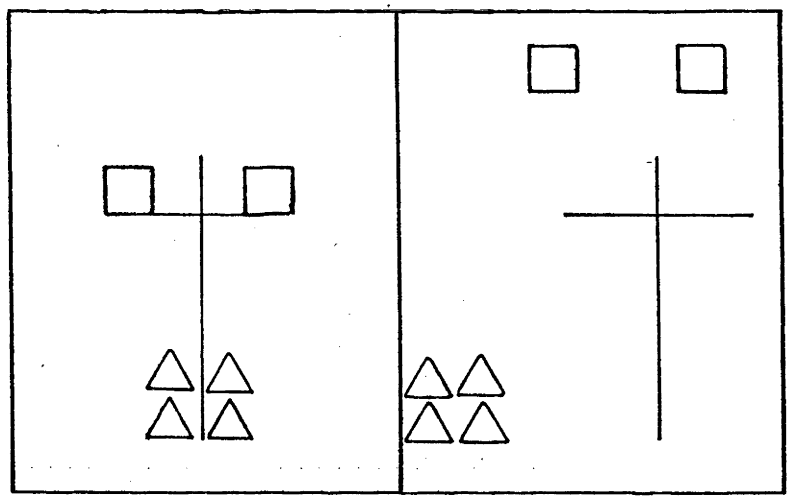
The Gestalt approach to processing of complex stimuli is an extreme configurationist one. The word *Gestalten* itself is often translated to mean configuration and pertains to the fundamental belief that "the whole is greater than the sum of its parts." According to this approach, any stimulus event occurs in the context of other stimulus events. These stimulus events are super-imposed on each other and represent a 'whole', a patterned perception. This pattern is certainly stored as a single trace which is unique to the pattern and corresponds in a one-to-one relation with the original perception. This fundamental assumption underlying Gestalt theory was described by Köhler (1938) who stated that:

> Neural events tend to modify slightly the state of the tissue in which they occur. Such changes will resemble those processes by which they have been produced both in their *pattern* and with respect to other properties. (p.236, italics mine).

Given this assumption of patterned neural traces, elemental stimuli presented in close conjunction are seen to be synthesised into a unitary percept upon their first

occurence. The properties of a complex stimulus are not present in any subpart but only when the parts are present as in the original complex.

The formation of these organised units proceed according to laws of proximity and similarity, amongst others. These laws correspond closely to the associationistic laws of contiguity and contrast. Over and above these basic laws, the Gestaltist would also predict better synthesis for relational events than for nonrelational events.† Evidence for this configurational approach was obtained from experiments using part-whole relational problems (Asch, 1969). A hypothetical example of such a problem is illustrated below. It was found that



'relational 'nonrelational'

subjects who had studied diagrams of the relational type showed accurate recall of the corresponding subparts. Those who studied the nonrelational diagrams often managed to recall only one subpart and frequently mismatched subparts.

†where relational events refer to unitary events or events which are organised into a perceptual whole.

However, such a finding simply points out that relational stimuli are easier to recall than nonrelational stimuli, or put another way, that certain conditions facilitate the rapid development of a configurate, or Gestalt.

In fact, it was primarily relational factors which concerned the Gestalt psychologist. The futility of breaking down a perception into its components was evidenced by the example of perceiving music. A musical composition yields a melody which is made up of individual notes. Transposing the melody to a different key eliminates all the original notes (components) while retaining the melody (configure). The example as given seems more pertinent to psychological transposition. However, one would expect the Gestaltist to predict that removing or changing notes in a melody would cause an altered perception of that melody. Such is the concern of configural conditioning.

In summary, although Gestalt psychology is more concerned with elucidation of the relations among stimuli which will yield a 'whole' stimulus, it does posit that a 'whole' is not separable into its parts. This hypothesis would seem to predict that responding to a component stimulus would never resemble responding to the complex from which it derived.

Pavlov objected to the methods and concepts of Gestalt psychology (Pavlov, 1957 cited in Kimmel, 1976). In spite of this antipathy, his description of complex stimulus processes is in some senses very similar to that of the

Gestaltists. He inferred that elemental stimuli must affect the same cortical cells whether they were presented individually or in conjunction with other stimuli. The conjunction of two or more stimuli was, however, synthesised into a functionally unique stimulus through the interactions of the cortical excitation produced by the individual stimuli. Pavlov (1927) wrote:

> Plainly the experiments reveal the great importance of the synthesizing activity of the cortical cells which are undergoing excitation. These cells must form, under the conditions of a given experiment, a very complicated excitatory unit, which is functionally identical with the simple excitatory units existing in the case of more elementary conditioned reflexes. Such active cortical cells must interact with one another, as has clearly been demonstrated in the case of compound simultaneous stimuli (pp.147-148).

Pavlov then extended this interpretation to the case of sequential complex stimuli. What he did not indicate was whether the synthesis of stimuli was automatic or whether it was achieved with continued exposure to the conjoint stimuli. In any case, the notion that synthesis of stimuli accounts for configural conditioning effects marks Pavlov a configurationist.

Perhaps the best known proponent of the configurationist school is Gregory Razran who explicitly refutes Gestalt theories of configuration. Razran (1939, 1965, 1971) accounts for both patterning and spontaneous configuring effects by postulating a perceptual learning substrate. According to Razran, when two stimuli are

* Unfortunately, Razran declined to elucidate how this might occur.

presented together repeatedly, afferent-afferent (S-S) learning takes place. In the course of this S-S learning, however, something more than an association is made in that it "... brings into being *new* neurobehavioural *existents*" (Razran, 1971, p.265).* So, although Razran does postulate a unitary stimulus which acquires distinct properties which differ from those of the elemental stimuli, he believes that this uniqueness emerges as the result of an S-S associative process. His view that components of a complex stimulus are independent at early stages and become associated later in training distinguishes him from the extreme Gestaltists. His formulation also allows the prediction to be made that components will become more distinct from the complex and, hence, will be capable of 'losing' associative strength through the course of training. This issue will be discussed presently.

An alternative to Razran's hypothesis has recently been proposed and is called the "unique stimulus hypothesis" (Whitlow & Wagner, 1972; Rescorla, 1972; 1973). This hypothesis relies on both configurationist and elementist assumptions. With respect to the former, the unique stimulus hypothesis assumes that the conjoint presentation of two stimuli results in a third 'unique' stimulus which is thought to manifested any time both components are presented together, a distinctly Gestalt notion on the surface. However, the unique stimulus is thought to act independently with all the characteristics of any other physically defined stimulus (Rescorla, 1973). Consequently, a complex can be seen as

the sum of its parts - parts which occur in the physical environment *and* parts which occur in the internal environment. Such an approach contradicts that taken by Razran who believed that a complex stimulus could become totally distinct from its components. The need to postulate the unique stimulus in the first place arose when it was shown repeatedly that addition of response measures from component tests rarely summed to the response level of the complex. In summary, the unique stimulus hypothesis is both configurationist, in so far as it postulates an *a priori* unique stimulus, and elementist in that the associative strengths of the individual components are additive in producing behaviour toward the complex. This formulation does not allow for the loss of absolute associative strength to components over the course of complex stimulus training. Given that such an outcome has rarely been demonstrated outside Soviet laboratories, the hypothesis has never been seriously challenged.

Hull's comprehensive treatment of complex stimulus processes illustrates an extreme elementist approach. Hull (1943; 1945) proposed an hypothesis of "afferent neural interaction" to account for the distinctiveness of a complex stimulus from its components. This hypothesis states that the neural impulse arising from one stimulus is modified by that of another coacting stimulus and *vice versa* . Hence while a component stimulus is represented as the effective stimulus s, when presented alone, it is represented as the effective stimulus s', when coacting.

Accordingly, a stimulus complex made up of effective components s_1 and s_2 becomes an effective stimulus of $s'_1 + s'_2$. Excitatory habit strength is then seen to accrue to each s' individually. These individual habit strengths sum to produce the total responding to the complex stimulus. Any decrement in responding to component stimuli can be seen as a function of two variables. First, the effective habit strength for any component is less than the habit strength for the whole complex. Second, since the effective stimulus (s) for a component in isolation differs from its effective stimulus (s') in a complex, Hull (1943) reasoned that there would be a constant degree of stimulus generalisation decrement from s' to s. Given this last assumption of constant generalisation decrement, along with an additive model, Hull's formulation would not predict or account for absolute decrements in component responses after extended complex training.

Although Weiss (1972) was primarily concerned with stimulus compounding rather than with configural conditioning, he can be described as an elementist with respect to complex stimulus processes. The stimulus compounding paradigm involves conditioning to component stimuli individually and testing responsiveness to the complex. Configural conditioning reverses this procedure. Weiss postulated that the response strengths acquired to invidual components summed to produce responding to the stimulus composite. Unlike Hull, he does not rely

on a notion of afferent interaction. Rather, he assumes that component stimuli maintain their integrity but he includes background stimuli as additional components. Depending on the response strengths accrued to the background or contextual stimuli, responding to a complex stimulus can be greater or less than to either component. The formulation has more difficulty in accounting for response levels that are an average of the component stimuli. Weiss postulates that, in the case of averaging, a mechanism of response competition must be acting. Weiss has not explicitly extended his model to configural conditioning but the elementist approach adopted by him is similar to that of Whitlow and Wagner (1972) and Rescorla (1972; 1973) described earlier. The distinction is that he views background stimuli, rather than an unique stimulus, as accruing the 'extra' associative strength which goes to make up response levels to a complex stimulus. Interestingly enough, a recent study by Odling-Smee (1978a) has demonstrated that the associative strength which accrues to background stimuli is maximal at low levels of training and dissipates with further training. The implications of this finding will be discussed in the concluding chapter of this thesis.

Overview of the nature of configural stimuli.

The continuum of configurationist-elementist theorising can be more simply delineated into two distinct categories. One category is constituted by theories which hold that a configural stimulus is represented in a unique fashion

upon its first presentation. Approaches which hold that a configure is only gradually synthesised from its parts fall into the remaining category (e.g. Razran).

The Gestalt perceptual wholes, the hypothesis of neural interaction and the unique stimulus hypothesis are all akin in that they postulate that a patterned input to the nervous system is different from the simple additions of the patterns' subparts. Wolpe (1949) has evaluated the first two hypotheses and postulated an alternative resembling the third. With respect to the Gestalt doctrine that the "whole is greater than the sum of its parts", Wolpe aptly wrote:

> Köhler recognises that this must depend upon certain properties of the nervous system. But he makes no attempt to suggest a hypothesis of the mechanism by which this occurs on the basis of our positive knowledge of the nervous system. It merely begs the question to say that the external object is mirrored in physiological processes (and) that the nervous system possesses a topographical arrangement preventing confusion ... (p.279, insertion mine).

In evaluating Hull's formulation wherein the receptor discharge, or impulse, arising from one source of stimulation modifies the impulse arising from another source, Wolpe quite reasonably points out that the law of all-or-none firing precludes such a possibility. Rather, Wolpe postulates that:

> ... when two stimuli act in combination, they activate not only the neurones that each alone would have activated but also certain *other* neurones. (p.282, italics mine).

This latter formulation can be seen as a unique stimulus hypothesis.

It is somewhat paradoxical that the strict empiricist approaches to complex stimulus processes taken by elementists such as Hull and Rescorla rely on a fundamentally innate perceptual mechanism whereby a complex is distinguished from its components. On the other hand, the advocate for a perceptual approach to configuring, Razran, states that the empirical evidence suggests an emergent, rather than innate, differentiation of the complex from its components. The distinction of innate versus acquired differentiation may seem to be a minor one until the expectations regarding experimental results are considered. Both approaches can account for patterning effects and both predict low levels of responding to components after substantial training with a complex.

Only Razran, with a less formalised approach, can predict losses in the strength of component stimuli after prolonged conditioning with the complex. He reasons that as the complex becomes more completely synthesized and distinct, performance to components will disappear. This expectation is similar to that for stimulus generalisation studies wherein, as a function of training, a conditioned stimulus becomes more distinct from variants of that stimulus (Hearst & Koresko, 1968).

A Common-Element model of Configuring

The theoretical bias of this thesis is that spontaneous configuring and stimulus generalisation reflect the

same behavioural outcome and, possibly, the same basic principles of neural organisation. Procedurally, the paradigms for both are similar. In both cases conditioning proceeds to only the given CS (complex or simple) and testing is to stimuli other than the original CS. The only difference is the number of stimuli constituting the acquisition CS. One could argue that this distinction is a critical one. However, the differences can be seen as quantitative rather than qualitative if a common-element model is adopted wherein "... the similarity of two stimuli is defined in terms of the fraction of those elements that two stimulus sets have in common ..." (Bellingham & Gillette, 1980).

The author agrees with Kehoe and Gormezano (1980) that any unique stimulus account of configural conditioning (Hull, 1943; Rescorla, 1973) would result in "... an uncontrollable proliferation of hypothetical stimuli ..." (p.375). It is not agreed, however, that common-element accounts are subject to the same criticism. Common elements of stimuli are far from hypothetical and can be removed from a stimulus situation in a systematic fashion. That is, the elements in a common-element model are physically defined and measurable attributes of a stimulus such as frequency, amplitude, brightness, spatial location and duration.

The unique stimulus account of configural conditioning was the successor of Rescorla and Wagner's (1972) common-element model. The later was based on well known common-

These experiments were effected by using discrete-trial discrimination training and the following designs where a = 1,200-Hz tone, b = 1 sec flash of houselight and c = 2 sec clicker.

Group	Phase 1	Phase 2	Phase 3	Phase 4
Experiment 1:				
ab+	a+,b+,ab-,c-	ab+		
c+	a+,b+,ab-,c-	c+		
a+b+	a+,b+,ab-,c-	a+,b+		
Experiment 2				
ab-	a+,b+,ab-	ab+		
c-	a+,b+,c-	ab+		
Experiment 3				
a-b-	a-,b-,ab+	a+,b+,c+	ab-	
c-	c-,ab+	a+,b+,c+	ab-	
Experiment 4				
ab+	a-,b-,ab+	a+,b+,ab+	a-,b-	ab-
c	a-,b-, ab+	a+,b+	a-,b-	ab-

The reults of these complex experiments generally supported the notion that a complex stimulus could be contrasted with its elements. In the case of negative patterning Rescorla posited a unique stimulus account in order to explain the fact that a complex could lose associative strength through nonreinforcement while the components maintained condioned associative strength.

element theories of discrimination and generalization (e.g. Estes & Burke, 1953). Rescorla (1973) conducted a series of experiments to test a unique stimulus account of patterning and configuring effects.* Although the data supported a unique stimulus interpretation, a common-element hypotheses can explain the findings equally well (see Kehoe & Gormezano for analysis). In fact Rescorla (1976) resurrected a common-element assumption with respect to stimulus generalisation stating that, "That assumption is clearly capable of describing in a qualitative way many of the facts of stimulus generalisation". (p.95). According to a common-element approach every stimulus, simple or complex, is made up of a number of subelements all of which can acquire associative strengths that sum to the total associative strength of the stimulus.

Although a common-element assumption combined with algebraic summation rules lacks the quantitative power of statistical decision theories of generalisation and discrimination (e.g. Blough, 1975), it does have qualitative generality. The latter theories retain an elementistic approach while looking at variations in the decision rules for responding to stimuli along a sensory dimension. The derived decision rules are based on elaborate and detailed probability transformations. The model has powerful predictive properties with respect to generalisation gradients for compound stimuli and their variants

along sensory dimensions of the components (Heinemann & Chase, 1975). Its ability to predict 'configural' conditioning† relies on the assumption that a certain amount of conditioning occurs to background stimuli. It was previously mentioned, however, that Odling-Smee (1978a) showed reduction of background conditioning with extended training.

Cumulative training effects are the focus of this thesis. Both a common-elements approach (Rescorla, 1976) and statistical decision theories (Blough, 1975) point to the analgoies between configural conditioning effects and stimulus generalisation. Bellingham and Gillette (1980) have adopted the former qualitative model and argued that configuring and generalisation are probably homologous. This conclusion was reached since it was shown that increased training steepened the generalisation gradient along a continuum from complex-to-component stimuli. Stimulus generalisation is known to decrease as a function of increased training (Hearst & Koresko, 1968). The question that neither existing common-element nor statistical decision formulations address is: What mechanism accounts for decreased stimulus generalisation as a function of increased training? It is true, however, that the decision theories do assume that any given stimulus results in a different neural effect on any particular trial. Not included in that assumption is a mechanism whereby the neural effect is altered.

†with relative loss of component strength but not absolute loss.

The theory in its very complexity reflects the complexity of neural organisation and functioning. However, this complex organisation often acts to produce 'simple' basic phenomena - both neural and behavioural. A pertinent example of a basic neural process is inhibition which results in behavioural habituation.

An expanded common-element model.

As stated, the general approach of the author is to view configuring and stimulus generalisation as reflecting common principles of neural and behavioural functioning. More specifically, it is proposed that the basic neural processes of excitation and inhibition are responsible for stimulus generalisation and its decrement. The interaction of these two processes is dynamic in the sense that one process can dominate at one point in time while the other attains ascendency at a different time.

Habituation curves show an initial sensitization before a decline in responding sets in to a repeatedly administered stimulus (Groves & Thompson, 1970). The initial sensitization implies that presentation of a discrete and novel stimulus results in diffuse excitation and such an assumption is borne out by findings of cross-modal generalisation which occurs after limited conditioning (Thompson, 1959). In a sense, then, early presentations of a stimulus may result in the generation of many additional neural 'elements' not physically represented in the subset of elements making up a stimulus.

The gradual, and relatively permanent ascendence of neural inhibition can be seen as limiting widespread excitation. Thus, inhibitory processes can be seen as a refining device.

The view that neural inhibition accounts for trial-to-trial discrepancies in the neural events due to unchanged stimulation is compatible with, or rather integrates various approaches to complex stimulus processing. For example, Razran's (1975) postulate that a complex stimulus gradually acquires distinctiveness from its components is supported. A common-element model can also be expanded to recognise that stimuli most probably generate a multitude of diffuse elements which come to be limited within more 'precise' parameters. Stimulus processing seen in the light of basic excitatory and inhibitory processes, is necessarily dynamic. Presumably, these dynamics would influence the course of learning wherein certain stimuli (CSs) are associated with environmental changes (UCSs) of one sort or another. For example, while overshadowing may be seen at one stage of training, "equalization" (Pavlov, 1927, p.272) of stimuli may be seen at a later stage. As well, the power of neural inhibition in limiting the extent of the impact of a given stimulus can be seen in the overtraining extinction effect (North & Stimmel, 1969): this phenomenon arises when, after prolonged training, the discriminative stimulus comes under almost total inhibitory control as evidenced by rapid extinction.

In studies of configural conditioning it is convenient to refer to a common-element approach since the very paradigm involves adding together and subtracting elemental stimuli. Neural inhibitory processes can be postulated as the mechanisms whereby the various elements of a given stimulus pattern are progressively limited. Thus learning can be seen as a dynamic and ongoing process superimposed on a dynamic perceptual (or stimulus processing) substrate. This approach cannot predict *when* a complex stimulus will be totally differentiated from its components but does predict that they inevitably *will* be. With reference to the failure of suprasummation studies to reveal this state of affairs, a statement by Kremer (1978) seems applicable. He wrote:

> It is not possible, however to specify exactly how many compound-CS - US pairings will be necessary to yield a detectable loss in associative strength.....(p.28)

Ironically, he write this in defiance of Razran's configurational approach to complex stimulus processing and in support of the Rescorla-Wagner elementist approach.

Resume and hypotheses

Given the basic assumption that configuring and stimulus generalisation reflect the same principles of excitation and inhibition, the approach taken in the present study is to view learning in general as a dynamic process. The utilisation of complex stimuli as discriminable stimuli for the purposes of examining the dynamics of learning is only infrequent. The more common direction of complex stimulus research is to observe facilitative or deleterous effects of the presence of one component stimulus upon

responding to the other. Examples include overshadowing (Kamin, 1968; Mackintosh, 1976; Miles, 1969), blocking (Kamin, 1969), conditioned inhibition (Brown & Jenkins, 1967; Rexcorla, 1966), stimulus compounding (Grings & O'Donnell, 1956; Henderson, 1975; Weiss, 1972; Whitlow & Wagner, 1972), and selective attention (Mackintosh, 1965; Reynolds, 1961).

The emphasis in configural conditioning studies is to observe the *conjunctive* effects of multiple stimuli on processing of *all* the individual component stimuli rather than the *disjunctive* effects, such as competition for associative strength between stimuli. Ideally, the relation of component to complex is shown to be a dynamic, rather than static, process wherein the whole gradually becomes more or different, than the sum of its parts. Such a process defies predictions based on a static combination rules approach (see Kehoe & Gormezano, 1980 for review). It would seem, then, that studies of configuring could make major contributions to a theoretical understanding of dynamic behavioural phenomena in a variety of situations.

The experiments to follow were directed at investigating the responsiveness of rats to complex flavour cues using a conditioned taste aversion procedure. In particular, I was interested to discover whether configural effects would occur across varied situations, some of which involved reinforced presentations of a complex while others involved nonreinforcement. If the general formulation of inhibition-refined stimulation is tenable, configural effects should

be demonstrable in the absence of reinforcement. That is, configuring should emerge as the result of a 'perceptual' process.

My first two experiments sought to demonstrate that configural conditioning could be achieved by overtraining a conditioned aversion to a complex stimulus. Using a modified sensory preconditioning procedure, Rescorla and Cunningham (1978) reached the conclusion that substantial associations seem to be formed between the components of a complex flavour stimulus. The outcome of the present flavour configuring experiments showed absolute losses of aversive control by component stimuli. Such an outcome suggests the absence of CS-CS associations.

Further experimentation was then conducted to examine the perceptual basis of configuring. First, the effects of complex flavour familiarisation on subsequent neophobia, conditioning and extinction to component stimuli were examined. Having shown that component stimuli were treated as being increasingly novel after increased exposure to the complex, it was argued that configuring most probably has a perceptual substrate. With this in mind the effects of partial reinforcement on configuring were examined. The purpose was to illustrate the interactive effects of perceptual and performance variables or, rather, to superimpose a performance variable on a perceptual learning process. The partial reinforcement manipualtion had only a marginal effect on the degree of configuring shown. To the degree that partial reinforcement did increase

generalisation from complex to component stimuli, configural stimuli were shown to be susceptible to the same manipulations as those of single stimuli.

Finally, I sought to exemplify how configuring effects may be related to other general learning phenomena, specifically sensory preconditioning. Using a complex flavour cue as the preconditioning CS_1-CS_2, sensory preconditioning was shown after a limited number of preconditioning exposures but not after more numerous exposure to the complex. The conclusion, once again, was that animals in the latter case had come to configure in the absence of reinforcement.

Several observations made during the course of experimentation suggested that configuring is a general phenomenon. Moreover, the conclusion was reached that the multiplicity of terms for numerous behavioural phenomena can be reduced by recognising the dynamic nature of learning. Learning (and perception) might well involve rules of combination but these rules seem to change throughout its course. The various phenomena observed may simply represent various stages of more general learning processes rather than discrete and unique forms, or aspects, of learning.

CHAPTER TWO

THE EFFECT OF OVERTRAINING A COMPLEX GUSTATORY STIMULUS ON EXTINCTION OF FLAVOUR AVERSIONS FOR COMPONENT STIMULI: EXPERIMENT 1

The experiment described in the present chapter was designed to determine whether the component stimuli of a complex gustatory stimulus would lose their aversiveness as a function of increased flavour aversion conditioning with the complex alone. A flavour aversion procedure was chosen for numerous reasons, the first being that rats are highly sensitive to gustatory stimulation and show rapid and subtle changes in ingestive behaviours as a result of the internal consequences following ingestion of novel flavoured substances (Revusky & Garcia, 1970). Second, given the rapid rate of acquisition for flavour aversions, asymptotic and overtraining conditions should be achieved in a relatively few trials. Third, flavour aversion procedures have been widely used with many of the critical variables and parameters having been clearly established.

Although the relationship between flavour aversion learning and other more traditionally studied learning remains a contentious issue, it is nevertheless true that the former conforms to a large number of general process principles (Revusky, 1977). Examples include blocking (Best, Best & Rudy, 1975; Revusky, 1971), conditioned inhibition (Best, 1975; Taukulis & Revusky,

1975), sensory preconditioning (Lavin, 1976) and partial reinforcement effects (Robbins, 1979).

Within the flavour aversion paradigm it has been shown that aversions conditioned to saccharin-rolled food transfer readily to saccharin solutions (Gillette, Bellingham & Martin, 1979). Such a finding indicates that stimulus generalisation is widespread early in training and it was expected that initial avoidance responding to complex and component flavours would be similar in the present study. Given the assumption that flavour aversion learning complies with most general learning principles and that there have been demonstrations of configural conditioning (Bellingham & Gillette, 1980; Gray & Lethbridge, 1976), it should be relatively straightforward to show that generalisation of an aversion from a complex flavour stimulus to its constituent components decreases with increased training.

The following experiment consisted of three sub-experiments designed to test the hypothesis that configural conditioning can readily be demonstrated in a conditioned flavour aversion paradigm. For such a result to be acceptable, it was first necessary to demonstrate that the salty (sodium chloride), sweet (saccharin), and salty-sweet solutions used during testing and/or training were equally associable with gastrointestinal distress. Second, increased generalisation decrement to the components as a function of overtraining the complex CS, must be the result of the complex emerging as a unique flavour cue rather than the complex having represented

some unique flavour, not separable into its components, from the outset.

With these qualifications in mind, the strategy of the following experiment was first to establish the relative salience of the complex and component stimuli when separately conditioned; secondly to train separate groups of animals with the complex flavour to differing levels of acquisition followed by testing for aversions to component stimuli; lastly to ensure that results obtained with the component flavours combined into a single solution were analogous to those that occur when the two components are presented simultaneously but in separate containers.

2.1 EQUIVALENCE OF COMPLEX AND INDIVIDUAL COMPONENT STIMULI IN SUPPORTING A CONDITIONED TASTE AVERSION (EXPERIMENT 1a)

The following experiment was conducted to ensure that any absence of avoidance responding to component stimuli after configural conditioning could not be due to a lack of salience. Another purpose of the experiment was to determine if the flavour stimuli to be used in the remainder of this project were equisalient, that is to determine if there was any likelihood that one component stimulus might overshadow the other when the two were presented simultaneously.

Three groups of rats were trained and tested with either the salty-sweet solution or one of the two single stimulus solutions. Saline controls were similarly trained and tested to observe whether or not unconditioned baseline consumption of the three solutions differed.

2.1.1 EXPERIMENTAL METHOD

Subjects. The subjects were 42 male Wistar hooded rats, 10-11 weeks old. All animals were bred at the Psychology Department Breeding Colony, Australian National University, Canberra. Prior to the initiation of experimental procedures all rats were group-housed. On Day 1, the animals were moved to individual wire cages (19x16x16 cm) where they remained for the duration of the experiment. The rats were maintained on Mecon rat cubes and tap water. A light (0700 h) and dark (1900 h) cycle was imposed throughout the experiment with room temperature maintained at 22-24^{o} C.

Conditioning Agents. The compound conditioned stimulus (N/S) used during training and test procedure was a salty-sweet solution, 0.15 M sodium chloride (NaCl) plus 0.1% saccharin, prepared by adding 8.77 g of NaCl and 1.0 g of crystalline saccharin to 1000 ml of tap water. The component stimuli used during training and testing procedures consisted of a salty solution, 0.15 M NaCl, and a sweet solution, 0.1% saccharin. The single component N solution was made by adding 8.77 g of NaCl to 1000 ml of tap water while the S solution contained 1.0 g of saccharin per 1000 ml of tap water. All solutions were presented at room temperature and consumption was measured by weighing the bottles before and after drinking sessions. Measures were taken to the nearest 0.1 ml.

Conditioned aversions to the N/S, N or S solutions were produced by immediate intraperitoneal injections

of 0.3 M lithium chloride (LiCl) made by dissolving 1.28 g of LiCl in 100 ml of distilled water. The LiCl was administered at a dosage of 1.0% of the animals' body weights.

Procedure. On Day 1, 1200 h, the rats were isolated and randomly assigned to three Flavour groups of 14 animals each. Food was provided *ad libitum* but water was not available. During Days 2-4 inclusive the rats were adapted to a restricted drinking regime wherein water was available for 10 mins at both 1000 h and 1400 h. This watering schedule was maintained throughout experimental procedures with all measures of fluid consumption being taken during the morning drinking session on the relevant days. On Day 5 pretraining measures of water intake were obtained to ensure group comparability.

On Day 6, the animals were given 10 mins access to either N/S, N or S. Immediately following the drinking period, half the animals in each Flavour group were injected with LiCl while the remainder were injected with an equivalent volume of physiological saline. Days 7-9 were recovery days and on Day 10 pretest measures of water intake were obtained, again, to ensure group comparability.

All animals were tested for flavour aversions on Day 11 when they were re-presented with their respective conditioning solutions for 10 mins. Consumption data were analysed with respect to two factors: Flavour group (N/S, N, S) and treatment group (LiCl, saline).

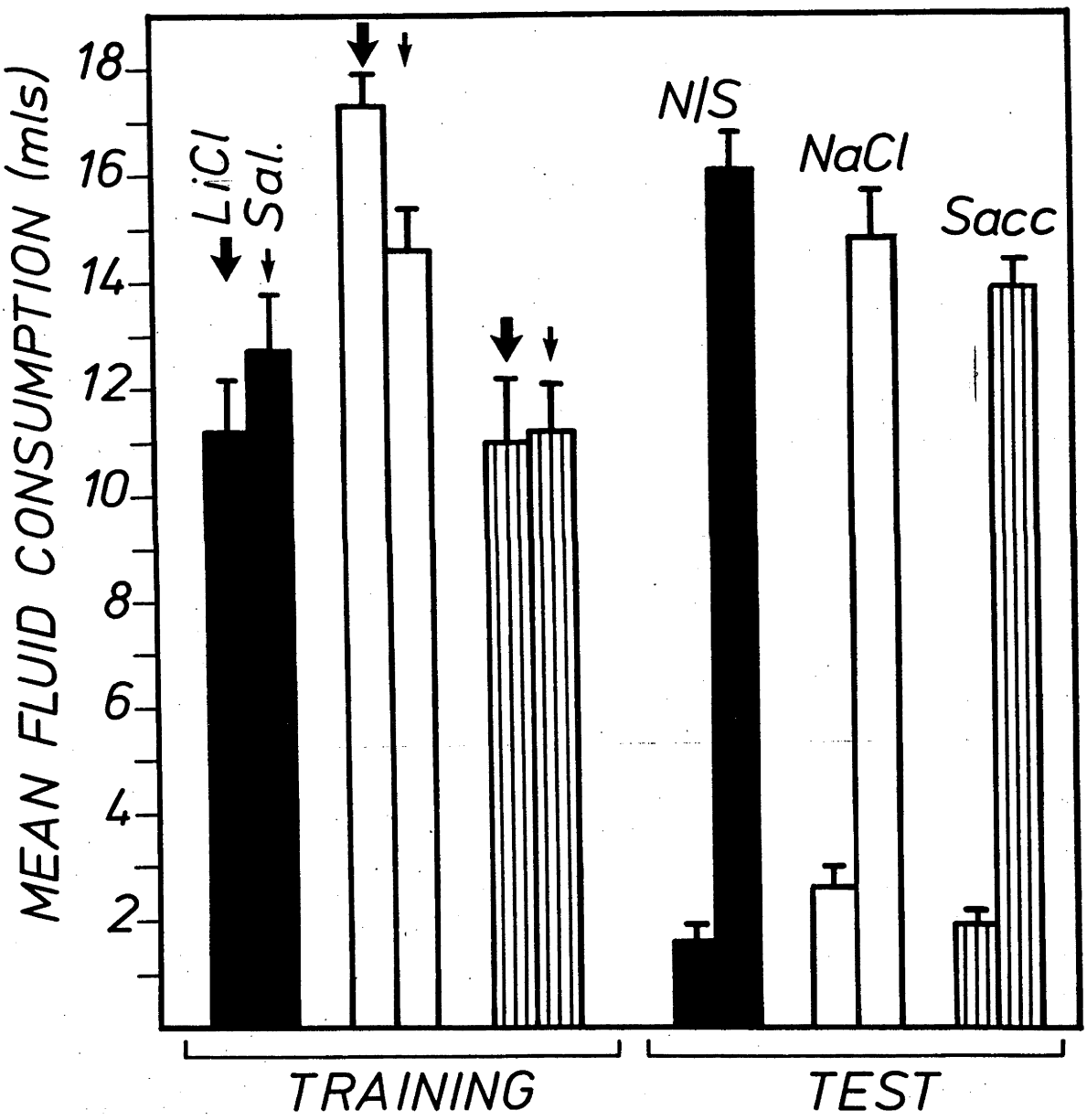
2.1.1 RESULTS

Figure 1 depicts the amounts consumed by experimental (LiCl) and control (saline) animals on the training and test days. Two-way ANOVA's were performed on pretraining, training, pretest and test measures of consumption by experimentals and controls. There were no significant differences in water consumption on the pretraining day, p's > .10; there was a significant Flavour group effect on the training day, $F(2,35) = 16.1$, $p < .001$; there was no difference between experimental and control groups, $p > .50$. Scheffé multiple comparisons showed that overall N/S consumption did not differ significantly from S consumption, $p > .05$, but that N consumption was significantly greater than N/S and S consumption, $p < .05$.

On the pretest day there was a significant tendency for the experimental groups to drink more than the control groups, $F(1,36) = 6.9$, $p < .025$, but Flavour group and interaction effects were not significant, p's > .05. Test day results indicated significant aversions for all experimental animals relative to control animals, $F(1,36 = 785.6$, $p < .001$, but no systematic effect due to Flavour group or interaction effects, p's > .05. That is, all experimental animals drank equivalently regardless of the flavours consumed, as did the controls, indicating recovery from neophobia to the N/S and S solutions. The conditionability of the three flavour stimuli used in the remainder of the study can therefore be considered

FIGURE 1

Mean consumption of N/S, N and S by experimental and saline control groups on training and test days from Experiment 1a. As indicated, black bars refer to N/S, white to N, and striped to S groups. Experimental groups are represented by the left bar in each pair of bars. Heavy arrows indicate i.p. injections of LiCl subsequent to drinking while light arrows indicate injections of physiological saline.


MEAN FLUID CONSUMPTION (mls)
18
16
14
12
10
8
6
4
2
LiCl
Sal.
N/S
NaCl
Sacc
TRAINING
TEST

more or less comparable.

2.2 TASTE AVERSION OVERTRAINING TO A COMPLEX STIMULUS AND ITS EFFECTS ON RESPONDING TO COMPONENT STIMULI (EXPERIMENT 1b)

The following experiment sought to demonstrate that after prolonged training with the complex N/S solution avoidance responding to component solutions would diminish. Using a between-subjects design, animals were trained one, two, three, six or ten times with the complex before tests to N/S, N or S were conducted.

2.2.1 EXPERIMENTAL METHOD

Subjects. The subjects were 105 male Wistar hooded rats, 10-11 weeks old. The animals were housed and maintained as described in the previous experiment.

Conditioning Agents. As described above.

Procedure. On Day 1, 1200 h, the rats were isolated and randomly assigned to one of five groups designated to receive different levels of training (Overtraining groups). The rats were maintained as in Experiment 1a during Days 2-5.

Training procedures commenced on Day 6 when N/S was presented for 10 mins. Immediately after removal of the training fluid, all animals were injected with LiCl. The five groups of 21 animals received either one, two, three, six or ten pairings of N/S consumption with LiCl injections. For the Overtraining group receiving one conditioning trial, tests for flavour aversions began

on Day 10 while all other groups continued to be trained. Three recovery days were always interposed between conditioning days and between the last conditioning day and the first day of testing. Pretraining measures of water consumption were taken on each day preceding a training day and pretest water consumption was measured one day prior to the beginning of testing procedures. As before, and from here on, all measures were taken at morning drinking sessions.

Each Overtraining group of 21 animals was further divided into three Flavour groups of seven rats for the pruposes of testing. The tests for spontaneous configuring involved a ten-minute presentation of either the complex solution, N/S, or one of the two component solutions, N or S, to the Flavour groups within each Overtraining group. Thus, one third of the animals received N/S, one third N and one third S after one, two, three, six or ten conditioning trials. Testing in extinction continued for ten consecutive days.

Procedural Notes. The restricted drinking regime employed produced daily fluid intake measures which were similar to those of *ad libitum* animals observed in pilot work. Although the animals were not experiencing any severe metabolic deficit, restricted access to fluid ensured that all animals drank in a stable manner at the designated times. Not only has it been demonstrated that a more sensitive measure of conditioned aversions is obtained

by using satiated animals (Peck & Ader, 1976), but it is also desirable to avoid any performance deficits or procedural artifacts resulting from physiological impairment of animals receiving multiple injections of a potent toxin. Body weights recorded on each pretraining day, in this study, showed essentially normal upward trends when compared with those of animals receiving no drug administration (Experiment 2). Food consumption, condition of fur, coloration of appendages and temperament all remained stable suggesting that general health was being maintained in the animals. (See Appendix 2, p.216).

Injections of LiCl were alternately administered to the left and right sides of the animals' abdomens. This procedure allowed eight days for any injection site to heal. As well, the order in which animals were injected was changed each training day to ensure that all animals gained experience with the CS and UCS in close temporal contiguity, a condition producing maximal flavour aversion learning. Training days were staggered so that no more than one Overtraining group was trained on any given day.

Data Analysis. Comparisons of multiple trial data *within* each Overtraining group were made using analyses for trends of trial means (Edwards, 1972). Comparisons of Flavour groups made *between* Overtraining groups were effected by performing two-way ANOVA's on two measures: 1) total consumption in extinction and 2) rate of extinction. Rate of extinction scores were computed for each animal

by finding the slope of the line of best fit represented by the equation:

$$S = \left[\sum_{j=1}^{n} x_j y_j \right] / \left[\sum_{j=1}^{n} x_j^2 \right]$$

where x = trial and y = amount consumed. Hence, each animal was assigned one slope value characterising its performance over all ten extinction trials, where greater slope values indicate rapid extinction and lesser slope values indicate resistance to extinction.

Differences were considered significant when $p < .05$; however more accurate probabilities are cited as per Rohlf and Sokal (1969).

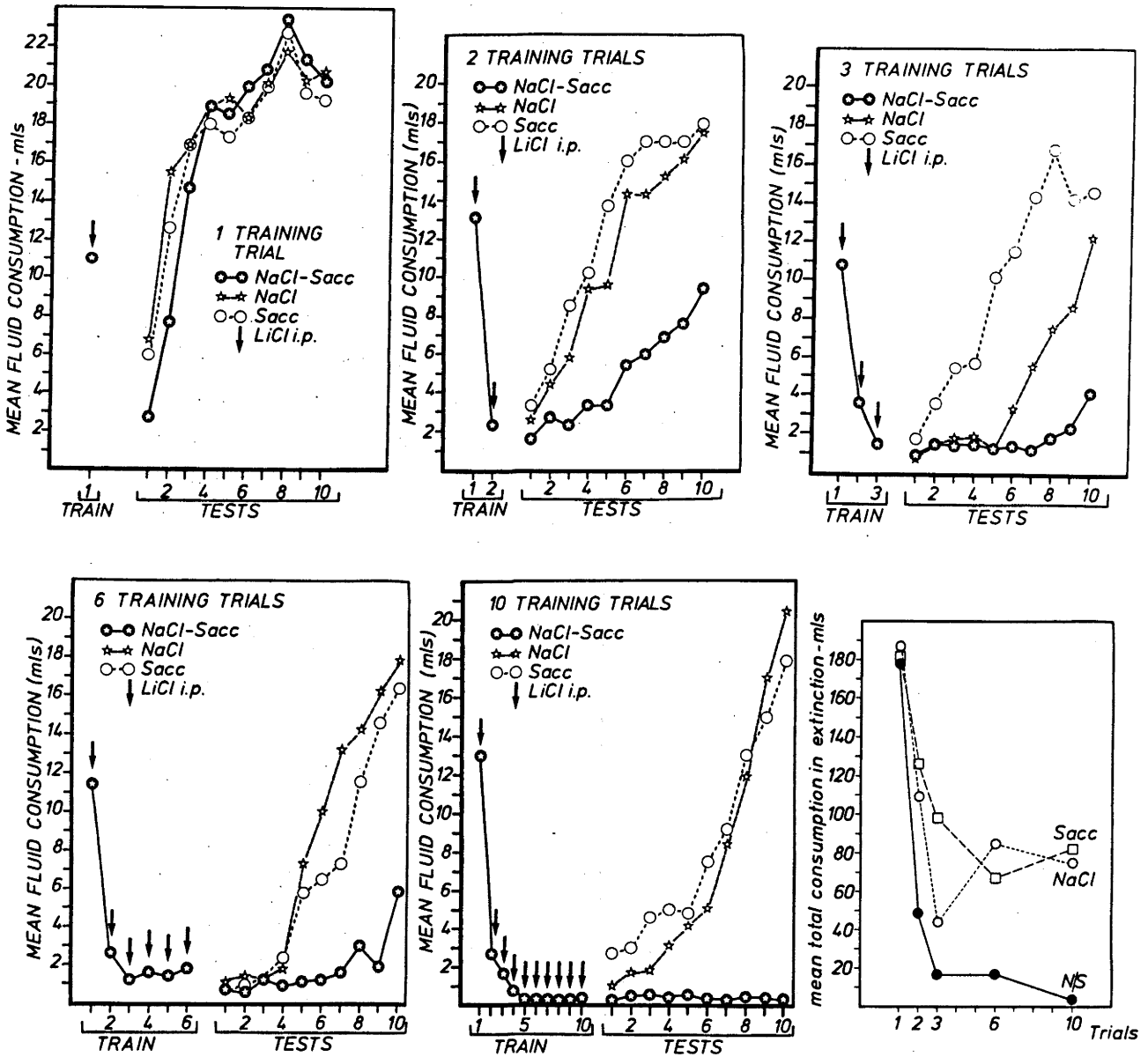
2.2.2 RESULTS AND DISCUSSION

Graphical representation of the results obtained during training and testing of the five Overtraining groups is shown in Figure 2. Data from the first pre-training day and the pretest day for each Overtraining group was compared using a one-way ANOVA. The results showed that all five groups of animals drank equivalent amounts of water, $p > .05$. Similarly, all groups consumed equivalent amounts of N/S on the first training day, $p > .25$, and exhibited no neophobia for N/S relative to pretraining tap water, $p > .25$.

Separate analyses of trends of trial means were performed comparing fluid consumption between the three Flavour groups within each Overtraining group. In no

FIGURE 2

Summary of acquisition and extinction means from the five Overtraining groups in Experiment 1b. The lower right hand illustration represents mean total consumption of the three flavours by animals in the five Overtraining groups. Arrows designate that LiCl was injected subsequent to N/S consumption on the days indicated.


MEAN FLUID CONSUMPTION - mls
1 TRAINING TRIAL
NaCl-Sacc
NaCl
Sacc
LiCl i.p.
TRAIN
TESTS
2 TRAINING TRIALS
3 TRAINING TRIALS
6 TRAINING TRIALS
10 TRAINING TRIALS
MEAN FLUID CONSUMPTION (mls)
mean total consumption in extinction - mls
Sacc
NaCl
NS
Trials

case was there a difference between the Flavour groups during acquisition, p's $> .50$. (The one-trial Overtraining group data for acquisition was analysed using a one-way ANOVA which yielded a nonsignificant difference between Flavour groups, $p > .05$). With the exception of the one-trial group, $p > .05$, analyses for trends of trial means showed significant Flavour group effects during extinction, p's $< .01$, with all groups showing significant trial and interaction effects. Table 1 summarises these results indicating that for each group receiving two or more conditioning trials the animals drinking component solutions showed less resistance to extinction than the animals drinking the complex solution.

The extinction data within each Overtraining group was summarised in two ways in order to compare consumption of the three solutions between Overtraining groups. Firstly, the consumption of fluid over all ten test trials was summed for each animal. A two-way ANOVA was then performed where Flavour group and Overtraining group were the main effects. This analysis yielded a significant Overtraining group effect, $F(4,90) = 69.97$, $p < .001$, a significant Flavour group effect, $F(2,90) = 41.67$, $p < .001$ and a significant interaction effect, $F(8,90) = 3.81$, $p < .001$. A second analysis on rate of extinction yielded similar effects, p's $< .005$. Four Scheffé multiple comparisons on each measure showed that: 1)consumption of N/S by animals in the six-trial group did not differ from N/S consumption in the ten-trial

TABLE 1

ANOVA Summaries of Flavour Group within Overtraining Group Extinction Tests

Overtraining group	Flavour	(Extinction) Trials	Flavour x Trials
One trial	$F(2,18) = 0.44$, $p > .50$	$F(9,162) = 83.87$, $p < .001$	$F(18,162) = 9.56$, $p < .001$
Two trials	$F(2,18) = 9.8$, $p < .01$	$F(9,162) = 41.2$, $p < .001$	$F(18,162) = 2.6$, $p < .01$
Three trials	$F(2,18) = 185.86$, $p < .001$	$F(9,162) = 175.47$, $p < .001$	$F(18,162) = 44.27$, $p < .001$
Six trials	$F(2,18) = 12.8$, $p < .001$	$F(9,162) = 37.3$, $p < .001$	$F(18,162) = 5.7$, $p < .001$
Ten trials	$F(2,18) = 13.0$, $p < .001$	$F(9,162) = 35.2$, $p < .001$	$F(18,162) = 9.6$, $p < .001$

group, 2) consumption of N by six-trial and ten-trial groups did not differ although 3) consumption of N was significantly greater by the six-trial group than by the three-trial group, $t = 12.54$, $p < .05$, * and 4) consumption of S, by the six-trial and ten-trial groups, did not differ.

These latter findings are similar to those of Booth and Hammond (1971) where one component lost absolute strength of association after prolonged complex stimulus training but the second did not. The findings of this experiment do not contribute positive evidence for configuring as defined by Baker (1968). However, two further observations suggested that configural conditioning could potentially be demonstrated using a flavour aversion procedure. Firstly, post-extinction tests of N/S consumption were conducted in a number of the groups and, secondly, video recordings of the early extinction trials were made.

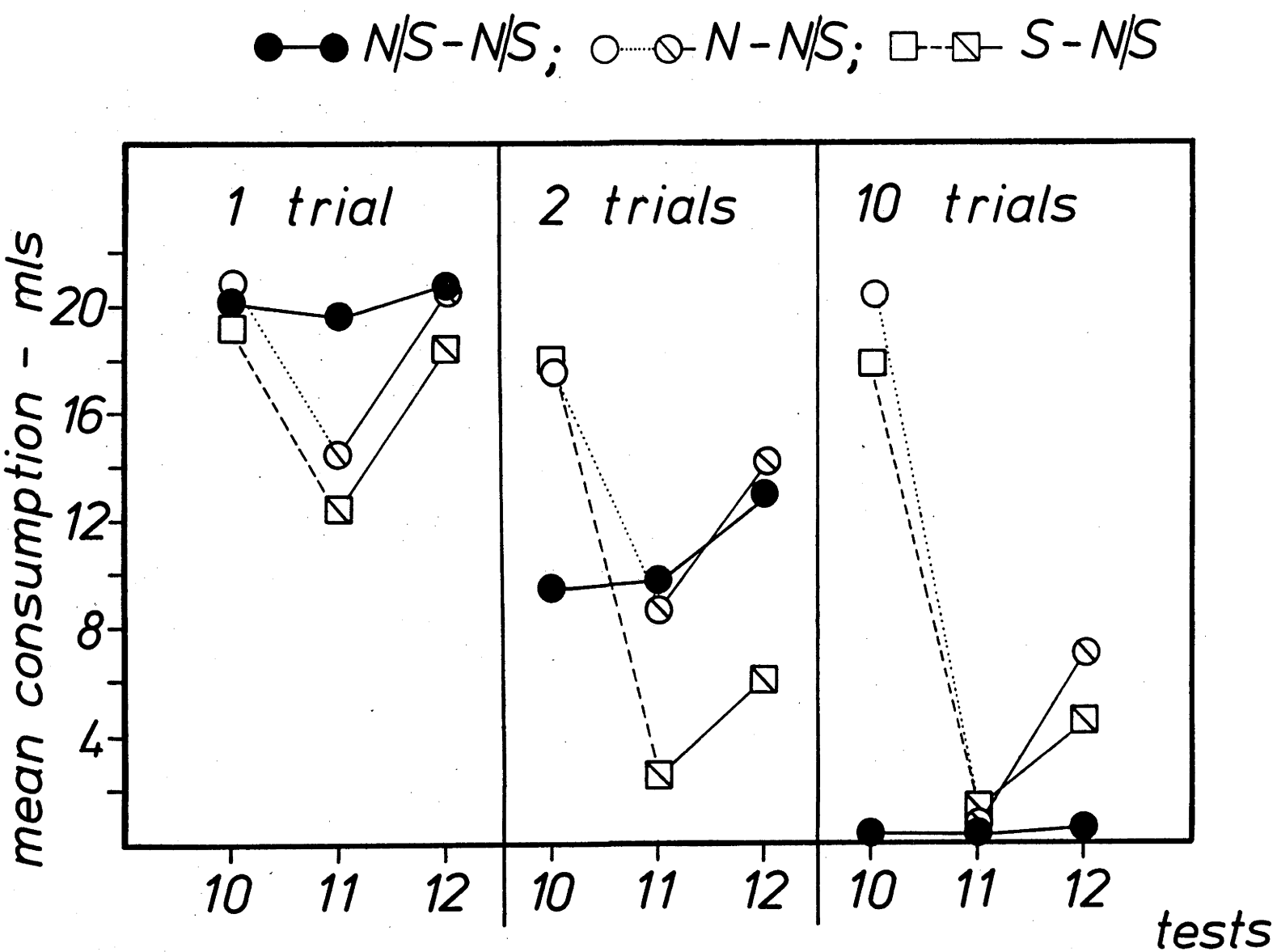
The Overtraining groups receiving one, two and ten conditioning trials were all retested with the complex solution, N/S, for two days following the tenth extinction trial. The results of the tenth, eleventh and twelfth tests are depicted in Figure 3 and statistical analysis is summarised in Table 2, which shows all the main and interaction effects of Flavour group, Overtraining group and trials to be significant, p's $< .001$. Table 3 summarises the post hoc comparisons made.

Referring to this table, comparisons i and ii indicate that with increased training to N/S, consumption of N/S

* t - value obtained using rate of extinction indices.

FIGURE 3

Summary of mean consumption of N/S, N or S, on the tenth extinction trial, and of N/S alone, on the eleventh and twelfth post-extinction trials from Experiment 1b.


N/S-N/S;
N-N/S;
S-N/S
1 trial
2 trials
10 trials
mean consumption - mls
20
16
12
8
4
10
11
12
10
11
12
10
11
12
tests

during later stages of extinction was progressively suppressed. Additionally, comparisons iii, iv and v show that, although there was no difference in consumption between the complex stimulus and component stimulus solutions during the tenth extinction test for Overtraining groups receiving one or two conditioning trials, after ten conditioning trials the complex stimulus was a significantly stronger stimulus for suppression than both component stimuli.

The effects of previous extinction of a component stimulus on subsequent consumption of the conditioned complex solution are shown by comparisons vi-x. Comparison viii shows that, with increased training, consumption of N/S was less affected by previous extinction to the component N solution while comparisons ix and x show a similar failure of S extinction to substantially disrupt a previous aversion for N/S after only two conditioning trials. These results indicate that the salty, N, solution tended to be the dominant, or more salient, stimulus when presented in the complex stimulus solution.

These latter results contrast markedly with Kamin and Idrobo's (1978) finding that extinction of one component caused substantial attenuation of avoidance behaviour, to a previously conditioned complex stimulus, as a function of increased training. That this was not the case in the present study is further supported by the outcome of comparisons xi-xvi. In the case of extinction to N,

TABLE 2

ANOVA Summary Table of Postextinction N/S Consumption by Overtraining Groups in Experiment 1b.

Source	SS	df	MS	*F*	*p*
A: Flavour Groups	388.25	2	194.13	8.84	< .001
B: Overtraining groups	5249.19	2	2624.60	119.46	< .001
A x B	956.23	4	239.06	10.88	< .001
S(AB): Error(a)	1186.24	54	21.97		
C: Test trials	2110.78	2	1055.39	121.73	< .001
A x C	1177.96	4	294.49	33.97	< .001
B x C	517.00	4	129.25	14.91	< .001
A x B x C	351.30	8	43.91	5.06	< .001
S(AB) x C: Error (b)	936.54	108	8.67		
TOTAL	1287.49	188			

only in the ten-trial Overtraining group is there a significant difference between consumption of N, in the tenth test, and N/S, in the twelfth test. That is, up to two trials, the animals treated N/S as the extinguished N solution. Differences in consumption of S, in the tenth test, and N/S in the twelfth test, were significant for both two- and ten-trial groups. Although Figure 3 shows that aversions for N/S are to some degree degraded through extinction of N or S, relative to final *training* consumption of N/S, the differences between terminal consumption of a component solution and subsequent N/S consumption increases. In the ten-trial group, the first post-extinction presentation of N/S produces almost complete suppression of consumption which shows a decline on the second presentation. This result indicates imperfect discrimination between the component and complex stimuli, with some sensitization accounting for initial suppression. Unfortunately, post-extinction testing of N/S was not undertaken for the three- or six-trial groups but the present findings are suggestive of a configural conditioning phenomenon.

Further, examination of behaviours filmed during extinction sessions showed increasing differentiation between component and complex stimulus groups as a function of conditioning trials. For example, during the first three extinction tests for the Overtraining group receiving ten conditioning trials, animals in the N/S Flavour group engaged in some behaviours which typically follow

TABLE 3

Summary of Scheffé Multiple Comparisons for Postextinction N/S Consumption in Experiment 1b.

i)	$N/S - N/S_1$ vs $N/S - N/S_2$ (tests 10. 11, 12)	6.80#
ii)	$N/S - N/S_2$ vs $N/S - N/S_{10}$ (tests 10, 11, 12)	1.11#
iii)	N/S_1 vs N_1 and S_1 (test 10)	0.13
iv)	N/S_2 vs N_2 and S_2 (test 10)	-3.81
v)	N/S_{10} vs N_{10} and S_{10} (test 10)	-8.65#
vi)	$N - N/S_1$ vs $N - N/S_2$ (tests 11,12)	3.69
vii)	$N - N/S_2$ vs $N - N/S_{10}$ (tests 11, 12)	4.30
viii)	$N - N/S_1$ vs $N - N/S_{10}$ (tests 11, 12)	7.99#
ix)	$S - N/S_1$ vs $S - N/S_2$ (tests 11, 12)	6.39#
x)	$S - N/S_2$ vs $S - N/S_{10}$ (tests 11, 12)	0.79
xi)	N_1 (test 10) vs $N - N/S_1$ (test 12)	-0.50
xii)	N_2 (test 10) vs $N - N/S_2$ (test 12)	2.13
xiii)	N_{10} (test) vs $N - N/S_{10}$ (test 12)	8.59#
xiv)	S_1 (test 10) vs $S - N/S_1$ (test 12)	0.48
xv)	S_2 (test 10) vs $S - N/S_2$ (test 12)	7.55#
xvi)	S_{10} (test 10) vs $S - N/S_{10}$ (test 12)	8.54#

* Subscripts refer to Overtraining groups

\# designates p's < .05, t' = 6.29.

LiCl injections. These behaviours included elongation of the body, dragging of the abdomen along the cage floor, and retreating to the rear of the cage for the duration of the test session. Animals in the component Flavour groups, while exhibiting little prolonged drinking, emitted a distinctly different pattern of behaviour wherein they usually licked or chewed various regions of the drinking spout (upright or on their backs), sniffed at the opening in the spout, and generally remained in close proximity to the front of the cage where the spouts were located. Later in extinction, the N/S animals began to show more active emotional behaviours where continual biting of the paws (sometimes resulting in severe mutilation), "boxing" with the spout, and wiping the paws on the floor were observed in every subject. Component animals, on the other hand, began sampling their solutions more often, interspersing drinking with bouts of grooming and feeding at the food hoppers located adjacent to the drinking spouts. These observations suggested the possibility that nonspecific sensitisation due to multiple LiCl injections might prevent animals from demonstrating a discrimination between solutions to the degree that the discrimination was actually made. This possibility is examined in Experiment 2.

2.3 CONDITIONING WITH SPATIAL SEPARATION OF COMPONENT SOLUTIONS (EXPERIMENT 1c)

The final concern during this experiment was whether or not rats could readily discern both the salty and sweet aspects of the N/S solution. The solution used heretofore was chosen by mixing solutions of varying N and/or S concentrations and allowing humans to sample small amounts of each until they could select one that was "as salty as sweet". Although this may seem a somewhat unorthodox procedure for selecting discriminative stimuli it confirmed, nevertheless, that humans could recognise both components of the complex solution when asked to do so. It has been demonstrated by Richter (1942) that rats and humans have almost identical taste thresholds for a wide variety of substances.

In order to establish that rats could detect the isolable components of N/S, rather than perceiving it as a single unique flavour unlike either of its components, the following experiment was conducted. During the training phase rats were presented with both N and S simultaneously but in separate containers placed side by side. It was anticipated that presentations of N/S, N and S during the test phase would elicit responding similar to that seen when the single N/S solution served as the conditioned aversive stimulus.

2.3.1 EXPERIMENTAL METHOD

Subjects. The subjects were 21 male Wistar hooded rats, 10-11 weeks old. The animals were bred,housed and maintained as described earlier.

Procedure. The subjects were isolated and treated as above during Days 1-5 with the exception that they were always provided with two bottles of water during the morning drinking sessions. On Day 6 all animals were presented with one bottle containing 6 ml of S and the other containing 6 ml of N. (In actuality each bottle was filled to 6.5 ml of which only 6 ml could be consumed, 0.5 ml being trapped in the spout). In the usual ten minute period all rats had emptied both bottles and were subsequently injected with LiCl. A second conditioning trial was conducted on Day 10 when the rats were presented with two full bottles of N and S. After ten minutes the bottles were removed and the animals were again poisoned. For the remainder of the experiment, all fluids were presented in a single bottle.

After the normal recovery period testing began with one third of the animals receiving N/S, one third N and one third S for ten consecutive days.

2.3.2 RESULTS AND DISCUSSION

Figure 4 summarises the results obtained from administration of two conditioning trials with separate bottles of N and S solutions. Given that the purpose of this control was to determine if N and S, presented

simultaneously, constituted distinctive and separable flavour stimuli whether presented in a single mixed solution or separately in different containers, the results of the two-bottle conditioning group are compared with the single bottle Overtraining group receiving two conditioning trials in Experiment 1b above. A one-way ANOVA performed on pretraining water consumption yielded a significant difference between one-bottle ($\bar{x}$ = 11.59 ml) and two-bottle ($\bar{x}$ = 13.77) groups, $F(1,40) = 9.56$, $p < .05$, indicating a tendency for animals drinking from two sources to consume more than those provided with a single source. Pretest water consumption by the two groups was equivalent, $p > .50$.

A one-way ANOVA with repeated measures showed that, during the second conditioning trial, animals in two-bottle groups tended to consume more N ($\bar{x}$ = 3.45 ml) than S ($\bar{x}$ = 2.12 ml), $F(1,20) = 10.33$, $p < .05$. Total consumption in extinction and rate of extinction were computed as test measures and analysed with two-way ANOVA's comparing effects due to number of bottles present during training and those due to Flavour group. Analysis of total consumption yielded no effect due to number of training bottles, $p > .10$, a significant effect due to Flavour group, $F(2,36) = 10.73$, $p < .05$, and no significant interaction, $p > .25$. Similarly, comparison of rates of extinction showed no difference between groups trained with one or two bottles, $p > .10$, a difference

FIGURE 4

Mean consumption of N and S from two simultaneously presented bottles, during acquisition, and consumption of N/S, N and S, during extinction, in Experiment 1c.

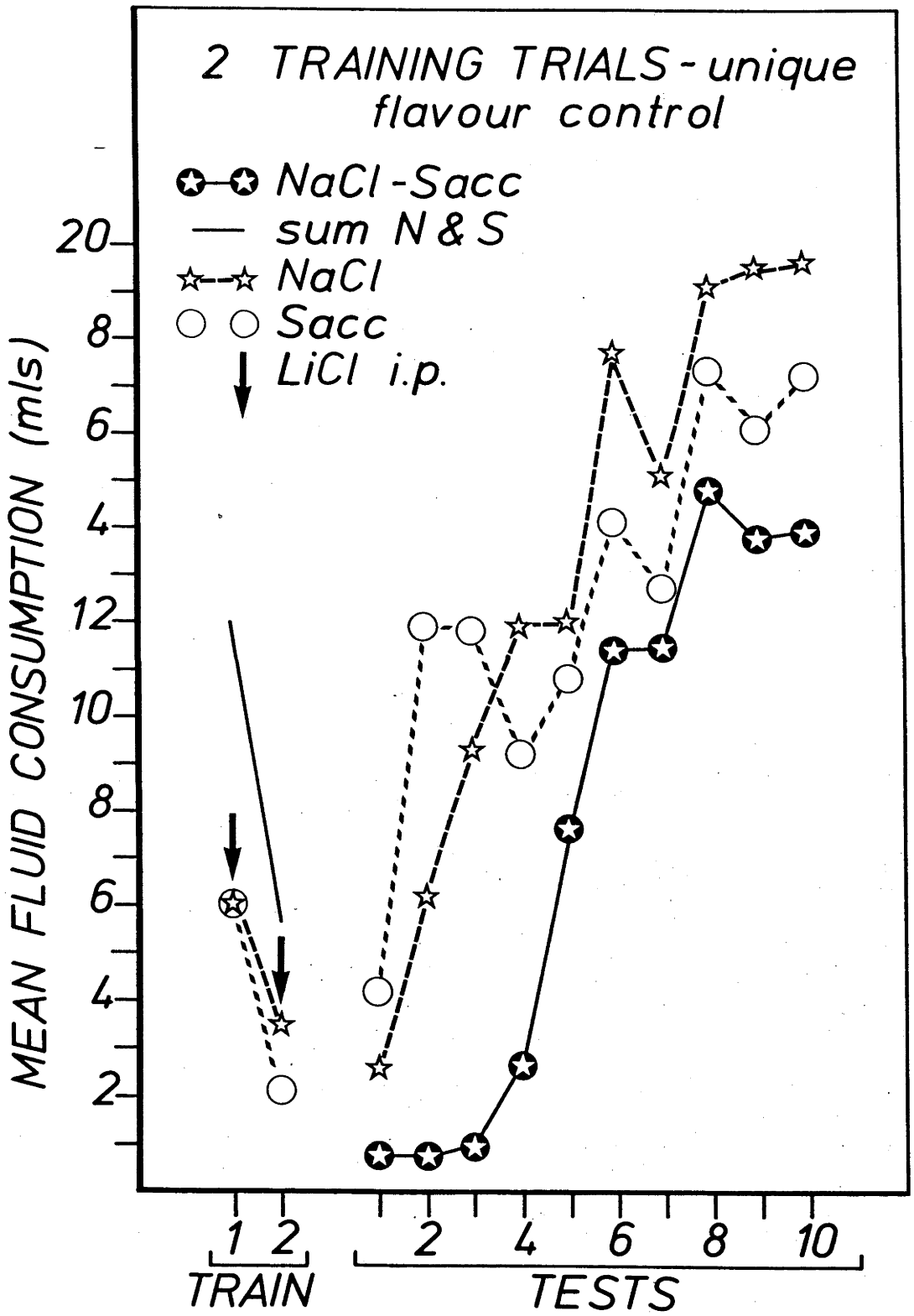
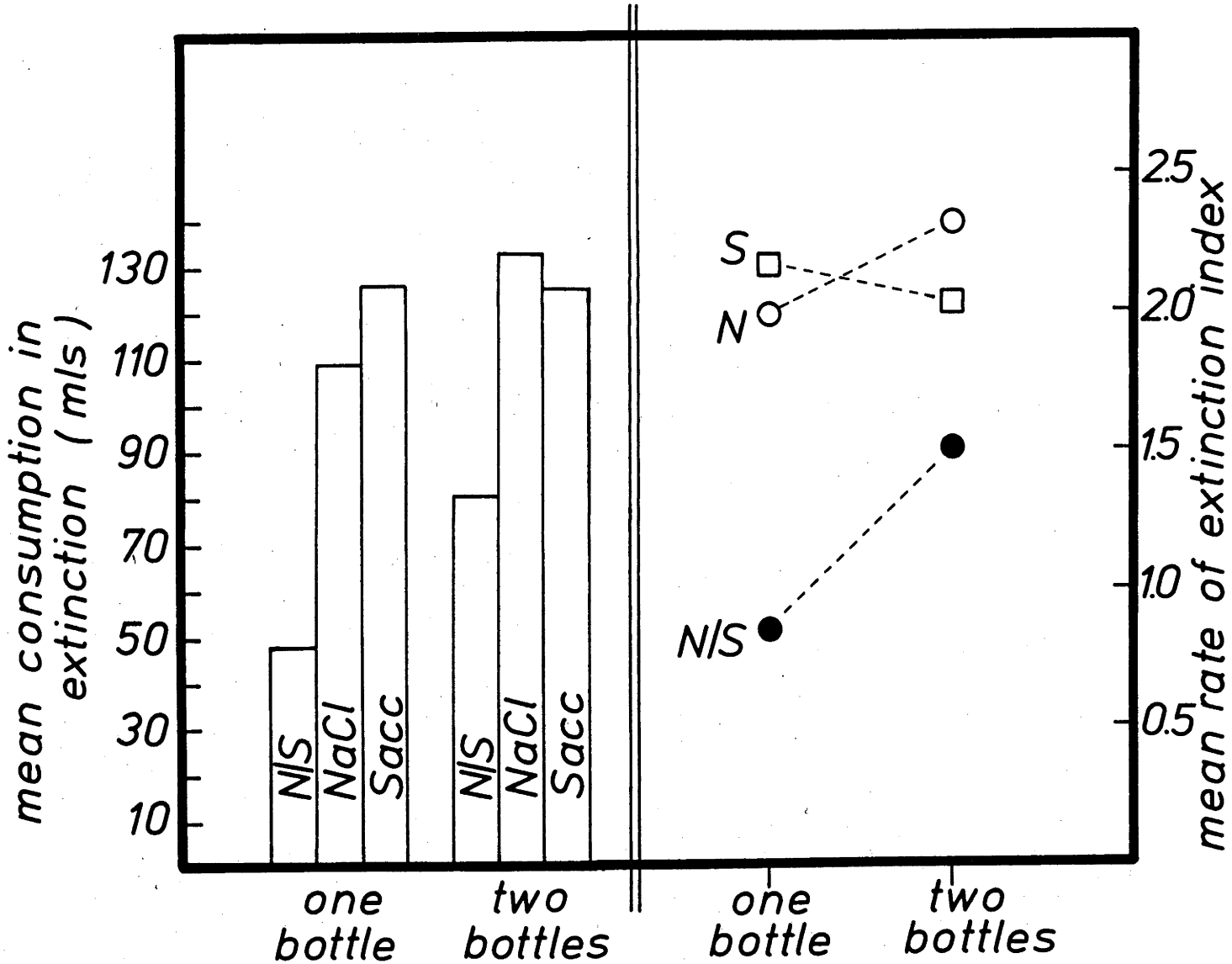

2 TRAINING TRIALS - unique flavour control
NaCl - Sacc
sum N & S
NaCl
Sacc
LiCl i.p.
MEAN FLUID CONSUMPTION (mls)
20
8
6
4
12
10
8
6
4
2
1 2
TRAIN
2 4 6 8 10
TESTS

FIGURE 5

Comparison of patterns for consumption of N/S, N and S during extinction in Experiment 1c with those for the two-trial conditioning group of Experiment 1b.


mean consumption in extinction (mls)
130
110
90
70
50
30
10
N/S
NaCl
Sacc
N/S
NaCl
Sacc
one bottle
two bottles
S
N
N/S
one bottle
two bottles
2.5
2.0
1.5
1.0
0.5
mean rate of extinction index

between Flavour groups, $F(2,36) = 13.13$, $p < .001$, and no significant interaction, $p > .10$. The test results are summarised in Figure 5 which illustrates that the only effect of presenting the component solutions separately was to weaken the level of N/S conditioning. Such an effect can be attributed to the lack of experimental control that can be exercised over individual patterns of consumption during training.

The conclusion merited by this finding is that the N/S solution can be seen as consisting of two discriminable stimuli which do not tend to interact in such a way to produce a single unique flavour stimulus. That this should be the case is suggested by Luongo's (1976) demonstration of discriminative stimulus selection for complex flavour stimuli. Initially, then, the complex and component stimuli are only marginally discriminated and any discrimination that does occur emerges as conditioning progresses.

2.4 GENERAL DISCUSSION OF EXPERIMENT 1

The primary result of the present experiment was essentially a replication of the Booth and Hammond (1971) finding where continued training with a complex stimulus resulted in reduced responding to only one of the two component stimuli. That is, although the three isolated flavours used in this study appeared to be equisalient, with the components maintaining their integrity when mixed in a single solution, the data do not unequivocally

indicate a configuring effect. Such a finding is further indication that the component flavours were separable when presented in combination.

The latter point is crucial to investigation of complex stimulus processes using intramodal stimuli in the sense that if these stimuli produce an *a priori* unique stimulus their use in such research will be limited. Although presenting two bottles containing component stimuli would not eliminate oral mixing of the flavours, it was seen that this procedure produced findings similar to those from the single-bottle condition. In turn it was seen that the results of overtraining with single-bottle N/S presentations produced responding analogous to that found when inter-modal stimuli are used in an aversive procedure (Booth & Hammond, 1971). The observation that both procedures resulted in changes in the degree to which generalisation from complex to select components occurred, argues against a notion that the complex stimulus represented an entirely unique stimulus not identifiable by features of its components.

The literature on taste mixtures supports the assumption that the integrity of component stimuli was maintained. Although it has frequently been shown that components of a taste mixture are often judged to be less intense in the mixed than unmixed states (Indow, 1969; Pangborn, 1960), various adaptation procedures can eliminate such an effect (Bartoshuk, Murphy & Cleveland, 1978). There is evidence that saltiness does not affect

bitterness but can reduce sweetness at high concentrations (cited in Schiffman, 1976). Given that saccharin flavours consist of both sweet and bitter taste components (Morrison & Jessup, 1977; Shiffman, Reilly & Clark, 1979) and that .15 M NaCl is a moderate concentration, it was assumed that the N component did not have any dramatic effect on reception of the S component in the present investigation. Conversely, neither sweetness nor bitterness affect saltiness (cited in Schiffman, 1976) indicating that the S component was unlikely to have modified reception of the N component.

In reviewing the nature of taste qualities, McBurney and Gent (1979) provide evidence that gustatory processing is not analogous to that for colour vision wherein presenting red and yellow simultaneously results in the sensation of orange. They state:

> First, no new qualities are produced by a taste mixture, which strongly suggests that taste sensations are limited (Bartoshuk, 1975). That is, a mixture of NaCl and HCl will taste salty and sour but never sweet and/or bitter and/or something else. There is no gustatory analogue to orange. Second, it is not possible to produce a tasteless mixture by an appropriate combination of components, ... Thus, there is no gustatory analogue to gray. On these bases, taste has been considered in an analytic sense rather than a synthetic sense. (p.155)

There seems to be support, then, for the assumption that N and S are separable when mixed in a single solution. With this in mind, the data yielded during postextinction tests of N/S consumption by animals in the Overtraining groups can be discussed. Postextinction testing provided some evidence that

configural conditioning had occurred during overtraining with the complex N/S solution. It was observed that the differences between consumption of component solutions during the final extinction test and subsequent N/S consumption increased as a function of extending N/S acquisition trials.

Qualitative observations led to the hypothesis that it might not have been possible to demonstrate reliable configuring when using a procedure typified by high levels of 'pseudoconditioning'.* The flavour aversion literature recognises such pseudoconditioning as prevalent within the paradigm and refers to it as nonspecific sensitisation and/or enhanced neophobia. It is not unusual for enhanced neophobia to occur after only a single flavour conditioning trial (Carroll, Dinc, Levy & Smith, 1975; Domjan, 1975; Mitchell, Hoch & Fitzsimmons, 1975), and extended training might reasonably be assumed to heighten such an effect. If this is the case, configuring, would be marked. The following experiment sought to eliminate enhanced neophobic behaviour as one of the variables which might interfere with a demonstration of configuring.

* The term pseudoconditioning is used literally. As will be seen presently, the degree of enhanced neophobia which occurs in the conditioned aversion paradigm often exceeds that which might be expected from simple stimulus generalisation. Some avoidance of highly dissimilar as well as of similar flavours is frequently demonstrated.

CHAPTER THREE

ELIMINATION OF POST-CONDITIONING SENSITIZATION PRIOR TO EXTINCTION OF AVERSIONS:

EXPERIMENT TWO

The previous experiment resulted in a finding analogous to that of Booth and Hammond (1971) in that one component, NaCl, produced losses in resistance to extinction, when training was continued beyond six trials, while the remaining saccharin stimulus did not. Although it is possible that an even longer number of conditioning trials might have resulted in weakened resistance to extinction of saccharin avoidance, it seemed undesirable to extend LiCl administrations for a number of reasons. Primarily, there were indications that some form of sensitization accrued with repeated conditioning trials, as previously mentioned, and it was expected that increased training would only serve to accentuate the effect. Consequently, it was hypothesised that, by modifying the procedure of Experiment 1b so that sensitization was eliminated prior to testing, any configuring that did occur within ten conditioning trials would be revealed.

The following experiment was conducted in two parts. The first part is, in essence, a replication of Experiment 1b in that the question of interest is the effect of N/S-LiCl overtraining on avoidance responding to component stimuli. Animals were trained with N/S four, six or ten times and tested as previously.

Subsequent to training and prior to testing, however, a 'desensitizing' phase was incorporated. During this phase, all animals within each Overtraining group were presented with a neutral stimulus - dilute vinegar - until their mean consumption of this solution equalled or exceeded that of normal tap water.

Vinegar was chosen as the neutral solution since it represents a taste dimension differing from those of the training and testing substances, i.e., sourness. With a view to the unlikely possibility that the desensitization solution would be perceived as more similar to one (or more) of the three test stimuli than to the others, thereby selectively facilitating extinction of avoidance responding to that stimulus, the second part of this experiment was conducted.

3.1 INTERPOSITION OF A NEUTRAL SOLUTION BETWEEN TRAINING AND TEST PHASES (EXPERIMENT 2a)

The following experiment re-examined the question as to whether or not configural conditioning could be achieved as a function of overtraining a conditioned aversion to a complex flavour stimulus. It was noticed in Experiment 1b that the substantial overshadowing of saccharin by NaCl after three conditioning trials had disappeared after six conditioning trials. In the present experiment an Overtraining group receiving four conditioning trials was included to narrow the range between three and six trials. The Overtraining groups,

then, received four, six or ten conditioning trials. A fourth group was treated exactly as the ten-trial conditioning group except that no UCS, LiCl, was administered during the training phase. Test phase responses by animals in this no-drug control group were used in determining the minimum resistance to extinction to be expected in the conditioning groups. All groups were retested with N/S subsequent to the complex versus component test phase.

3.1.1 EXPERIMENTAL METHOD

Subjects. Eighty-four male Wistar hooded rats, 10-11 weeks old, were assigned to four equally sized Overtraining groups. Animals were bred, housed and maintained as in Experiment 1.

Conditioning Agents. Conditioned and unconditioned stimuli used in this experiment were identical to those used in Experiment 1. An additional neutral solution was used as a 'desensitizing' agent. This solution was 1.0% vinegar made by adding 10 ml of Seppelt's white salad vinegar to 1000 ml of tap water.

Procedure. The general procedure followed that of Experiment 1b with three exceptions. Three Overtraining groups were given four, six or ten conditioning trials in which N/S consumption was followed by LiCl injections. A fourth Overtraining group received ten nonreinforced exposures to N/S on the same schedule as the ten-trial

conditioning group. Finally, on the fourth day following their last conditioning trial, all rats were given access to the neutral vinegar solution.

Vinegar presentations were continued on a daily basis until mean consumption of vinegar, in each Overtraining group, equalled or exceeded mean consumption of tap water on the last pretraining day for that group. Although this criterion was not satisfactorily met in the ten-trial group, the difference between vinegar consumption and that of tap water was nonsignificantly different by the sixth vinegar presentation. 'Desensitization' was then discontinued to avoid producing major discrepancies in the procedures for the various groups.

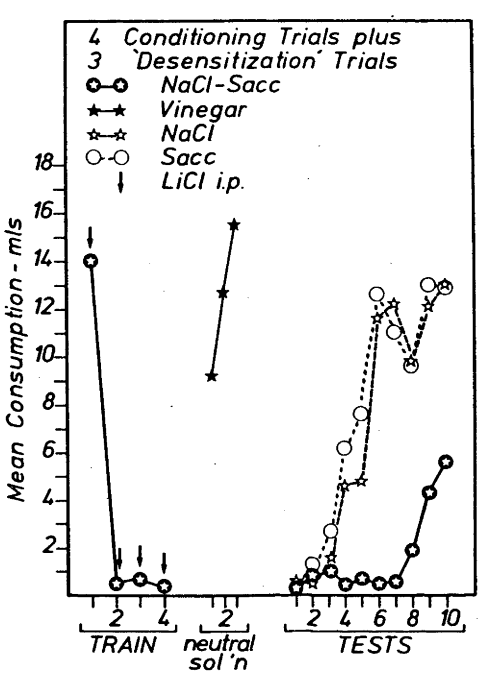
Testing of N/S, N and S consumption in extinction began the day following the last vinegar presentation. Post-extinction N/S consumption was measured as in Experiment 1b.

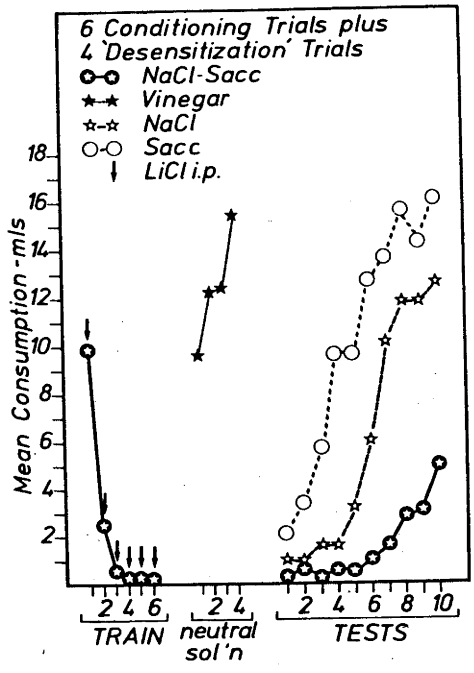
3.1.2 RESULTS

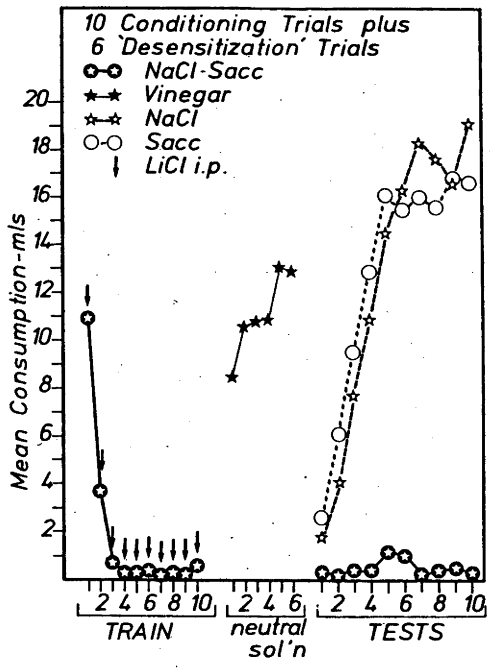
The experimental results obtained during training, desensitizing and testing of the four Overtraining groups are illustrated in Figure 6. A one-way ANOVA yielded a significant difference between the four groups on pretraining water consumption, $F(3,80) = 6.32$, $p < .001$. This difference was found to be entirely attributable to the fact that animals in the four-trial conditioning group drank significantly more than animals in all other groups, $t = 4.08$, $p < .05$. Similarly, there was a significant difference between the four groups with respect to N/S

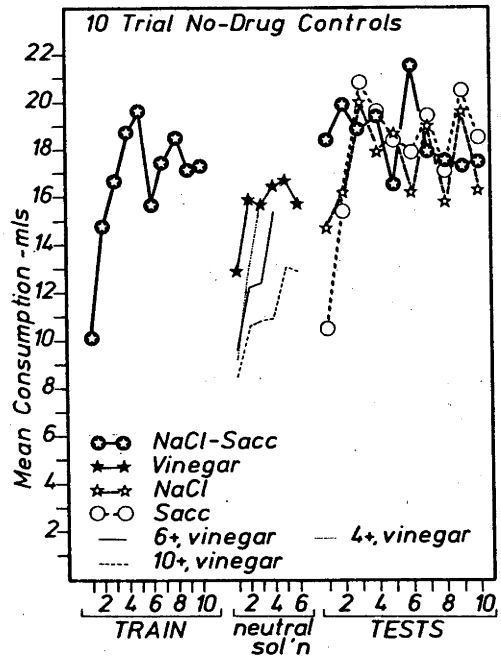
FIGURE 6

Summary of acquisition, desensitization, and extinction phase means for Overtraining groups receiving four, six ten or ten no-drug conditioning trials with the complex solution, N/S, in Experiment 2a. Arrows indicate that LiCl was injected after N/S was removed on the day indicated.


4 Conditioning Trials plus
3 'Desensitization' Trials
NaCl-Sacc
Vinegar
NaCl
Sacc
LiCl i.p.
Mean Consumption - mls
TRAIN
neutral sol'n
TESTS


6 Conditioning Trials plus
4 'Desensitization' Trials
NaCl-Sacc
Vinegar
NaCl
Sacc
LiCl i.p.
Mean Consumption - mls
TRAIN
neutral sol'n
TESTS


10 Conditioning Trials plus
6 'Desensitization' Trials
NaCl-Sacc
Vinegar
NaCl
Sacc
LiCl i.p.
Mean Consumption - mls
TRAIN
neutral sol'n
TESTS


10 Trial No-Drug Controls
NaCl-Sacc
Vinegar
NaCl
Sacc
6+, vinegar
4+, vinegar
10+, vinegar
Mean Consumption - mls
TRAIN
neutral sol'n
TESTS

consumption on the first conditioning day, $F(3,80) = 2.87$, $p < .05$, with the difference again being due to higher consumption by the group receiving four conditioning trials. As in Experiment 1b, there was no neophobia for N/S ($\bar{x}$ = 11.36 ml) relative to pretraining tap water consumption ($\bar{x}$ = 12.09 ml), $p > .25$.

Analyses for trends of trial means showed that there were no differences between Flavour groups, during tests for nonspecific sensitization, within the three Overtraining groups receiving LiCl injections, p's > .25. There was a difference between Flavour groups in the no-drug group, $F(2,18) = 3.88$, $p < .05$, attributable to lower levels of vinegar consumption in the group to be tested with the N/S solution. All four Overtraining groups showed a significant increase in consumption of vinegar with repeated presentations, p's < .001, and no significant interactions were found, p's > .10. The results also show that nonspecific sensitization due to LiCl injections accrued as a function of increased training. Groups receiving zero, four and six conditioning trials met the desensitization criterion on the first, third and fourth vinegar presentation respectively. After ten conditioning trials, criterion was not met even on the sixth presentation of the neutral vinegar solution.

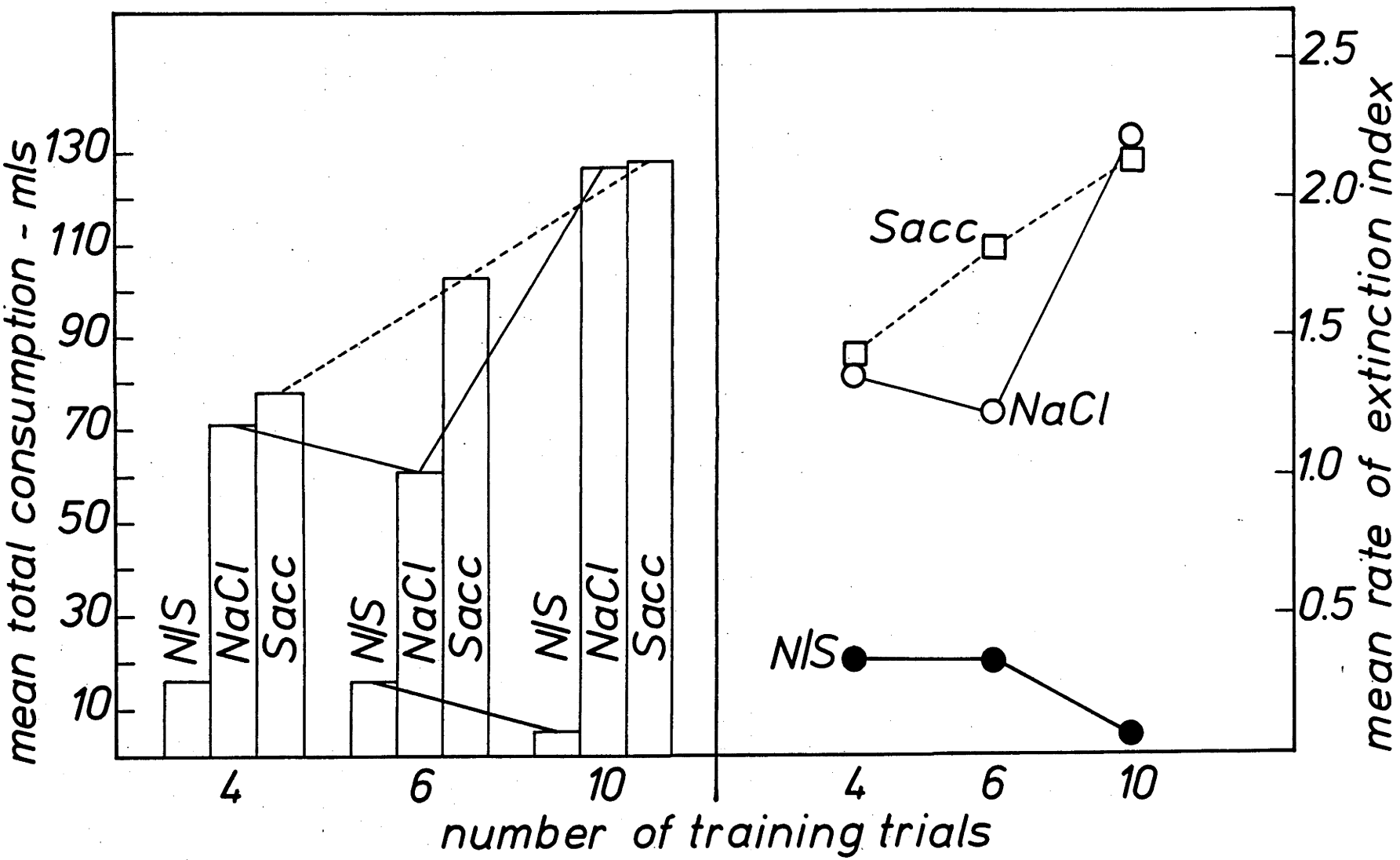
With the exception of the no-drug group, analyses of trial means during extinction yielded significant differences between Flavour groups, p's < .005, significant

trials, p's < .001 and interaction, p's < .001 effects. In all cases the N and S groups extinguished more rapidly than N/S groups. The no-drug control group showed no differences between Flavours, $p > .50$, but did achieve a significant trial, $F(9,162) = 6.83$, $p < .001$, and a significant interaction, $F(18,162) = 3.71$, $p < .001$, effect. The significant interaction indicates that the forms of the 'extinction' curves are different and an examination of Figure 6 indicates that there was an initial neophobia for the component N and S solutions relative to the lack of neophobia for N/S, after ten exposures to the complex stimulus solution. A one-way ANOVA on the first extinction test for the control group resulted in a significant difference between the three Flavour groups, $F(2,18) = 6.40$, $p < .01$. Scheffé multiple comparisons indicated that mean consumption of N/S was greater than that of N and S, $t = 3.06$, $p < .05$, while the consumption of N did not differ significantly from that of S, $p > .05$.

In order to examine differences between Overtraining groups the data were summarised, as in Experiment 1, where total amount consumed and rate of extinction were the test measures. The results are summarised in Figure 7. A two-way ANOVA comparing Flavour group effects and Overtraining group effects on total amount consumed, for the three experimental conditions, showed a significant difference between the three Flavour groups, $F(2,54 = 78.89$, $p < .001$, a difference due to level of training,

FIGURE 7

Comparison of N/S, N and S consumption patterns during extinction as a function of level of training in Experiment 2. The left panel depicts mean total consumption while the right shows mean rate of extinction.


mean total consumption - mls
130
110
90
70
50
30
10
N/S
NaCl
Sacc
4
6
10
number of training trials
Sacc
NaCl
N/S
2.5
2.0
1.5
1.0
0.5
mean rate of extinction index

$F(2,54) = 9.73$, $p < .001$, and a significant interaction, $F(4,54) = 6.01$, $p < .001$. The interaction effect suggests that while the complex stimulus solution remained unpalatable, the component solutions tended to become more palatable as a function of increased conditioning trials. The comparisons of means bore out this conclusion showing that consumption of component solutions after four conditioning trials was significantly less than after ten trials, $t = -5.61$, $p < .05$, with lower consumption also shown after six conditioning trials than after ten, $t = -4.87$, $p < .05$. There was no appreciable difference in the amount of N/S consumed after four or ten conditioning trials, $p > .05$.

A two-way ANOVA performed on rate of extinction indices yielded a significant effect due to level of training, $F(2,54) = 5.73$, $p < .01$, a Flavour group effect, $F(2,54) = 71.57$, $p < .001$, and a significant interaction, $F(4,54) = 4.76$, $p < .005$. Comparisons of means again showed that the rate of extinction of avoidance responding to N and S was significantly slower after four conditioning trials than after ten, $t = -4.49$, $p < .05$.

Comparing mean total consumption of the ten-trial conditioning group with that of the ten-trial control group, using a two-way ANOVA, yielded significant differences between experimental and control groups, $F(1,36) = 213.56$, $p < .001$, a significant Flavour group effect, $F(2,36) = 35.97$, $p < .001$, and a significant interaction, $F(2,36) = 47.64$, $p < .001$. Comparisons of means showed total

consumption of each of N/S, N and S by experimental animals to be less than that of control animals, p's < .001. However, multiple comparisons of means demonstrated that although the rate of avoidance extinction to N/S was slower in experimentals than controls, t = -16.87, p < .05, rates of extinction to N and of extinction to S did not differ reliably between the two groups, p's > .05.

Figure 8 depicts the results obtained during testing of post-extinction consumption of the N/S solution. Analysis of the results showed all main and interactive effects to be significant p's < .001, with the exception of the Flavour group x Overtraining group (A x B) interaction, p > .10 (see Table 4). Thus, comparisons of means were limited to those between test trials. Using the mnemonics of Experiment 1 and Figure 8, N_4 (test 10) vs N-N/S_4, (test 12) and N_6 (test 10 vs N-N/S_6 (test 12) were nonsignificant comparisons while N_{10} (test 10) vs N-N/S_{10} (test 12) was significant, t = 7.00, p = .05. A similar result was obtained with the S groups but with S_6 (test 10) vs S-N/S_6 (test 12) also yielding a significant t-value of 7.50, p < .05.

As in Experiment 1b, these results indicate that, with fewer than ten conditioning trials, consumption of the complex stimulus solution was less different from consumption of the 'extinguished' component solutions than after ten conditioning trials. That is, the differences between terminal consumption of a component

FIGURE 8

Summary of mean consumption of N/S, N or S, on the tenth extinction trial, and of N/S alone, on the eleventh and twelfth post-extinction trials, for Experiment 2a.

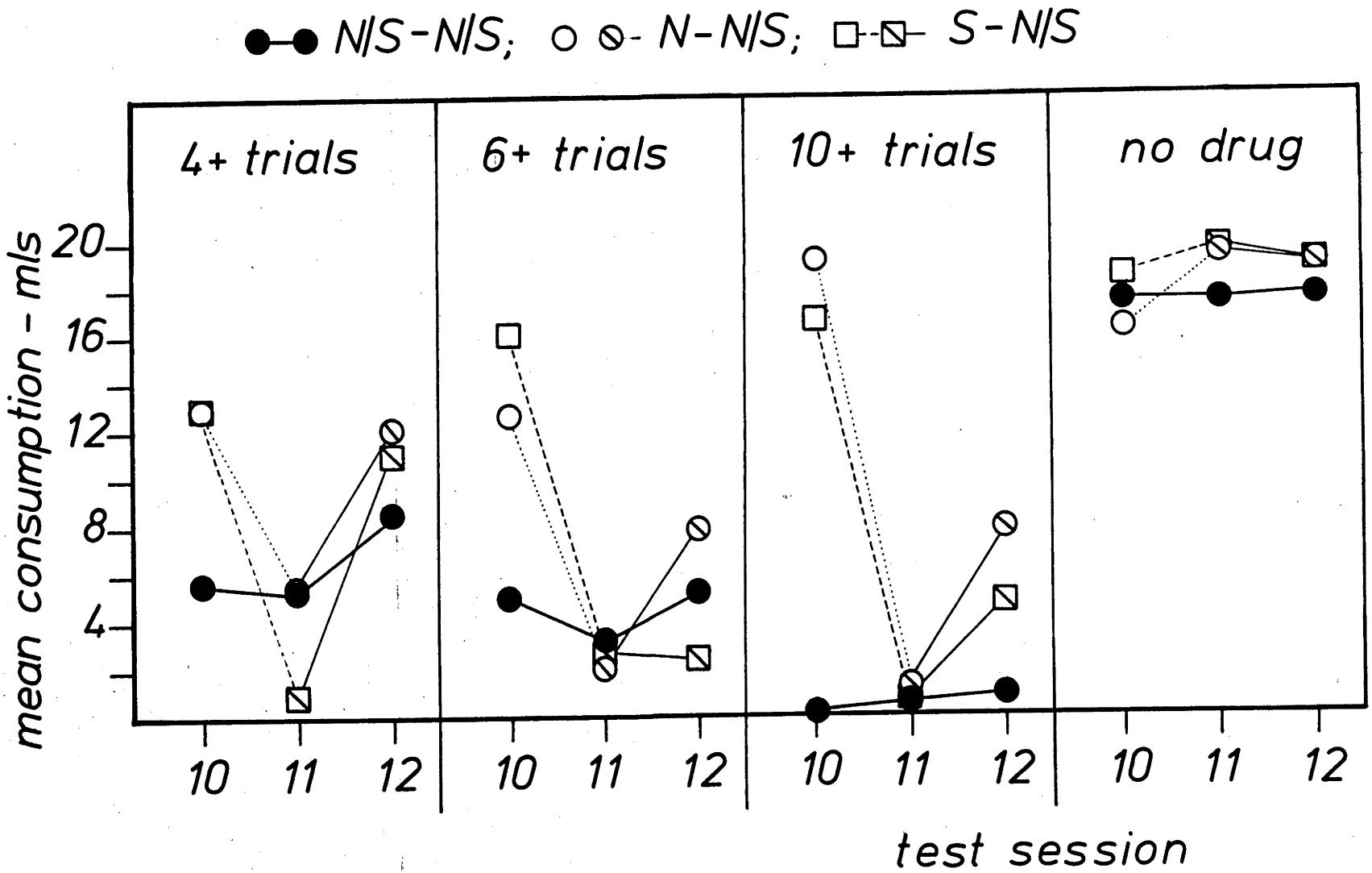

N/S-N/S;
N-N/S;
S-N/S
4+ trials
6+ trials
10+ trials
no drug
mean consumption - m/s
20
16
12
8
4
10
11
12
test session

TABLE 4

ANOVA Summary Table of Postextinction N/S Consumption by Overtraining Groups in Experiment 2a

SOURCE	SS	df	MS	*F*	*p*
A: Flavour groups	765.34	2	382.67	8.47	< .001
B: Overtraining groups	6403.30	3	2134.43	47.24	< .001
A x B	414.35	6	69.06	1.53	> .10
S(AB): Error (a)	3252.21	72	45.17		
C: Test trials	1649.50	2	824.75	70.85	< .001
A x C	820.82	4	205.21	17.63	< .001
B x C	1201.46	6	200.24	17.20	< .001
A x B x C	636.77	12	53.06	4.56	< .001
S(AB) x C: Error (b)	1675.99	144	11.64		
TOTAL	16819.74	251			

solution and subsequent N/S consumption increased with additional conditioning trials. Again, degradation of the N/S aversion was observed on the twelfth test suggesting that some generalisation of extinction may have been occurring. This would be especially true for the ten-trial groups which showed little resistance to extinction during component testing. Nevertheless, the results again fail to confirm Kamin and Idrobo's (1978) report that extinction to component-stimulus avoidance produces increased attenuation of complex-stimulus avoidance as a function of increased training.

3.1.3 DISCUSSION

The present experiment confirmed the hypothesis that the inability to demonstrate strong configural conditioning in the previous experiment entailed a performance deficit rather than a failure to configure. When sensitized avoidance responses were eliminated, configural conditioning was demonstrated using as few as ten trials. Neither in this experiment nor that of Bellingham and Gillette (1980) was it observed that test responses to the complex stimulus as trained were weakened as a function of increased training. It would seem that the samll decrements in avoidance responding seen in Gray and Lethbridge's (1976) study could be ascribed to a number of factors other than summation, as proposed by Kamin and Idrobo (1978). Between subjects designs engender more difficulty in establishing consistent baseline responding to the complex. In spite

of this, both the present study and that of Gray and Lethbridge show disproportionately large changes in responding to components accompanied by only minor fluctuations in responding to the complex stimulus. No simple summation model can account for such a finding. It is possible that, in the CER paradigm used by Gray and Lethbridge, the overtraining extinction effect (North & Stimmel, 1960 ; Theios & Brelsford, 1964) might account for decrements in avoidance responses to the overtrained complex.

Although the evidence for configural conditioning through overtraining was substantial in this experiment, it could not be ignored that the desensitizing procedure was an unorthodox one. The following experiment sought to demonstrate that the introduction of the vinegar solution, prior to testing, did not differentially affect responding to test solutions.

3.2 VERIFICATION OF THE NONSELECTIVE EFFECTS OF THE NEUTRAL FLAVOUR ON EXTINCTION OF REFERENCE FLAVOURS (EXPERIMENT 2b)

The following experiment was conducted to evaluate the possibility that the vinegar solution used previously exercised its desensitization effect selectively. For example, if the vinegar solution were perceived as more similar to saccharin than to NaCl then the desensitizing phase would act to enhance extinction with respect to saccharin and not to NaCl.

This control experiment was conducted as a joint

enterprise with Graeme Marchant whom I supervised for an undergraduate research project. The experiment consisted of training three groups of animals with one of the three test flavours (N/S, N or S), desensitizing them, and then extinguishing the aversions to their respective training solutions. In this way, any selective effect that the vinegar trials had on extinction of avoidance to any test flavours would be manifested in differential rates of extinction.

3.2.1 EXPERIMENTAL METHOD

Subjects. Twelve male Wistar hooded rats, 10-11 weeks old, were assigned to three equally sized groups. Animals were maintained as above.

Conditioning Agents. As for Experiment 2a.

Procedure. The four animals in each of three Flavour groups were maintained as previously. Each group received three conditioning trials with either the N/S, N or S solution. Upon recovery all animals were given the desensitizing vinegar solution on four consecutive days. Subsequently, ten extinction tests were conducted in which the respective training solutions were re-presented to the appropriate Flavour groups.

3.2.2 RESULTS AND DISCUSSION

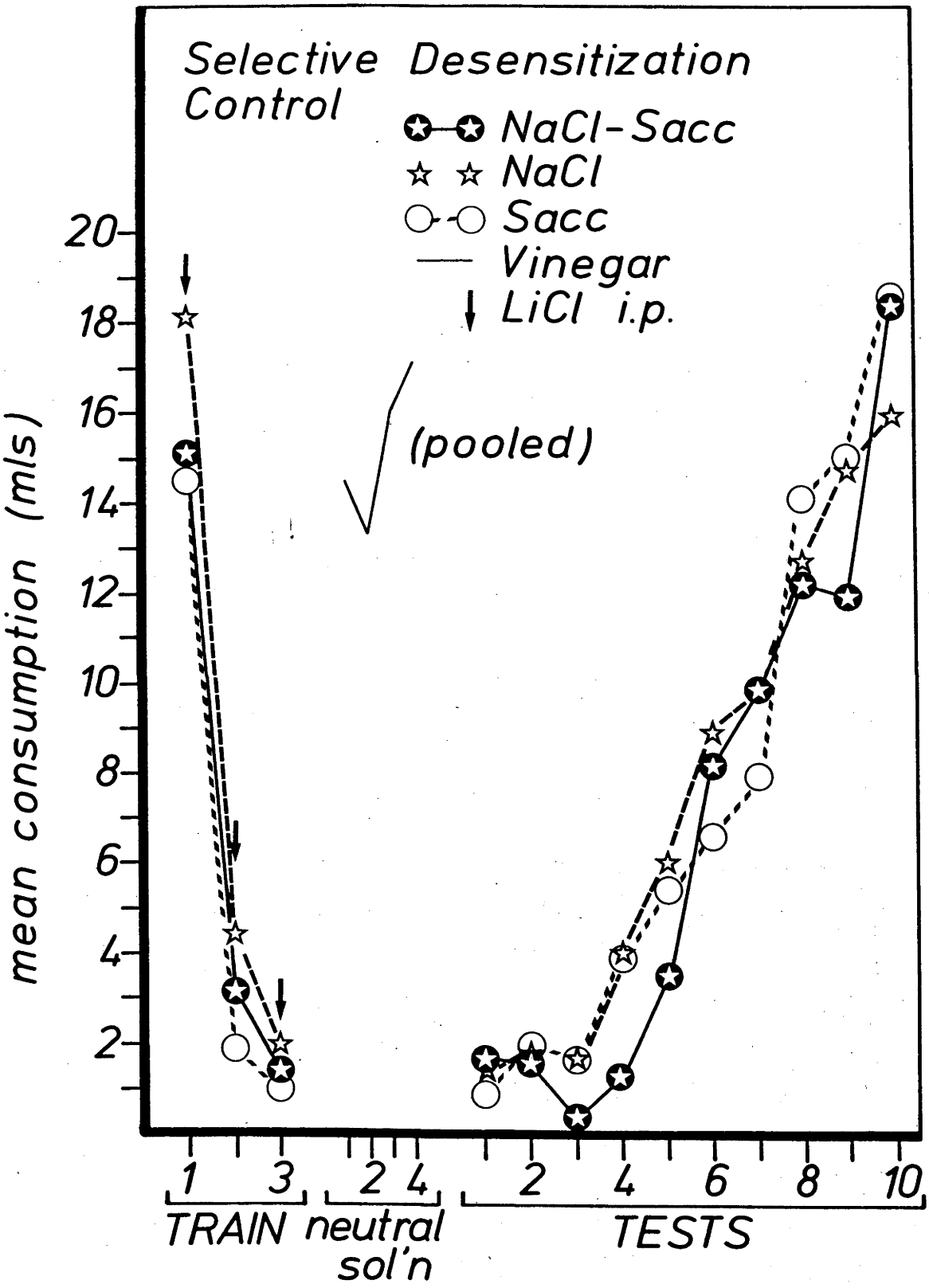
During the first pretraining session, all three Flavour groups drank equivalent amounts of tap water, $p > .25$. An analysis for trends of trial means during

acquisition indicated a significant Flavour group effect, $F(2,9) = 4.64$, $p < .05$, a significant trials effect, $F(2,18) = 88.1$, $p < .001$, and no significant interaction, $p > .75$. Although there was apparently a difference in levels of consumption of N/S, N and S, Scheffé multiple comparisons of means, with $\alpha = 0.05$ or .10, yielded no significant differences. The significant Flavour group effect was thus attributed to the fact that mean consumption of N tended to exceed that of both N/S and S during acquisition. This tendency was most apparent on the first presentation of the novel solutions, which is in accord with the data from Experiment 1a. As can be seen in Figure 9, the three stimuli would seem to be equisalient.

Analyses of desensitization and extinction trends showed no differences, in either case, between Flavour groups, p's $> .50$, while trials effects indicated significant increases in consumption during both phases, p's $< .001$. It should be noted that extinction of the N/S aversion in the present experiment proceeded more rapidly than that in Experiment 1b after three conditioning trials. The acceleration of extinction could be due to elimination of whatever sensitization had accrued over three extinction trials or possibly, in the case of few training trials where sensitization would be less pronounced, due to some generalisation of extinction from the desensitization trials to the test trials. Aside from deducing the *modus operandi* of the vinegar presentations in the present

FIGURE 9

Results of Experiment 2b during acquisition, desensitization, and extinction test phases for groups conditioned with N/S, N or S. Arrows indicate that LiCl was injected after the designated drinking period.


Selective Desensitization
Control
NaCl-Sacc
NaCl
Sacc
Vinegar
LiCl i.p.
(pooled)
mean consumption (mls)
20
18
16
14
12
10
8
6
4
2
1
3
2
4
2
4
6
8
10
TRAIN
neutral sol'n
TESTS

experiment, it is apparent that the effects were manifested nonselectively with respect to the three test solutions.

The fact that sensitization effects seem to become more pronounced with increased training in the taste aversion paradigm, suggests that researchers using multiple flavour-illness pairings should be wary of possible artifacts in interpreting their results.

3.3 GENERAL DISCUSSION

The results of Experiment 2a were interpreted as positive evidence that significant flavour configuration effects can be demonstrated in as few as ten conditioning trials. The finding is in accord with the recent demonstrations of Gray and Lethbridge (1976), with Kamin and Idrobo's (1978) replication of the former's findings, as well as with Bellingham and Gillette's (1980) study using appetitive procedures. All the above showed absolute loss of component associative strength as a result of extended complex stimulus training. This should serve to establish configural conditioning of inter- and intra-modal stimuli as a general process.

A more interesting feature of the present experiment was indicated by the no-drug control group's initial responding to component flavours after ten nonreinforced exposures to the complex flavour. Mean consumption of N and S in this situation was substantially reduced relative to the familiar N/S solution and, in fact resembled

consumption levels of N and S upon first presentation in Experiment 1a.

Several studies have shown that presentations of a component stimulus dishabituate a response previously habituated to a complex stimulus. For example, Engen and Lipsitt (1965) observed decrements in neonates' breathing responses to inert mixtures of olfactory stimuli followed by recovery of the response upon presentation of a component of the mixture. In our own laboratory, Gillette (Note 1) obtained similar dishabituating effects due to component presentations when rats had been habituated to complex stimuli consisting of tones, lights and/or shock. Thus, the behaviour of the no-drug control group was taken to indicate that the configuring effects achieved in the present study did not necessarily arise through CS_{1+2} - UCS association but, rather, reflected the possibility that the process of configuring has a nonassociative substrate. That configuring could be viewed in such a way was hinted at by Razran in 1965 when he suggested that the phenomenon is a perceptual rather than a learning problem. The following experiment was conducted to evaluate this interesting hypothesis.

CHAPTER FOUR

A DEMONSTRATION OF STIMULUS CONFIGURING IN THE ABSENCE OF REINFORCEMENT:

EXPERIMENT 3

The aim of the following experiment was to provide an opportunity to evaluate the possibility that configuring could occur as a result of simple, nonreinforced exposure to a complex stimulus. Rescorla and Cunningham (1978) have suggested that nonreinforced presentations of a complex flavour solution results in associations being formed between the individual component flavours. The previous experiment challenged this interpretation of complex stimulus processing and provided evidence that configuring involves more than an S-S association in that it seemingly "....brings into being new neurobehavioural existants" (Razran, 1971, p.265).

Using a latent inhibition procedure, the present experiment is concerned with the question of whether or not the configuring observed in Experiment 2a was the result of an associative or of a perceptual process. Rats were presented the complex, N/S, solution for two, ten or twenty nonreinforced trials. Subsequently, their neophobic responses to the component stimuli, relative to the complex stimulus, were examined as a function of N/S pre-exposures during the pretraining phase. The latent inhibition effects of N/S pre-exposures on aversion conditioning to the components was also examined as a

function of number of pre-exposures.

Hypothetically, if configuring is a perceptual process, one would expect little neophobia for N or S after two N/S pre-exposures but normal component neophobia after substantially more repetitions of the complex. As well, one would expect that the effects of latently inhibiting the complex flavour should selectively retard the acquisition of an aversion for N/S while having little or no effect on acquiring aversions for N or S.

4.1 EXPERIMENTAL METHOD

Subjects. The experimental subjects were 63 male Wistar hooded rats, 10-11 weeks old which were bred, housed and maintained as in the previous experiments. All animals were randomly assigned to three groups of 21 animals each.

Conditioning Agents. All flavoured solutions and injections were identical to those in Experiment 2a.

Procedure. Days 1-5 followed the procedure outlined previously. On Day 6 pre-exposure to the complex flavour stimulus, N/S, commenced. One group of 21 animals received nonreinforced presentations of N/S on two consecutive days, (Days 6-7), while animals in the remaining groups received ten (Days 6-15) and twenty (Days 6-25) pre-exposures to N/S respectively.

Following the latent inhibition phase, each Exposure group was divided into three Flavour groups of seven animals each. On the day following their last respective N/S pre-exposure animals received their first

conditioning trial with either N/S, N or S as the flavour stimulus followed by three recovery days during which water was available at the usual times.

Conditioning trials were conducted once every four days until mean consumption of all three flavours within each Exposure group fell below 4 ml (the highest level of consumption, after one conditioning trial that was previously observed in this study). In order to achieve the 4 ml criterion it was necessary to conduct two, three and five conditioning trials in the two, ten and twenty pre-exposure groups respectively. Due to the necessity of administering injections prior to weighing water bottles, each group received an additional injection after achieving this level of conditioning which would serve to bring consumption of all three solutions to more or less the same low level prior to the extinction phase.

After recovering from the final conditioning trial, all animals were tested for sensitization effects by presenting a vinegar solution for 10 mins each day until vinegar consumption equalled or exceeded pretraining water consumption. On the day following the last desensitization trial extinction tests began. Each Flavour group was re-presented with its respective training solution over ten consecutive days.

4.2 RESULTS

The results of this experiment are presented in three parts: (a) neophobia for N/S, N and S as a function

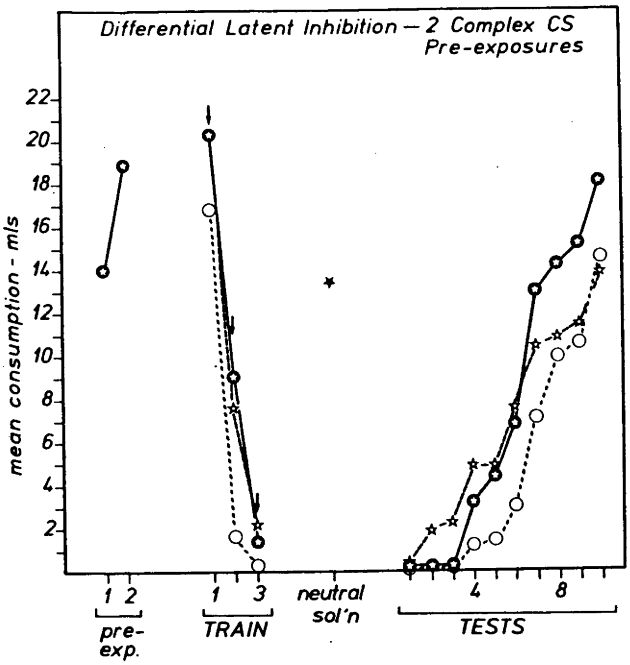
of N/S pre-exposures, (b) speed of acquisition of aversions for N/S, N and S as a function of N/S pre-exposures, and (c) resistance to extinction of an aversion for N/S, N and S as a function of N/S pre-exposure and number of training trials. Figure 10 depicts the untransformed data obtained.

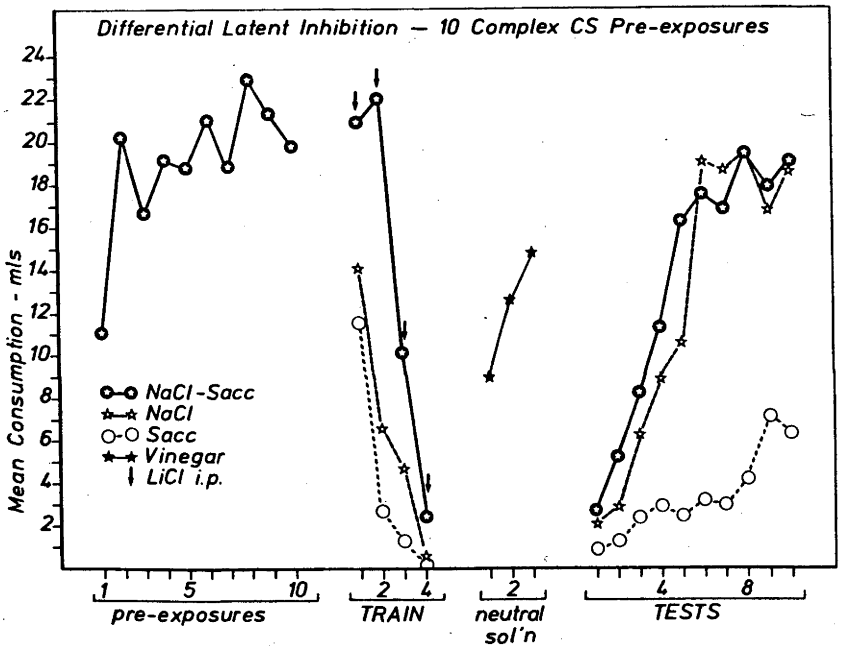
(a) Neophobia. Each animal's consumption of N/S, N or S, during the first conditioning trial, was computed as a percentage of their N/S consumption during the final pre-exposure session. Although the raw data showed approximately the same relationships as the transformed data, expressing neophobia as a percentage of terminal N/S consumption equates the N/S baseline for all three groups. Figure 11 (left) illustrates the results of this manipulation. A two-way ANOVA established that there were significant effects due to Exposure group, $F(2,54) = 41.48$, $p < .001$, Flavour group, $F(2,54) = 59.90$, $p < .001$, and E x F interaction, $F(4,54) = 9.73$, $p < .001$. An examination of Figure 11 indicates that these results can be interpreted as showing that, with increased numbers of pre-exposures to the complex flavour solution, subsequent neophobia for the component flavours increased up to some optimal level.

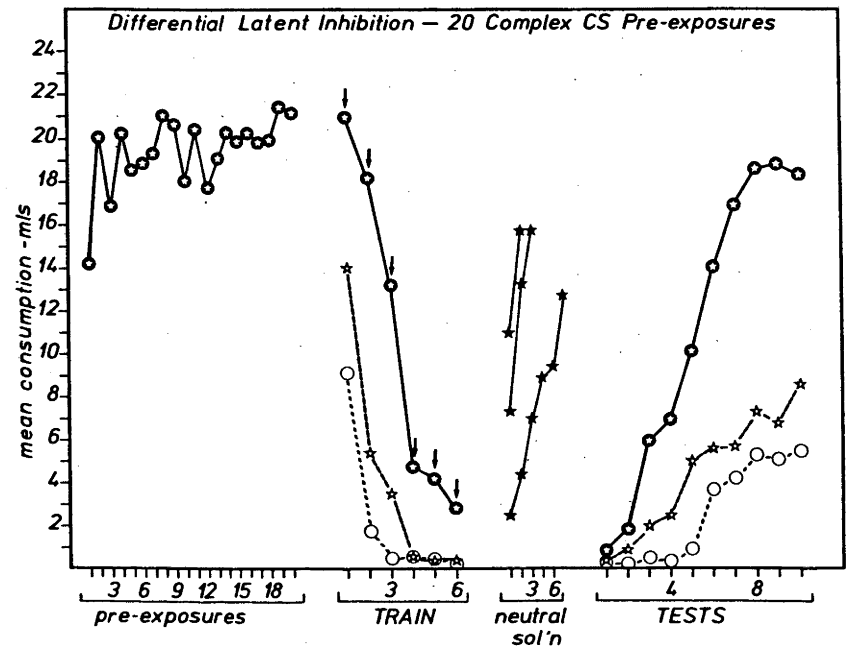
(b) Acquisition. The measure used to determine speed of acquiring a flavour avoidance response was the number of trials required, by each animal, to suppress consumption of N/S, N or S by 80% of their respective terminal consumption of N/S during the pretraining phase. Individual animals

FIGURE 10

Results of Experiment 3 during latent inhibition pretraining, differential conditioning, desensitization and extinction phases for groups receiving two, ten or twenty pre-exposures to N/S. N/S animals in the group receiving twenty N/S exposures were given two vinegar presentations while N animals received three and S animals six.


Differential Latent Inhibition — 2 Complex CS Pre-exposures
mean consumption - mls
22
20
18
16
14
12
10
8
6
4
2
1 2
pre-exp.
1 3
TRAIN
neutral sol'n
4 8
TESTS


Differential Latent Inhibition — 10 Complex CS Pre-exposures
Mean Consumption - mls
24
22
20
18
16
14
12
10
8
6
4
2
NaCl-Sacc
NaCl
Sacc
Vinegar
LiCl i.p.
1 5 10
pre-exposures
2 4
TRAIN
2
neutral sol'n
4 8
TESTS

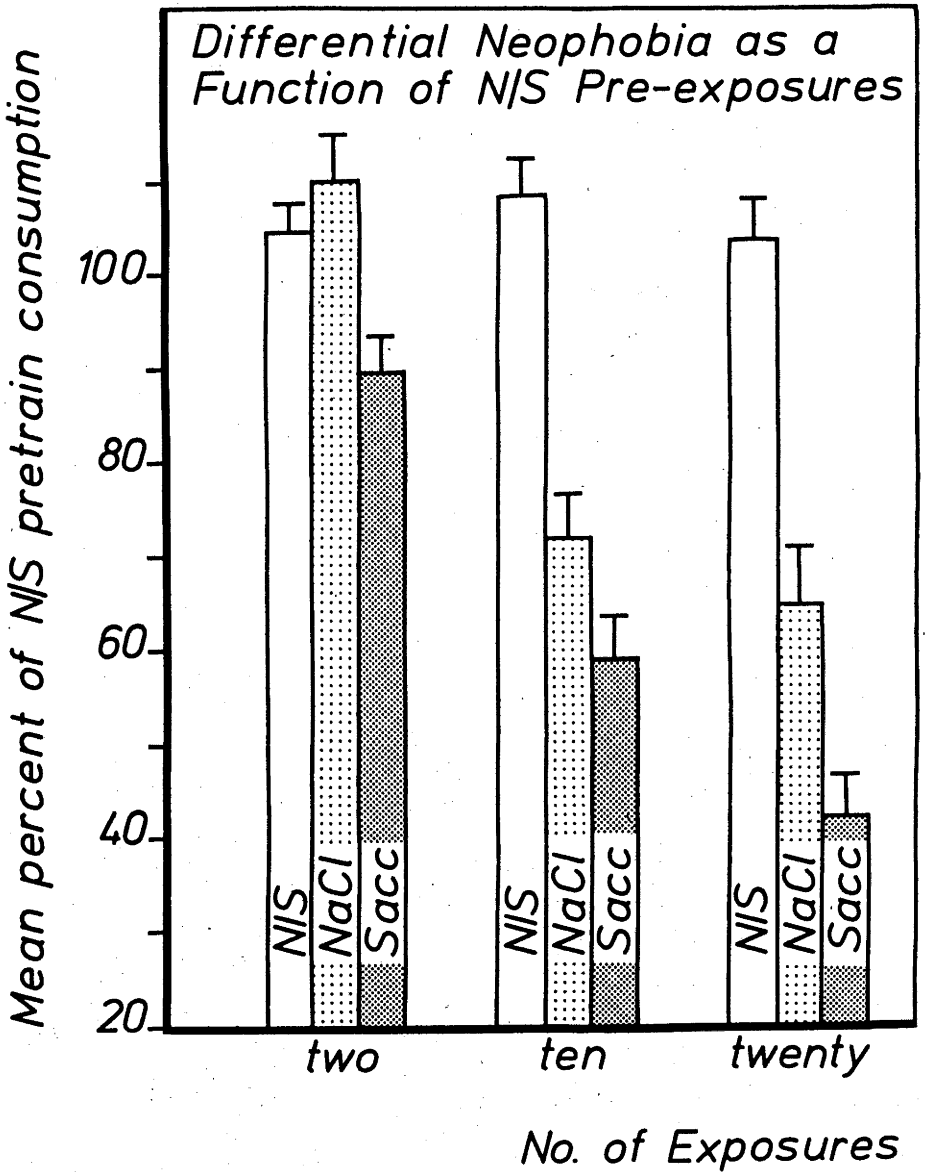

Differential Latent Inhibition — 20 Complex CS Pre-exposures
mean consumption - mls
24
22
20
18
16
14
12
10
8
6
4
2
3 6 9 12 15 18
pre-exposures
3 6
TRAIN
3 6
neutral sol'n
4 8
TESTS

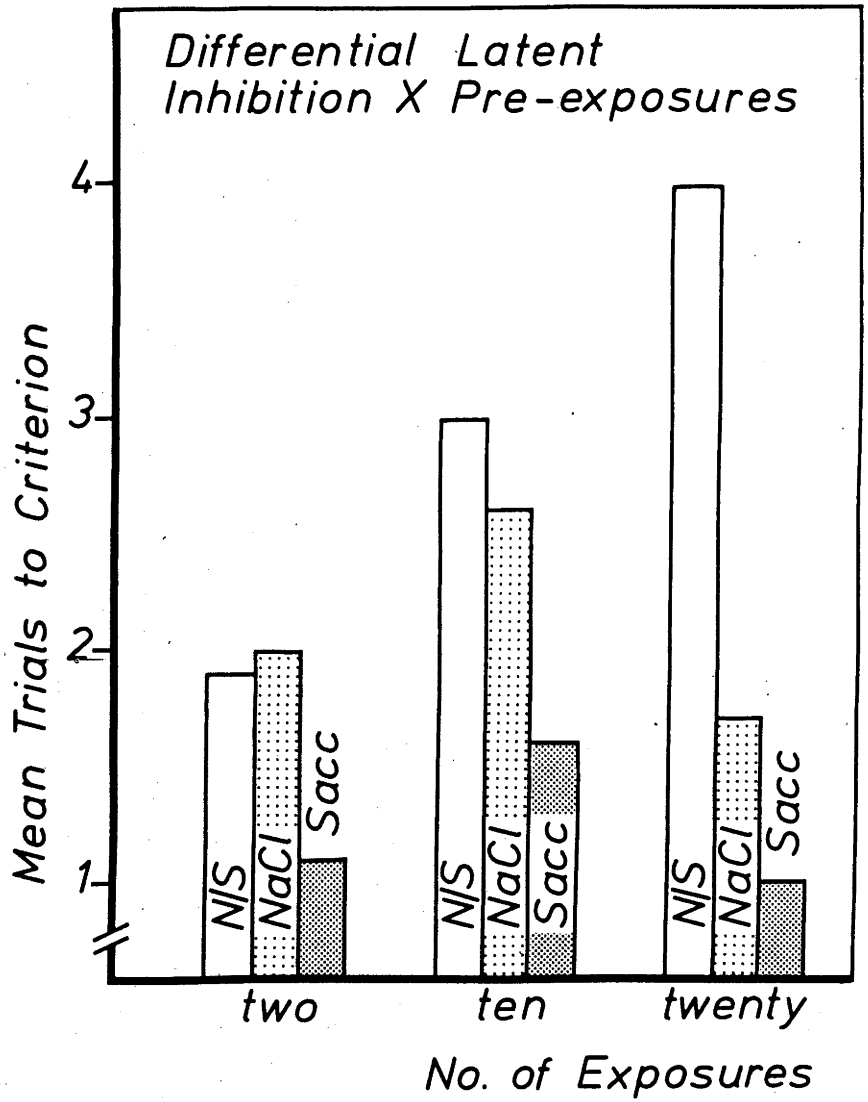
not reaching this criterion within the training phase were assigned the maximum number of trials possible for their respective Exposure group. This procedure was valid in that all animals tended to have fallen to criterion by the first extinction trial, if not before. A two-way ANOVA performed on the trials-to-criterion measure resulted in a significant Exposure group effect, $F(2,54) = 4.69$, $p < .025$, a significant Flavour group effect, $F(2,54) = 24.10$, $p < .001$, and a significant interaction $F(4,54) = 5.47$, $p < .005$. Comparisons of means showed that aversions to N/S were formed more slowly after ten pre-exposures to N/S than after two, $t = -5.43$, $p < .05$, and more slowly after 20 pre-exposures than after ten, $t = -4.76$, $p < .05$. Aversions for the N solution were acquired more rapidly after 20 pre-exposures to N/S than after ten, $t = 4.14$, $p = .05$, while no differences were shown in groups receiving S as the training solution, p's $> .05$. However, it can be seen in Figure 11 that there was a slight attenuation to S after ten N/S pre-exposures.

(c) Resistance to Extinction. Figure 12 summarises the extinction data obtained subsequent to acquisition criterion being met. It must be pointed out that an unexpected finding resulted during the desensitizing stage prior to testing in extinction. For some as yet unknown reason, the three Flavour groups in the 20 pre-exposure group were markedly different in their consumption of

FIGURE 11

The left panel represents differential neophobia for N/S, N or S after two, ten or twenty pre-exposures to N/S alone. The rate to acquire an aversion for N/S, N or S in each pre-exposure condition is shown in the right panel.


Differential Neophobia as a Function of N/S Pre-exposures
Mean percent of N/S pretrain consumption
100
80
60
40
20
N/S
NaCl
Sacc
two
ten
twenty
No. of Exposures

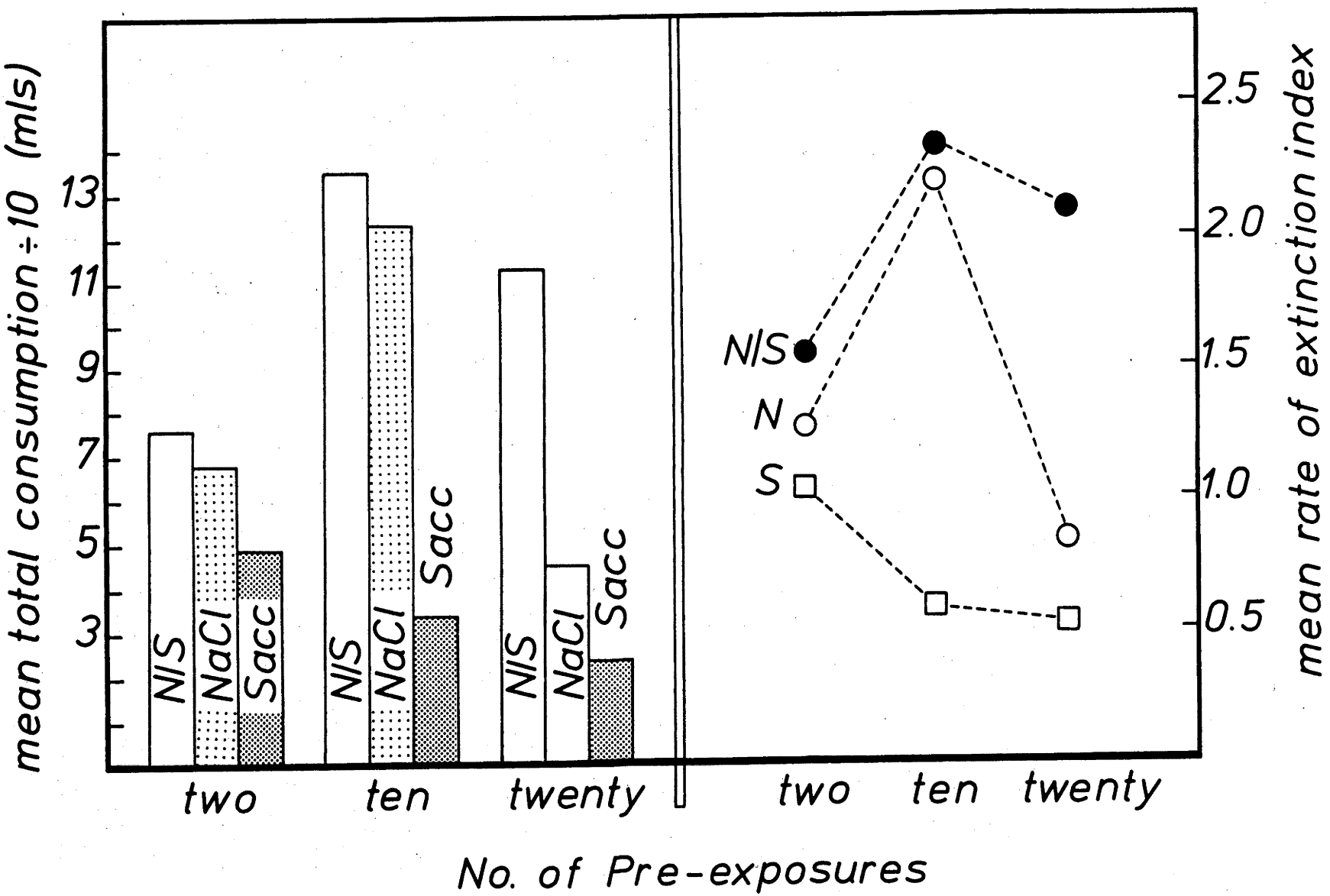

Differential Latent Inhibition X Pre-exposures
Mean Trials to Criterion
4
3
2
1
N/S
NaCl
Sacc
two
ten
twenty
No. of Exposures

vinegar. The N/S group was fully desensitized in two trials, the N group in three and the S group after six. The level of vinegar consumed initially by the S group is remarkably low and does not correspond with any results previously obtained even after ten injections in this study. At this stage, we must accept that for some reason the 20 pre-exposures plus six conditioning trials interacted to remove sensitization from the N/S group while greatly enhancing it in the S group. It is also apparent from this result that the sensitization observed is less likely to be due to simply injecting a noxious agent than to some form of enhanced neophobia. In any case, all groups were desensitized according to the criteria set out previously.

A two-way ANOVA was performed on total amounts of the three flavours consumed during extinction by the three Exposure groups. This analysis yielded a significant Flavour group effect, $F(2,54) = 24.01$, $p < .001$, a significant Exposure group effect, $F(2,54) = 7.56$, $p < .005$, and a significant E x F interaction, $F(4,54) = 4.43$, $p < .005$. Scheffé comparisons showed that, for the group receiving two N/S pre-exposures, there was no difference between N/S and N consumption and no difference between N/S and S consumption, p's $> .05$. For the group receiving 10 N/S pre-exposures there was no difference between N/S and N consumption, $p > .05$, while significantly more N/S was consumed than was S, $t = 5.61$, $p < .05$. In the last

FIGURE 12

Comparison of N/S, N and S consumption patterns during extinction for groups receiving differential conditioning after N/S pre-exposure in Experiment 3.


mean total consumption ÷10 (mls)
13
11
9
7
5
3
N/S
NaCl
Sacc
two
ten
twenty
N/S
N
S
2.5
2.0
1.5
1.0
0.5
mean rate of extinction index
No. of Pre-exposures

pre-exposure group it was seen that significantly more N/S was consumed than N and S, $t = 4.93$, $p < .05$. The comparisons indicate that, once level of conditioning to N/S was equated for all three Exposure groups, the effect of only two pre-exposures was to leave all three flavours equally resistant to extinction while after ten pre-exposures only N was similar to N/S and, after twenty, both N and S were significantly more resistant to extinction than N/S. N/S consumption did not differ between either the two and the ten pre-exposures group, or between the ten and 20 pre-exposures groups, p's > .05.

Similar results were obtained by analysing rate of extinction where significant effects due to Flavour group, $F(2,54) = 26.09$, $p < .001$, Exposure group, $F(2,54) = 5.33$, $p < .01$, and E x F interaction, $F(4,54) = 5.21$, $p < .005$, were found. Multiple comparisons again showed no difference in rate of extinction between N/S and N groups or N/S and S groups which had experienced two N/S pre-exposures, p's > .05; no difference in rate of extinction between N/S and N groups, $p > .05$, but a difference between N/S and S groups, $t = 5.65$, $p < .05$, after ten pre-exposures; significant differences between N/S and N, $t = 4.10$, $p < .05$, and between N/S and S, $t = 5.06$, $p < .05$, after 20 pre-exposures to N/S; no differences in N/S extinction over any of the groups, p's > .05.

Both measures of resistance to extinction reflected for the most part, the results obtained in the neophobia

and acquisition phases of this experiment. The pattern observed was that, with few pre-exposures to the complex stimulus, no discrimination was made between the complex and its components. With a greater number of pre-exposures discrimination was made between the complex and one component with the remaining component losing its similarity to the complex when the pre-exposure phase was further extended.

4.3 DISCUSSION

The preceding experiment provided evidence that components of a complex flavour stimulus can be spontaneously differentiated from that complex stimulus simply as a function of pre-exposures. It was observed that this differentiation can emerge at dissimilar rates for the various components. The latter finding provides a possible interpretation of Booth and Hammond's finding that only one component stimulus was clearly distinguished from the complex stimulus of the time of testing. Further training may have resulted in their finding a true configural effect.

The present finding constitutes a demonstration of spontaneous negative patterning while Experiment 2a resulted in spontaneous positive patterning after a relatively few trials. This suggests that configuring would be easily demonstrated in any task where the organism is highly sensitive to the stimuli employed. The most salient feature of the present investigation was that

configuring is more than likely a nonassociative process - nonassociative in the sense that no explicit UCS or reinforcer is required.

The findings do not support Rescorla and Cunningham's (1978) suggestion that there is "... substantial within-compound learning of associations among simultaneously presented stimuli" (p.267). Rather, they indicate quite the opposite in that, with increased exposure to a complex stimulus and using sensitive test measures, the components of the complex lose their apparent association with each other. That there ever exists an association between the component stimuli is questionable when one considers the approach taken by Bellingham and Gillette (1980). Using a tone-light stimulus in an appetitive paradigm, it was shown that nondiscrimination of complex and components early in training and good discrimination later in training followed a traditional stimulus generalisation continuum. The view that continued configural conditioning ".... progressively narrows the range of stimulus generalisation and ultimately even excludes the elements presented separately," has also been expressed by Logan and Ferraro (1978), p.342.

It should be mentioned that there was a discrepancy between the number of exposures to N/S required to show configural effects in this experiment and Experiment 2a. Although animals in the present study exhibited significantly more neophobia for both components after ten N/S pre-exposures than after two, complete configuring was

not further observed in acquisition or extinction phases (especially with respect to N) until after 20 pre-exposures. This does not necessarily imply that the rates to configure differed in the reinforcement and nonreinforcement conditions. Comparisons of discrimination shown during acquisition stages in one situation with that shown during extinction stages in a different situation are dubious. It is possible that a comparison of acquisition for the NaCl group receiving ten N/S pre-exposures with acquisition of an NaCl group receiving NaCl pre-exposures would have resulted in greater latent inhibition effects in the latter group relative to that shown in the former group. In any case, after 20 nonreinforced exposures to N/S, the degree of spontaneous configuring was pronounced for all three measures: level of neophobia, rate of aversion acquisition, and rate of extinction.

The implication of this finding is that configuring of taste stimuli does not involve an explicitly associative process. Razran (1965; 1971) hypothesized that configural conditioning in general reflected an essentially perceptual process. Although there is no general agreement as to a definition of perceptual learning, Gibson & Gibson (1955) have described it in terms which seem applicable to configuring (and generalisation) phenomena. They describe perceptual learning as an increase in the specificity of responses to a stimulus, "...accompanied by an increase in the ability to respond differentially to the dimensional variables of the stimulus" (p.447). This definition makes no mention of the necessity for reinforcement to effect

perceptual learning. In fact, in reviewing the experimental work concerned with improvement in human perceptual judgements, Gibson (1953) points out that explicit reinforcement does not appear to be a necessary condition for improvement even when the opportunity for self-reinforcement is eliminated. It was indicated however that reinforcement could accelerate improved perceptual judgement.

Whether perceptual learning is fundamentally associative or nonassociative may depend on whether or not it can be shown that, when an organism comes to respond to new variables and qualities of repeated stimulation patterns, there occur concomitant changes in the reactions of the central nervous system to that stimulation (Postman, 1963). For the purposes of the present investigation, however, the terms nonassociative process and perceptual learning will be employed to describe changes in behaviour toward a stimulus in the absence of any explicit, quantifiable reinforcer.

It appeared in the above experiment that configuring occured as the result of a perceptual process wherein the complex stimulus came to act as a functionally unitary stimulus. To the degree that a complex stimulus does represent a unitary stimulus, the variables shown to affect behaviour in single stimulus situations should also affect behaviour toward a configural stimulus but not the component stimuli. The next experiment demonstrates the powerful nature of stimulus configuration

in the face of deliberate manipulations to acquisition conditions which might be expected to disrupt performance during extinction.

CHAPTER FIVE

THE EFFECTS OF PARTIAL REINFORCEMENT SCHEDULES ON CONFIGURING OF COMPLEX GUSTATORY STIMULI:

EXPERIMENT 4

The following experiment was designed to examine the effect of partial reinforcement on flavour configuring effects as tested in extinction. Klein, Mikulka, Rochelle and Blair (1978) have shown that partial reinforcement schedules act to retard learning of conditioned taste aversions and Robbins (1979) found increased resistance to extinction of an aversion in partially reinforced mice relative to continually reinforced mice. Both findings are consistent with partial reinforcement effects obtained in more traditional learning paradigms (see Lewis, 1960 for review).

The strategy of the present investigation was to compare the rates of extinction for an aversion to the complex versus the component stimuli as a function of reinforcement schedule. One of the effects due to partial reinforcement is to widen the range of stimulus generalisation. Both Sheffield (1949) and Wickens, Schroder and Snide (1954) demonstrated broader generalisation after partial reinforcement than after continuous reinforcement schedules. Having drawn an analogy between stimulus generalisation and configuring, it was expected that the effect of a partial reinforcement schedule would be to attenuate the degree of configuring shown by continuously reinforced

animals. That is, one could hypothesize that less discrimination between complex and components might be shown the more severe the partial reinforcement conditions. Alternatively, discrimination might be largely unaffected or even increased depending on the robustness of configuring effects. The aim of this experiment was to determine which of these three possibilities, were viable ones.

5.1.2 EXPERIMENTAL METHOD

Subjects. The subjects used in this study were 42 male Wistar hooded rats which were bred, housed and maintained as all other subjects described previously in this study. The animals were assigned randomly to two treatment groups comprised of 21 animals each. The first group received 10 nonreinforced and 10 reinforced N/S trials, (1:1), while the second group was administered 20 nonreinforced and ten reinforced N/S trials (2:1). (For the sake of comparison, data from the ten-trial Overtraining group (0:1) of Experiment 2a is also referred to).

Procedure. Following the usual Day 1-5 adaptation phase, experimental manipulations commenced with the 1:1 group receiving a total of 20 N/S exposures over Days 6-34, ten of which were reinforced by LiCl injections and ten of which were nonreinforced. The 2:1 group received 20 nonreinforced N/S exposures and ten reinforced exposures over Days 6-45. This procedure kept the number of N/S-LiCl trials constant for all groups. This precaution could not be made

in the previous latent inhibition experiment, due to the nature of the experimental question, and resulted in confounding of number of exposures and number of training trials prior to testing in extinction.

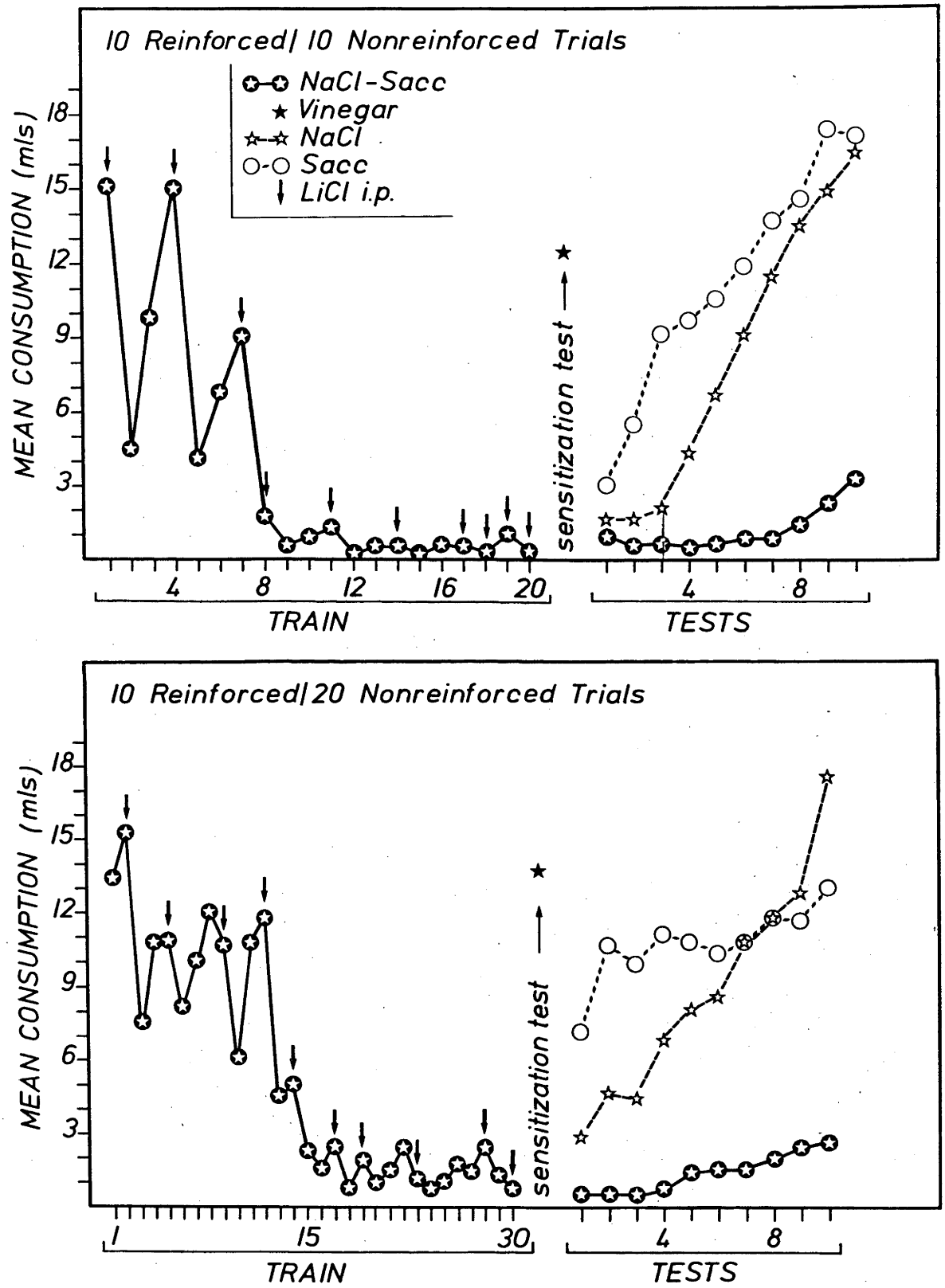
The schedules of reinforcement were randomly selected (see Figure 13) but the minimum intertrial interval (ITI) was 48 hours, in both groups, with the average ITI being 72 hours. Following three days recovery, the usual vinegar test for sensitization/enhanced neophobia was administered. The day after this test was the beginning of the extinction phase where both groups were subdivided into three Flavour groups of 7 animals each which were tested with either N/S, N or S over 10 consecutive days.

5.2 RESULTS

The data obtained during acquisition, sensitization testing and extinction are depicted in Figure 13. It is readily seen that the 1:1 group acquired and maintained a strong avoidance response to N/S earlier than the 2:1 group. This observation is consistent with the effects of partial reinforcement obtained in other instrumental learning paradigms (Lewis, 1960). The procedure was also revealed to have the advantage of eliminating (or preventing) sensitization. Both groups drank as much vinegar, upon first postconditioning presentation, as they had of tap water during the pretraining trial.

FIGURE 13

Results of Experiment 4 showing acquisition by groups under 1:1 and 2:1 schedules of nonreinforcements to reinforcements and subsequent extinction to N/S, N and S as a function of partial reinforcement schedules. Arrows indicate injection days.

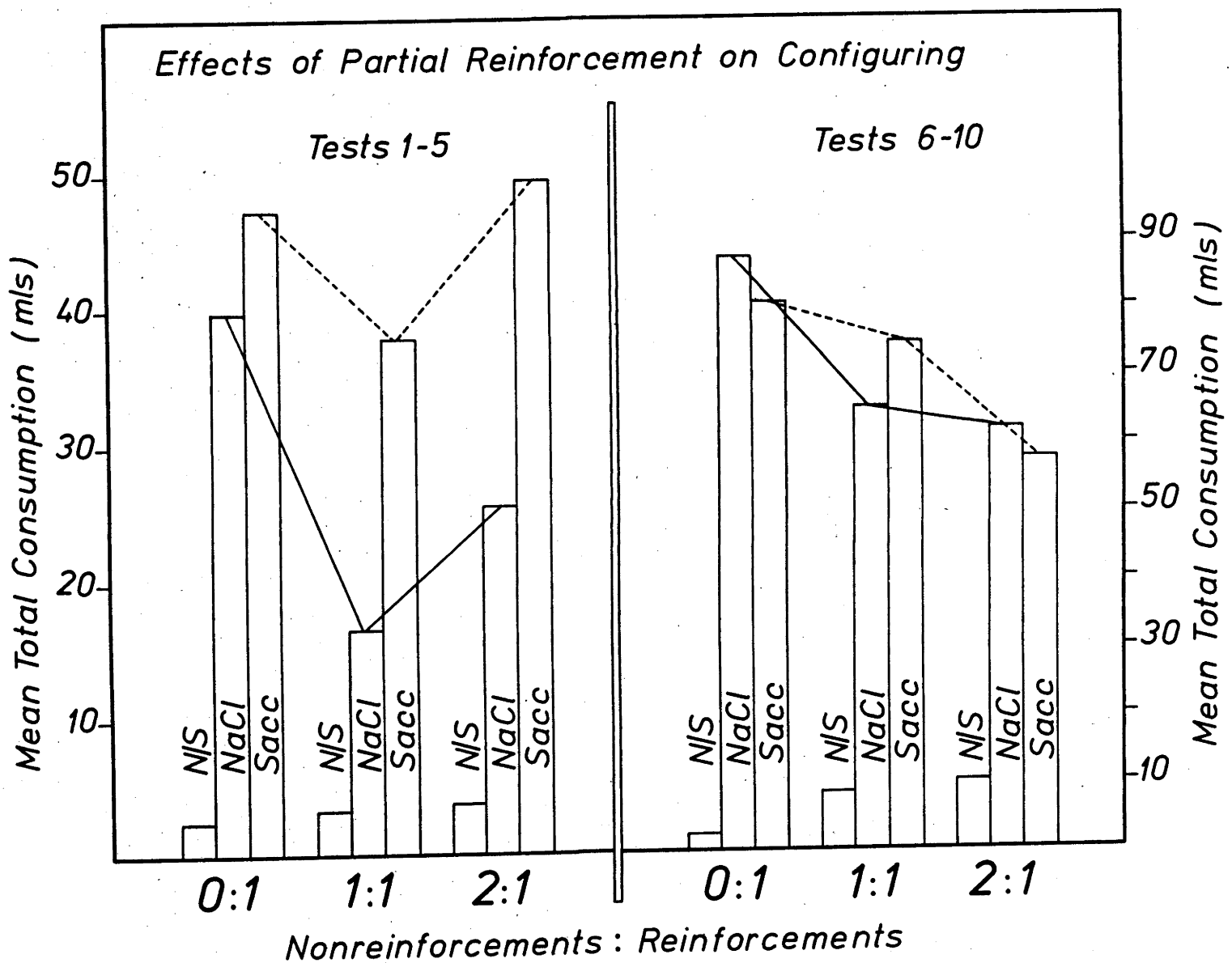

10 Reinforced/ 10 Nonreinforced Trials
NaCl-Sacc
Vinegar
NaCl
Sacc
LiCl i.p.
MEAN CONSUMPTION (mls)
18
15
12
9
6
3
sensitization test
4
8
12
16
20
TRAIN
4
8
TESTS
10 Reinforced/20 Nonreinforced Trials
MEAN CONSUMPTION (mls)
18
15
12
9
6
3
sensitization test
1
15
30
TRAIN
4
8
TESTS

The results obtained during the extinction phase were somewhat surprising in that both configuring effects and partial reinforcement effects were manifested in an interactive fashion. A two-way ANOVA comparing summed consumption by the three Flavour groups during tests 1 and 2 showed a significant effect due to Flavour group, $F(2,36) = 11.23$, $p < .001$, a significant effect due to reinforcement schedule, $F(1,36) = 4.48$, $p < .05$, and no interaction, $p > .25$. The results confirm that in spite of the partial reinforcement schedules, animals with more N/S experience initially show higher consumption levels in response to the N and S components. However, in applying the analyses of overall total amount consumed in extinction and rate of extinction used throughout this study, no significant differences were found due to the two reinforcement schedules.

An inspection of Figure 14 reveals the interesting interaction of partial reinforcement effects and configuring effects using the 0:1 N/S_{10} group from Experiment 2a as a point of reference. Statistical comparisons were not made on this selected data as the 0:1 group was not conducted in conjunction with the 1:1 and 2:1 groups and multiple comparisons of reorganised data represents unsound statistical technique. The tendency observed during tests 1-5, however, was that resistance to extinction was increased in the 1:1 component groups relative to that in the 0:1 component groups. This may be taken as a partial reinforcement generalisation effect (PRGE). A

FIGURE 14

The left panel compares N/S, N and S consumption during extinction for groups receiving 0:1, 1:1 and 2:1 partial reinforcement schedules for tests 1-5. The right panel depicts the results of tests 6-10.


Effects of Partial Reinforcement on Configuring
Tests 1-5
Tests 6-10
Mean Total Consumption (mls)
50
40
30
20
10
90
70
50
30
10
N/S
NaCl
Sacc
0:1
1:1
2:1
Nonreinforcements : Reinforcements

configuring effect is revealed when the 1:1 and 2:1 groups are compared in that resistance to extinction was somewhat weakened in the latter relative to the former. There was still greater generalisation from N/S to N in the 2:1 group than in the 0:1 group. During the final five extinction tests this tendency was reversed with 2:1 group drinking the least of the N and S solutions. This tendency could be attributable to a partial reinforcement extinction effect (PREE).

Consumption of N/S was slightly higher in the two experimental groups relative to the reference group, 0:1, taken from Experiment 2a. However, these two groups did not differ reliably, $p > .05$. In any case, this experiment did not control actual acquisition levels but rather number of actual conditioning trials. It was also observed that neither partial reinforcement group displayed enhanced neophobia while the continuously reinforced groups were not fully desensitized when testing began.

5.3 DISCUSSION

The results of this experiment can be taken as confirmation that configuring is a powerful phenomenon in the flavour aversion paradigm. If this were not the case one would have expected that, with a larger ratio of nonreinforcements to reinforcements, suppression to the component solutions would be greater. Rather, it was observed that rats initially showed a greater

discrimination between complex and component stimuli after the 2:1 schedule of reinforcement than after a 1:1 schedule. That extinction subsequently progressed more slowly simply attests to the power of partial reinforcement and indicates that its effects are to some extent generalised. Had no significant differences been found, at any stage, the results would still confirm the power of the configuring effect in that the more severe partial reinforcement condition (2:1) did not act to attenuate the degree of configuring shown under the less severe condition (1:1).

The findings described do not support the notion that strong CS-CS associations are formed during complex stimulus exposures (Rescorla & Cunningham, 1978). If such were the case, less configuring should have been demonstrated in the 2:1 group, which received ten more N/S exposures than the 1:1 group. The final experiment was designed to provide a direct assessment of the notion that CS-CS associations are not accomplished during complex stimulus exposures.

CHAPTER 6

SUMMARY AND DISCUSSION OF CHAPTERS 2-5 (EXPERIMENTS 1-4)

Thus far, the main result of the present research programme has been to demonstrate that components of a familiar complex stimulus can be increasingly differentiated from that complex simply as a function of the degree to which it is familiar. That is, configuring occurs as a function of increased complex stimulus presentations. The dynamics and behavioural manifestations of the configuring process seem to be influenced by the conditions of exposure and the critical measures adopted.

6.1 SUMMARY OF EXPERIMENTS 1-4

Experiment 1 was comprised of three interrelated subexperiments. The rationale behind the first experiment was to demonstrate that the flavours of the N/S, N and S solutions were more or less equally associable with gastrointestinal distress produced by LiCl. It was shown that, after one conditioning trial with one of the three flavours, aversions of similar magnitudes were demonstrated for all flavour groups. Unfortunately, only one test trial was administered and differences which might have arisen during the course of ten extinction trials could not be determined. The results of Experiment 2b, to be discussed below, did indicate that such differences were not to be expected.

The second subexperiment of Experiment 1 was the critical one. It was designed to test the hypothesis

that configural conditioning, meeting Baker's (1968) stringent criteria, would be manifested when animals were repeatedly conditioned to avoid ingesting a solution characterised by a novel complex flavour. Initially, the experiment provided only weak evidence that equisalient flavour stimuli came to form a configure after repeated conditioning trials. Using patterns of consumption in extinction as test measures it was seen that: one N/S conditioning trial resulted in weak aversions to all test solutions, i.e. N/S, N and S; after three N/S conditioning trials N appeared to overshadow S; after six N/S conditioning trials N lost associative strength and no longer overshadowed S; ten N/S conditioning trials resulted only in strengthening the N/S aversion and not in further loss of associative strength for N or S. As stated previously, the findings resembled those of Booth and Hammond (1971) who used a CER paradigm.

During extinction the 'emotional' behaviours of animals presented with component flavour solutions and those given N/S differed. After ten conditioning trials, animals given N/S would actively remove themselves from the vicinity of the drinking spout while animals in the component groups engaged in distinct approach behaviours towards the spout. The possibility that a form of enhanced neophobia accounted for suppression of consumption in component groups was entertained. Domjan (1977) has aptly described this type of suppression as conditioned-aversion-mediated neophobia. In spite of

this seemingly mediated neophobia, however, there were quantifiable results during postextinction N/S testing which indicated that configuring might have occurred during conditioning trials. Specifically, the results showed that extinction testing with a component solution disrupted the original N/S aversion at low levels of training but not at high levels of training. Groups with intermediate training levels were not retested with N/S which prevented any firm conclusions regarding the differential effects of component extinction on N/S aversions as a function of training level.

The third subexperiment in Experiment 1 was conducted to determine if the combination of NaCl and saccharin in a single mixture produced a unitary flavour not separable into its individual component flavours. If such were the case, the procedure adopted above would represent a straightforward stimulus generalisation study and nothing more. It was shown that similar results ensued whether N and S were delivered from two separate sources or from a single source. This experiment is subject to various interpretations e.g. heightened suppression to N/S due to summation of N and S aversions but none favour a unitary stimulus interpretation.

Experiment 2 was comprised of two subexperiments, the purpose of which were to eliminate mediated neophobia prior to testing for configural effects. In the first

experiment it was shown that mediated neophobia for a neutral vinegar solution increased as the prior number of N/S-LiCl conditioning trials was increased. Once mediated neophobia was attenuated, robust configural conditioning was evidenced by increased differentiation of complex and component stimuli during testing. Specifically, component flavour cues lost absolute associative strength as a function of increased training levels with a complex cue. It was also apparent that this decrement was not accompanied by a similar decrement regarding the complex. A comparison of N and S extinction after ten N/S trials in Experiment 2a (see Figure 6) with that after one N/S trial in Experiment 1b (see Figure 2) indicates that the degree of configuring demonstrated is very close to the absolute limit possible within the procedural limits that were adopted.

The configuring effects observed in Experiment 2a were unlikely to have arisen as a result of selective effects of vinegar exposures on extinction to one or two of the test solutions. Neither the literature nor the results of Experiment 2b indicate that post-training flavour experiences tend to disrupt acquired aversions in any selective fashion (Braveman & Jarvis, 1978). The more interesting observation in Experiment 2 was that UCS administration might have been superfluous to development of configuring.

Experiment 3 was conducted to systematically examine this latter possibility. Using a latent inhibition

procedure, the effect of two, ten and twenty non-reinforced exposures to the salty-sweet solution on subsequent behaviour toward the component solutions was examined. It was observed: that neophobia to N and S was attenuated after only two N/S exposures, but reappeared after ten N/S exposures; that latently inhibiting N/S tended to selectively affect acquisition of an aversion for N/S while having little effect on component acquisition, as a function of number of exposures; that extinction of aversions reflected the latent inhibition effects on acquisition. Once again, it was shown that the salt component, N, could be selectively attended to causing overshadowing (see N/S_{10} Exposure group) of the saccharin component. After twenty exposures to N/S, overshadowing effects had been completely attenuated.

The aim of Experiment 4 was to illustrate that manifestations of configuring in *performance* are susceptible to those manipulations which affect performance in general. In particular, it was hypothesised that wider stimulus generalisation would proceed from the adoption of partial reinforcement schedules during training. All animals were given ten N/S - LiCl training trials in addition to which half the animals experienced ten nonreinforced N/S trials (1:1) and the other half experienced twenty nonreinforced N/S trials (2:1).

Comparisons with continuously reinforced animals from Experiment 2a were made and it was seen that, on an

overall basis, the partial reinforcement schedules did seem to cause more generalisation from complex to component stimuli during extinction. In spite of this, animals in the 2:1 group showed significantly more differentiation between complex and components than those in the 1:1 group during the first two test trials. These results indicated that both configuring and partial reinforcement effects were co-acting. That is, by increasing the absolute number of N/S exposures, initial complex-component differentiation was improved but, by increasing the nonreinforcement-to-reinforcement ratio, resistance extinction to all stimuli was to some extent increased.

6.2 DISCUSSION AND IMPLICATIONS OF EXPERIMENTS 1-4.

In overview, the present study has served to illustrate that configural conditioning is a dynamic process which appears to have a perceptual substrate rather than an associative one. The most convincing evidence for a perceptual interpretation was obtained in the latent inhibition experiment wherein increased pre-exposure to N/S resulted in increased neophobia to N and S. Such a finding stands in marked contrast to that of Braveman and Jarvis (1978). They claimed that familiarising animals with one distinctively flavoured solution attenuated neophobia to solutions of a different flavour. On close inspection, however, their data fail to confirm this finding.

In Braveman and Jarvis' first experiment (see p.407) it was shown that: after eight exposures to tap water,

animals drank about 9 ml of NaCl; after eight exposures to either saccharin, lemon, coffee or almond solution, consumption of NaCl was 15-16 ml; after eight exposures to NaCl, consumption of NaCl was about 21 ml. In pilot work and in the present study, NaCl consumption upon first presentation has been consistently in the 14-16 ml range. Moreover, the animals in Braveman and Jarvis' study were highly deprived and could be expected to drink more than 9 ml of NaCl. In fact, in their second experiment (see p.408) the consumption of NaCl upon first presentation averaged over 20 ml for thirty-eight animals. In other words, there is a major discrepancy regarding rats neophobic intake of NaCl within their study. Also, it might have been appropriate to compare the NaCl intake with that of the familiarised flavour in estimating neophobia or the lack of it.

In any case, the present study showed that, as a result of systematically increasing the degree of familiarity with N/S, neophobia to N and S increased up to an optimal level. That is, N and S were responded to as novel stimuli. Before concluding that this effect represents *perceptual* learning of a configuration of stimuli in the absence of reinforcement, the role of drive reduction as an implicit reinforcer has to be considered. As Domjan (1977) has expressed it, approach responses could be conditioned to a novel flavour if "... the novel fluid could have become a conditioned reinforcer through association with hunger and thirst reduction ..." (p.157). However, both Siegel

(1974) and Domjan (1976) have systematically eliminated the possibility that the flavours of solutions become conditioned reinforcers through association with thirst reduction.

Undoubtedly, with a little imagination it might be possible to postulate some implicit reinforcer associated with consumption of the N/S solution, during Experiment 3. The evidence, however, favours a perceptual learning interpretation of the results thus far. It does not seem unreasonable that the substrate of most learning behaviours is a perceptual one. By adopting this view toward spontaneous configuring, we can give a new emphasis to the "spontaneous" aspect of the phenomenon by investigating its possible perceptual basis. The problem, as seen in this study, is primarily to decipher what it is that the organism is perceiving and what the dynamics are in arriving at that perception at any given time. One can then proceed to examine how those perceptions are influenced and utilised in associative learning situations.

The fact that components of a complex stimulus can and do lose absolute strength as a result of continued conditioning is problematic for formulations of learning which incorporate the concept of shared and limited associative strength due to the particular reinforcer used (Rescorla, 1969; Wagner, 1969). These notions could be modified in the case of configural conditioning such that it is assumed that all associative strength is acquired by the complex stimulus and any responding to components is

due to stimulus generalisation. There are two problems with such an approach. If a common-element model of stimulus generalisation is adopted, then presumably the common element would have acquired some associative strength. How, then, is that associative strength lost? Also, it is clear from the data presented in this study that reinforcement as such is ancillary to the development of configuring.

A demonstration of the ancillary nature of *differential* reinforcement on spontaneous patterning was actually demonstrated a decade ago but has been overlooked. Using a classical conditioning paradigm Wickens, Nield, Tuber and Wickens (1970) examined a paw withdrawal response to a light-tone complex under two conditions. Cats in the first condition were differentially reinforced such that all complex stimulus presentations were reinforced and all component presentations were not. In the second condition an equivalent number of complex stimulus presentations were reinforced but the components were never presented during training. Rather, the nonreinforced component trials were replaced with an equivalent number of nonreinforced *complex* trials. The levels of responding to the complex and both component stimuli, during the first two extinction trials, were essentially equivalent. From there on, the non-differentially reinforced group simply showed greater resistance to extinction to the complex, presumably as a result of some partial reinforcement of the complex.

While the baptism of configural effects as a general process does pose difficulties for learning theory as it currently stands, it is also true that these effects can account for several behavioural phenomena or can allow predictions regarding others. For example, a configural approach to overshadowing effects could predict that they might be transitory. That is, extensive repetition of an overshadowed and an overshadowing stimulus simultaneously may eventually result in *neither* stimulus effecting responding while their conjunction does. This remains to be definitively shown but is suggested in the present findings, as previously mentioned, and those of Thomas, Berman, Serednesky and Lyons (1968).

Sensory preconditioning, an illusive effect, can be seen as a stage in configurational learning where one might expect to find "CS-CS associations", when testing follows a relatively few CS-CS pairings, and the loss of these associations, when testing is delayed until a substantial number of pairings have occurred. This formulation of sensory preconditioning was examined in the following experiment with the purpose of elucidating the generality of configural effects.

CHAPTER 7

CONFIGURAL PRECONDITIONING - THE EFFECT OF VARYING NUMBERS OF PRETRAINING TRIALS ON SENSORY PRECONDITIONING:

EXPERIMENT 5

The following experiment represents an attempt to illustrate that various behavioural phenomena can be viewed simply as sequential stages in the learning process. For example, at early stages in training animals show considerable stimulus generalisation, including cross-modal generalisation (Thompson, 1959). With continued training generalisation is decreased and the animals are said to show discrimination, although generalisation and discrimination need not be seen as opposite sides of a coin (Brown, 1965). Similarly, configural conditioning emerges only after extensive training. Its emergence is usually preceded by a stage of redintegration where the appearance of a stimulus element, which was part of a stimulus complex appears to 'reinstate the memory' of the whole complex.

Sensory preconditioning can also be seen as a phenomenon wherein a form of redintegration is shown such that a stimulus which has been associated with a second stimulus is capable of eliciting the response learned to the second. The basic sensory preconditioning paradigm consists of three phases. In the first stage, CS_1 and CS_2 are presented together or in close conjunction. After these initial pairings are completed CS_2 is paired with a UCS until a sufficiently reliable CR (conditioned response) is established.

In the final phase, testing for CR's to CS_1 is conducted.

Although Brogden (1939) provided the first demonstration of sensory preconditioning in America, Russian investigators had discovered the effect a few years earlier (Panferov, 1926; Narbutovich & Podkopayev, 1936; both cited in Razran, 1971). There has been a substantial amount of research done in Russian laboratories which, although lacking the experimental rigour demanded for Western publication, often parallels findings from American laboratories. The two variables which appear to be critical to the development of sensory preconditioning are the time relationships between CS_1 and CS_2 and the number of CS_1-CS_2 preconditioning trials.

Several studies have shown that when preconditioning involves simultaneous presentation of CS_1 and CS_2, the amount of response transfer from CS_2 to CS_1 is less than optimal. However, it is clear that neither backward nor simultaneous designs are as disruptive to sensory preconditioning as they are to simple classical conditioning (Hoffeld, Thompson & Brogden, 1958; Silver & Meyer, 1954; Wynne & Brogden, 1962).

The amount of sensory preconditioning shown in Brogden's (1939) early study is fairly modest. He presented CS_1 and CS_2 simultaneously for two hundred preconditioning trials with dogs. In summarising the Russian findings with dogs, Sergeyev (cited in Razran, 1971) concluded that, when CS_1 and CS_2 are presented simultaneously, maximum sensory

preconditioning effects were reached after twenty pairings. After thirty trials effects were weakened and after fifty trials no effects were demonstrated. In a study using cats, Hoffeld, Kendall, Thompson & Brogden (1960) found substantial sensory preconditioning after only four CS_1 - CS_2 pairings with only low levels being evident with a fewer or a greater (up to 800) number of preconditioning pairings.

In the older literature (prior to 1960) there seem to be as many failures to demonstrate sensory preconditioning as successes (see Seidel, 1959, for review). Recent investigations, however, are on the whole successful in showing that apparently strong associations between neutral stimuli can be formed in the absence of reinforcement (e.g. Pfautz, Donegan & Wagner, 1978; Prewitt, 1967; Rizley & Rescorla, 1972; Tait, Marquis, Williams, Weinstein & Suboski, 1969). All of these experiments have found reliable sensory preconditioning after only sixteen or fewer CS_1-CS_2 pairings, Prewitt (1967) did mention that by extending the number of these pairings up to sixty-four some attenuation of the effect was shown.

Some interpretations of the deleterous effect of extended pretraining on sensory preconditioning have been based on an intuitively sound notion that CS_1 comes to be habituated (Pfautz, Donegan & Wagner, 1978). An alternative approach is to view CS_1 - CS_2 pairings as the presentation of a complex CS which acquires configurational properties as a function of increased exposure. That is, at low

levels of exposure the occurrence of an elemental stimulus may seem to evoke the memory of the complex but not at high levels. Given this approach, one should expect to find that the effect of 'overpreconditioning' CS_1-CS_2 is to eliminate sensory preconditioning effects. The following experiment was designed to test this hypothesis using a taste aversion procedure.

Two studies have shown substantial interflavour associations both when CS_1 and CS_2 are presented sequentially in small quantities (Lavin, 1976) or simultaneously in a single drinking bottle (Rescorla & Cunningham, 1978). In the latter case, rats were exposed four times to each of two complex solutions, during the preconditioning phase. Two aversion conditioning trials with CS_2 followed this phase and aversions to CS_1 were then tested in extinction. The present experiment included a four-trial group to ensure that Rescorla and Cunningham's results could be replicated using a similar conditioning procedure. Three other groups received either one, seven or ten N/S pairings prior to conditioning. Each of these four groups consisted of four subgroups - two of which were trained with N and two of which were trained with S. The two groups trained with N were then tested for aversions to either N or S and similarly for S-trained groups. It was expected that: after one N/S pre-exposure there would be little sensory preconditioning ; substantial sensory preconditioning would be shown after four N/S exposures; sensory preconditioning would decline at some stage

thereafter when N/S exposures were increased. In summary, it was expected that sensory preconditioning would be manifested at an early stage (redintegration stage) in the course of configurational learning. Configuring of flavour stimuli at a perceptual level was seen to occur as a function of the number of 'configural preconditioning' trials in Experiment 3. Hence, the title of this chapter: Configural Preconditioning.

7.1 EXPERIMENTAL METHOD

Subjects. The subjects were 128 male Wistar hooded rats, 10-11 weeks old. The animals were bred, housed and maintained as previously described.

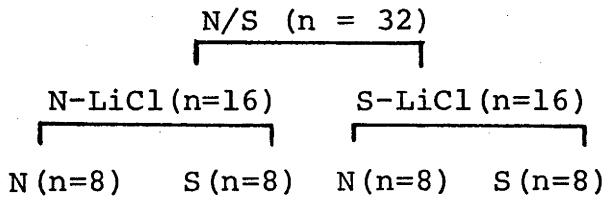
Conditioning agents. As before (but no vinegar trials were administered).

Procedure. The animals were isolated and adapted to deprivation during Days 1-5 as previously. Animals were randomly allocated to four preconditioning groups of 32 animals each: PC_1, PC_4, PC_7 and PC_{10}, where subscripts indicate the number of N/S exposures.

On Day 6, N/S exposure commenced. Group PC_1 was given only one 10-minute exposure to N/S while groups PC_4, PC_7 and PC_{10} were given four, seven or ten 10-minute exposures respectively over four, seven or ten days. As before, tap water was available for 10 mins at 1400 hrs. On the day following the last N/S exposure, training procedures were commenced. Each PC group was divided into four subgroups which were labelled S-S, S-N, N-S and N-N.

The S-S group was given access to saccharin solution for 10 mins and then poisoned with LiCl. Three such conditioning trials were conducted, one every fourth day. After four days recovery from the last S-LiCl trial, this group was presented saccharin for 10 mins once every day for four consecutive days. Similarly, group S-N was trained with S and tested with N, group N-S was trained with N (NaCl) and tested with S, and group N-N was trained and tested with N.

It should be noted that although comparability with Rescorla and Cunningham's design was sought, the present design included three CS-LiCl conditioning trials rather than two. The reason for this modification rests with the fact that three trials were required to overcome the latent inhibition effects of 10 N/S exposures in Experiment 3. By using the present procedure the number of preconditioning trials could be varied while the number of conditioning trials were held constant for all groups. The basic design for each PC group is summarised in the chart below.



7.2 RESULTS

The results of this experiment are presented in three parts: a) neophobia for N or S as a function of N/S exposures, b) level of acquisition of aversions for N or S

as a function of N/S exposures, and c) preconditioning of N to S, or vice versa, as a function of N/S exposures. Figure 15 depicts the untransformed data obtained for PC_1, PC_4, PC_7 and PC_{10} groups.

(a) *Neophobia.* Each animal's consumption of N or S, during the first conditioning trial, was computed as a percentage of their N/S consumption during the final preconditioning session. Figure 16 (left panel) illustrates the results of this manipulation. A set of planned orthogonal contrasts looking for linear trends was conducted comparing neophobia to saccharin and NaCl for the 16 conditioning groups.* An analysis using the Bonferroni technique (Miller, 1966) showed that there was a significant linear trend for saccharin groups, $F(1,112) = 19.16$, $p < .001$, indicating that neophobia for S increased as a function of increased N/S exposure. Similarly, a significant linear trend was found for NaCl groups $F(1,112) = 47.47$, $p < .001$, but no S x N interaction was apparent, $p > .05$. The results confirm the findings of Experiment 3 (see Figure 16) while giving a more satisfactory description of the rate at which perceptual configuring occurs, as measured by neophobic responses.

* In the PC_1 condition, three animals from three different groups drank so little on the first N/S exposure compared to N or S on the first training day, that their percent indices were calculated to be 460.6%, 2080.0% and 935.0%. Therefore they were assigned their group's mean not to unfairly bias results to fit the prediction.

FIGURE 15

Results of Experiment 5 during N/S preconditioning and sensory preconditioning test phases for groups receiving one, four, seven or ten N/S exposures.

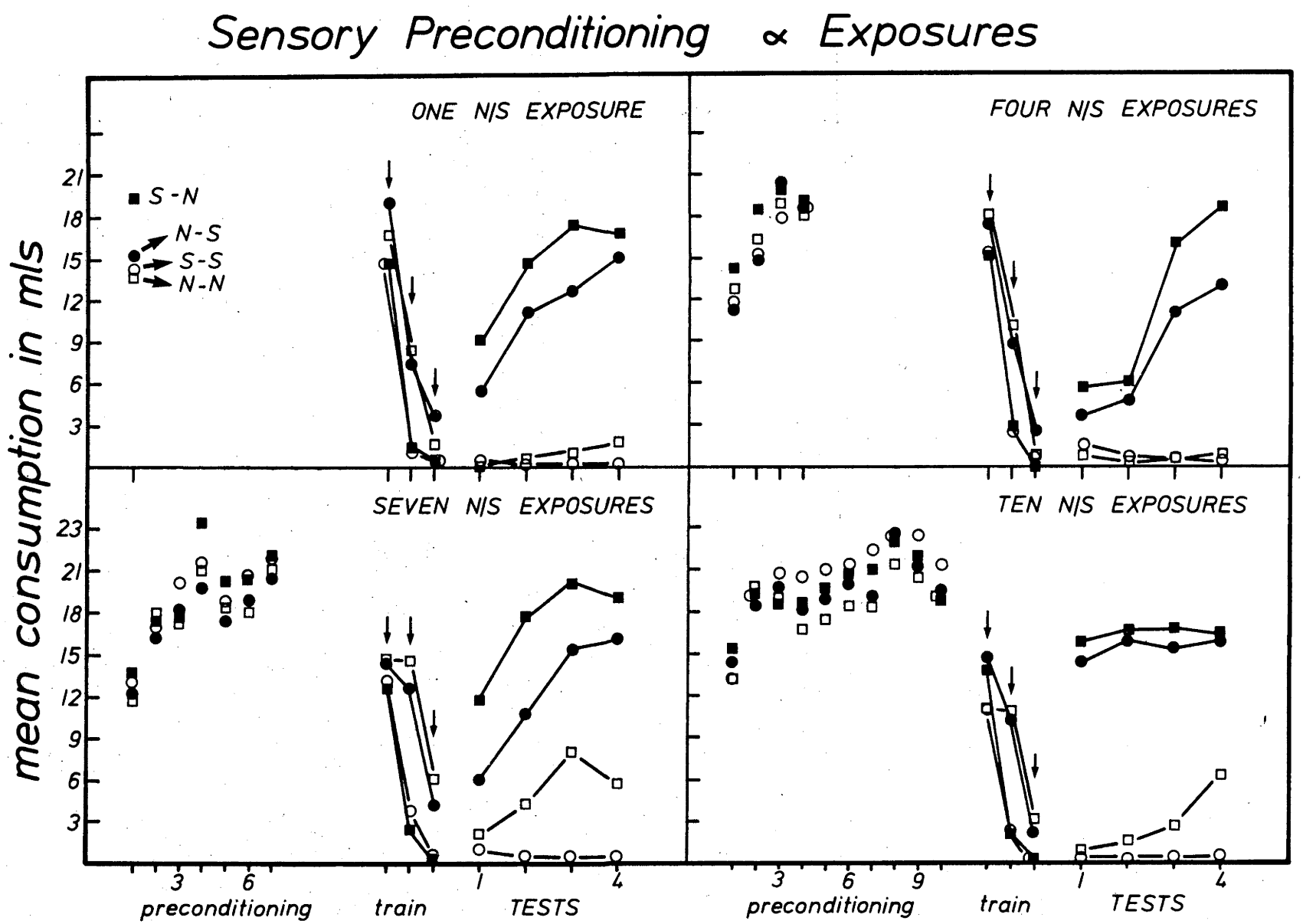
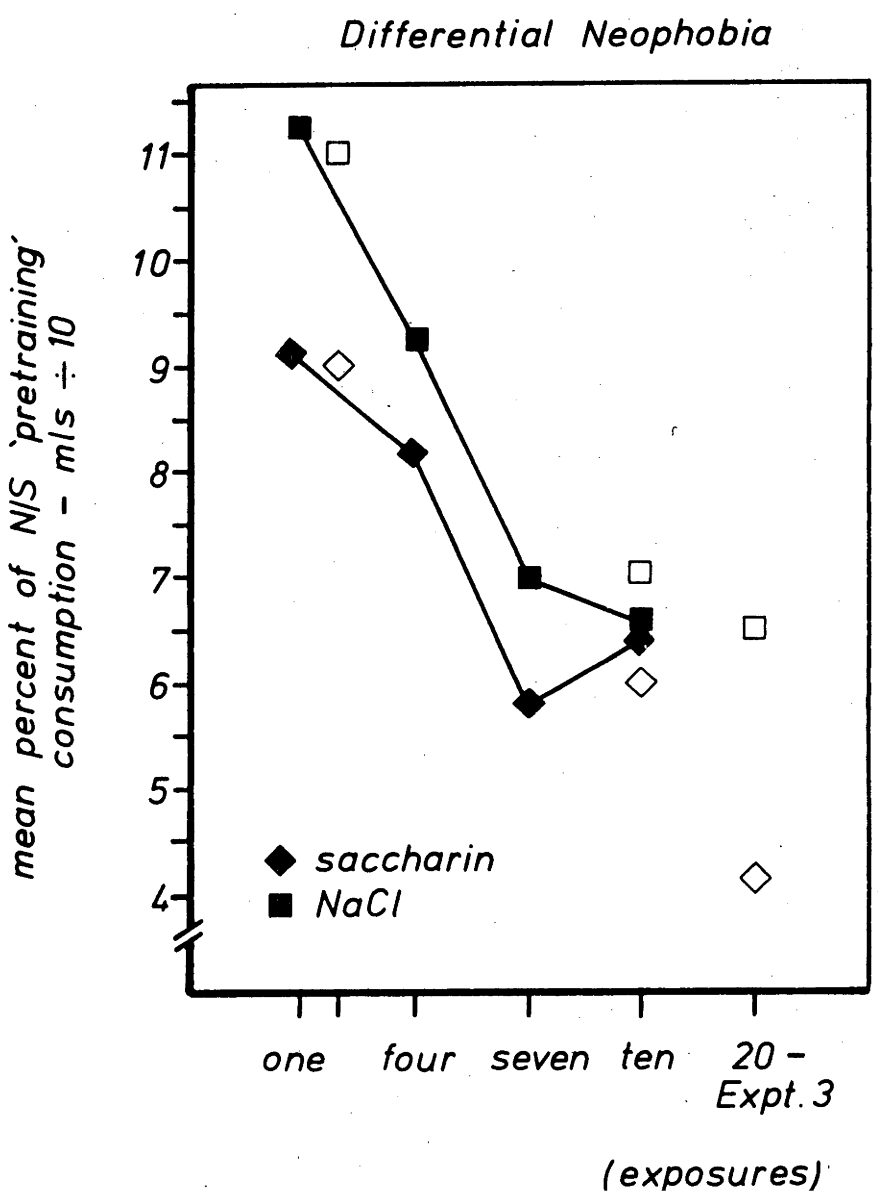
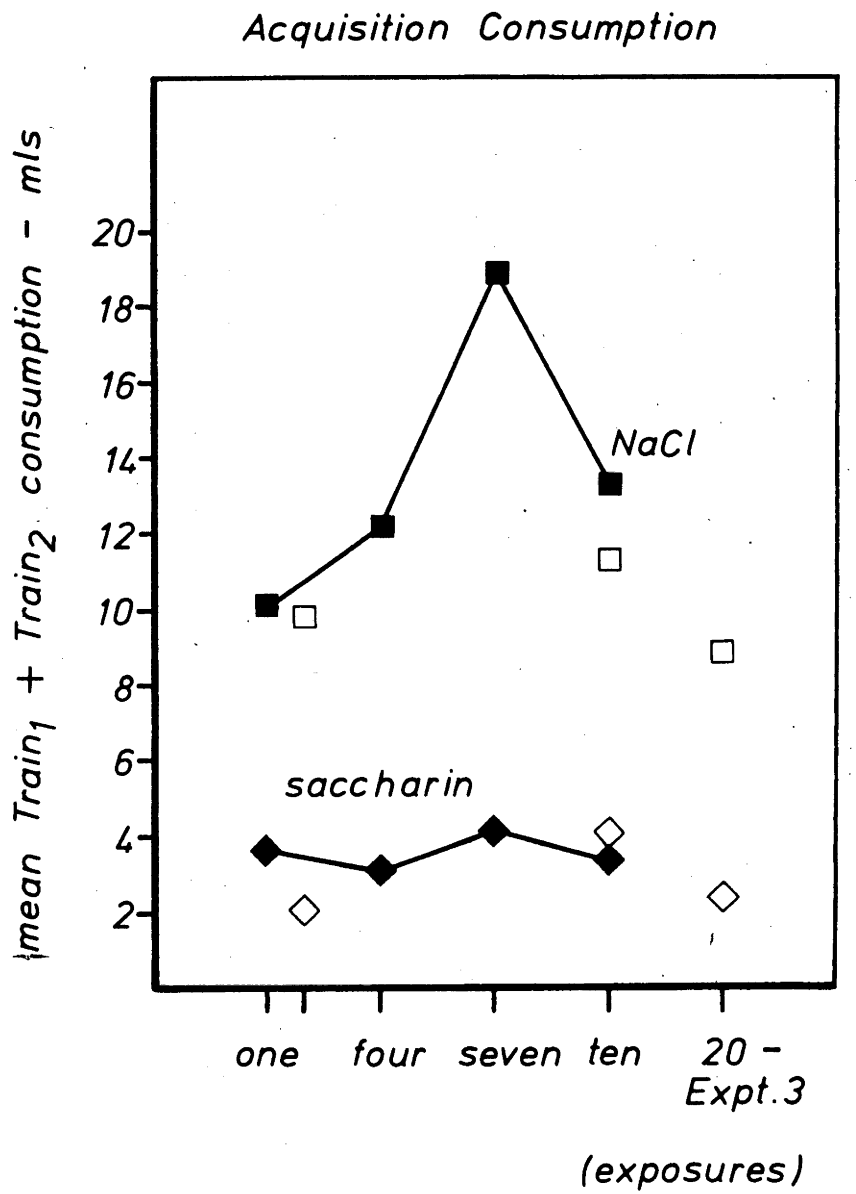

Sensory Preconditioning ∝ Exposures
ONE N/S EXPOSURE
FOUR N/S EXPOSURES
SEVEN N/S EXPOSURES
TEN N/S EXPOSURES
S-N
N-S
S-S
N-N
mean consumption in mls
21
18
15
12
9
6
3
23
3
6
9
preconditioning
train
1
4
TESTS

FIGURE 16

Differential neophobia for N or S after one, four, seven or ten exposures to N/S alone is shown in the left panel. The right panel depicts summed consumption of N or S over the second and third conditioning trials as a function of prior N/S exposures. Open symbols represent the findings from Experiment 3 where each sumbol is the mean of seven animals.


Differential Neophobia
mean percent of N/S 'pretraining' consumption - mls ÷ 10
11
10
9
8
7
6
5
4
saccharin
NaCl
one
four
seven
ten
20 - Expt. 3
(exposures)


Acquisition Consumption
mean Train1 + Train2 consumption - mls
20
18
16
14
12
10
8
6
4
2
NaCl
saccharin
one
four
seven
ten
20 - Expt. 3
(exposures)

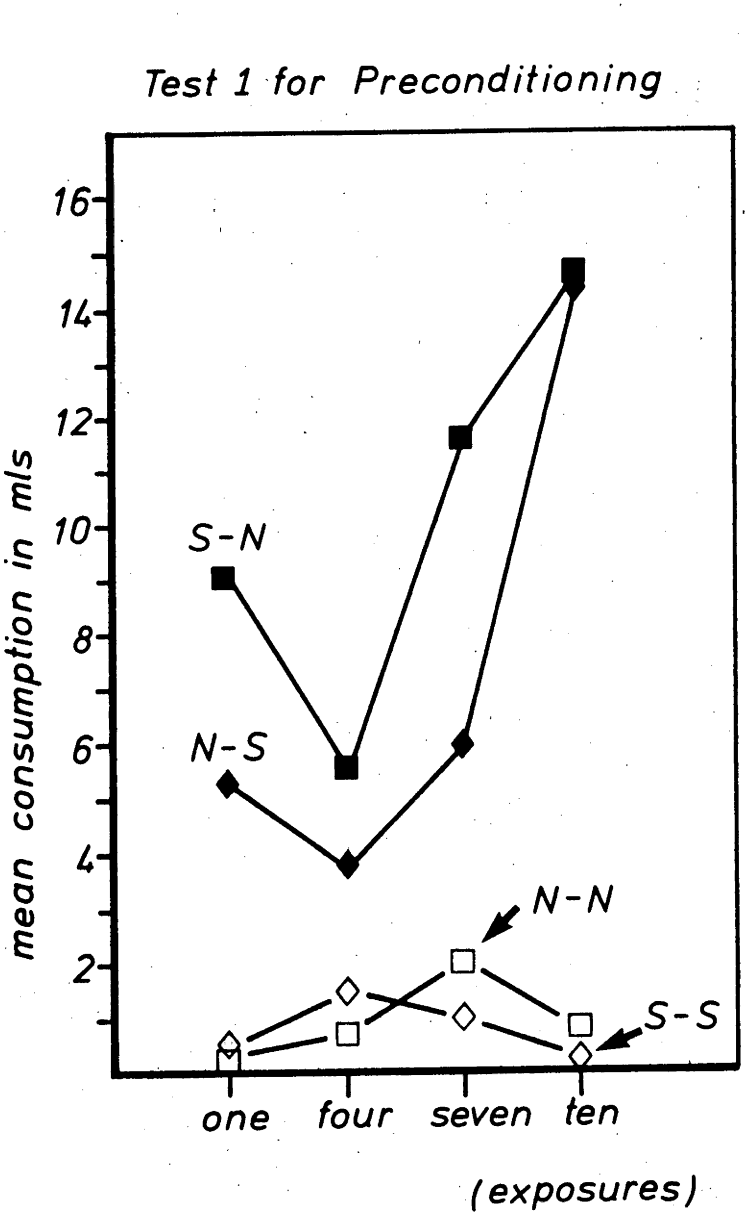
(b) *Acquisition.* After the first training day, one animal in the PC_7 group developed a middle-ear infection and was removed from the study. Figure 16 (right panel) shows the summed amount consumed during the second and third training days for saccharin-trained and NaCl-trained groups. A set of planned orthogonal contrasts looking for linear and quadratic trends was carried out to compare any latent inhibition to S and N for the 16 conditioning groups. The analysis showed a significant overall Flavour group (N versus S) effect, $F(1,111) = 20.28$, $p < .001$, indicating the tendency for N groups to drink more than the S groups. Neither S groups nor N groups showed significant linear trends, p's $>.25$, while only the N groups had a significant quadratic trend, $F(1,111) = 7.59$, $p < .01$. These results indicate: 1) that there was no difference in the level of conditioning to S as a function of N/S exposures; 2) that the effect of increased N/S exposures on acquisition of aversions to N was to initially increase and then decrease the degree of latent inhibition to N.

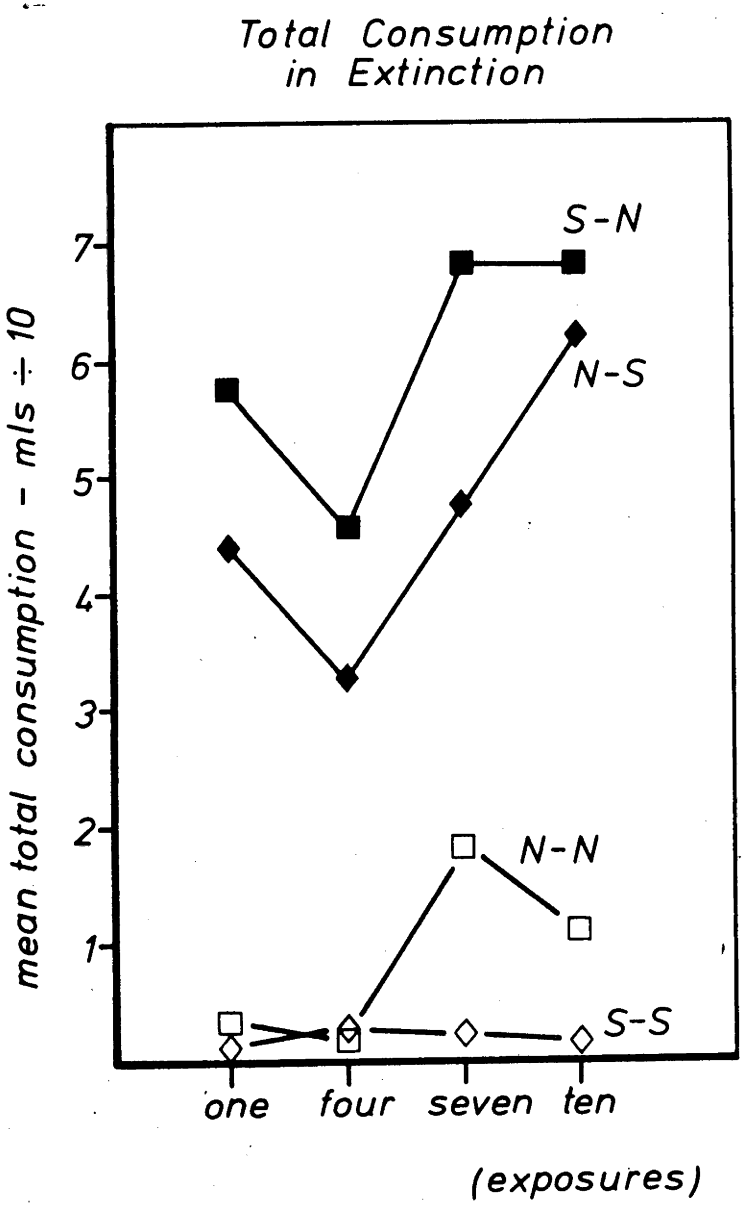
Although this result was not expected, it does correspond with the general result of Experiment 3. For the sake of comparison, the sum of N and S consumption on the second and third training days from Experiment 3 are shown in Figure 16.

(c) *Preconditioning tests.* The results of the first test for sensory preconditioning are shown in Figure 17 (left panel). These data were analysed with respect to two

FIGURE 17

Comparison of test results for conditioned aversion groups versus preconditioned aversion groups. The left panel shows only the results of the first test while the right shows total consumption in extinction.


Test 1 for Preconditioning
mean consumption in mls
16
14
12
10
8
6
4
2
S-N
N-S
N-N
S-S
one
four
seven
ten
(exposures)


Total Consumption
in Extinction
mean total consumption - mls ÷ 10
7
6
5
4
3
2
1
S-N
N-S
N-N
S-S
one
four
seven
ten
(exposures)

factors: test groups and trends as a function of PC group. The two test groups were either aversion controls, (S-S and N-N) or tested for sensory preconditioned aversions, (N-S and S-N). All comparisons appearing in Table 5 were planned and orthogonal.

The analysis showed that there was an overall difference between Test groups, $F(1,111) = 254.90$, $p < .001$. Those groups tested for aversions to the same flavour with which they were trained, drank less of that solution than groups which were tested for aversions to the flavour which had been preconditioned along with their conditioning flavour. In other words, no preconditioned aversions were as powerful as the conditioned aversions. There were no linear or quadratic trends for either the conditioned aversion groups tested with S or those tested with N as a function of preconditioning level, p's $> .25$. This indicates that by the first test trial, all groups had achieved the same high level of acquisition.

In the experimental groups, which were tested for preconditioned aversions (N-S and S-N), both significant linear and quadratic trends were found as a function of PC level, p's $< .001$. An inspection of Figure 17 suggests that the linear trend best describes the relationship for PC_4, PC_7 and PC_{10}. The quadratic trend accounts for the slightly attenuated level of preconditioning shown for PC_1. Thus, sensory preconditioning was seen to first increase and then decrease as a function of increased pretraining with a complex flavour stimulus.

TABLE 5

Summary of Trend Analysis Comparing Effects of Increased N/S Exposure on Sensory Preconditioning in Experiment 5.

Source	SS	df	MS	*F*	*p*
Between	3,254.56	15	-		
Test group	2,064.67	1	2,064.67	254.90	<.001
Linear:					
S-S	0.37	1	0.37	0.05	>.75
N-N	3.67	1	3.67	0.45	>.50
N-S	346.45	1	346.45	42.77	<.001
S-N	281.75	1	281.75	34.78	<.001
Quadratic:					
S-S	5.64	1	5.64	0.70	>.25
N-N	5.18	1	5.18	0.64	>.25
N-S	204.42	1	204.42	25.24	<.001
S-N	123.56	1	123.56	15.25	<.001
Within	898.96	111	8.10		
Total	4,153.52	126			

As in the previous experiments of this study, total consumption over all test trials was computed for each animal. An analysis similar to that used for Test 1 above was conducted on the total consumption scores. The basic finding was the same as that for Test 1 with two exceptions. First, there was a significant linear component for the N-N group, $F(1,111) = 7.21$, $p < .01$, indicating a tendency for aversions to N to extinguish more rapidly as a function of prior N/S exposures. Such a finding is in accord with the results of Experiment 3. Second, although there was a significant quadratic trend for the N-S group, $F(1,111) = 14.36$, $p < .001$, the quadratic trend for S-N failed to reach significance, $p > .05$. This result reflects the fact that there was no apparent difference between consumption levels of N for the PC_7 and PC_{10} S-N groups.

7.3 DISCUSSION

The findings of the present study indicate that 'sensory preconditioning' first increased and then dissipated as a function of increased pretraining with $CS_1 - CS_2$. In the present case $CS_1 - CS_2$ consisted of two simultaneously presented flavour stimuli, a condition favouring configuring over sensory preconditioning. Still, the amount of preconditioning that *was* shown after only four N/S pairings was substantial and corresponds to the finding of Rescorla and Cunningham (1978). Further N/S pairings acted to promote configuring in the sense that the presentation of one element of the preconditioned complex did not serve to

evoke the memory of the conditioned element.

That the animals had come to configure after prolonged N/S exposure is evidenced by the neophobia shown to elements of the complex. Neophobia for N and S increased in a linear fashion as a function of N/S exposure. This result can be interpreted as decreased stimulus generalisation from the complex stimulus to the component stimuli which occurred in the absence of reinforcement.

Whether or not the findings of the present experiment can be generalised to the more usual situation where CS_1 and CS_2 are not presented simultaneously is largely an empirical question. However, there is sufficient evidence in the extant learning literature to suggest that they can be. Although there is no systematic study of the configuring of successive complex stimuli, Razran (1965) reports several Russian studies which have examined response patterns to complex stimuli made up of successively delivered stimuli. In particular he describes a study conducted by Beritov in 1918. With dogs as his subjects, Beritov observed that conditioned responding to the components of a successive complex stimulus passed through three discernible stages. After a limited amount of conditioning with the complex stimulus, CR's were elicited only by the second of the two CS's. After further conditioning some CR's were elicited by the first CS. Finally, CR's to both stimuli were equal but greater responding was produced when both stimuli were presented together. These results are similar to those of Thomas, Berman,

Serednesky and Lyons (1968).

The aim of the Thomas *et al.* (1968) study was to test the Egger and Miller (1962) 'information hypothesis' of secondary reinforcement. They conducted three experiments in which two sequential visual stimuli followed a keypeck response but preceded the delivery of food. Their basic finding was that after low levels of training (30-50 sequences) S_2 was a more powerful conditioned reinforcer than S_1. After further training (180-650 sequences) S_1 was the more effective conditioned reinforcer. However, after extensive training (2,050-2,145 sequences) the S_1 - S_2 complex was more effective than either of the single components. In fact their last experiment shows that the S_1 - S_2 complex was more effective than an S_2 - S_1 complex where both stimuli are presented but with the order reversed. Given these findings, the authors postulated that configuring of the sequential stimuli could account for the relative lack of secondary reinforcement properties of S_1 and S_2. The use of a within-subjects design, however, has rendered the study ineligible for recognition as a demonstration of configural conditioning.

Nevertheless, there is no salient reason that configural effects should be confined to the case of simultaneously exposed stimuli. That these effects underlie failures to demonstrate sensory preconditioning after extended pretraining is suggested in the Hoffeld *et al.* (1960) study described earlier. In fact it is interesting

that the recent demonstrations of sensory preconditioning in the CER paradigm typically use sixteen CS_1-CS_2 exposures while Gray and Lethbridge (1976) found configuring in the same paradigm after twenty-four trials. It may simply be the case that sequential configuring takes longer to develop than simultaneous configuring.

A systematic analysis of the relationship between configural conditioning and sensory preconditioning, given the present findings and the extant literature can be described as follows. Stimulus generalisation decreases as a function of increased training (Hearst & Koresko, 1968). In adopting a common-element model of stimulus generalisation one can then say that, with extended training, elements of a stimulus become less effective in eliciting the trained response than the original 'intact' stimulus. Such a model predicts that configural conditioning would develop as a function of increased training in that elements of a complex stimulus become ineffective response elicitors. In the case of both stimulus generalisation and configuring studies there is initially a stage of redintegration followed by spontaneous discrimination (Bellingham, 1969). Thus, configuring can be described as a special case of stimulus generalisation.*

Experiments 3 and 5 of the present study showed that generalisation from a complex stimulus to an elemental stimulus can be decreased in the absence of any reinforcement conditions. This is unlikely to be due to the possibility that one stimulus protects the other from habituation

* or *vice versa* - see Chapter 8.

given that both N *and* S are responded to in a neophobic fashion after extended training; (see also Pfautz, et al., 1978). In other words, in the absence of reinforcement, elemental testing results in redintegration of a complex after only a few exposures to that complex but not after extensive exposure. The implications for sensory preconditioning are clear: after only a few exposures to the CS_1-CS_2 complex sensory preconditioning will be shown but not after extended exposures. Thus, the term sensory preconditioning may simply describe the stage of redintegration. Sensory preconditioning is postulated as an effect which occurs during this early stage of configural learning and thus constitutes complex-to-component generalisation. In this light it is interesting to note that the early Russian literature called sensory preconditioning the formation of "associative temporary connections" (cited in Razran, 1971). The proposed analysis provides a means of resolving the "overriding parametric puzzle" posited by Razran (1971) when he wrote:

> "Just when does combining sensory-orienting reactions lead to the conditioning of one reaction *to* another and when to integrating one *with* the other? A view that the former is favored when only two reactions, one following another, are combined and the latter when more than two are presented simultaneously ... is hardly more than a general guideline, since both have been obtained with both conditions." (p.123).

CHAPTER EIGHT

GENERAL DISCUSSION: COMPLEX STIMULUS PROCESSES IN RETROSPECT AND CONCLUDING COMMENTS.

After conducting hundreds of experiments Pavlov concluded his text, *Conditioned Reflexes*, with the following remarks:

> So far as we ourselves are concerned we can only say that at present we are confronted with many more problems than ever before. At first, not to lose sight of the main issue, we were compelled to simplify, and, so to speak, schematize the subject. At present, after having acquired some knowledge of its general principles, we feel surrounded, nay crushed, by the mass of details, all calling for elucidation. (p.411)

The present report comprises only five experiments but also presents to the author more questions than answers. Therefore, having previously discussed the results of each experiment in some detail, my purpose in this concluding chapter is to attempt to simplify and schematize the results and implications of the foregoing research. The general observations made were that configuring can occur spontaneously in the presence or absence of reinforcement and that it seems to be the inevitable result of repeated complex stimulus exposure regardless of the paradigm within which these exposure occurred (e.g., sensory preconditioning. These findings have many implications for: 1) basic assumptions regarding the nature of a configural stimulus, 2) methodological considerations, 3) problems of inferring learning from performance and 4) current models of learning. Each of these will be handled in turn.

The nature of configural stimuli revisited.

The use of intramodal stimuli, i.e. flavour stimuli, obtaining from a single proximal source, in the present study, might be thought to favour rapid formation of a Gestalt. If this were the case, it should have been seen that component flavours were almost totally distinguished from the conditioned complex flavour even after a limited number of training trials. However, whether the complex had been reinforced or not, it usually required extended exposure before configuring was manifested in performance. In the flavour aversion paradigm, asymptotic learning occurred in only a few trials. The fact that configuring effects were not manifested until the N/S aversion had been overtrained argues against a Gestaltist approach to configurational learning.

The afferent neural interaction hypothesis posited by Hull (1943) was incorrect in assuming that one afferent impulse could be modified by another simultaneous impulse at the level of receptor sites or *en route* to the cerebral cortices. In spite of the error due to ignorance of physiological functioning, the hypothesis could still be tenable if the locus of interaction was elevated to the level of the cortex which is massively intraconnected. It will be remembered that Wolpe (1949) modified the afferent neural interaction hypothesis. He postulated that, at the level of the cortex, the presentation of

more than one stimulus would cause additional neural impulses not arising when any one of the stimuli was presented alone.

The data collected in the present research show that Wolpe's modification is not sufficient to vindicate Hull's formulation of learning with complex stimuli. Whether simultaneous inputs modify each other at the level of receptor discharge or at the level of the cortex Hull's fundamental premise was that a configural stimulus is never formed. Each modified stimulus, or effective stimulus, was assumed to gain response strength independently. Responding to a complex stimulus, then, must reflect the summed response strengths accrued to components. He further assumed a constant degree of stimulus generalisation decrement from the effective stimulus of a component in a complex to the effective stimulus of a component in isolation.

The assumption that components of a complex act independently is not borne out by the present research. There was substantial evidence that both components, N and S, conditioned separately, resulted in parallel rates of acquisition and extinction (Experiments 1a and 2b). When these components were compounded, however, the parallels were lost. It was observed that, after varying levels of N/S exposure, responses to N or S could change such that: $N = S = N/S$, $N = N/S > S$, $N/S > N = S$. In the case of the first, the component strengths sum to more than

the strength of the complex. Overshadowing is demonstrated in the second case and could imply summation of response strengths. However, the overshadowing stimulus in the last case has lost its response strength. The results clearly indicate that the component stimuli are not entirely independent; that they do not simply accrue response strengths which sum to the total strength of the complex; that there is a variable and ultimately increasing, rather than constant, degree of generalisation decrement from a complex stimulus to its components.

A unique stimulus hypothesis represents a more sophisticated version of Wolpe's (1949) interpretation of configural learning. This hypothesis does not postulate that additional neural activity modifies the cortical pattern of stimulation for each component stimulus. Rather, it assumes that stimulation is unchanged for the components but that their conjunction gives rise to a separate additional stimulus. Whereas Wolpe would predict that A + B = A' + B', the unique stimulus hypothesis states that A + B = A + B + u, where u is the unique stimulus. Given present neurophysiological knowledge, it is not unreasonable to postulate such a unique stimulus.

Microelectrode recordings of cortical responses to external stimulation are now commonplace. Fallon and Beneveto (1977) have recently reported findings regarding auditory-visual interactions in the cortex of the cat. Specifically, they sought to describe the response characteristics of single units in the orbital-insular cortex

(areas of the association cortex) of the cat. Many of these units are bimodal and provide an interesting preparation for studying the interaction of visual and auditory stimuli. As a result of sampling from 123 cells in thirteen cats, Fallon and Beneveto (1977) found that 12% of the cells responded only to visual stimuli, 16% only to auditory stimuli, and 49% to visual and auditory stimuli. The remainder were unresponsive. Those cells which responded to visual and auditory stimuli were of two types. Half of them would not respond when either the visual or auditory stimulus was presented alone but only when they were presented together. The other half would respond to either stimulus alone but showed a different pattern of responding when both were presented. The effects varied according to variations in the onset times of the stimuli with maximum effects being shown when onset was simultaneous or close to it.

Such a finding provides a physiological basis for positing the existence of unique stimuli arising from conjunctive presentation of multiple stimuli. What it does not do is suggest that this unique stimulus functions like any other independent stimulus. By what means is it that the organism could isolate this stimulus from the physically defined ones? Put another way, does it seem reasonable that an animal could selectively attend to this stimulus? It would seem more reasonable to resurrect the Gestalt approach at this point and point out that

any simple or complex stimulus event results in a unique and innate pattern of neural activity. Neither approach to configuring is entirely satisfactory. On the one hand, the unique stimulus hypothesis suggests that animals could be conditioned to the unique 'internal' stimulus quite independently of the 'external' stimuli which gave rise to it. It behooves proponents of this hypothesis to devise the critical experiment. On the other hand, the Gestaltists would claim that the internal stimulus environment *is* the external stimulus environment. Presumably, then, as long as the external environment does not change neither will the internal.

The results of the present study showed that although the external gustatory environment of rats was not changed, perception of that environment over time did change. Further it was shown that an additive model, into which a unique stimulus hypothesis is incorporated, cannot account for the data obtained. In order to account for configuring such a model must postulate some mechanism whereby associative strength to individual components is lost while the unique stimulus gains strength.

An alternative approach to delineating the nature of a configural stimulus is to discard combination rules which cannot, as yet, be seen to reflect basic principles of neural activity. The hypothesis outlined below is an attempt to relate configural conditioning to fundamental neural processes. In a sense, the hypothesis incorporates concepts of both common-element and unique stimulus formulations. I have called this hypothesis an inhibition-

refined stimulus hypothesis. It is not intended that this formulation be seen as definitive but rather as indicating a possible framework within which complex stimulus processes might be examined.

The hypothesis assumes that any stimulus capable of causing receptor discharge causes neural activity at many levels of the nervous system, in particular at the level of the cortex. This activity is evidenced in behavioural responses such as the acoustic startle reflex. For the sake of simplicity in explication, this neural activity will be called excitatory activity*. The hypothesis secondly assumes that every instance of excitatory activity generates a proportional amount of neural inhibitory activity. This assumption is derived from empirically generated habituation curves which reveal that responsiveness to a stimulus decreases with repeated presentations of that stimulus. It does appear, however, that excitation and inhibition are not simply the opposite sides of a coin. Excitation develops rapidly and seems to be relatively transient. Inhibition seems to develop more slowly but is relatively more permanent. That this is the case is again seen in habituation. For a brief period, responsiveness increases, indicating the spread of excitation, and then begins to decline, indicating the gradual build up of inhibition. The relatively permanent nature of inhibition is evidenced by spontaneous recovery phenomena. Although responses to a previously habituated stimulus can reappear

*The author recognises that many forms of stimulation involve the inhibition of cortical activity. The proposed model does not exclude such cases and utilises an inhibition-of-inhibition explanation to predict outcomes.

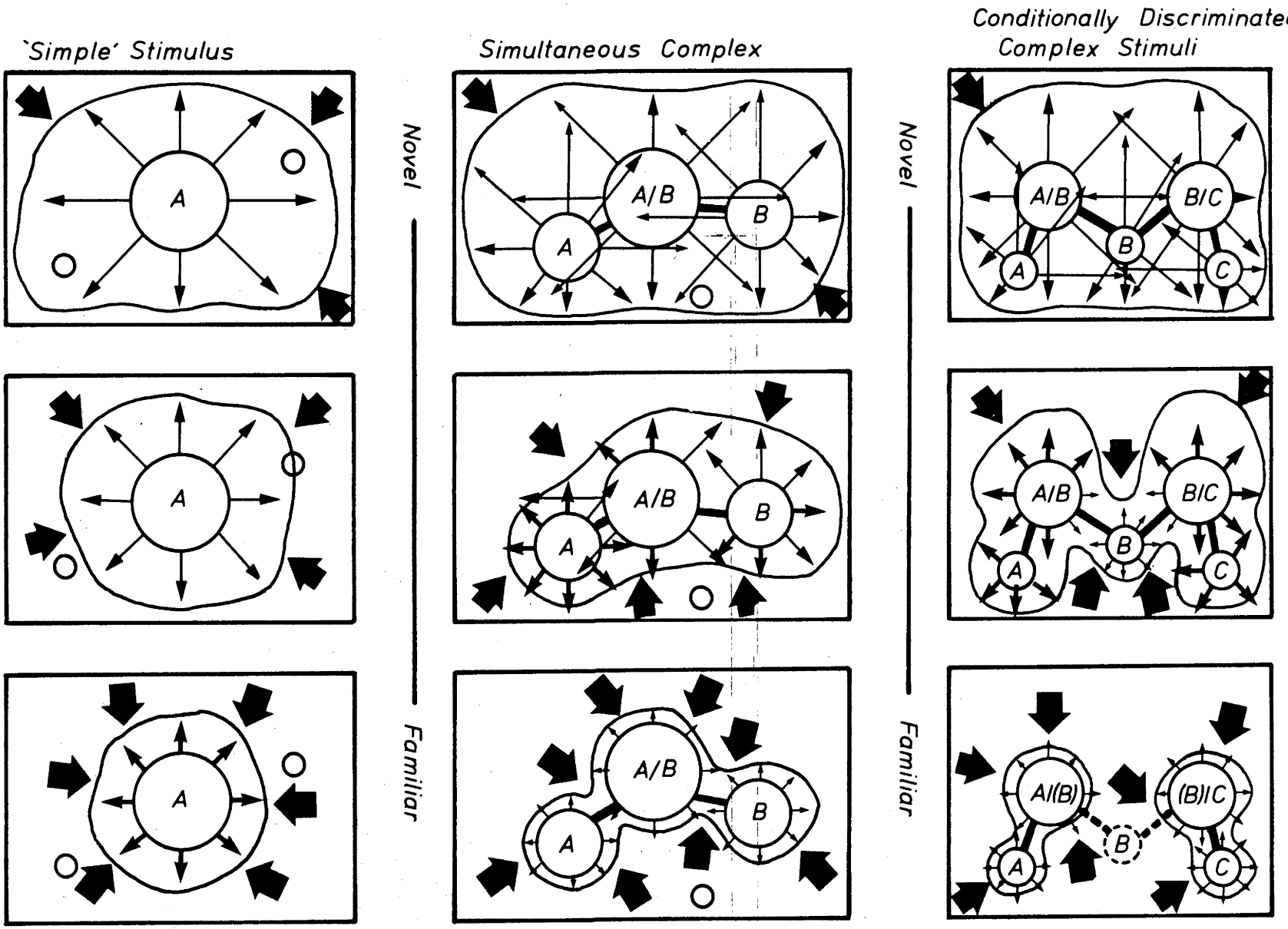
after long periods without that stimulation, these responses are rarely of the same magnitude as the initial responses to that stimulus and rehabituate rapidly. (See Groves and Thompson, 1970 for an excellent review of the habituation process).

It is postulated then that neural inhibition acts to reduce rampant excitation and in this way progressively refines the characteristics of a stimulus input. A schematic representation of this excitatory-inhibitory process is given in Figure 18. The left-hand panel illustrates the hypothesised process with respect to 'simple' stimulus presentations and stimulus generalisation. Stimulus A generates a unique and broad field of excitation upon its first presentation. This unique field comprises innumerable units, or elements of excitation. Through the impingement of inhibition on the excitatory field the field of excitatory elements is gradually reduced. Hence, *each* presentation of an unchanged stimulus results in a unique pattern of neural activity which gradually becomes more closely defined. Hence, stimulus generalisation from a target stimulus to a test stimulus will probably occur if the fields of neural activity for both overlap. This is likely to be the case when exposure to the target has been limited. In fact, intermodal generalisation occurs at low levels of training (Thompson, 1959) but decreases with further training.

It can be argued, then, that no single stimulus is a 'simple' stimulus. Razran (1951) argued that "... a dog

FIGURE 18

Schematic representation of the postulated reduction in the number of elements attributable to a stimulus presentation via neural inhibition. A and B represent independent stimuli, e.g. tone and light, while A/B refers to their interaction. Light arrows indicate hypothetical range of excitatory spread while heavy arrows denote inhibitory convergence on focii of excitation. Small circles indicate test stimuli other than specific stimulus conditioned or exposed. Solid black lines indicate cortico-cortico projections.


'Simple' Stimulus
Simultaneous Complex
Conditionally Discriminated Complex Stimuli
Novel
Familiar
A
A/B
B
B/C
C
A/(B)
(B)/C

conditioned to a certain tone frequency is also co-conditioned to the intensity, the duration, and the locus of the tone..." (p.154). Thus, every stimulus comprises specific elements that can be physically defined. In addition, every stimulus comprises elements due to context (Odling-Smee, 1978a) and of nonspecific elements of neural activity according to the present hypothesis. Ultimately, all stimuli are complex stimuli. The middle panel of Figure 18 schematises the inhibition-refined stimulus hypothesis with respect to a complex stimulus comprising of two distinct external stimuli. The process of refinement is identical to that for stimulus generalisation. Initially A, B and A/B* are all encompassed in a large activity field which is gradually restricted. This restriction reduces the number of excitatory elements that A has in common with B or with A + B, i.e. the total stimulus.

It was stated earlier that configuring could be described as a special case of stimulus generalisation. Since generalisation is a well-established phenomenon while configuring is less well-established, it was convenient to use the above phraseology when responses to elements of complex stimuli followed the pattern of those seen in stimulus generalisation. According to the

*Simplified reference to areas such as the association area where there are A sensitive and/or B sensitive cells as discussed earlier.

present analysis, however, the relationship should be reversed such that 'simple' stimulus generalisation is a special case of configuring in that, for simple stimuli, the total number of initial neural elements may be fewer and consequently more rapidly inhibited.

The hypothesis of inhibition-refined stimuli can be extended to other situations such as conditional discrimination problems. The right-hand panel of Figure 18 illustrates how an animal could come to respond to an A + B complex and withhold responding to a B + C complex. Since element B is presented twice as often, it accrues inhibition more rapidly than other foci of excitation. As a result, stimulus A and stimulus C would overshadow B and appropriate responding could be elicited by these more active elements alone.

At this point, the role of UCSs or reinforcers needs to be considered. If the above analysis is tenable one would expect to find that configuring of a complex stimulus (e.g., tone + light) proceeds at the same rate regardless of the paradigm adopted. This is not the case. In a CER paradigm, substantial configuring of a tone-light complex occurs within 24 trials (Gray & Lethbridge, 1976; Kamin & Idrobo, 1978). On the other hand, configuring of a tone-light complex required hundreds to thousands of trials in a discrete-trial bar press procedure (Bellingham & Gillette, 1980). Of course the selected tones and lights could not be identical in the two studies but the

behavioural discrepancy would still seem disproportionate to the stimulus discrepancies. It must be remembered, however, that UCSs and reinforcers are also stimulus events. Consequently, these events generate their own patterns of excitation and inhibition. Depending on their time relationships with CS events they may have varying effects and be variously effected by inhibition-refining mechanisms. The possible interactions of CS events with UCS events is limitless and defies simple description at this time. Suffice it to say that, if stimulus generalisation can be shown to decrease within a given paradigm then configuring most probably can be demonstrated as well. It may just take longer.

I would like to conclude this discussion on the nature of the configural stimulus by positing that the nature of processing of all stimuli is similar in principle. Further, that it is not necessarily the particular nature of the stimulus (complex or simple) which affects the course of learning but rather the fundamental neural events elicited by that stimulation. In keeping with this I would especially like to dedicate this thesis to I.P. Pavlov whose basic formulations of neural functioning provided the model for the present author's hypothesis. Unlike many modern researchers he recognised the powerful nature of neural inhibition.

Methodological considerations

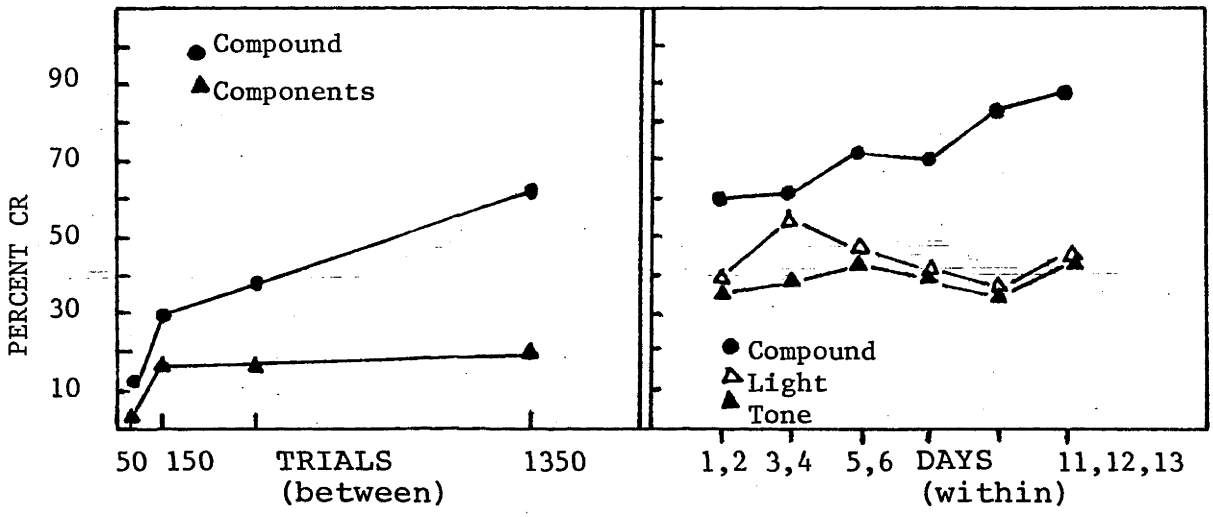
The foregoing research findings and analyses of complex stimulus processes may suggest directions for further research; in particular for systematic research directed toward establishing the generality of configural conditioning and elucidating its substrate. In the interest of facilitating such investigations and maximizing the information yielded by them, a reconsideration of methodological issues is in order. Specifically, the notion that within-subjects designs are inappropriate for the study of configuring (Baker, 1968) has to be re-evaluated. The empirical evidence seems equivocal regarding this issue.

Baker (1969) assessed complex-component differentiation using both between subjects and within-subjects designs. He sought to show that increased differentiation for within-subjects groups was a result of accrued extinction to components repeatedly tested. He was forced to conclude that "....the similar levels of differentiation as a function of training yielded by the separate designs is apparent" (p. 345). However, Baker later went on to say that:

> Although an increase in differentiation was found in both designs, the different manner in which this increase was accomplished is considered crucial to the hypothesis. (p. 346).

The latter statement pertained to the fact that responding to component stimuli in the within-subjects group was seen to be decreasing as a function of training trials while responding to components did not decrease in the

between-subjects groups. The data presented below are extracted from Baker's (1969, p. 343) study to provide the reader with an opportunity to evaluate such a claim. The present author is inclined to view the results from both conditions as identical in form but disparate in magnitude.



Given that there is a wide range of stimulus generalisation early in training, it is altogether possible that the elevated responding by the within-subjects group arose through partial reinforcement via early and nonreinforced component testing. That non-reinforced testing of components leads to inadvertent positive patterning, however, is not clearly substantiated by Baker's data. More recently, Saavedra (1975) has provided evidence that a modest number of nonreinforced test trials produce no differential decrements in responding to components.

Although adopting a between-subjects design provides the strongest case for configural conditioning, should it be shown, there are disadvantages inherent in doing so.

The most obvious disadvantage is the enormous investment in time and subjects required to conduct even the most preliminary experiments. Less obvious, is the loss of potentially useful data. For example, it is possible that some subjects initially attend to one component selectively while other subjects selectively attend to the second component. This possibility has been illustrated in the work of Reynolds (1961). If such were the case would it not be useful to observe the status of the 'attended' and 'nonattended' stimuli through the course of extended training? In order to make this observation, subjects would have to be tested with all stimuli at all levels of training. It would seem that the information gained would outweigh the facilitation of 'patterning' inherent in a within-subjects design. This is especially true given that spontaneous patterning, or configuring, does seem to occur without differential reinforcement - indeed, without reinforcement at all.

Given the present state of the art, a compromise is probably the best solution. A design which is both between- and within-subjects still requires a high labour and time investment but allows retrieval of information that would otherwise be lost. Such a design would provide for different groups of subjects to be tested at various levels of training but which continue to be tested, thereafter, at all the subsequent levels of training under scrutiny. In a sense, this

procedure would provide an important control which is not available in a simple between-subjects design. Specifically, a between-subjects design cannot control for the fact that baseline responding to the trained complex stimulus itself can vary from group to group. That is, in some cases one might find more rapid extinction to the complex in groups that were more highly trained. For example, a configural conditioning study, wherein a bar press response serves as the dependent variable, might require twelve groups of eight animals each -- three test stimuli x four levels of training. Given normal apparatus restrictions, it is not inconceivable that subjects for one or more groups will perform differently than others simply due to differences in the conditions of training which can occur even with highly controlled procedures. A within-subjects design allows comparison with a fixed baseline across all levels of training.

In summary then, there seems to be little evidence that within-subjects designs yield fortuitous configuring. In fact such designs might provide a measure of control not afforded by between-subjects designs. Until configuring is accepted as a general phenomenon, experimental designs combining both between- and within-subjects components will yield the maximum amount of information for a given level of resource investment.

Problems of inference.

As for most paradigms, researchers of configural processes can expect to encounter difficulty in deciding whether an animal has failed to demonstrate a discrimination because it has not *learned* the discrimination or because it has not *performed* discriminatively. That performance does not necessarily reflect learning has been illustrated in portions of the present research. For example, animals receiving a large number of aversive conditioning trials to a flavour stimulus, with which they had minimised contact, showed a form of nonspecific sensitization, or pseudoconditioning. Efforts to eliminate this sensitization resulted in a demonstration of the animal's ability to discriminate between complex and component flavour cues (Experiments 1 and 2). In the context of a highly familiar complex cue, animals trained a relatively few times with the saccharin component (Experiment 3) showed excessive levels of sensitization. Such a finding corresponds with the more traditional description of enhanced neophobia which often accompanies primary saccharin aversions.

A general concern of this thesis is to stress the performance-learning distinction. Specifically, when an animal appears to generalise, on the basis of behavioural output, one cannot infer that it is not discriminating. The processes of discrimination and generalisation are not in opposition.

Brown (1967) has illustrated the independence of generalisation and discrimination. He pointed out that

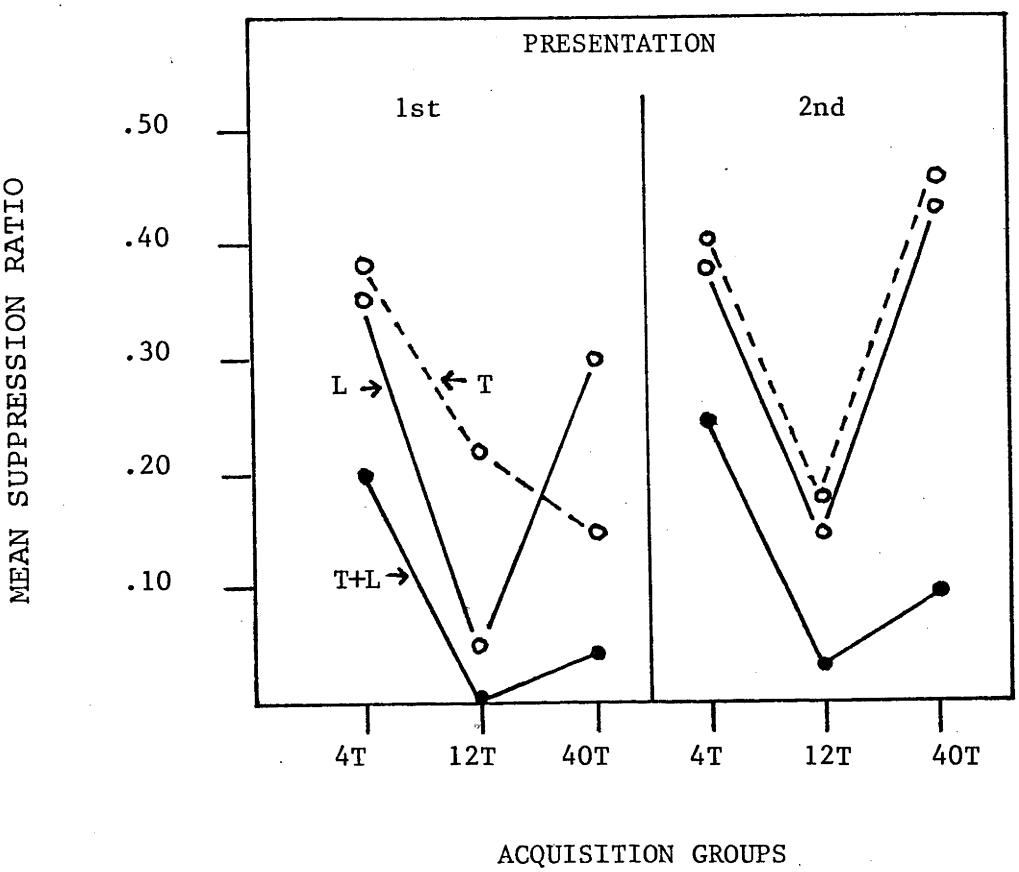
discriminative performance can increase while generalised performance remains unchanged. Such a state of affairs is reminiscent of configuring studies wherein responding to components remained unchanged while responding to the complex increased (e.g. Rescorla, 1972). In spite of Brown's illustrative account, a finding of relative loss of associative strength to component stimuli is not deemed to show increased discrimination between complex and component stimuli.

In light of certain procedures of the present study the issue regarding absolute changes versus relative changes in responding needs to be readdressed. The adoption of a latent inhibition procedure in Experiment 3 did result in absolute loss in the amount of associative strength acquired by the complex flavour stimulus as a function of exposure trials. One can envisage, however, paradigms in which latent inhibition effects might reach a 'ceiling' very quickly. At the same time, however, components could continue to gain strength (as they appeared to in the present study). Thus, the result would be a relative but not an absolute discrimination between a familiar complex and 'novel' component stimuli.

The possibility of floor and ceiling effects, then, must be considered when applying a criterion of absolute change in responding in both generalisation and configurating studies. Baker's (1969) own study is a case in point. His procedure resulted in very little absolute responding to component stimuli either early

or late in training. Responding to the complex was initially low and later rose (see page 141 above). With or without knowing the level of pseudoconditioning which might have resulted, Baker's demonstration of relative rather than absolute discrimination can probably be attributed to a floor effect for responding to components.

Aside from the issue of relative versus absolute loss of response strength to components, there are numerous other difficulties in assessing the degree of discrimination between a complex and component stimuli. One which seems pertinent to existing findings is the problem of choosing appropriate test measures. In the present study, configuring was revealed in repeated extinction tests. The Booth and Hammond (1971) study has been discounted in configuring literature because only one component lost strength as a function of training level while the other gained strength. This is only true, however, for the first presentation of the components (see diagram below). During the second presentation, neither component elicited responding while the complex maintained strength. Is it reasonable then, to reject these findings as incompatible with configuring effects? Certainly they seem more easily explained from a configurationist's stance than from that of an elementist.



(from Booth & Hammond, 1971, p.256)

Current models of learning

Much of the foregoing has been concerned with the implications of configuring for current models of learning. In general, it has been shown that a combination rules approach to configural phenomenon would seem an unavailing exercise in that the rules of combination appear to change from trial to trial. Presumably this change might be described as a systematic function for a chosen circumstance but it is unlikely to be transituational. The point is that attempts to describe simultaneous stimuli A and B as, for example, AabB, A+B or AxB, or in any other terms

of A and B are probably misdirected. The term A+B describes the sensory information definable in the physical world, at receptor sites and along primary sensory pathways. It is apparent that, at some stage in the processing of stimuli, A+B becomes "C". Thus the total representation of A+B in Figure 18 should be labelled "C". In describing configural conditioning, Pavlov (1927; p. 147) stated that "The experiments show that a compound stimulus, the component units of which remain in themselves unaltered, and consequently most probably affect the same cells of the cerebral cortex, behaves in different modifications as a different stimulus, evoking in the cells now an excitatory process and now an inhibitory one". Similarly, the inhibition-refined stimulation hypothesis assumes that at all levels of sensory reception there is little modification of stimulus input. Rather, the discrepancy between complex and component effectiveness seems to emerge with continued access to perceptual analyser /information integration centres at the level of the cortex.

The association cortices, for example, would seem likely locales for inextricably linking A and B as "C". Such a result would certainly support the Russian findings (see Razran, 1971) which suggest that facility to configure is related to phylogenetic scaling, i.e. the more developed the cortex, the more rapid and complete the configuring.

The findings of the present study require that a perceptual learning account of configuring be adopted

along with a more general approach to the "rules" of the process. It would seem that the dynamism of the relationship of component to complex defies specific mathematical formulae but does warrant a general principle: simple repeated exposure to a complex stimulus results in gradual weakening of the components' ability to elicit responses or reactions attached to the complex.

The adoption of such a principle affords exciting possibilities for future research. The configural effect would seem to parallel much work on human pattern recognition and could be seen as a basis for reading behaviour. Recently, Gaffan (1977) virtually taught monkeys to read by overtraining complex word-like stimuli. The monkeys were able to spontaneously discriminate between complex stimuli and between complex and component stimuli. Furthermore, they seemed to have developed a learning set which allowed them to make more rapdi complex-component discriminations as a result of previously learning such a discrimination.

The seemingly perceptual nature of configuring provides a common ground on which both perception and learning theorists might converge. A large number of psychologists are currently studying the integration of sensory information in infants and adults. It can be profitable, therefore, to attempt a unification of the techniques and theories of both the perception and learning disciplines.

The emphasis of this thesis has been primarily on stimulus processing. Quite clearly this does not comprise

a theory of learning. However, current theories of learning are largely concerned with responding - an equally unbalanced approach. The latter, however, would seem more misdirected in that asymptotic responding is seen to reflect the end point of the associative process. For example, with respect to the latent inhibition study in this thesis (Experiment 3) one might ask modern theorists if there is any limit on nonassociative strength due to nonreinforcement. The results obtained in the present study indicate that learning and stimulus processing is continuous and dynamic.

In conclusion, aside from having demonstrated configural learning in rats, this research program has resulted in three assertions. First, stimulus processing, or perception, must be accounted for in an adequate theory of learning. Second, a reconsideration of basic neural functioning might serve to relate seemingly diverse behavioural phenomena. Last, the fact that performance does not necessarily reflect learning must be continually borne in mind when inferring the capacities or capabilities of any organism.

REFERENCES

Asch, S.E. Reformulation of the problem of association. *American Psychologist*, 1969, *24* 92-102.

Baker, T.W. Properties of compound conditioned stimuli and their components. *Psychological Bulletin*, 1968, *70*, 611-625.

Baker, T.W. Component strength in a compound CS as a function of number of acquisition trials. *Journal of Experimental Psychology*, 1969, *79*, 347-352.

Bartoshuk, L.M., Murphy, C., & Cleveland, C.T. Sweet taste of dilute NaCl: Psychophysical evidence for a sweet stimulus. *Physiology and Behaviour*, 1978, *21*, 609-613.

Bellingham, W.P. *Stimulus compounding and generalization.* Unpublished doctoral dissertation, University of New Mexico, 1969.

Bellingham, W.P., & Gillette, K. Spontaneous configuring to a tone-light compound using appetitive training: A common element interpretation. *Learning and Motivation.* In submission.

Best, M. Conditioned and latent inhibition in taste aversion learning: Clarifying the role of learned safety. *Journal of Experimental Psychology: Animal Behaviour Processes*, 1975, *1*, 97-113.

Best, P.J., Best, M., & Rudy, J. Blocking in conditioned toxiphobia. Paper presented at the 16th annual meeting of the Psychonomic Society, Denver, Colorado, 1975.

Blough, D.S. Steady state data and a quantitative model of operant generalization and discrimination. *Journal of Experimental Psychology: Animal Behavior Processes*, 1975, *1*, 3-21.

Booth, J.H., & Hammond, L.J. Configural conditioning: Greater fear in rats to compound than component through over-training of the compound. *Journal of Experimental Psychology*, 1971, *87*, 255-262.

Braveman, N.S., & Jarvis, P.S. Independence of neophobia and taste aversion learning. *Animal Learning and Behavior*, 1978, *6*, 406-412.

Brogden, W.J. Sensory pre-conditioning. *Journal of Experimental Psychology*, 1939, *25*, 323-332.

Brown, J.S. Generalization and discrimination. In D.I. Mostofsky (Ed.), *Stimulus generalization*. Stanford: Stanford University Press, 1965.

Brown, P.L., & Jenkins, H.M. Conditioned inhibition and excitation in operant discrimination learning. *Journal of Experimental Psychology*, 1967, *75*, 255-266.

Carroll, M.E., Dinc, H.I., Levy, C.J., & Smith, J.C. Demonstrations of neophobia and enhanced neophobia in the albino rat. *Journal of Comparative and Physiological Psychology*, 1975, *89*, 457-467.

Domjan, M. Poison-induced neophobia in rats: Role of stimulus generalization of conditioned taste aversions. *Animal Learning and Behaviour*, 1975, *3*, 205-211.

Domjan, M. Determinants of the enhancement of flavored-water intake by prior exposure. *Journal of Experimental Psychology: Animal Behavior Processes*, 1976, *2*, 17-27.

Domjan, M. Attenuation and enhancement of neophobia for edible substances. In L.M. Barker, M.R. Best and M. Domjan (Eds.), *Learning mechanisms in food selection*. Baylor University Press, 1977.

Dweck, C.S., & Wagner, A.R. Situational cues and correlation between CS and US as determinants of the conditioned emotional response. *Psychonomic Science*, 1970, *18*, 145-147.

Edwards, A.L. *Experimental design in psychological research*. New York: Holt, Rinehart & Winston, 1972.

Egger, M.D., & Miller, N.E. Secondary reinforcement in rats as a function of information value and reliability of the stimulus. *Journal of Experimental Psychology*, 1962, *64*, 97-103.

Engen, T., & Lipsitt, L.P. Decrement and recovery of responses to olfactory stimuli in the human neonate. *Journal of Comparative and Physiological Psychology*, 1965, *59*, 312-316.

Estes, W.K., & Burke, C.J. A theory of stimulus variability in learning. *Psychological Review*, 1953, *60*, 276-286.

Fallon, J.H., & Benevento, L.A. Auditory-visual interaction in cat orbital-insular cortex. *Neuroscience Letters*, 1977, *6*, 143-149.

Gaffan, D. Discrimination of word-like compound visual stimuli by monkeys. *Quarterly Journal of Experimental Psychology*, 1977, *29*, 589-596.

Gibson, E.J. Improvement in perceptual judgements as a function of controlled practice or training. *Psychological Bulletin*, 1953, *50*, 401-431.

Gibson, J.J., & Gibson, E.J. What is learned in perceptual learning? A reply to Professor Postman. *Psychological Review*, 1955, *62*, 447-450.

Gillette, K. Dishabituation of the startle reflex by presentations of component stimuli subsequent to habituating a complex stimulus. Unpublished manuscript, 1976.

Gillette, K., Bellingham, W.P., & Martin, G.M. Transfer of a taste aversion from food to water under various states of deprivation. *Animal Learning and Behaviour*, 1979, *7*, 441-446.

Gray, T., & Lethbridge, D.A. Configural conditioning in the CER: Loss of element strength after repeated reinforced compound CS trials. *Learning and Motivation*, 1976, *7*, 532-539.

Grings, W.W., & O'Donnell, D.E. Magnitude of response to compounds of discriminated stimuli. *Journal of Experimental Psychology*, 1956, *52*, 354-359.

Groves, P.M., & Thompson, R.F. Habituation: A dual-process theory. *Psychological Review*,1970 , *77*, 419-450.

Guth, S.L. Pattern effects with compound stimuli. *Journal of Comparative and Physiological Psychology*, 1967, *63*, 480-485.

Hearst, E., & Koresko, M.B. Stimulus generalization and amount of prior training on variable-interval reinforcement. *Journal of Comparative and Physiological Psychology*, 1968, *66*, 133-138.

Heinemann, E.G., & Chase, S. Stimulus generalization. In W.K. Estes (Ed.), *Handbook of learning and cognitive processes: Vol.2. Conditioning and behaviour theory.* Hillsdale, N.J.: Erlbaum, 1975.

Henderson, R.W. Compounds of conditioned fear stimuli. *Learning and Motivation*, 1975, *6*, 20-42.

Hoffeld, D.R., Kendall, S.B., Thompson, R.F., & Brogden, W.J. Effect of amount of preconditioning training upon the magnitude of sensory preconditioning. *Journal of Experimental Psychology*, 1960,*59*,198-204.

Hoffeld, D.R., Thompson, R.F., & Brogden, W.J. Effect of stimuli time relations during preconditioning training upon the magnitude of sensory preconditioning. *Journal of Experimental Psychology*, 1958, *56*, 437-442.

Hull, C.L. *Principles of behavior.* New York: Appleton-Century-Crofts, 1943.

Hull, C.L. The discrimination of stimulus configurations and the hypothesis of neural efferent interaction. *Psychological Review*, 1945 , *52*, 133-139.

Indow, T. An application of the τ-scale of taste. Interaction among the four qualities of taste. *Perception & Psychophysics*, 1969, *5*, 347-351.

Kamin, L.J. Attention-like processes in classical conditioning. In M.R. Jones (Ed.), *Miami symposium on the prediction of behavior: Aversive stimulation.* Miami: University of Miami Press, 1968.

Kamin, L.J. Predictability, surprise, attention and conditioning. In B.A. Campbell and R.M. Church (Eds.), *Punishment and aversive behavior.*New York: Appleton-Century-Crofts, 1969.

Kamin, L.J. & Idrobo, F. Configural conditioning in the CER: A possible artifact. *Animal Learning and Behavior*, 1978, *6*, 290-293.

Kehoe, E.J., & Gormezano, I. Configuration and combination laws in conditioning with compound stimuli. *Psychological Bulletin*, 1980, *87*, 351-378.

Kimmel, H.D. Notes from "Pavlov's Wednesdays": Gestalt relationships as conditioned stimuli. *American Journal of Psychology*, 1976, *89*, 745-749.

Klein, S.B., Mikulka, P.J., Rochelle, F.G., & Blair, V. Postconditioning CS-alone as a source of interference in a taste aversion paradigm. *Physiological Psychology*, 1978, *6*, 255-260.

Köhler, W. *The place of value in a world of facts*. New York: Liveright, 1938.

Kremer, E.F. The Rescorla-Wagner model: Losses in associative strength in compound conditioned stimuli. *Journal of Experimental Psychology: Animal Behavior Processes*, 1978, *4*, 22-36.

Lavin, M.J. The establishment of flavor-flavor associations using a sensory preconditioning training procedure. *Learning and Motivation*, 1976, *1*, 173-183.

Lewis, D.J. Partial reinforcement: A selective review of the literature since 1950. *Psychological Bulletin*, 1960 *57*, 1-28.

Logan, F.A., & Ferraro, D.P. *Systematic analyses of learning and motivation.* New York: John Wiley & Sons, 1978.

Luongo, A.F. Stimulus selection in discriminative taste-aversion learning in the rat. *Animal Learning and Behaviour,* 1976, *4,* 225-230.

Mackintosh, N.J. Selective attention in animal discrimination learning. *Psychological Bulletin,* 1965, *64,* 124-150.

Miles, C.G. A demonstration of overshadowing in operant conditioning. *Psychonomic Science,* 1969, *16,* 139-140.

Miller, R.G. *Simultaneous statistical inference.* New York: McGraw-Hill, 1966.

Mitchell, D., Hoch, N.E., & Fitzsimmons, M. Effects of neophobia sensitization on the rat's preference for earned food. *Behavioral Biology,* 1975, *13,* 519-525.

Morrison, G.R., & Jessup, A. A dual taste for saccharin in the rat. *Chemical Senses and Flavor,* 1977, *2,* 395-400.

North, A.J., & Stimmel, D.T. Extinction of an instrumental response following a large number of reinforcements. *Psychological Reports,* 1960, *6,* 227-234.

Odling-Smee, F.J. The role of background stimuli during Pavlovian conditioning. *Quarterly Journal of Experimental Psychology,* 1975, *27,* 201-209 (a).

Odling-Smee, F.J. Background stimuli and the inter-stimulus interval during Pavlovian conditioning. *Quarterly Journal of Experimental Psychology*, 1975, *27*, 387-392 (b).

Odling-Smee, F.G. The overshadowing of background stimuli: Some effects of varying amount of training and UCS intensity. *Quarterly Journal of Experimental Psychology*, 1978, *30*, 737-746 (a).

Odling-Smee, F.G. The overshadowing of background stimuli by an informative CS in aversive Pavlovian conditioning with rats. *Animal Learning and Behavior*, 1978, *6*, 43-51 (b).

Pangborn, R.M. Taste interrelationships. *Food Research*, 1960, *25*, 245-256.

Pavlov, I.P. *Conditioned reflexes*. (Translated by G.V. Anrep) London: Oxford University Press, 1927.

Pearce, J.M., & Hall, G. Loss of associability by a compound stimulus comprising excitatory and inhibitory elements. *Journal of Experimental Psychology: Animal Behavior Processes*, 1979, *5*, 19-30.

Peck, J.H., & Ader, R. Illness-induced taste aversion under states of deprivation and satiation. *Animal Learning and Behavior*, 1974, *2*, 6-8.

Pfautz, P.L., Donegan, N.H., & Wagner, A.R. Sensory preconditioning versus protection from habituation. *Journal of Experimental Psychology: Animal Behavior Processes*, 1978, *4*, 286-295.

Postman, L. Perception and learning. In S. Koch (Ed.), *Psychology: A study of science*, vol. 5. New York: McGraw Hill, 1963.

Prewitt, E.P. Number of preconditioning trials in sensory preconditioning using CER training. *Journal of Comparative and Physiological Psychology*, 1967, *64*, 360-362.

Razran, G. Studies in configural conditioning: 1. Historical and preliminary experimentation. *Journal of General Psychology*, 1939, *21*, 307-330.

Razran, G. Reply to Grice's "Comments on Razran's discussion of stimulus generalization". *Psychological Bulletin*, 1951, 152-155.

Razran, G. Empirical codification and specific theoretical implications of compound-stimulus conditioning: Perception. In W. Prokasy (Ed.), *Classical conditioning*. New York: Appleton-Century-Crofts, 1965.

Razran, G. *Mind in evolution*. New York: Houghton-Mifflin, 1971.

Rescorla, R.A. Predictability and number of pairings in Pavlovian fear conditioning. *Psychonomic Science*, 1966, *4*, 383-384.

Rescorla, R.A. Conditioned inhibition of fear. In N.J. Mackintosh and W.K. Honig (Eds.), *Fundamental issues in associative learning*. Halifex, N.S.: Dalhousie University Press, 1969.

Rescorla, R.A. "Configural" conditioning in discrete-trial bar pressing. *Journal of Comparative and Physiological Psychology*, 1972, *79*, 307-318.

Rescorla, R.A. Evidence for "unique stimulus" account of configural conditioning. *Journal of Comparative and Physiological Psychology*, 1973, *85*, 331-338.

Rescorla, R.A. Stimulus generalization: Some predictions from a model of Pavlovian conditioning. *Journal of Experimental Psychology: Animal Behavior Processes*, 1976, *2*, 88-96.

Rescorla, R.A. & Cunningham, C.L. Within-compound flavor associations. *Journal of Experimental Psychology: Animal Behavior Processes*, 1978, *4*, 267-275.

Rescorla, R.A., & Wagner, A.P. A theory of Pavlovian conditioning: Variations in the effectiveness of reinforcement and nonreinforcement. In A. Black & W.F. Prokasy (Eds.), *Classical conditioning II*. New York: Appleton-Century-Crofts, 1972.

Revusky, S.H. The role of interference in association over a delay. In W.K. Honig and W.F. Prokasy (Eds.), *Animal Memory*. New York: Academic Press, 1971.

Revusky, S.H. Learning as a general process with an emphasis on data from feeding experiments. In Milgram, N.W., Krames, L. & Alloway, T.M., (Eds.), *Food aversion learning*. New York: Plenum Press, 1977.

Revusky, S.H. & Garcia, J. Learned associations over long delays. In G.H. Bower & J.T. Spence (Eds.), *The Psychology of learning and motivation: Advances in research and theory* (Vol. 4). New York: Academic Press, 1970.

Reynolds, G.S. Attention in the pigeon. *Journal of the Experimental Analysis of Behavior*, 1961, *4*, 203-208.

Richter, C.P. Total self regulatory functions in animals and human beings. *The Harvey lectures*. 1942-1943, Ser. 38, Vol. *38*, 63-103.

Rizley, R.C., & Rescorla, R.A. Associations in second-order conditioning and sensory preconditioning. *Journal of Comparative and Physiological Psychology*, 1972, *81*, 1-11.

Robbins, R.J. The effect of flavor pre-exposure upon the acquisition and retention of poison-based taste aversions in deer mice: Latent inhibition or partial reinforcement? *Behavioral and Neural Biology*, 1979, *25*, 387-397.

Rohlf, F.J. & Sokal, R.R. *Statistical tables*. San Francisco: W.H. Freeman, 1969.

Saavedra, M.A. Pavlovian compound conditioning in the rabbit. *Learning and Motivation*, 1975, *6*, 314-326.

Schiffman, H.R. *Sensation and perception: An integrated approach*. New York: John Wiley & Sons, 1976, p.132.

Seidel, R.J. A review of sensory preconditioning. *Psychological Bulletin*, 1959, *56*, 58-73.

Sheffield, V.F. Extinction as a function of partial reinforcement and distribution of practice. *Journal of Experimental Psychology*, 1949, *39*, 511-526.

Shiffman, S.S., Reilly, D.A., & Clark, T.B. Qualitative differences among sweetners. *Physiology and Behavior*, 1979, *23*, 1-9.

Siegel, S. Flavor preexposure and "learned safety". *Journal of Comparative and Physiological Psychology*, 1974, *87*, 1073-1082.

Silver, C.A., & Meyer, D.R. Temporal factors in sensory preconditioning. *Journal of Comparative and Physiological Psychology*, 1954, *47*, 57-59.

Tait, R.W., Marquis, H.A., Williams, R., Weinstein, L., & Suboski, M.D. Extinction of sensory preconditioning using CER training. *Journal of Comparative and Physiological Psychology*, 1969, *69*, 170-172.

Taukulis, H.K., & Revusky, S.H. Odor as a conditioned inhibitor: Applicability of the Rescorla-Wagner model to feeding behavior. *Learning and Motivation*, 1975, *6*, 11-27.

Theios, J., & Brelsford, J. Overlearning extinction effect as as incentive phenomenon. *Journal of Experimental Psychology*, 1964, *67*, 463-467.

Thomas, D.R., Berman, D.L., Serednesky, G.E., & Lyons, J. Information value and stimulus configuring as factors in conditioned reinforcement. *Journal of Experimental Psychology*, 1968, *76*, 181-189.

Thompson, R.F. Effect of acquisition level upon the magnitude of stimulus generalization across sensory modality. *Journal of Comparative and Physiological Psychology*, 1959, *52*, 183-185.

Wagner, A.R. Stimulus selection and a "modified continuity theory". *Learning and Motivation*, 1969, *3*, 1-41.

Weiss, S.J. Stimulus compounding in free-operant and classical conditioning: A review and analysis. *Psychological Bulletin*, 1972, *78*, 189-208.

Wickens, D.D., Schroder, H.M., & Snide, J.D. Primary stimulus generalization of the GSR under two conditions. *Journal of Experimental Psychology*, 1954, *47*, 52-56.

Whitlow, J.W., & Wagner, A.R. Negative patterning in classical conditioning: Summation of response tendencies to isolable and configural components. *Psychonomic Science*, 1972, *27*, 299-301.

Wickens, D.D., Nield, A.F., Tuber, D.S., & Wickens, C. Classically conditioned compound-element discrimination as a function of length of training, amount of testing and CS-UCS interval. *Learning and Motivation*, 1970, *1*, 95-109.

Wolpe, J. An interpretation of the effects of combinations of stimuli (patterns) based on current neurophysiology. *Psychological Review*, 1949, *56*, 277-283.

Woodbury, C.B. The learning of stimulus patterns by dogs. *Journal of Comparative Psychology*, 1943, *35*, 29-40.

Wynne, J.D., & Brogden, W.J. Supplementary report: Effect upon sensory preconditioning of backward, forward, and trace preconditioning training. *Journal of Experimental Psychology*, 1962, *64*, 422-423.

APPENDIX 1a

DATA FOR EXPERIMENT 1a

EXPERIMENT 1a

CONSUMPTION MEASURES (in mls) FOR N/S, N and S CONDITIONING GROUPS ON EXPERIMENTAL DAYS.*

Flavour group	Subject	Pretrain EXP	Pretrain CON	Train EXP	Train CON	Pretest EXP	Pretest CON	Test EXP	Test CON
N/S	1	15.0	13.8	7.0	14.7	5.3	10.9	2.6	18.8
	2	13.1	12.6	11.6	8.1	13.9	11.1	0.8	14.9
	3	12.9	6.9	11.7	15.3	14.0	10.1	1.7	16.8
	4	13.0	13.7	13.7	16.3	15.5	9.7	1.6	16.2
	5	13.0	8.3	8.4	12.1	14.1	11.3	0.8	14.7
	6	11.8	9.1	13.8	12.1	12.2	10.3	0.9	17.5
	7	9.9	10.8	12.1	10.6	12.0	8.4	2.7	13.9
	$\bar{x}$	12.7	10.7	11.2	12.7	12.4	10.3	1.6	16.1
N	8	11.2	10.8	19.8	10.2	11.9	10.9	3.7	10.0
	9	13.0	14.9	19.0	16.5	13.9	11.5	1.4	17.1
	10	11.3	12.8	17.8	15.7	12.7	10.4	21.4	16.5
	11	10.9	12.5	14.4	13.6	12.3	9.5	1.2	15.0
	12	13.1	11.0	19.2	15.7	13.1	9.1	2.9	17.0
	13	12.3	12.1	17.4	15.5	12.9	11.3	4.1	14.4
	14	12.2	10.3	16.4	15.2	14.1	9.1	2.8	13.9
	$\bar{x}$	12.0	12.1	17.3	14.6	13.0	10.3	2.6	14.8
S	15	10.7	14.9	12.4	13.0	12.5	13.4	2.9	15.2
	16	5.3	9.9	10.7	6.6	9.5	8.5	2.7	11.8
	17	15.2	11.9	16.5	9.7	13.6	11.6	1.1	14.8
	18	12.8	9.5	10.5	12.3	9.7	9.8	1.4	13.7
	19	9.5	14.7	9.2	12.8	8.5	13.8	1.6	14.7
	20	12.4	12.9	6.1	11.3	10.5	9.8	2.8	12.6
	21	13.2	12.7	11.5	12.6	11.7	11.5	1.1	14.8
	$\bar{x}$	11.3	12.4	11.0	11.2	10.9	11.2	1.9	13.9

* NOTE: EXP = experimental, CON = control.

APPENDIX 1b

DATA FOR EXPERIMENT 1b

EXPERIMENT 1b

CONSUMPTION MEASURES (in mls) FOR ONE N/S CONDITIONING TRIAL GROUPS ON EXPERIMENTAL DAYS.*

Flavour group	Subject	P-Tr	b.w.	Tr 1	P-T	Ex 1	Ex 2	Ex 3	Ex 4
	1	17.7	290	19.1	17.2	0.3	3.9	15.0	20.6
	2	13.9	257	10.0	12.7	0.9	2.9	11.3	16.3
	3	15.1	272	2.1	17.5	10.8	21.7	23.5	24.7
N/S	4	13.2	260	10.8	14.2	2.6	6.0	13.7	17.2
	5	12.4	225	13.5	12.5	0.0	3.9	9.5	16.2
	6	10.0	291	14.3	12.1	1.7	5.2	15.7	19.7
	7	12.5	220	17.7	12.2	2.5	10.4	13.9	17.8
	$\bar{x}$	13.5		12.5	14.1	2.7	7.7	14.7	18.9
	8	12.7	272	15.2	12.2	8.9	17.6	18.7	18.0
	9	12.5	197	13.7	13.0	7.8	14.3	15.0	16.1
	10	9.5	255	13.7	13.5	5.1	16.6	19.3	21.6
N	11	16.7	255	17.0	16.8	7.6	17.9	20.6	20.9
	12	13.0	261	4.8	12.3	3.2	9.6	22.4	19.5
	13	14.1	243	14.4	14.8	9.8	17.1	20.3	18.7
	14	14.7	290	13.4	13.3	5.5	15.1	2.2	17.0
	$\bar{x}$	13.3		13.2	13.7	6.8	15.5	16.9	18.8
	15	8.9	264	13.5	14.1	5.4	13.9	17.2	19.1
	16	14.0	258	4.3	15.6	8.6	13.3	17.8	18.7
	17	14.3	293	5.6	15.1	5.6	12.7	14.5	15.6
S	18	9.1	278	13.3	16.7	6.1	14.9	19.4	19.1
	19	12.7	236	10.2	10.9	6.2	12.2	15.1	15.2
	20	13.9	203	3.9	17.8	7.3	16.4	18.4	19.2
	21	14.7	261	1.1	16.1	2.5	5.1	16.6	19.4
	$\bar{x}$	12.5		7.4	15.2	6.0	12.6	17.0	18.0
overall	$\bar{X}$	13.1	244	11.0	14.3				

* From here on, P-Tr = pretrain, b.w. = body weight (g), Tr = train, P-T = pretest, Ex = Extinction trial, P-Ex = postextinction.

(Experiment 1b continued)

Flavour group	Subject	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10	P-Ex	P-Ex
	1	20.2	20.7	21.9	25.8	23.4	20.4	21.0	23.1
	2	16.6	19.8	21.2	22.8	22.8	20.7	17.9	21.1
	3	25.1	26.5	24.4	29.4	24.4	26.0	23.7	26.0
N/S	4	17.2	18.1	18.9	22.9	19.8	19.2	18.8	19.9
	5	18.7	16.9	18.7	21.9	19.0	17.4	18.0	20.9
	6	16.4	21.2	21.8	21.8	21.3	19.5	20.5	21.6
	7	15.3	16.2	16.7	19.5	18.1	18.4	17.9	20.2
	$\bar{x}$	18.5	19.9	20.8	23.4	21.3	20.2	19.7	21.8
	8	16.7	17.6	19.6	19.7	18.7	18.3	10.5	20.5
	9	15.9	17.3	18.5	19.2	17.1	18.0	11.9	17.2
	10	21.8	22.2	23.1	25.3	24.3	22.5	15.4	25.6
N	11	19.8	10.2	21.9	21.3	20.2	21.0	13.7	21.9
	12	22.8	19.9	17.5	21.7	20.1	22.4	18.2	22.9
	13	19.6	20.8	19.0	22.2	19.9	21.7	15.2	20.8
	14	18.3	20.4	21.2	22.3	20.9	21.0	16.2	21.5
	$\bar{x}$	19.3	18.3	20.1	21.7	20.2	20.7	14.4	21.5
	15	17.6	19.0	19.9	20.6	19.7	15.2	5.6	15.6
	16	18.0	17.4	19.2	23.6	18.5	20.9	20.0	19.1
	17	16.9	18.4	21.4	23.0	20.4	17.6	3.2	16.0
S	18	18.4	18.9	21.1	25.3	21.5	21.9	7.4	21.1
	19	12.9	14.8	17.8	20.9	18.1	17.8	13.0	19.9
	20	18.9	18.6	20.5	22.3	18.3	18.6	18.6	16.4
	21	18.2	21.6	19.6	23.3	20.6	22.4	18.8	21.0
	$\bar{x}$	17.3	18.4	19.9	22.7	19.6	19.2	12.4	18.4

CONSUMPTION MEASURES (in mls) for TWO N/S CONDITIONING TRIALS GROUPS

Flavour Group	Subject	P-Tr	b.w.	Tr 1	P-Tr	b.w.	Tr 2	P-T
	1	11.5	215	14.4	11.9	212	3.0	15.1
	2	15.5	271	15.3	8.7	280	2.2	14.0
	3	14.0	251	11.9	12.2	261	1.1	17.7
N/S	4	11.7	226	13.2	10.2	235	2.7	14.9
	5	9.3	206	3.0	9.3	188	0.8	12.8
	6	11.3	217	14.9	10.2	232	2.4	13.9
	7	11.1	190	11.2	11.9	185	2.3	10.9
	$\bar{x}$	12.1		12.0	10.6		2.1	14.2
	8	13.7	252	15.3	10.6	259	3.4	16.7
	9	6.0	198	12.1	8.6	210	2.2	12.7
	10	11.9	202	12.0	10.1	209	2.8	10.2
N	11	10.0	212	16.6	10.0	224	41.4	13.1
	12	10.5	213	12.9	9.6	226	1.6	16.5
	13	9.7	270	10.6	14.5	278	0.4	18.0
	14	11.6	202	16.1	10.1	222	2.8	12.0
	$\bar{x}$	10.5		13.7	10.5		2.5	14.2
	15	9.1	224	12.7	9.9	231	0.7	14.1
	16	12.1	262	19.1	11.8	276	0.6	16.3
	17	12.6	231	12.2	13.6	239	3.3	15.7
S	18	14.4	253	11.8	13.7	245	2.2	18.5
	19	13.3	223	8.6	15.9	250	2.2	18.6
	20	11.3	243	17.1	7.1	263	3.6	18.0
	21	12.8	230	13.7	12.1	233	4.1	10.8
	$\bar{x}$	12.2		13.6	12.0		2.4	16.0
overall	$\bar{X}$	11.6	228	13.1	11.1	236	2.3	14.8

(Experiment 1b continued)

Flavour group	Subject	Ex 1	Ex 2	Ex 3	Ex 4	Ex 5	Ex 6
N/S	1	1.4	2.8	0.6	0.6	0.8	1.4
	2	2.0	2.6	6.7	11.7	15.3	20.2
	3	1.1	2.1	0.9	1.1	1.1	0.9
	4	2.1	3.4	1.6	1.0	0.6	0.6
	5	1.5	2.5	0.9	0.9	0.1	0.9
	6	1.8	3.1	3.1	2.4	1.6	2.7
	7	1.2	2.2	2.3	5.7	3.4	11.1
	$\bar{x}$	1.6	2.7	2.3	3.3	3.3	5.4
N	8	2.9	4.8	14.7	18.1	13.3	23.3
	9	1.5	1.7	1.0	4.3	4.7	11.6
	10	4.2	7.8	11.5	13.5	13.3	18.3
	11	2.7	2.8	3.1	4.5	9.9	15.6
	12	2.9	3.9	5.4	11.4	7.1	18.5
	13	1.6	2.0	1.9	1.0	1.0	2.9
	14	2.1	7.7	2.8	12.9	18.0	9.8
	$\bar{x}$	2.6	4.4	5.8	9.4	9.6	14.3
S	15	1.5	1.8	0.3	3.8	9.7	12.6
	16	5.2	7.1	13.5	14.2	12.1	17.6
	17	1.9	1.8	3.9	4.3	9.9	13.0
	18	1.5	4.2	8.5	7.5	16.6	14.5
	19	4.1	5.5	12.6	14.5	15.7	17.1
	20	5.4	10.1	17.1	12.8	17.6	20.5
	21	3.5	6.0	3.3	14.0	14.5	16.6
	$\bar{x}$	3.3	5.2	8.5	10.2	13.7	16.0

(Experiment 1b continued)

Flavour group	Subject	Ex 7	Ex 8	Ex 9	Ex 10	P-Ex	P-Ex
	1	1.2	5.7	10.1	1.3	15.2	18.5
	2	22.2	15.5	8.7	19.5	5.0	3.2
	3	1.4	1.4	1.4	4.7	5.5	15.0
N/S	4	0.5	2.4	4.2	9.3	12.4	15.9
	5	0.7	0.8	0.9	1.5	2.7	5.2
	6	2.9	7.7	12.4	13.2	14.7	17.3
	7	13.4	14.6	15.7	16.6	12.5	16.4
	$\bar{x}$	6.0	6.9	7.6	9.4	9.7	13.1
	8	20.6	20.0	19.4	21.9	11.7	19.9
	9	11.9	14.1	16.2	14.8	9.6	14.9
	10	16.8	15.8	14.8	18.4	11.5	14.8
N	11	11.7	11.8	11.9	16.6	4.0	12.5
	12	11.7	15.9	20.1	19.9	8.1	11.7
	13	7.2	10.3	13.3	14.6	0.6	8.1
	14	19.6	18.2	16.7	16.6	15.2	17.4
	$\bar{x}$	14.2	15.2	16.1	17.5	8.7	14.2
	15	14.5	14.0	13.5	15.2	1.0	1.3
	16	17.0	16.1	15.2	16.2	6.2	16.7
	17	15.5	16.7	17.8	17.3	2.4	4.7
S	18	20.5	21.2	21.8	21.0	3.2	9.8
	19	16.0	16.9	17.8	17.9	0.6	0.1
	20	17.2	16.7	16.2	19.1	2.9	6.0
	21	18.6	17.6	16.6	18.3	1.5	-3.5
	$\bar{x}$	17.0	17.0	17.0	17.9	2.5	6.0

CONSUMPTION MEASURES (Mls) FOR THREE N/S CONDITIONING TRIALS GROUP

Flavour group	Subject	P-Tr	b.w.	Tr 1	P-Tr	b.w.	Tr 2	P-Tr
	1	13.3	282	5.5	12.8	285	1.0	#
	2	5.4	250	10.1	6.9	253	3.1	
	3	14.0	280	1.0	12.5	281	2.6	
N/S	4	1.3	245	14.8	6.8	250	6.2	
	5	12.7	275	12.8	15.7	271	6.0	
	6	0.9	248	11.0	14.6	237	3.4	
	7	14.7	307	10.1	18.6	306	3.4	
	$\bar{x}$	8.9		9.3	12.6		3.7	
	8	4.2	248	14.1	15.1	238	4.5	
	9	13.0	249	9.0	9.2	238	5.6	
	10	14.1	256	4.7	15.3	260	1.4	
N	11	11.6	247	10.7	14.4	256	3.0	
	12	10.9	279	16.4	13.4	290	1.8	
	13	11.3	295	13.9	9.8	298	3.0	
	14	15.5	275	13.7	15.6	293	2.1	
	$\bar{x}$	11.5		11.8	13.3		3.1	
	15	11.8	235	8.8	12.3	252	3.8	
	16	14.8	284	11.6	6.6	290	8.4	
	17	12.4	269	13.0	15.5	285	5.2	
S	18	9.3	282	8.5	7.6	276	1.8	
	19	12.6	252	16.3	7.7	250	0.6	
	20	12.6	265	9.9	8.7	278	4.7	
	21	13.3	244	7.5	10.5	248	3.6	
	$\bar{x}$	12.4		10.8	9.8		4.0	
overall	$\bar{X}$	10.9	265	10.6	11.9	268	3.6	

data not available

(Experiment 1b continued)

Flavour group	Subject	b.w.	Tr 3	P-T	Ex 1	Ex 2	Ex 3	Ex 4
	1	273	0.5	22.1	0.6	1.0	1.0	1.8
	2	229	0.8	14.4	1.0	1.7	1.0	1.2
	3	269	1.2	16.7	0.6	0.7	1.0	0.8
N/S	4	259	2.0	17.3	1.3	1.5	2.7	2.0
	5	276	2.6	16.5	0.9	2.5	2.0	2.9
	6	205	1.0	16.8	1.3	1.0	0.9	0.8
	7	293	1.4	20.1	0.5	1.8	1.8	0.8
	$\bar{x}$		1.4	17.7	0.9	1.5	1.5	1.5
	8	200	1.6	15.2	0.7	2.1	3.8	6.1
	9	247	2.2	16.6	0.6	1.0	1.1	2.0
	10	254	1.2	19.9	0.8	1.6	1.6	1.4
N	11	264	2.2	14.3	1.5	1.4	1.0	0.6
	12	286	2.2	16.6	1.1	1.0	1.5	0.8
	13	290	1.3	15.1	1.3	2.2	1.5	0.6
	14	302	0.8	18.0	0.1	1.2	2.3	1.0
	$\bar{x}$		1.6	16.5	0.9	1.5	1.8	1.8
	15	259	1.1	13.9	1.4	1.2	1.3	0.7
	16	295	0.9	17.3	2.1	3.5	8.8	0.9
	17	281	1.6	16.2	0.8	1.0	1.7	0.8
S	18	286	1.5	15.3	3.8	9.1	0.8	9.8
	19	242	2.2	16.7	2.1	4.4	9.5	15.4
	20	261	1.3	13.4	1.3	5.2	13.4	0.5
	21	246	1.8	15.9	1.3	1.1	2.3	11.2
	$\bar{x}$		1.5	15.5	1.8	3.6	5.4	5.6
overall	$\bar{X}$	263	1.5	16.6				

(Experiment 1b continued)

Flavour group	Subject	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10
	1	0.6	0.7	0.3	1.3	0.3	4.0
	2	0.9	0.7	1.6	1.3	2.1	4.2
	3	0.9	1.2	1.0	0.8	1.1	0.4
N/S	4	1.8	2.7	1.9	1.9	2.2	5.5
	5	2.3	2.1	2.5	4.7	9.2	7.2
	6	0.8	1.1	0.2	1.1	0.4	6.1
	7	1.8	1.3	0.7	1.3	0.6	1.0
	$\bar{x}$	1.3	1.4	1.2	1.8	2.3	4.1
	8	0.7	13.1	19.4	19.1	19.3	18.1
	9	1.0	1.5	2.1	7.2	0.2	10.4
	10	2.5	1.7	1.4	1.1	1.7	6.9
N	11	1.5	2.2	6.2	10.5	13.5	16.9
	12	1.3	1.1	1.2	1.3	3.9	9.6
	13	1.0	1.2	0.7	0.7	1.7	3.3
	14	1.7	2.0	7.6	12.7	19.8	20.0
	$\bar{x}$	1.4	3.3	5.5	7.5	8.6	12.2
	15	0.8	3.5	4.3	10.6	12.6	11.8
	16	13.6	17.0	18.8	19.1	8.5	19.9
	17	1.0	2.8	9.5	15.2	14.7	17.3
S	18	14.5	14.9	15.7	15.9	14.7	16.1
	19	17.9	19.1	18.5	19.7	16.3	0.4
	20	10.5	9.0	17.3	18.3	16.8	19.4
	21	13.3	14.4	15.8	18.5	16.0	17.6
	$\bar{x}$	10.2	11.5	12.8	16.8	14.2	14.6

CONSUMPTION MEASURES (mls) FOR SIX N/S CONDITIONING TRIALS GROUPS

Flavour group	Subject	P-Tr	b.w.	Tr 1	P-Tr	b.w.	Tr 2	P-Tr
	1	11.9	231	19.9	13.3	230	4.0	10.9
	2	11.3	242	11.9	15.4	251	3.0	15.0
	3	12.5	263	6.3	15.7	275	1.2	16.8
N/S	4	15.2	270	9.3	10.2	285	2.3	12.5
	5	11.5	234	5.0	13.1	250	3.0	14.0
	6	16.2	284	8.5	15.9	300	2.1	16.7
	7	8.3	227	20.7	10.6	268	2.7	16.2
	$\bar{x}$	12.4		11.7	13.5		2.6	14.6
	8	16.1	241	22.0	16.2	253	2.4	18.1
	9	14.6	285	20.9	15.0	304	2.9	15.5
	10	9.0	223	6.6	13.5	225	1.6	13.5
N	11	11.5	247	3.3	15.6	252	2.1	14.3
	12	13.1	237	8.3	13.4	253	2.9	13.5
	13	18.7	267	11.9	18.3	292	1.2	20.6
	14	14.4	310	7.4	18.2	332	3.5	15.5
	$\bar{x}$	13.9		11.5	15.7		2.4	15.9
	15	14.2	293	13.7	17.1	317	4.1	15.7
	16	13.9	287	15.7	8.9	307	2.2	14.8
	17	15.1	290	14.8	15.4	289	1.8	14.6
S	18	11.4	243	7.4	12.8	239	2.2	14.5
	19	6.9	246	11.2	17.3	254	2.6	14.2
	20	12.8	226	10.1	11.0	242	2.4	13.0
	21	11.5	236	4.2	10.4	235	4.2	14.7
	$\bar{x}$	12.3		11.0	13.3		2.8	14.5
overall	$\bar{X}$	12.9	256	11.4	14.2	269	2.6	15.0

(Experiment 1b continued)

Flavour group	Subject	b.w.	Tr 3	P-Tr	b.w.	Tr 4	P-Tr	b.w.
	1	227	1.5	14.4	237	1.6	14.3	246
	2	240	1.3	13.5	248	1.7	15.5	259
	3	268	1.4	13.7	279	1.1	8.8	287
N/S	4	270	2.0	15.6	285	1.9	15.6	298
	5	237	1.0	13.0	250	2.2	11.5	262
	6	295	0.9	20.6	310	2.1	18.3	324
	7	263	1.1	11.0	275	0.9	15.8	286
	$\bar{x}$		1.3	14.5		1.6	14.3	
	8	250	1.1	20.0	253	1.9	7.0	255
	9	296	1.1	16.6	307	1.0	18.5	316
	10	204	2.0	17.6	222	1.8	16.2	232
N	11	240	1.0	17.8	257	2.1	15.0	262
	12	235	1.4	15.5	249	1.5	13.2	266
	13	287	0.8	21.7	300	1.8	22.2	313
	14	316	1.5	19.4	335	1.4	18.3	349
	$\bar{x}$		1.3	18.4		1.6	15.8	
	15	298	1.1	21.9	315	2.2	19.2	323
	16	256	1.3	14.7	282	1.5	14.8	283
	17	278	1.2	16.0	294	1.5	16.1	303
S	18	226	0.9	16.9	234	1.0	15.2	237
	19	217	1.2	21.4	249	1.8	13.9	262
	20	231	1.1	5.1	233	1.1	14.3	227
	21	230	1.1	14.9	240	1.4	15.3	246
	$\bar{x}$		1.1	15.8		1.5	15.5	
overall	$\bar{X}$	255	1.2	16.3	269	1.6	15.2	278

(Experiment 1b continued)

Flavour group	Subject	Tr 5	P-Tr	b.w.	Tr 6	P-T	Ex 1	Ex 2
	1	7.6	15.6	238	2.2	11.1	1.0	0.5
	2	2.2	12.6	259	2.2	16.9	0.2	0.3
	3	1.6	14.4	289	1.3	12.0	0.5	0.1
N/S	4	2.2	15.4	299	1.7	14.5	1.3	0.7
	5	1.1	14.6	263	1.8	13.1	1.0	0.7
	6	1.8	19.7	320	2.2	18.3	0.7	0.7
	7	1.4	17.0	287	1.7	6.6	0.3	1.2
	$\bar{x}$	2.6	15.6		1.9	13.2	0.7	0.6
	8	0.6	10.4	247	1.7	16.9	0.8	2.1
	9	1.0	16.9	307	2.2	15.0	1.6	1.7
	10	1.1	16.9	232	2.3	13.9	1.1	1.0
N	11	1.7	14.7	264	2.0	13.3	1.0	1.5
	12	1.0	15.8	264	1.8	13.2	0.8	1.3
	13	0.6	18.5	304	2.1	19.9	1.6	1.1
	14	0.9	18.0	348	1.5	16.2	0.8	0.9
	$\bar{x}$	1.0	15.9		1.9	15.5	1.1	1.4
	15	0.7	19.3	318	2.0	16.3	0.1	0.5
	16	0.9	14.7	286	1.4	12.7	0.3	0.8
	17	0.5	13.7	302	1.4	7.4	0.6	0.9
S	18	0.7	18.3	240	0.9	16.1	0.9	0.4
	19	0.4	17.1	270	1.9	13.9	0.5	0.6
	20	0.7	11.9	231	1.1	11.6	0.6	2.4
	21	0.1	11.7	246	1.5	14.5	0.7	1.0
	$\bar{x}$	0.6	15.2		1.5	13.2	0.5	0.9
overall	$\bar{X}$	1.4	15.6	277	1.8	14.0		

(Experiment 1b continued)

Flavour group	Subject	Ex 3	Ex 4	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10
	1	0.5	0.6	1.0	0.6	0.2	1.2	0.2	0.3
	2	1.0	0.8	0.9	0.8	1.5	1.3	1.5	1.5
	3	0.9	0.6	1.0	0.4	1.4	1.4	1.6	0.7
N/S	4	3.0	1.1	2.0	1.1	1.0	1.5	5.1	13.2
	5	0.7	1.5	0.9	1.7	4.6	12.9	0.6	19.1
	6	1.3	0.9	1.3	1.1	2.2	1.6	1.8	5.0
	7	1.2	0.8	0.9	2.6	0.5	0.8	2,4	1.0
	$\bar{x}$	1.2	0.9	1.1	1.2	1.6	3.0	1.9	5.8
	8	1.6	1.8	4.1	11.8	14.9	16.0	13.7	16.8
	9	1.2	3.1	13.7	4.4	16.5	13.3	17.9	18.9
	10	0.9	1.8	4.2	12.9	11.5	16.5	13.3	13.1
N	11	1.5	0.8	3.9	9.3	7.5	8.1	10.8	8.2
	12	2.0	1.2	3.2	5.2	12.8	21.0	16.8	19.4
	13	1.0	3.2	16.3	18.3	13.4	20.5	19.6	23.1
	14	1.0	1.0	5.4	8.1	19.1	3.7	21.3	25.1
	$\bar{x}$	1.3	1.8	7.3	10.0	13.7	14.2	16.2	17.8
	15	0.3	0.5	3.8	7.6	13.9	22.1	21.3	23.3
	16	1.0	3.7	12.2	13.9	11.9	16.0	16.5	19.0
	17	4.0	10.3	16.4	18.8	12.7	18.5	18.3	20.3
S	18	1.3	0.6	0.7	0.8	0.9	3.4	9.3	12.5
	19	0.5	0.3	1.0	1.2	9.6	16.9	19.3	18.6
	20	2.3	0.3	4.3	2.2	1.9	3.9	10.5	11.1
	21	0.1	0.5	2.2	1.2	0.3	0.2	7.0	10.2
	$\bar{x}$	1.4	2.3	5.8	6.5	7.3	11.6	14.6	16.4

CONSUMPTION MEASURES (mls) for TEN N/S CONDITIONING TRIALS GROUPS

Flavour group	Subject	P-Tr	b.w.	Tr 1	P-Tr	b.w.	Tr 2	P-Tr
	1	16.9	281	1.3	12.2	273	4.6	17.3
	2	14.2	273	12.2	9.4	285	3.7	13.9
	3	9.5	230	7.7	15.5	236	2.2	13.8
N/S	4	13.0	240	11.5	13.1	249	2.5	15.3
	5	14.0	247	12.1	10.3	262	4.2	15.3
	6	11.5	201	26.0	13.7	210	1.3	16.1
	7	7.2	202	16.5	11.4	203	1.7	10.8
	$\bar{x}$	12.3		12.5	12.2		2.9	14.6
	8	3.5	230	9.0	14.5	233	3.6	11.1
	9	13.4	264	13.3	8.8	269	1.5	14.7
	10	16.6	238	6.4	15.6	237	1.5	15.5
N	11	8.1	293	15.9	15.4	300	2.3	18.5
	12	10.2	254	12.2	12.8	252	2.3	4.2
	13	15.6	322	29.9	17.4	314	1.5	10.1
	14	10.7	212	2.5	15.7	198	2.4	11.0
	$\bar{x}$	11.2		12.7	14.3		2.2	12.2
	15	7.7	214	10.9	10.8	220	6.0	9.3
	16	14.1	241	13.4	13.4	243	3.6	17.7
	17	11.6	281	13.9	15.5	285	1.6	8.2
S	18	9.7	213	10.8	11.5	203	1.3	13.4
	19	12.0	246	14.7	14.3	254	5.4	16.1
	20	12.5	264	13.9	13.6	267	1.9	15.7
	21	9.0	272	16.3	15.2	258	1.2	16.4
	$\bar{x}$	10.9		13.4	13.5		3.0	13.8
overall	$\bar{X}$	11.5	249	12.9	13.3	250	2.7	13.5

(Experiment 1b continued)

Flavour group	Subject	b.w.	Tr 3	P-Tr	b.w.	Tr 4	P-Tr	b.w.
	1	284	1.6	15.0	300	0.6	16.6	303
	2	291	1.6	17.3	303	0.7	8.3	302
	3	250	1.2	17.3	265	0.9	16.3	264
N/S	4	261	1.5	15.9	269	0.8	16.2	268
	5	271	1.5	16.0	287	0.2	10.1	299
	6	210	1.6	14.2	214	1.1	15.6	207
	7	210	1.6	13.8	212	0.9	16.5	214
	$\bar{x}$		1.5	15.6		0.7	14.2	
	8	236	1.6	16.4	243	0.3	14.4	246
	9	275	0.9	19.4	282	1.1	18.3	282
	10	242	2.2	15.8	226	1.3	19.6	237
N	11	301	1.6	19.4	288	0.9	15.6	304
	12	232	1.7	10.3	256	0.5	8.0	257
	13	326	2.3	11.1	322	0.1	15.9	337
	14	203	1.6	13.7	220	0.8	6.5	208
	$\bar{x}$		1.7	15.2		0.7	14.0	
	15	225	1.1	11.1	236	0.7	12.8	238
	16	250	1.7	17.0	256	0.7	15.0	258
	17	300	1.6	18.3	303	0.9	19.3	312
S	18	221	1.5	14.9	232	0.1	14.0	242
	19	254	2.7	16.9	268	1.4	16.7	274
	20	267	1.7	17.2	275	1.9	15.5	280
	21	257	2.3	16.2	285	0.6	16.6	300
	$\bar{x}$		1.8	15.9		0.9	15.7	
overall	$\bar{X}$	256	1.7	15.6	264	0.8	14.7	268

(Experiment 1b continued)

Flavour group	Subject	Tr 5	P-Tr	b.w.	Tr 6	P-Tr	b.w.	Tr 7
	1	0.4	14.8	298	1.0	15.5	310	0.7
	2	0.5	17.5	295	0.2	17.9	313	1.0
	3	0.8	17.2	261	0.6	16.0	278	0.3
N/S	4	1.0	14.2	265	0.8	13.3	272	0.1
	5	0.5	20.3	295	0.7	17.8	316	0.5
	6	0.1	16.1	210	0.8	15.5	216	0.9
	7	0.4	16.3	217	0.4	17.0	223	0.6
	$\bar{x}$	0.5	16.6		0.6	16.1		0.6
	8	0.6	17.0	245	0.2	14.9	261	0.1
	9	0.3	18.9	278	0.8	18.9	290	0.4
	10	0.0	19.3	248	0.3	20.7	264	0.4
N	11	0.0	18.9	305	0.5	18.0	330	0.2
	12	0.7	16.5	269	0.3	15.6	285	0.1
	13	0.0	16.2	341	0.1	19.6	361	0.2
	14	0.3	7.6	183	0.0	13.7	205	0.0
	$\bar{x}$	0.3	16.3		0.3	17.3		0.2
	15	0.5	6.4	234	0.1	11.4	245	1.0
	16	0.2	16.7	264	0.0	17.1	276	0.1
	17	0.0	12.7	307	0.0	19.1	326	0.1
S	18	0.0	13.9	243	0.2	13.2	252	0.2
	19	0.3	17.2	267	0.2	15.0	290	0.1
	20	0.0	17.5	275	0.2	14.0	312	0.0
	21	0.1	19.4	303	0.2	16.8	324	0.2
	$\bar{x}$	0.2	14.8		0.1	15.2		0.2
overall	$\bar{X}$	0.3	15.9	267	0.4	16.2	283	0.3

(Experiment 1b continued)

Flavour group	Subject	P-Tr	b.w.	Tr 8	P-Tr	b.w.	Tr 9	P-Tr
	1	10.0	307	0.4	12.4	313	0.6	16.0
	2	14.7	312	0.8	13.6	331	0.6	14.8
	3	15.4	286	0.1	14.5	293	0.0	11.9
N/S	4	14.4	276	0.4	9.0	288	0.5	13.2
	5	9.2	312	0.4	18.6	333	0.6	10.1
	6	1.0	214	0.2	1.5	232	0.6	13.4
	7	16.6	232	0.2	16.2	244	0.2	16.0
	$\bar{x}$	11.6		0.4	12.3		0.4	13.6
	8	16.3	257	0.7	2.4	262	0.0	7.5
	9	18.6	288	0.4	14.7	302	0.9	17.1
	10	18.6	264	0.3	16.7	277	0.2	14.9
N	11	17.0	334	0.6	16.0	347	0.2	16.3
	12	16.7	290	0.4	14.3	305	0.3	16.8
	13	17.5	364	0.0	15.5	373	0.8	17.1
	14	6.1	211	0.0	15.7	254	0.4	4.7
	$\bar{x}$	15.8		0.3	13.6		0.4	13.5
	15	8.1	243	0.7	1.1	250	0.2	7.0
	16	6.0	270	0.2	17.6	296	0.2	18.4
	17	6.0	320	0.3	17.9	337	0.0	19.0
S	18	13.0	254	0.1	15.0	263	0.1	14.0
	19	13.6	291	0.2	16.7	296	0.0	16.5
	20	5.6	287	0.0	14.5	301	0.0	13.3
	21	18.9	326	0.0	18.8	341	0.2	16.8
	$\bar{x}$	10.2		0.2	14.5		0.1	15.0
overall	$\bar{X}$	12.5	283	0.3	13.5	281	0.3	14.0

(Experiment 1b continued)

Flavour group	Subject	b.w.	Tr 10	P-T	Ex 1	Ex 2	Ex 3	Ex 4
	1	308	0.2	12.3	0.6	0.1	0.7	0.5
	2	329	0.6	14.7	0.4	0.7	0.5	0.3
	3	290	0.5	15.0	0.2	0.2	0.8	0.1
N/S	4	287	0.3	12.5	0.5	0.3	0.4	0.3
	5	322	0.9	18.4	0.7	0.9	0.6	0.8
	6	232	0.2	13.7	0.0	0.9	0.6	0.8
	7	245	0.8	16.2	0.0	0.7	0.5	0.5
	$\bar{x}$		0.5	14.7	0.3	0.5	0.6	0.5
	8	256	0.8	15.5	1.0	1.6	1.3	1.2
	9	300	0.9	16.7	0.8	2.8	5.1	3.3
	10	278	0.6	15.9	0.8	1.4	1.4	0.9
N	11	343	0.1	10.2	0.9	2.0	1.4	0.3
	12	310	0.0	14.2	0.9	2.0	2.1	2.2
	13	373	0.1	15.2	0.6	0.5	0.5	1.0
	14	254	1.0	14.6	2.2	1.8	1.1	12.6
	$\bar{x}$		0.5	14.6	1.0	1.7	1.8	3.1
	15	246	0.1	9.3	9.9	10.5	13.6	12.8
	16	297	0.2	16.3	0.7	0.8	0.4	2.6
	17	336	0.7	15.1	0.3	0.9	0.6	0.0
S	18	266	0.2	8.3	0.7	1.6	0.2	0.5
	19	295	0.1	16.5	6.6	6.1	17.2	17.8
	20	300	0.0	14.8	0.5	0.1	0.2	1.1
	21	340	0.0	17.9	0.2	0.3	0.2	0.1
	$\bar{x}$		0.2	14.0	2.7	2.9	4.6	5.0
overall	$\bar{X}$	296	0.4	14.4				

(Experiment 1b continued)

Flavour group	Subject	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10	P-Ex	P-Ex
	1	0.5	0.2	0.4	0.0	0.6	0.4	0.3	0.7
	2	0.2	0.2	0.0	0.0	0.1	0.0	0.4	0.9
	3	0.7	0.2	0.3	0.2	0.3	0.1	0.3	0.8
N/S	4	0.3	0.6	0.5	0.2	0.3	0.4	0.6	0.7
	5	0.9	0.5	0.6	0.4	0.4	0.2	0.2	0.3
	6	1.0	1.0	0.1	3.0	0.6	0.9	0.9	0.6
	7	0.5	0.0	0.2	0.0	0.2	0.3	0.3	0.3
	$\bar{x}$	0.6	0.4	0.3	0.5	0.4	0.3	0.4	0.6
	8	1.3	1.7	2.8	9.1	17.8	20.2	0.7	9.1
	9	2.2	3.7	5.6	16.8	18.8	20.5	0.7	5.2
	10	0.7	3.1	10.6	21.8	15.9	21.0	0.8	0.3
N	11	0.6	0.7	0.5	4.3	17.3	21.3	0.4	8.5
	12	3.0	9.7	17.1	9.7	15.4	20.9	0.8	3.9
	13	0.3	0.6	0.8	1.8	12.9	18.3	1.2	15.3
	14	20.7	16.4	21.2	19.5	21.1	20.8	0.3	6.3
	$\bar{x}$	4.1	5.1	8.4	11.9	17.0	20.4	0.7	6.9
	15	11.2	14.0	11.2	14.9	12.7	15.2	0.8	0.3
	16	1.2	4.6	12.9	18.4	19.4	16.0	0.9	5.7
	17	0.2	0.0	0.3	3.4	8.3	12.3	0.6	2.6
S	18	2.0	7.0	10.9	13.4	14.6	16.6	0.6	0.7
	19	14.3	16.2	17.6	19.0	17.3	22.5	4.9	8.7
	20	4.3	9.8	10.1	14.2	11.6	18.9	1.0	8.9
	21	0.1	0.9	1.4	7.8	20.1	22.9	0.1	4.6
	$\bar{x}$	4.8	7.5	9.2	13.0	14.9	17.8	1.3	4.5

EXPERIMENT 1b

RATE OF EXTINCTION INDICES FOR FLAVOUR GROUPS x OVERTRAINING GROUPS

Flavour groups	Subject	Overtraining Group N/S$_1$	N/S$_2$	N/S$_3$	N/S$_6$	N/S$_{10}$
N/S	1	2.99	0.47	0.20	0.08	0.05
	2	2.73	2.14	0.27	0.17	0.02
	3	3.62	0.16	0.12	0.14	0.04
	4	2.61	0.46	0.40	0.60	0.05
	5	2.46	0.14	0.67	0.93	0.07
	6	2.76	0.98	0.25	0.30	0.15
	7	2.41	1.64	0.16	0.18	0.04
	$\bar{x}$	2.80	0.85	0.30	0.34	0.06
N	8	2.62	2.68	1.99	1.64	1.26
	9	2.46	1.58	0.54	1.79	1.60
	10	3.20	2.20	0.36	1.49	1.65
	11	2.76	1.63	1.16	1.00	1.10
	12	2.86	2.11	0.45	1.73	1.66
	13	2.88	1.13	0.22	2.28	0.86
	14	2.72	2.53	1.47	1.80	2.50
	$\bar{x}$	2.79	1.98	0.88	1.68	1.52
S	15	2.59	1.64	0.99	1.99	1.89
	16	2.74	2.15	2.00	1.85	1.61
	17	2.66	1.91	1.37	2.22	0.60
	18	2.96	2.48	1.96	0.67	1.40
	19	2.40	2.28	1.93	1.50	2.51
	20	2.73	2.42	2.00	0.77	1.46
	21	2.84	2.23	2.04	0.50	1.27
	$\bar{x}$	2.70	2.16	1.76	1.36	1.53

APPENDIX 1c

DATA FOR EXPERIMENT 1c

EXPERIMENT 1c

CONSUMPTION MEASURES FOR GROUPS RECEIVING TWO TRIALS WITH N AND S IN SEPARATE BOTTLES

Flavour group	Subject	P-Tr*	b.w.	Tr 1*	P-Tr*	b.w.	(sacc) Tr 2*
	1	17.0	269		17.5	270	7.5
	2	14.1	224	all	13.6	226	2.6
	3	11.3	272	drank	10.8	273	1.1
N/S	4	13.6	285	6 mls	14.1	287	2.2
	5	15.3	304	N +	15.7	303	2.0
	6	14.3	255	6 mls	14.7	259	2.8
	7	14.8	249	S	14.5	250	0.4
	$\bar{x}$	14.3		(12.0)	14.4		2.7
	8	15.4	269		14.4	271	0.8
	9	18.0	302		17.3	300	2.4
	10	15.7	288	"	15.9	291	1.1
N	11	12.7	249		14.3	249	1.3
	12	15.5	242		15.0	239	1.4
	13	6.2	241		10.9	241	1.8
	14	13.6	311		15.6	314	2.4
	$\bar{x}$	13.9		(12.0)	14.8		1.6
	15	12.6	237		10.7	239	1.1
	16	11.9	204	"	14.9	201	2.1
	17	13.9	250		15.9	255	6.5
S	18	14.7	286		13.2	291	1.1
	19	11.3	219		12.5	225	1.8
	20	14.5	250		15.1	249	1.4
	21	12.8	275		16.4	279	0.7
	$\bar{x}$	13.1		(12.0)	14.1		2.1
overall	$\bar{X}$	13.8	261	12.0	14.4	263	2.1

* two bottles presented

(Experiment 1c continued)

Flavour group	Subject	(NaCl) Tr 2*	P-T	Ex 1	Ex 2	Ex 3	Ex 4
	1	6.5	17.3	0.8	0.1	0.6	0.1
	2	4.0	14.1	1.1	1.2	3.5	0.1
	3	2.4	16.3	0.4	0.3	1.2	0.1
N/S	4	2.0	18.7	1.1	0.4	1.0	3.8
	5	4.0	15.2	1.4	3.0	3.6	4.8
	6	5.9	17.6	0.4	0.1	0.3	1.6
	7	1.4	17.8	0.2	0.6	3.8	8.3
	$\bar{x}$	3.7	16.7	0.8	0.8	2.0	2.7
	8	2.6	16.4	1.4	2.8	9.0	17.7
	9	5.7	20.2	9.8	23.7	22.0	21.2
	10	1.4	17.8	2.2	6.0	6.7	10.6
N	11	1.1	12.9	0.5	1.7	9.9	20.3
	12	3.8	15.6	1.1	1.7	0.1	0.1
	13	1.0	4.5	2.0	7.5	17.1	22.4
	14	0.6	15.6	0.9	0.3	0.3	0.2
	$\bar{x}$	2.3	14.7	2.6	6.2	9.3	11.9
	15	0.9	12.6	0.7	3.4	0.1	1.3
	16	4.8	11.6	8.0	17.8	15.8	16.3
	17	7.2	14.1	9.6	23.6	17.3	18.6
S	18	6.3	19.7	5.2	20.1	21.6	9.3
	19	6.6	12.3	5.1	14.0	19.4	18.9
	20	0.8	16.5	0.3	2.3	2.5	0.1
	21	3.5	14.8	0.5	2.3	5.8	0.1
	$\bar{x}$	4.3	14.5	4.2	11.9	11.8	9.2
overall	$\bar{X}$	3.5	15.3				

(Experiment 1c continued)

Flavour group	Subject	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10
	1	3.4	9.7	7.4	17.1	14.8	17.1
	2	11.7	17.8	15.2	18.2	11.6	16.0
	3	3.6	3.8	11.6	16.8	16.2	17.6
N/S	4	6.5	12.2	10.6	13.4	14.1	13.9
	5	8.9	11.7	11.9	14.8	13.9	10.7
	6	6.3	10.7	10.2	11.9	13.2	11.5
	7	12.7	16.1	15.2	13.2	14.0	12.8
	$\bar{x}$	7.6	11.7	11.7	15.1	14.0	14.2
	8	18.0	20.6	21.1	21.1	19.4	19.0
	9	20.0	21.9	19.5	21.9	21.0	21.4
	10	4.2	23.0	15.7	19.2	16.7	13.8
N	11	18.0	20.9	18.9	21.2	21.4	22.1
	12	4.2	11.3	6.9	19.1	19.8	19.6
	13	19.5	25.3	21.3	24.2	23.3	21.5
	14	0.4	0.6	2.3	7.1	15.2	19.5
	$\bar{x}$	12.0	17.7	15.1	19.1	19.5	19.6
	15	8.0	14.5	14.6	16.2	16.0	16.4
	16	16.6	17.7	17.1	19.0	18.0	17.2
	17	14.6	16.6	17.0	17.5	13.2	16.4
S	18	8.1	20.5	18.2	21.8	20.2	22.7
	19	18.6	20.2	18.5	18.1	10.2	16.8
	20	9.5	0.1	2.1	17.6	19.8	17.4
	21	0.0	9.1	1.4	11.2	15.0	13.8
	$\bar{x}$	10.8	14.1	12.7	17.3	16.1	17.2

APPENDIX 2a

DATA FOR EXPERIMENT 2a

EXPERIMENT 2a

CONSUMPTION MEASURES (in mls) FOR FOUR N/S CONDITIONING TRIALS GROUPS ON EXPERIMENTAL DAYS.*

Flavour group	Subject	P-Tr	b.w.	Tr 1	P-Tr	b.w.	Tr 2	P-Tr
	1	10.1	282	16.4	14.6	268	0.6	14.9
	2	12.2	221	6.8	13.2	213	0.7	11.9
	3	16.6	332	14.9	17.3	320	0.4	16.2
N/S	4	12.3	256	16.6	14.5	255	0.7	12.9
	5	15.0	274	14.3	11.4	261	1.3	13.1
	6	15.1	256	17.2	16.6	250	0.6	15.0
	7	15.1	272	15.9	15.3	257	0.8	16.6
	$\bar{x}$	14.0		13.2	14.7		0.7	14.4
	8	14.5	252	14.9	13.9	243	0.5	15.6
	9	14.2	235	14.1	15.2	229	0.8	15.8
	10	16.1	276	13.4	13.9	261	0.7	13.7
N	11	11.3	262	4.5	13.1	249	0.3	12.3
	12	12.5	258	12.8	14.3	244	0.5	12.7
	13	14.7	266	19.8	13.7	258	0.2	14.5
	14	13.4	271	14.4	14.8	261	0.4	13.0
	$\bar{x}$	14.6		13.4	14.1		0.5	13.9
	15	11.7	248	14.3	14.0	229	0.6	13.3
	16	12.3	235	13.8	8.8	218	0.1	10.7
	17	14.0	280	17.2	13.4	274	0.1	11.4
S	18	19.3	300	8.5	17.5	284	0.3	16.2
	19	14.3	235	12.7	11.0	227	0.3	13.1
	20	14.5	295	15.9	13.9	267	0.5	14.8
	21	13.3	276	15.5	14.8	258	0.2	14.6
	$\bar{x}$	13.2		14.0	13.3		0.3	13.4
overall	$\bar{X}$	13.9	266	13.5	14.1	254	0.5	13.9

* Des = desensitization vinegar trial

(Experiment 2a continued)

Flavour group	Subject	b.w.	Tr 3	P-Tr	b.w.	Tr 4	Des	Des
	1	295	0.5	16.3	295	0.3	7.1	16.3
	2	240	0.8	12.6	240	0.5	11.4	10.4
	3	345	0.4	18.1	346	0.4	10.7	5.5
N/S	4	284	1.4	13.7	283	1.1	8.4	13.8
	5	281	0.5	13.8	281	0.7	11.0	13.3
	6	261	0.6	16.6	268	0.7	12.2	15.0
	7	282	0.5	16.4	282	0.2	10.2	13.8
	$\bar{x}$		0.7	15.4		0.6	10.1	12.6
	8	242	0.4	16.1	256	0.4	9.2	13.4
	9	250	0.0	14.0	259	0.3	7.2	9.7
	10	287	0.6	16.5	281	0.5	10.3	15.2
N	11	274	1.1	12.9	279	0.2	7.0	10.7
	12	262	0.9	14.3	254	0.5	12.9	10.6
	13	279	0.2	14.2	282	0.3	8.5	11.6
	14	274	0.4	14.3	275	0.1	5.4	10.8
	$\bar{x}$		0.5	14.6		0.3	8.6	11.7
	15	255	0.6	15.2	252	0.4	8.1	12.0
	16	222	0.4	11.6	227	0.5	10.2	13.6
	17	283	0.2	11.7	298	0.1	8.0	14.2
S	18	290	0.5	18.9	317	0.1	6.3	15.3
	19	231	0.8	15.5	255	0.2	6.8	14.7
	20	259	3.0	13.5	287	0.1	9.6	9.9
	21	266	0.4	17.2	288	0.2	12.8	15.8
	$\bar{x}$		0.8	14.8		0.2	8.8	13.6
overall	$\bar{X}$	270	0.7	14.9	276	0.4	9.2	12.7

(Experiment 2a continued)

Flavour group	Subject	Des	Ex 1	Ex 2	Ex 3	Ex 4	Ex 5	Ex 6
	1	15.4	0.2	0.4	0.3	0.1	0.3	1.0
	2	13.1	0.1	0.3	0.2	0.1	0.1	0.0
	3	18.9	0.4	2.7	4.4	0.8	3.2	1.2
N/S	4	16.5	0.4	1.3	1.4	1.1	1.0	0.5
	5	15.4	0.2	0.3	0.3	0.2	0.2	0.1
	6	16.7	0.4	0.3	0.4	0.1	0.1	0.3
	7	17.2	0.2	0.2	0.2	0.1	0.2	0.3
	$\bar{x}$	16.2	0.3	0.8	1.0	0.4	0.7	0.5
	8	13.5	0.4	0.4	2.8	16.1	14.2	18.2
	9	16.3	1.1	0.7	1.7	2.0	1.0	6.1
	10	17.4	0.1	0.3	0.9	5.7	5.9	16.9
N	11	14.5	0.2	0.5	1.5	1.3	3.4	19.2
	12	13.2	0.4	0.2	1.2	4.4	7.7	14.0
	13	16.8	0.6	0.9	1.0	1.1	0.3	1.7
	14	13.3	1.5	0.7	2.0	1.3	1.4	5.4
	$\bar{x}$	15.0	0.6	0.5	1.6	4.6	4.8	11.6
	15	16.2	0.3	0.4	0.5	1.2	5.1	11.2
	16	12.4	0.4	4.8	5.8	13.4	12.4	18.0
	17	12.6	0.0	3.0	2.7	8.3	1.8	3.2
S	18	17.9	0.1	0.3	0.3	0.7	7.8	15.8
	19	14.4	0.0	0.4	2.1	5.7	10.5	14.0
	20	14.7	1.4	0.1	7.2	12.3	13.5	15.3
	21	18.6	0.0	0.3	0.2	1.7	8.8	10.6
	$\bar{x}$	15.2	0.3	1.3	2.7	6.2	8.6	12.6
overall	$\bar{X}$	15.5						

(Experiment 2a continued)

Flavour group	Subject	Ex 7	Ex 8	Ex 9	Ex 10	P-Ex	P-Ex
	1	0.1	0.4	0.4	0.4	0.8	0.9
	2	0.0	0.5	0.5	0.5	2.0	7.5
	3	1.6	4.6	12.3	21.2	12.1	21.6
N/S	4	1.3	1.0	1.1	0.4	0.3	0.5
	5	0.5	1.2	0.0	4.1	6.6	16.1
	6	0.1	0.2	0.2	0.1	0.2	0.2
	7	0.9	5.4	15.3	12.3	14.9	12.6
	$\bar{x}$	0.6	1.9	4.3	5.6	5.3	8.5
	8	18.0	11.6	17.9	17.3	19.6	21.2
	9	3.1	0.6	1.7	5.0	1.1	5.2
	10	15.7	14.5	19.1	14.5	1.5	9.5
N	11	19.8	17.7	19.4	20.4	3.9	22.6
	12	15.0	12.4	11.8	16.6	1.3	3.9
	13	0.4	0.2	0.9	5.2	2.0	11.1
	14	13.1	11.6	13.6	12.0	6.0	10.8
	$\bar{x}$	12.2	9.8	12.1	12.9	0.9	12.0
	15	0.1	14.8	8.6	0.1	0.6	11.9
	16	19.5	16.7	20.2	20.8	0.6	11.6
	17	16.5	0.1	0.0	1.4	3.0	13.7
S	18	15.0	14.0	17.5	17.9	0.6	10.7
	19	12.5	13.3	15.1	17.5	0.4	10.8
	20	0.0	0.0	15.6	18.6	0.8	4.4
	21	13.4	8.2	13.9	14.0	0.3	15.9
	$\bar{x}$	11.0	9.6	13.0	13.0	5.1	11.3

CONSUMPTION MEASURES (in mls) FOR SIX N/S CONDITIONING TRIALS GROUPS

Flavour group	Subject	P-Tr	b.w.	Tr 1	P-Tr	b.w.	Tr 2	P-Tr
	1	10.7	290	15.9	16.8	298	2.7	3.8
	2	8.6	255	16.7	10.0	254	1.8	10.5
	3	10.6	291	3.3	14.1	295	0.6	0.0
N/S	4	9.5	230	3.9	10.2	225	3.5	14.0
	5	3.6	279	18.9	12.7	294	5.8	15.7
	6	13.6	277	15.4	13.9	289	3.9	14.3
	7	10.1	237	1.9	14.1	239	0.0	0.0#
	$\bar{x}$	9.5		10.9	13.1		2.6	8.3
	8	7.6	269	17.3	15.6	282	3.6	20.3
	9	11.8	254	13.0	15.0	261	5.1	17.0
	10	11.8	301	1.2	10.6	308	1.6	13.7
N	11	12.8	260	15.6	12.4	271	2.4	13.5
	12	19.0	281	0.9	17.8	290	0.5	0.0#
	13	12.4	283	9.6	10.0	281	2.7	0.0#
	14	13.7	259	1.0	13.4	260	1.2	16.0
	$\bar{x}$	12.7		8.4	13.5		2.4	11.5
	15	11.6	260	9.6	13.0	270	4.4	12.8
	16	9.7	308	6.9	13.9	322	0.7	15.8
	17	18.4	300	13.5	15.1	312	2.2	12.4
S	18	12.4	225	2.9	12.4	226	1.7	0.1#
	19	12.5	245	12.0	9.7	255	3.2	12.6
	20	8.8	270	13.1	12.9	271	2.8	0.0#
	21	12.3	289	13.0	11.8	294	1.0	0.0#
	$\bar{x}$	12.2		10.1	12.7		2.3	7.7
overall	$\bar{X}$	11.5	270	9.8	13.1	276	2.5	9.2

air blockages

(Experiment 2a continued)

Flavour group	Subject	b.w.	Tr 3	P-Tr	b.w.	Tr 4	P-Tr	b.w.
	1	303	0.2	17.2	325	0.1	15.2	331
	2	263	0.0	11.4	258	0.0	10.3	249
	3	287	0.5	14.7	300	0.0	17.4	303
N/S	4	239	2.3	13.1	243	0.1	12.4	248
	5	311	1.7	16.8	326	0.4	16.7	332
	6	296	1.4	11.6	299	0.2	12.5	297
	7	230	0.0	15.6	243	0.1	16.7	252
	$\bar{x}$		0.9	14.3		0.1	14.5	
	8	292	0.0	18.4	292	0.0	20.0	294
	9	272	1.0	13.7	274	0.1	14.7	276
	10	313	0.2	12.9	325	0.1	15.0	328
N	11	277	1.0	13.7	281	0.1	16.0	287
	12	281	0.6	18.7	292	0.0	19.7	296
	13	274	0.1	9.3	290	0.2	12.1	294
	14	269	0.0	11.6	265	0.2	17.9	267
	$\bar{x}$		0.4	14.0		0.1	16.5	
	15	272	1.2	14.3	293	0.4	14.9	298
	16	330	0.1	15.6	341	0.6	17.1	347
	17	315	0.0	15.3	320	0.3	13.3	329
S	18	210	0.0	10.7	202	1.0	12.2	221
	19	261	0.2	11.3	268	0.1	13.3	271
	20	266	0.7	14.6	287	0.2	14.8	295
	21	280	0.0	6.5	299	0.3	12.0	299
	$\bar{x}$		0.3	12.6		0.4	13.9	
overall	$\bar{X}$	278	0.5	13.7	287	0.2	15.0	291

(Experiment 2a continued)

Flavour group	Subject	Tr 5	P-Tr	b.w.	Tr 6	Des	Des	Des
	1	0.0	14.0	352	0.2	7.7	13.8	11.6
	2	0.2	10.2	269	0.1	9.3	8.6	11.4
	3	0.0	15.3	305	0.2	11.1	10.6	10.8
N/S	4	0.1	10.9	254	0.4	8.6	11.2	9.4
	5	0.0	15.9	351	0.7	9.9	13.3	14.3
	6	0.1	9.8	306	0.2	10.8	13.8	12.9
	7	0.0	14.8	255	0.0	11.8	11.0	8.2
	$\bar{x}$	0.3	13.0		0.3	9.9	11.8	11.2
	8	0.1	17.3	299	0.1	10.0	16.7	19.1
	9	0.0	14.4	284	0.1	9.4	13.9	7.3
	10	0.4	13.9	343	0.3	7.1	12.7	11.6
N	11	0.2	14.5	290	0.4	12.2	12.6	12.0
	12	0.5	19.7	284	0.0	19.0	20.4	21.9
	13	0.2	12.5	308	0.2	9.9	11.0	10.0
	14	0.1	14.5	275	0.0	5.3	11.2	7.3
	$\bar{x}$	0.2	15.3		0.2	10.4	14.1	12.7
	15	0.0	13.4	306	0.4	9.5	13.1	14.3
	16	0.9	14.9	364	0.2	7.3	10.6	13.3
	17	0.6	10.2	354	0.1	9.3	11.2	15.9
S	18	0.0	13.0	231	0.1	9.7	10.9	13.8
	19	0.0	12.0	277	0.5	7.5	9.6	11.9
	20	0.1	11.7	303	0.4	10.9	10.6	14.0
	21	0.2	10.6	289	0.0	5.9	9.1	10.2
	$\bar{x}$	0.1	12.3		0.2	8.6	10.7	13.3
overall	$\bar{X}$	0.2	13.5	300	0.2	9.6	12.2	12.4

(Experiment 2a continued)

Flavour group	Subject	Des	Ex 1	Ex 2	Ex 3	Ex 4	Ex 5	Ex 6
	1	17.0	0.0	0.3	0.6	0.7	0.5	0.4
	2	13.0	0.7	0.4	0.2	0.5	0.4	3.8
	3	17.2	0.2	0.3	0.2	0.9	0.6	0.6
N/S	4	12.9	0.4	2.4	0.5	0.5	0.6	0.8
	5	15.6	0.4	0.3	0.5	0.9	0.6	0.6
	6	10.8	0.6	0.2	0.3	0.4	0.7	0.7
	7	18.4	0.0	0.1	0.0	0.3	0.1	0.1
	$\bar{x}$	15.0	0.3	0.6	0.3	0.6	0.5	1.0
	8	20.0	0.6	0.3	0.8	1.0	3.2	10.2
	9	13.1	0.5	0.8	1.0	1.6	7.4	12.5
	10	18.5	0.6	0.5	0.5	0.5	0.8	0.8
N	11	16.3	1.4	1.5	3.8	3.1	4.4	4.0
	12	16.8	1.1	0.7	1.1	2.6	5.0	8.2
	13	12.6	1.3	2.0	1.1	1.5	0.7	2.0
	14	18.0	1.2	0.8	2.8	1.0	1.0	4.3
	$\bar{x}$	16.5	1.0	0.9	1.6	1.6	3.2	6.0
	15	14.0	0.2	0.1	1.1	17.1	10.8	14.2
	16	18.1	4.9	9.7	13.6	18.3	15.6	12.4
	17	17.8	1.4	0.1	0.5	0.7	3.9	10.7
S	18	15.5	5.0	11.3	12.7	14.7	5.2	11.0
	19	10.0	0.2	0.2	0.3	0.7	6.6	12.2
	20	15.1	1.7	0.1	0.3	3.1	10.8	14.7
	21	11.5	1.1	2.2	11.2	12.4	14.4	13.5
	$\bar{x}$	14.6	2.1	3.4	5.7	9.6	9.6	12.7
overall	$\bar{X}$	15.4						

(Experiment 2a continued)

Flavour group	Subject	Ex 7	Ex 8	Ex 9	Ex 10	P-Ex	P-Ex
	1	0.4	0.5	0.0	0.9	0.2	1.0
	2	6.1	10.0	9.1	10.8	0.3	8.3
	3	0.1	0.1	0.0	0.7	0.3	0.4
N/S	4	0.3	0.5	0.9	2.1	2.6	4.3
	5	0.5	0.5	0.4	0.8	1.5	4.1
	6	0.6	0.1	0.2	1.1	0.8	1.0
	7	3.4	7.8	11.0	17.8	16.7	17.7
	$\bar{x}$	1.6	2.8	3.1	4.9	3.2	5.3
	8	21.9	19.6	18.5	17.1	0.4	8.5
	9	13.7	14.5	14.8	15.9	0.3	11.6
	10	1.1	2.5	2.3	10.3	0.2	2.5
N	11	4.7	5.2	4.0	1.4	0.5	3.6
	12	14.1	18.6	18.0	15.5	10.1	21.4
	13	2.7	5.4	11.1	14.7	0.6	1.5
	14	12.5	16.8	14.1	13.6	1.0	5.8
	$\bar{x}$	10.1	11.8	11.8	12.6	1.9	7.8
	15	15.8	16.6	14.1	14.6	16.9	4.5
	16	11.8	17.9	19.1	18.6	0.5	3.5
	17	15.0	16.3	14.0	18.0	0.4	0.7
S	18	12.3	12.7	11.7	15.0	0.4	0.3
	19	13.5	14.4	12.6	16.5	0.7	6.9
	20	13.5	16.7	15.1	15.8	0.0	0.3
	21	13.7	14.5	14.4	14.5	0.0	1.2
	$\bar{x}$	13.7	15.6	14.4	16.1	2.7	2.5

CONSUMPTION MEASURES (in mls) FOR TEN N/S CONDITIONING TRIALS GROUPS

Flavour group	Subject	P-Tr	b.w.	Tr 1	P-Tr	b.w.	Tr 2	P-Tr
	1	12.6	250	15.8	14.3	253	3.3	16.1
	2	10.6	253	14.4	12.0	256	4.4	0.4#
	3	10.1	269	9.8	13.9	274	2.4	14.1
N/S	4	11.4	217	23.0	13.4	241	1.0	17.5
	5	11.5	259	13.2	13.2	264	2.1	13.5
	6	10.6	274	0.8	7.8	282	0.8	14.6
	7	11.0	254	17.3	11.0	268	5.4	15.4
	$\bar{x}$	11.1		13.5	12.2		2.8	13.1
	8	9.8	225	12.9	6.5	207	3.7	0.0#
	9	6.1	258	17.8	14.1	261	2.8	16.6
	10	11.9	267	14.6	14.0	279	9.0	12.2
N	11	11.6	218	6.2	14.2	233	2.8	14.0
	12	10.6	243	14.1	10.1	260	6.0	0.8#
	13	13.0	270	14.5	15.1	269	1.8	11.7
	14	15.2	293	1.3	13.5	304	6.6	15.5
	$\bar{x}$	11.2		11.6	12.5		4.7	10.2
	15	11.8	261	9.7	14.3	273	4.0	17.3
	16	11.5	255	7.2	10.9	266	1.0	13.0
	17	10.7	241	12.8	10.8	240	6.0	3.3
S	18	8.1	278	18.6	15.3	294	7.0	0.0#
	19	9.3	250	1.0	10.9	258	1.2	13.7
	20	11.6	214	14.1	7.7	220	5.9	0.2#
	21	10.4	260	3.7	10.7	251	0.7	0.0#
	$\bar{x}$	10.5		9.6	11.5		3.7	6.9
overall	$\bar{X}$	10.9	253	11.6	12.1	260	3.7	10.0

air blockages

(Experiment 2a continued)

Flavour group	Subject	b.w.	Tr 3	P-Tr	b.w.	Tr 4	P-Tr	b.w.
	1	260	0.7	12.1	257	0.1	16.3	265
	2	242	0.6	13.0	249	0.1	14.3	253
	3	280	1.3	15.1	288	0.6	15.7	292
N/S	4	248	0.0	16.7	259	0.0	14.1	260
	5	269	0.7	9.8	270	0.8	12.5	263
	6	291	0.2	12.7	297	0.2	13.7	298
	7	275	0.2	11.5	281	0.3	15.2	284
	$\bar{x}$		0.5	13.0		0.3	14.5	
	8	214	0.8	0.0	236	0.4	12.2	240
	9	268	0.1	16.5	259	0.1	14.6	258
	10	285	0.7	14.6	295	0.6	16.6	297
N	11	244	0.8	14.1	255	0.6	13.6	258
	12	252	0.8	9.9	265	0.4	12.1	271
	13	282	1.0	13.6	296	0.5	15.0	300
	14	308	0.7	13.6	319	0.7	14.4	311
	$\bar{x}$		0.7	11.8		0.5	14.1	
	15	285	3.5	14.8	292	0.2	17.2	293
	16	236	0.5	11.4	290	0.1	13.4	287
	17	287	0.7	12.8	235	0.2	12.4	233
S	18	265	0.1	12.9	308	0.4	19.3	311
	19	278	0.1	11.3	276	0.0	11.7	270
	20	179	0.3	12.0	172	0.5	12.3	160
	21	222	0.3	16.1	238	0.1	13.1	240
	$\bar{x}$		0.8	13.0		0.2	14.2	
overall	$\bar{X}$	260	0.7	12.6	268	0.3	14.3	269

(Experiment 2a continued)

Flavour group	Subject	Tr 5	P-Tr	b.w.	Tr 6	P-Tr	b.w.	Tr 7
	1	0.2	13.5	269	0.4	13.9	276	0.2
	2	0.3	11.7	265	0.2	12.6	278	0.3
	3	0.3	14.4	298	0.2	15.2	302	0.2
N/S	4	0.9	14.9	278	0.5	14.3	291	0.0
	5	0.4	9.8	272	0.5	9.8	277	0.0
	6	0.7	11.9	311	0.4	10.1	297	0.2
	7	0.6	13.9	293	0.2	13.9	298	0.3
	$\bar{x}$	0.5	12.9		0.3	12.8		0.2
	8	0.2	9.8	266	0.3	15.5	249	0.1
	9	0.5	14.0	273	0.2	14.1	288	0.0
	10	0.0	13.7	310	0.4	13.8	317	0.7
N	11	0.3	11.4	267	0.4	10.7	272	0.1
	12	0.3	12.4	284	0.2	6.7	291	0.1
	13	0.1	13.3	313	0.4	14.4	324	0.1
	14	0.1	14.1	337	0.2	13.6	344	0.1
	$\bar{x}$	0.2	12.7		0.3	12.7		0.2
	15	0.2	11.5	302	0.9	12.2	314	0.0
	16	0.1	13.6	306	1.1	12.2	303	0.4
	17	0.4	11.5	243	0.3	14.4	247	0.2
S	18	0.3	14.4	327	0.4	14.8	331	0.0
	19	0.2	10.6	290	0.3	9.0	297	0.2
	20	0.5	12.3	165	0.2	14.9	170	0.7
	21	0.4	16.1	266	0.4	15.3	270	0.0
	$\bar{x}$	0.3	12.9		0.5	13.3		0.2
overall	$\bar{X}$	0.3	12.8	283	0.4	12.9	287	0.2

(Experiment 2a continued)

Flavour group	Subject	P-Tr	b.w.	Tr 8	P-Tr	b.w.	Tr 9	P-Tr
	1	13.2	284	0.4	14.2	290	0.2	14.7
	2	12.7	278	0.0	13.4	280	0.1	13.7
	3	15.0	308	0.1	15.9	310	0.1	13.0
N/S	4	14.2	292	0.4	14.7	297	0.2	14.4
	5	0.0	270	0.0	12.7	280	0.1	11.5
	6	13.1	305	0.3	11.5	313	0.2	14.2
	7	13.0	301	0.2	15.1	305	0.1	13.6
	$\bar{x}$	11.6		0.2	13.9		0.1	13.6
	8	16.6	248	0.0	13.7	267	0.0	12.1
	9	14.4	281	0.0	12.2	289	0.1	14.1
	10	15.6	316	0.4	13.9	316	0.1	14.9
N	11	11.9	268	0.1	10.3	262	0.3	12.2
	12	10.4	292	0.5	12.2	296	0.0	10.7
	13	14.5	322	0.3	13.8	326	0.0	14.8
	14	14.9	343	0.0	10.0	344	0.5	14.4
	$\bar{x}$	14.0		0.2	12.3		0.1	13.3
	15	17.9	308	0.6	14.2	311	0.6	18.3
	16	14.7	303	0.3	15.0	308	0.4	13.1
	17	9.1	251	0.4	11.6	261	0.5	13.3
S	18	13.9	330	0.0	15.1	332	0.1	13.6
	19	11.0	293	0.2	12.1	294	0.2	11.1
	20	12.3	170	2.5	11.5	180	0.1	11.6
	21	12.3	269	0.0	12.0	274	0.1	16.5
	$\bar{x}$	13.0		0.6	13.1		0.3	13.9
overall	$\bar{X}$	12.9	287	0.3	13.1	292	0.2	13.6

(Experiment 2a continued)

Flavour group	Subject	b.w.	Tr 10	Des	Des	Des	Des	Des
	1	305	0.2	6.9	10.4	10.6	9.8	13.6
	2	288	0.0	5.7	11.7	10.5	11.1	12.7
	3	325	0.1	5.0	13.5	11.9	15.3	14.0
N/S	4	308	0.2	6.6	10.6	12.1	12.7	14.2
	5	291	0.3	9.4	4.0	13.5	0.0	11.9
	6	307	0.4	11.2	3.5	12.7	14.0	15.2
	7	321	0.5	12.8	12.4	14.6	12.8	12.7
	$\bar{x}$		0.2	8.2	9.4	12.3	10.8	13.5
	8	293	0.6	12.9	14.2	13.7	0.0	14.4
	9	306	0.1	5.4	15.0	0.0	14.6	14.3
	10	330	0.5	13.6	13.5	3.8	14.4	14.6
N	11	280	0.5	11.2	11.4	5.1	13.9	12.4
	12	314	0.2	4.2	10.7	12.4	9.8	12.4
	13	338	0.5	7.2	7.1	12.3	11.5	13.8
	14	364	0.7	11.1	10.3	10.3	13.0	11.3
	$\bar{x}$		0.4	9.4	11.7	8.2	11.0	13.3
	15	326	4.2	8.6	13.6	11.0	12.0	15.9
	16	320	0.6	12.3	14.7	14.5	5.9	11.2
	17	281	0.4	4.9	12.0	10.7	7.8	13.9
S	18	337	0.6	11.7	12.2	13.9	13.9	12.7
	19	313	0.6	9.3	10.8	12.0	11.6	11.7
	20	214	0.8	1.6	0.0	10.0	12.7	11.5
	21	295	0.2	7.6	11.3	12.0	12.1	11.6
	$\bar{x}$		1.1	8.0	10.7	12.0	10.9	12.6
Overall	$\bar{X}$	307	0.6	8.5	10.6	10.8	10.9	13.1

(Experiment 2a continued)

Flavour group	Subject	Des	Ex 1	Ex 2	Ex 3	Ex 4	Ex 5	Ex 6
N/S	1	10.9	0.3	0.0	0.3	0.1	1.4	2.7
	2	11.6	0.2	0.1	0.2	0.1	0.5	0.3
	3	16.0	0.4	0.1	0.4	0.2	0.7	0.5
	4	13.0	0.2	0.1	0.3	0.3	2.3	1.3
	5	10.8	0.3	0.3	0.4	0.3	1.0	1.0
	6	14.4	0.2	0.2	0.5	1.5	1.5	0.7
	7	13.9	0.4	0.5	0.4	0.3	0.7	0.3
	$\bar{x}$	12.9	0.3	0.2	0.4	0.4	1.2	1.0
N	8	13.1	1.1	1.0	3.4	5.2	12.6	16.0
	9	14.7	1.0	16.2	21.5	17.2	16.4	17.3
	10	11.9	5.9	4.8	12.1	20.8	19.0	17.6
	11	14.7	0.8	1.6	3.8	12.3	17.8	16.0
	12	11.3	1.0	2.9	9.9	15.1	14.3	15.1
	13	13.0	0.9	0.7	0.5	1.7	8.1	14.5
	14	10.4	1.6	1.3	2.9	3.7	13.4	17.7
	$\bar{x}$	12.7	1.8	4.1	7.7	10.9	14.5	16.3
S	15	12.0	1.4	0.8	1.4	7.8	16.3	18.2
	16	15.0	0.6	0.7	8.1	11.6	14.0	16.0
	17	12.0	1.2	7.6	9.4	13.2	17.7	13.0
	18	14.3	1.2	4.8	10.2	15.5	17.0	16.2
	19	12.8	1.5	1.3	7.7	12.4	13.7	13.2
	20	13.2	11.4	12.5	12.2	11.3	14.9	12.7
	21	11.9	0.6	14.7	17.5	18.7	19.2	19.2
	$\bar{x}$	13.0	2.6	6.1	9.5	12.9	16.1	15.5
overall	$\bar{X}$	12.9						

(Experiment 2a continued)

Flavour group	Subject	Ex 7	Ex 8	Ex 9	Ex 10	P-Ex	P-Ex
	1	0.1	0.0	0.6	0.4	0.3	1.1
	2	0.1	0.1	0.2	0.0	0.1	0.8
	3	0.0	0.4	0.3	0.1	0.5	0.4
N/S	4	1.2	0.4	0.4	0.4	0.7	0.8
	5	0.0	0.5	0.3	0.5	1.1	0.6
	6	0.3	0.6	1.0	0.6	0.2	1.0
	7	0.0	0.5	0.5	0.0	0.4	1.3
	$\bar{x}$	0.2	0.4	0.5	0.3	0.5	0.9
	8	19.6	18.8	17.6	20.5	2.6	18.1
	9	17.9	17.7	15.4	17.1	0.0	0.2
	10	20.7	19.0	22.4	21.9	4.3	21.1
N	11	19.3	15.7	18.5	16.7	0.0	2.7
	12	17.7	16.4	15.8	20.7	0.2	4.9
	13	14.6	15.3	12.9	17.0	0.8	2.6
	14	18.6	20.2	13.7	19.6	1.2	5.2
	$\bar{x}$	18.3	17.6	16.6	19.1	1.3	7.8
	15	17.1	20.8	17.9	20.9	0.3	0.3
	16	13.3	16.5	18.6	18.4	0.7	7.7
	17	17.0	15.4	18.1	17.1	0.5	2.2
S	18	17.3	16.1	17.1	17.0	0.5	5.0
	19	15.1	14.0	18.1	13.5	1.1	5.4
	20	13.0	10.3	16.1	12.3	2.2	12.0
	21	19.3	15.8	12.0	17.3	0.4	0.9
	$\bar{x}$	16.0	15.6	16.8	16.6	0.8	4.8

CONSUMPTION MEASURES (in mls) FOR TEN N/S NONREINFORCED TRIALS GROUPS

Flavour group	Subject	P-Tr	b.w.	"Tr 1"	P-Tr	b.w.	"Tr 2"	P-Tr
	1	10.9	227	7.9	12.9	235	17.3	11.1
	2	13.2	232	7.6	11.2	247	14.7	11.5
	3	10.9	195	8.9	12.9	201	11.5	9.1
N/S	4	11.3	206	8.5	11.2	218	13.0	10.7
	5	8.9	191	7.9	8.2	189	10.7	6.8
	6	11.7	209	10.6	13.8	219	14.2	11.2
	7	8.8	201	12.7	11.8	213	9.6	8.1
	$\bar{x}$	10.8		9.2	11.7		13.0	9.8
	8	11.9	202	10.1	12.2	219	13.3	11.7
	9	13.9	236	17.2	14.5	250	13.9	11.8
	10	11.9	228	14.9	13.7	235	13.2	13.6
N	11	13.5	279	16.9	14.4	288	21.2	12.1
	12	10.7	260	12.0	10.4	275	15.1	9.9
	13	10.0	201	1.0	13.2	207	13.2	8.1
	14	14.3	260	16.7	12.3	267	17.2	12.6
	$\bar{x}$	12.3		12.7	13.0		15.3	11.4
	15	11.0	267	7.2	12.9	277	14.1	9.2
	16	12.5	253	7.6	12.7	256	17.7	10.6
	17	11.5	224	6.6	12.4	231	14.4	11.4
S	18	13.7	245	11.9	13.8	252	14.0	11.1
	19	10.0	249	7.7	10.5	270	14.6	11.0
	20	15.4	272	14.7	18.5	289	19.2	15.6
	21	16.4	277	3.0	15.2	288	18.5	14.7
	$\bar{x}$	12.9		8.4	13.7		16.1	11.9
overall	$\bar{X}$	12.0	234	10.1	12.8	244	14.8	11.0

(Experiment 2a continued)

Flavour group	Subject	b.w.	"Tr 3"	P-Tr	b.w.	"Tr 4"	P-Tr	b.w.
	1	252	8.6	10.2	267	24.5	15.0	262
	2	263	16.0	11.3	277	19.3	13.8	270
	3	210	12.9	12.6	223	17.4	11.0	212
N/S	4	237	16.0	11.8	257	20.1	15.1	245
	5	194	8.9	8.5	196	11.9	8.9	176
	6	228	17.1	11.1	226	17.7	13.2	227
	7	226	15.7	8.1	241	19.7	10.7	235
	$\bar{x}$		13.6	10.5		18.7	12.5	
	8	232	13.9	10.0	243	15.3	13.7	233
	9	263	19.1	12.3	260	21.4	5.3	258
	10	241	17.5	10.2	248	16.7	13.3	233
N	11	299	24.2	12.5	315	25.0	15.1	303
	12	275	19.0	10.3	290	19.2	12.5	280
	13	217	16.2	10.0	231	17.6	13.8	221
	14	282	20.1	11.0	294	20.6	16.4	284
	$\bar{x}$		18.6	10.9		19.4	12.9	
	15	283	12.5	13.9	294	20.8	14.3	276
	16	261	18.2	12.6	263	20.1	15.3	257
	17	245	16.9	12.4	260	12.8	13.7	232
S	18	261	18.9	13.2	276	13.2	14.4	266
	19	291	16.7	11.7	311	17.7	11.8	294
	20	301	19.9	16.1	309	18.8	18.2	294
	21	302	23.1	16.9	315	22.4	17.8	306
	$\bar{x}$		18.0	13.8		18.0	15.1	
overall	$\bar{X}$	255	16.7	11.8	266	18.7	13.5	255

(Experiment 2a continued)

Flavour group	Subject	"Tr 5"	P-Tr	b.w.	"Tr 6"	P-Tr	b.w.	"Tr 7"
	1	21.8	14.9	280	21.8	11.9	289	20.1
	2	23.3	12.9	298	16.6	13.0	306	19.6
	3	16.7	12.1	225	16.3	10.5	230	14.9
N/S	4	20.7	13.4	266	18.7	13.6	278	17.3
	5	17.4	9.7	189	12.5	10.1	191	11.9
	6	19.5	13.5	251	18.1	11.8	261	19.3
	7	21.4	11.5	257	17.6	8.8	263	17.1
	$\bar{x}$	20.1	12.6		17.4	11.4		17.2
	8	18.7	13.7	245	13.8	14.5	250	15.3
	9	21.6	14.3	288	19.2	13.5	292	22.1
	10	16.7	11.4	253	15.9	12.7	258	15.6
N	11	22.2	15.8	319	22.1	14.9	323	23.7
	12	18.2	13.7	300	18.3	12.2	308	19.5
	13	18.1	11.1	235	17.8	10.8	243	16.9
	14	20.6	13.2	311	19.6	8.6	321	19.9
	$\bar{x}$	19.4	13.3		18.1	12.5		19.0
	15	17.3	13.1	294	13.4	14.3	311	10.1
	16	20.2	8.7	281	15.9	15.5	291	20.5
	17	18.3	0.5	231	9.1	9.6	223	8.9
S	18	22.8	15.2	287	11.8	15.8	295	10.4
	19	13.4	10.5	329	14.9	10.3	339	16.6
	20	16.3	16.0	314	11.1	16.7	317	21.0
	21	25.6	16.7	330	5.0	11.5	334	24.0
	$\bar{x}$	19.1	11.5		11.6	13.4		15.9
overall	$\bar{X}$	19.6	12.5	275	15.7	12.4	282	17.4

(Experiment 2a continued)

Flavour group	Subject	P-Tr	b.w.	"Tr 8"	P-Tr	b.w.	"Tr 9"	P-Tr
	1	10.8		19.7	14.7	288	11.8	13.4
	2	12.8		19.7	15.2	311	18.3	14.8
	3	9.5	data	14.0	12.1	227	11.7	11.4
N/S	4	14.2	missing	19.3	14.7	278	19.5	14.2
	5	10.8		14.1	10.3	190	11.9	9.0
	6	13.2		17.4	13.7	259	15.6	14.2
	7	11.5		19.4	10.5	261	18.7	13.1
	$\bar{x}$	11.8		17.7	13.0		15.4	12.9
	8	13.0		15.4	14.9	249	15.0	12.8
	9	7.4		21.6	14.6	278	18.2	12.9
	10	10.6		15.8	10.6	255	16.0	10.4
N	11	13.8		14.7	13.6	320	20.5	14.9
	12	12.4		19.7	13.7	302	20.3	10.6
	13	13.9		17.4	12.8	237	17.5	12.5
	14	13.1		20.6	5.4	308	21.3	12.2
	$\bar{x}$	12.0		17.9	12.2		18.4	12.3
	15	12.3		22.2	12.9	305	9.5	14.1
	16	13.0		22.1	11.3	288	19.5	14.2
	17	13.0		20.9	10.4	238	18.4	12.2
S	18	16.0		19.0	13.8	285	18.7	15.1
	19	11.2		12.6	10.6	334	15.5	8.0
	20	17.2		20.2	15.6	312	17.3	17.0
	21	18.1		23.2	19.9	322	23.4	15.8
	$\bar{x}$	14.4		20.0	13.5		17.5	13.8
overall	$\bar{X}$	12.8	280	18.5	12.9	278	17.1	13.0

(Experiment 2a continued)

Flavour group	Subject	b.w.	"Tr 10"	"Des"	"Des"	"Des"	"Des"	"Des"
	1	308	21.1	11.4	12.0	16.1	14.9	15.5
	2	327	18.3	12.9	16.3	16.4	17.4	14.8
	3	236	13.4	9.5	12.6	10.3	15.0	16.4
N/S	4	299	21.4	10.4	16.7	15.9	15.7	15.9
	5	199	14.1	10.7	10.3	16.0	16.2	14.4
	6	270	14.4	10.6	13.3	13.3	13.8	13.8
	7	278	11.4	15.6	15.8	14.1	15.2	18.5
	$\bar{x}$		16.3	11.6	13.9	14.6	15.5	15.6
	8	264	16.0	12.8	16.6	14.7	19.1	18.3
	9	286	9.1	15.6	17.6	17.1	17.2	18.3
	10	276	18.9	10.7	16.2	16.0	12.4	14.4
N	11	341	23.9	12.1	15.8	12.9	16.9	17.9
	12	318	20.8	12.8	17.6	12.5	16.1	18.5
	13	254	19.3	11.7	15.3	18.2	15.3	14.7
	14	337	21.1	13.6	19.6	15.2	19.5	17.7
	$\bar{x}$		18.4	12.8	17.0	15.2	16.6	17.1
	15	325	23.1	9.5	16.7	16.5	16.1	17.6
	16	302	8.7	15.6	16.8	16.8	18.3	14.0
	17	269	20.2	13.9	14.4	17.9	15.1	16.9
S	18	308	20.8	14.0	16.3	16.7	16.6	18.4
	19	347	18.1	10.7	14.3	14.8	14.8	13.1
	20	326	18.8	19.5	20.2	19.2	20.6	20.9
	21	323	11.0	16.7	19.3	18.7	19.5	20.5
	$\bar{x}$		17.2	14.3	16.9	17.2	17.3	17.3
overall	$\bar{X}$	295	17.3	12.9	15.9	15.7	16.5	16.7

(Experiment 2a continued)

Flavour group	Subject	"Des"	Ex 1	Ex 2	Ex 3	Ex 4	Ex 5	Ex 6
	1	13.8	22.3	21.5	23.8	22.9	20.3	24.0
	2	14.6	20.4	16.7	19.1	20.3	17.3	20.0
	3	15.3	12.7	14.9	12.3	15.5	12.9	21.2
N/S	4	14.8	20.6	20.0	23.0	24.1	20.1	25.9
	5	12.2	16.6	19.8	14.2	13.3	8.5	16.9
	6	17.1	16.9	25.6	20.3	20.1	17.8	21.9
	7	13.1	19.2	20.6	19.2	19.9	18.6	21.6
	$\bar{x}$	14.4	18.4	19.9	18.8	19.4	16.5	21.6
	8	15.9	16.8	16.4	17.6	15.6	17.4	14.4
	9	17.1	6.8	19.7	21.8	18.2	21.0	15.7
	10	13.6	13.9	16.0	16.4	14.4	18.1	12.2
N	11	16.0	14.7	23.7	22.1	22.4	18.6	17.9
	12	16.1	17.9	19.5	22.2	18.6	19.4	15.7
	13	15.0	16.5	0.6	16.9	17.8	17.7	16.6
	14	18.7	15.5	17.6	23.2	18.4	19.2	20.7
	$\bar{x}$	16.1	14.6	16.2	20.0	17.9	18.8	16.2
	15	13.1	11.4	19.1	20.5	18.7	19.4	15.4
	16	15.0	1.0	19.2	20.0	19.1	18.1	16.9
	17	15.0	17.8	14.8	22.0	20.8	18.9	19.9
S	18	16.6	8.3	2.5	20.5	19.9	13.3	17.3
	19	15.4	12.8	13.9	17.4	17.8	15.5	16.7
	20	20.9	12.7	18.0	21.2	16.6	20.2	18.0
	21	19.4	9.7	20.2	24.2	24.0	23.2	21.2
	$\bar{x}$	16.5	10.5	15.4	20.8	19.6	18.4	17.9
overall	$\bar{\bar{x}}$	15.7						

(Experiment 2a continued)

Flavour group	Subject	Ex 7	Ex 8	Ex 9	Ex 10	P-Ex	P-Ex
	1	19.0	22.0	16.3	19.1	15.9	16.2
	2	17.3	17.8	17.1	17.0	16.6	16.8
	3	13.9	13.8	15.4	13.6	16.3	16.0
N/S	4	19.9	19.0	21.1	21.9	21.8	21.2
	5	14.2	12.3	12.2	13.8	11.8	13.4
	6	20.6	19.2	18.0	18.7	18.8	19.1
	7	20.2	18.5	20.7	18.1	21.6	20.5
	$\bar{x}$	17.9	17.5	17.3	17.5	17.5	17.6
	8	19.1	15.1	18.5	15.0	16.4	16.3
	9	20.6	17.6	19.6	19.1	19.7	19.5
	10	16.1	11.7	15.8	12.4	18.5	18.1
N	11	17.1	16.1	24.0	18.2	19.4	19.0
	12	21.2	17.3	20.3	14.1	21.7	20.5
	13	17.2	19.9	19.2	17.4	18.3	17.9
	14	21.4	12.7	19.7	17.9	22.1	20.9
	$\bar{x}$	19.0	15.8	19.6	16.3	19.4	18.9
	15	17.2	10.1	21.3	18.2	21.1	21.0
	16	19.1	17.3	20.3	16.0	23.2	20.7
	17	19.8	20.2	19.3	16.7	19.3	19.1
S	18	20.6	15.4	19.7	18.3	20.3	19.9
	19	16.0	15.9	17.2	15.7	18.5	18.3
	20	18.5	20.3	22.0	22.1	21.6	19.2
	21	24.9	20.3	23.4	22.3	13.2	14.0
	$\bar{\bar{X}}$	19.4	17.1	20.5	18.5	19.6	18.9

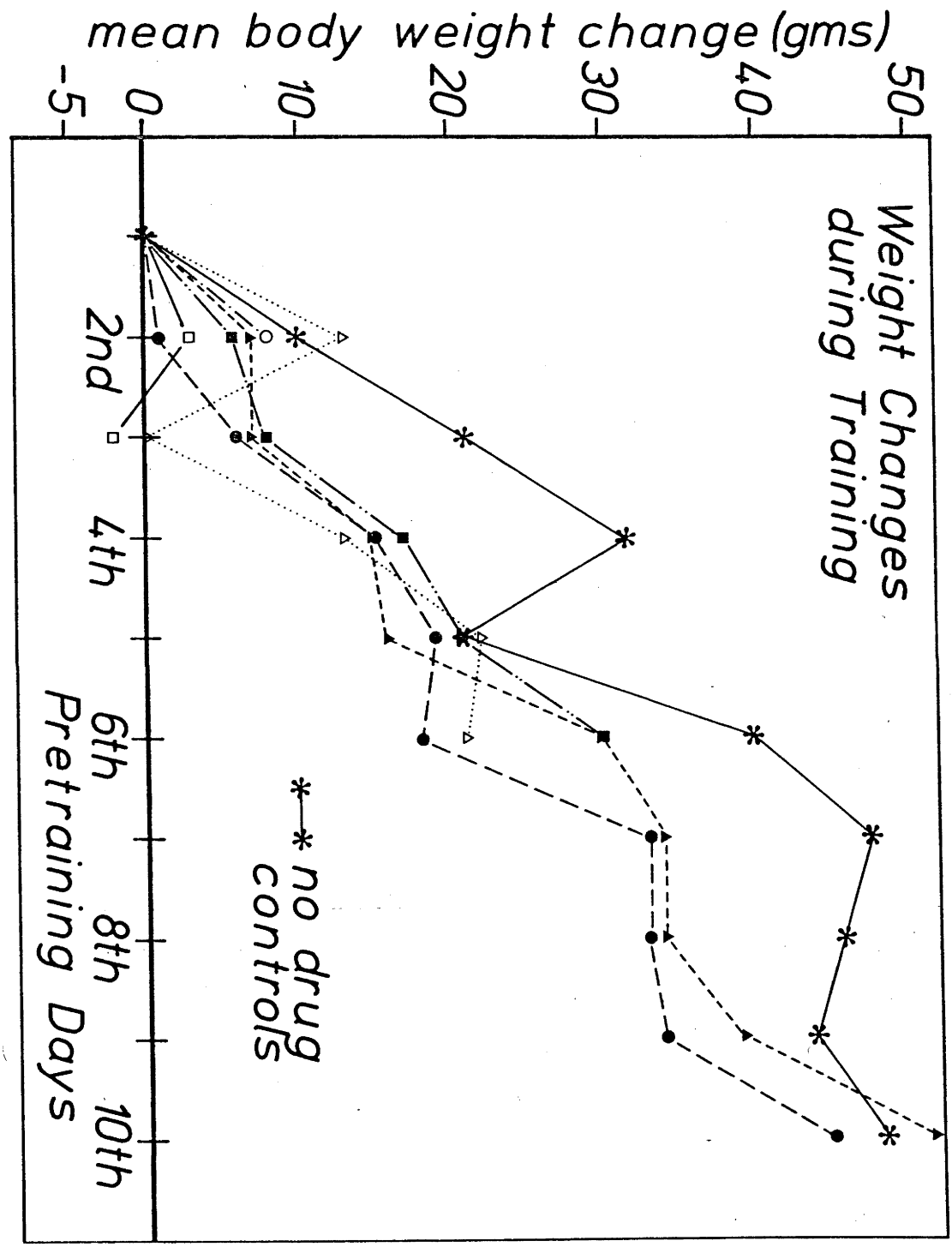
EXPERIMENT 2a

RATE OF EXTINCTION INDICES FOR FLAVOUR GROUPS x OVERTRAINING GROUPS

Flavour group	Subject	Overtraining group N/S_4	N/S_6	N/S_{10}	control N/S_{10}
N/S	1	0.06	0.07	0.09	2.91
	2	0.04	0.89	0.02	2.56
	3	1.08	0.05	0.04	2.12
	4	0.13	0.13	0.11	3.07
	5	0.15	0.08	0.07	1.96
	6	0.03	0.08	0.10	2.80
	7	0.82	0.95	0.05	2.80
	$\bar{x}$	0.33	0.32	0.07	2.60
N	8	2.10	1.90	2.19	2.36
	9	0.39	1.63	2.41	2.64
	10	1.82	0.43	2.74	2.05
	11	2.08	0.52	2.19	2.78
	12	1.61	1.70	2.24	2.60
	13	0.22	0.88	1.69	2.48
	14	1.25	1.38	2.11	2.66
	$\bar{x}$	1.35	1.21	2.22	2.51
S	15	0.77	1.89	2.30	2.47
	16	2.37	2.27	2.12	2.55
	17	0.55	1.64	2.18	2.73
	18	1.80	1.71	2.23	2.47
	19	1.74	1.55	1.92	2.32
	20	1.45	1.76	1.84	2.85
	21	1.40	1.89	2.37	3.20
	$\bar{x}$	1.44	1.82	2.14	2.66

FIGURE 19

Mean changes in body weights as measured on pretraining days for animals in Experiments 1b and 2a.


mean body weight change (gms)
-5
0
10
20
30
40
50
Weight Changes during Training
2nd
4th
6th
8th
10th
Pretraining Days
* no drug controls

APPENDIX 2b

DATA FOR EXPERIMENT 2b

EXPERIMENT 2b

CONSUMPTION MEASURES (in mls) FOR VINEGAR DESENSITIZATION CONTROL GROUPS

Flavour group	Subject	P-Tr	b.w.	Tr 1	P-Tr	b.w.	Tr 2	P-Tr	b.w.
N/S	1	12.0	280	19.5	15.5	315	2.1	17.6	321
	2	8.1	170	13.1	11.3	193	2.4	13.5	191
	3	10.4	209	19.6	13.4	231	0.4	13.7	231
	4	8.7	211	8.2	17.7	244	8.0	15.6	240
	$\bar{x}$	9.8		15.1	14.5		3.2	15.1	
N	5	9.1	208	18.5	13.3	237	6.8	13.5	241
	6	13.1	260	19.6	13.9	284	4.0	14.7	282
	7	15.1	221	14.4	13.4	248	2.7	14.0	250
	8	10.0	223	20.0	18.1	257	4.1	12.6	258
	$\bar{x}$	11.8		18.1	14.7		4.4	13.7	
S	9	10.6	260	13.5	14.3	281	2.7	15.1	266
	10	10.1	296	11.5	13.5	298	1.2	13.6	302
	11	10.7	272	14.6	17.0	293	2.1	11.9	293
	12	14.6	285	18.2	14.8	315	1.2	10.2	312
	$\bar{x}$	11.5		14.5	14.9		1.8	12.7	
overall	$\bar{X}$	11.0	241		14.7	266		13.8	266

(Experiment 2 b continued)

Flavour group	Subject	Tr 3	Des	Des	Des	Des	Ex 1	Ex 2	Ex 3
N/S	1	1.1	17.3	17.2	19.3	21.4	0.9	1.1	0.5
	2	1.3	12.5	11.7	12.2	14.3	1.2	1.5	0.1
	3	0.9	15.5	12.5	15.0	17.5	4.2	2.1	0.6
	4	2.4	16.6	11.0	16.8	16.8	0.6	1.6	0.2
	$\bar{x}$	1.4	16.5	14.7	14.1	17.4	1.7	1.7	0.6
N	5	4.4	14.5	13.1	13.7	16.9	2.6	3.5	2.6
	6	1.0	13.9	14.0	14.9	14.4	1.1	1.4	2.5
	7	1.4	13.7	13.1	12.9	14.3	1.2	1.4	1.4
	8	1.2	17.2	13.3	15.0	17.1	0.9	0.9	0.4
	$\bar{x}$	2.0	14.8	13.4	14.1	15.7	1.5	1.8	1.7
S	9	1.0	12.6	12.6	18.3	14.6	1.2	3.2	0.4
	10	0.9	10.0	9.3	15.7	17.8	0.1	2.6	0.7
	11	1.1	14.6	16.0	19.1	20.9	0.0	0.8	0.4
	12	0.9	15.1	16.1	19.2	19.3	2.2	1.5	4.9
	$\bar{x}$	1.0	11.5	12.5	17.6	17.5	1.0	1.8	1.9
overall	$\bar{X}$		14.2	13.6	16.3	17.0			

(Experiment 2b continued)

Flavour group	Subject	Ex 4	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10
N/S	1	1.2	1.1	1.0	1.4	4.7	12.4	20.0
	2	1.6	4.2	12.4	15.5	22.8	10.2	22.2
	3	1.5	6.4	17.4	21.4	20.1	21.4	22.7
	4	1.0	2.3	1.7	1.0	1.2	3.0	8.5
	$\bar{x}$	1.2	2.7	5.7	6.9	8.6	9.3	15.6
N	5	6.0	10.4	13.7	15.8	18.7	19.3	19.0
	6	8.0	12.7	17.9	18.8	21.7	21.2	22.3
	7	0.9	0.6	1.4	0.8	1.4	1.9	3.2
	8	1.2	0.1	2.5	3.7	8.9	16.4	19.0
	$\bar{x}$	4.0	6.0	8.8	9.8	12.7	14.7	15.9
S	9	1.2	1.0	1.5	4.4	12.0	15.9	18.7
	10	1.2	1.0	2.2	0.7	1.7	7.0	11.6
	11	0.9	0.8	6.7	11.5	20.8	15.5	21.0
	12	12.4	11.5	16.1	15.0	22.1	21.6	22.9
	$\bar{x}$	2.9	4.2	5.1	7.6	12.3	13.4	16.7

APPENDIX 3

DATA FOR EXPERIMENT 3

EXPERIMENT 3

CONSUMPTION MEASURES (in mls) FOR TWO N/S PRE-EXPOSURES GROUPS*

Flavour group	Subject	P-Tr	Exp 1	Exp 2	b.w.	Tr 1	b.w.	Tr 2
	1	12.5	15.1	20.4	277	18.1	273	1.3
	2	16.8	19.8	20.8	327	22.5	328	14.4
	3	16.2	16.9	17.4	299	18.2	316	14.1
N/S	4	12.6	14.9	19.3	270	19.6	270	13.4
	5	13.8	13.8	19.7	286	21.3	274	6.4
	6	12.8	10.6	18.6	288	22.1	292	11.5
	7	12.6	17.0	19.3	318	20.0	307	2.4
	$\bar{x}$	13.9	15.4	19.4		20.3		9.1
	8	10.0	12.4	17.3	279	20.1	271	2.3
	9	14.5	12.9	22.2	311	20.7	300	2.0
	10	17.2	14.0	18.5	301	22.7	301	12.4
N	11	14.6	12.7	19.8	286	21.9	279	13.2
	12	10.3	13.6	18.0	282	19.4	277	5.9
	13	12.4	11.4	14.6	270	19.7	262	12.8
	14	15.4	12.6	18.9	299	18.0	285	4.5
	$\bar{x}$	13.5	12.8	18.5		20.4		7.6
	15	12.0	13.4	18.0	281	15.2	276	2.9
	16	16.1	13.7	20.9	280	20.8	267	1.1
	17	10.2	14.5	16.3	282	17.0	267	1.0
S	18	10.6	13.7	16.1	257	14.5	252	1.0
	19	15.4	9.7	17.6	256	16.7	253	3.6
	20	16.1	19.1	22.1	326	19.0	306	0.6
	21	16.1	13.2	21.2	311	14.7	304	0.8
	$\bar{x}$	13.8	13.9	18.9		16.8		1.6
overall	$\bar{X}$	13.7	14.1	18.9	290		284	

* Exp = nonreinforced N/S exposure

(Experiment 3 continued)

Flavour group	Subject	b.w.	Tr 3	Des	Ex 1	Ex 2	Ex 3	Ex 4
	1	275	1.1	10.1	0.1	0.5	0.2	9.1
	2	320	5.2	17.4	0.6	0.1	0.4	2.1
	3	303	0.9	10.9	0.2	0.8	0.7	3.4
N/S	4	258	0.7	11.8	0.1	0.6	0.2	1.8
	5	274	0.1	14.1	0.1	0.0	0.3	1.5
	6	286	1.6	14.9	0.4	0.0	0.2	2.0
	7	307	0.4	15.0	0.0	0.0	0.1	2.4
	$\bar{x}$		1.4	13.5	0.2	0.3	0.3	3.2
	8	274	0.5	13.7	0.2	0.3	0.2	0.2
	9	304	0.5	12.6	0.1	0.4	0.7	0.7
	10	301	4.0	18.7	1.6	10.6	11.0	9.0
N	11	292	3.1	11.5	0.4	0.4	0.7	3.3
	12	288	2.6	12.1	0.1	0.6	1.0	14.8
	13	269	4.8	10.8	0.4	0.6	2.7	5.9
	14	299	0.2	16.6	0.1	0.3	0.0	0.1
	$\bar{x}$		2.2	13.7	0.4	1.9	2.3	4.9
	15	284	0.5	13.1	0.2	0.2	0.2	1.0
	16	273	0.2	15.7	0.1	0.2	0.4	1.0
	17	274	0.4	11.8	0.1	0.3	0.3	1.7
S	18	260	0.3	10.5	0.0	0.1	0.1	0.6
	19	255	0.2	13.4	0.1	0.0	0.1	1.7
	20	309	0.4	11.1	0.0	0.0	0.2	1.7
	21	313	0.3	14.8	0.0	0.3	0.1	0.4
	$\bar{x}$		0.3	12.9	0.1	0.2	0.2	1.2
overall	$\bar{X}$	287		13.4				

(Experiment 3 continued)

Flavour group	Subject	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10
	1	14.1	13.1	21.5	19.8	18.3	20.0
	2	3.4	6.0	15.2	19.3	20.2	22.6
	3	3.2	1.0	1.4	4.3	10.0	13.0
N/S	4	3.5	12.1	19.7	15.4	15.3	19.5
	5	2.6	1.6	5.5	11.7	13.0	15.6
	6	1.6	3.1	6.1	8.9	10.6	14.0
	7	2.7	10.8	21.1	19.8	18.1	21.2
	$\bar{x}$	4.4	6.8	12.9	14.2	15.1	18.0
	8	0.3	0.3	0.1	0.5	0.4	1.3
	9	0.8	0.5	1.3	2.8	6.4	12.7
	10	3.1	9.6	16.9	18.6	19.1	20.9
N	11	8.2	14.9	19.2	18.9	18.3	19.3
	12	13.2	15.7	20.7	18.6	18.1	19.8
	13	8.8	12.0	14.8	15.4	15.6	16.6
	14	0.1	0.1	0.1	0.6	1.9	6.1
	$\bar{x}$	4.9	7.6	10.4	10.8	11.4	13.8
	15	1.3	2.9	7.0	9.8	10.4	14.4
	16	1.0	1.2	5.4	12.3	12.9	15.9
	17	1.1	2.6	6.3	10.9	10.0	16.7
S	18	0.7	1.7	7.2	8.7	10.4	16.6
	19	3.6	5.6	10.2	12.9	12.6	14.0
	20	1.5	1.7	1.4	1.5	1.2	6.9
	21	0.8	5.8	12.5	13.4	16.3	17.0
	$\bar{x}$	1.4	3.0	7.1	9.9	10.5	14.5

EXPERIMENT 3

CONSUMPTION MEASURES (in mls) FOR TEN N/S PRE-EXPOSURES GROUP

Flavour group	Subject	P-Tr	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6	Exp 7
	1	12.6	20.5	22.4	19.2	19.8	13.0	19.8	19.9
	2	11.5	15.6	21.3	19.7	20.0	18.8	21.4	21.8
	3	12.8	14.9	22.8	20.8	23.1	23.3	23.9	23.5
N/S	4	12.1	9.2	22.4	19.1	19.7	19.3	20.8	21.9
	5	8.9	9.9	21.4	18.2	20.0	16.7	19.3	19.7
	6	10.9	14.5	18.7	14.7	14.6	14.6	15.1	12.1
	7	12.9	13.3	9.1	6.3	21.2	20.2	22.2	14.5
	$\bar{x}$	11.7	14.0	19.7	16.9	19.8	18.0	20.4	19.1
	8	7.6	14.9	19.0	21.5	15.2	21.1	19.8	18.7
	9	10.9	16.4	22.3	21.1	21.8	21.0	23.6	19.8
	10	7.6	7.3	20.0	17.6	23.0	22.5	22.9	22.3
N	11	10.5	8.3	20.8	18.2	18.5	20.9	20.5	16.8
	12	10.9	6.7	20.1	17.2	19.4	18.2	20.0	15.4
	13	7.4	11.6	20.7	15.4	18.0	18.3	19.0	14.9
	14	12.2	2.1	25.2	12.7	23.8	12.8	26.2	26.0
	$\bar{x}$	9.6	9.6	21.2	17.7	20.0	19.3	21.7	19.1
	15	13.6	14.2	22.2	17.0	16.8	19.7	21.7	20.8
	16	12.1	12.3	25.6	19.3	20.5	21.6	22.1	22.0
	17	7.9	11.0	23.4	15.1	20.2	4.6	17.9	13.4
S	18	13.6	6.1	18.1	19.9	18.8	22.7	22.7	23.9
	19	8.0	12.6	19.0	14.8	13.9	19.6	23.3	13.9
	20	10.6	5.6	19.4	17.3	20.6	18.6	20.2	18.5
	21	8.4	6.1	10.7	6.5	13.3	27.1	17.1	16.2
	$\bar{x}$	10.6	9.7	19.8	15.7	17.7	19.1	20.7	18.4
overall	$\bar{X}$	10.6	11.1	20.2	16.8	19.2	18.8	20.9	18.9

(Experiment 3 continued)

Flavour group	Subject	Exp 8	Exp 9	Exp 10	b.w.	Tr 1	b.w.	Tr 2	b.w.
	1	25.1	21.4	20.4	284	20.7	298	19.7	293
	2	24.0	22.7	17.8	257	20.0	268	25.3	263
	3	26.8	24.9	17.4	314	22.7	317	22.4	311
N/S	4	24.9	22.4	20.6	301	20.9	313	24.2	303
	5	23.2	20.3	20.7	282	20.6	294	24.0	283
	6	18.2	14.5	17.4	272	19.2	275	18.7	262
	7	14.8	18.4	23.3	310	22.0	315	20.0	317
	$\bar{x}$	22.4	20.7	19.7		20.9		22.0	
	8	23.5	19.9	22.5	256	13.9	360	10.0	363
	9	28.2	22.9	22.5	347	15.5	339	9.8	351
	10	26.2	23.7	20.6	287	15.8	277	9.3	278
N	11	26.1	19.9	15.7	268	13.9	263	6.2	275
	12	26.1	21.5	20.6	304	11.8	294	0.1	316
	13	21.6	21.3	16.3	288	14.4	277	6.7	275
	14	25.8	21.6	22.3	320	13.6	319	4.0	325
	$\bar{x}$	25.4	21.5	20.1		14.1		6.6	
	15	17.4	24.3	22.0	290	14.6	288	0.7	296
	16	26.0	23.7	22.5	340	11.4	340	7.6	341
	17	15.2	20.3	18.3	339	13.4	322	2.7	338
S	18	22.7	25.7	18.0	329	11.6	319	2.3	322
	19	21.9	19.8	17.7	267	12.4	253	0.2	259
	20	23.5	19.9	21.4	281	9.8	270	1.0	278
	21	20.3	18.0	17.0	238	7.4	242	4.3	245
	$\bar{x}$	21.0	21.7	19.6		11.5		2.7	
overall	$\bar{X}$	22.9	21.3	19.8	294		297		300

(Experiment 3 continued)

Flavour group	Subject	Tr 3	b.w.	Tr 4	Des	Des	Des	Ex 1	Ex 2
	1	4.4	298	0.5	10.4	12.8	13.1	0.6	1.0
	2	13.2	260	2.9	7.1	11.5	12.7	1.1	2.7
	3	7.5	315	0.4	11.5	16.2	15.6	0.8	2.5
N/S	4	15.7	313	7.1	12.5	12.0	15.5	3.5	9.9
	5	9.4	280	1.4	9.9	12.3	20.9	4.2	7.0
	6	1.0	278	1.4	10.8	13.2	13.2	7.0	12.8
	7	19.7	313	3.0	5.0	10.0	11.4	1.8	0.6
	$\bar{x}$	10.1		2.4	9.6	12.6	14.6	2.7	5.2
	8	4.7	370	0.3	12.8	14.6	16.6	1.0	3.6
	9	5.7	353	0.4	9.4	13.5	12.7	0.3	4.5
	10	2.3	277	0.2	8.7	11.8	12.4	1.1	2.6
N	11	5.9	279	0.5	9.4	10.9	13.6	3.2	6.2
	12	9.0	320	0.7	9.5	12.7	15.4	4.6	1.0
	13	3.7	274	0.5	13.2	12.3	13.1	1.6	1.5
	14	1.4	320	1.4	9.9	13.8	16.7	2.9	0.7
	$\bar{x}$	4.7		0.6	10.4	12.8	14.4	2.1	2.9
	15	0.1	305	0.7	10.4	14.2	15.4	4.2	8.3
	16	0.4	344	0.3	5.3	13.8	17.2	0.2	0.2
	17	0.2	348	0.1	4.7	11.7	14.6	0.3	0.0
S	18	0.2	328	0.1	4.2	9.5	13.5	0.3	0.0
	19	6.9	260	0.0	10.3	12.1	14.9	0.5	0.5
	20	0.2	281	0.2	7.1	12.4	13.7	0.3	0.0
	21	1.1	238	0.2	7.2	12.9	18.3	0.4	0.3
	$\bar{x}$	1.3		0.2	7.0	12.4	15.4	0.9	1.3
overall	$\bar{X}$		303		9.0	12.6	14.8		

(Experiment 3 continued)

Flavour group	Subject	Ex 3	Ex 4	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10
	1	2.4	5.1	8.5	13.0	13.8	17.6	15.9	19.9
	2	2.7	6.1	8.9	14.6	15.1	17.1	16.6	18.3
	3	5.6	7.7	14.7	19.2	16.2	21.7	20.7	17.6
N/S	4	16.1	18.7	23.1	21.9	20.6	21.6	20.9	21.3
	5	12.5	14.5	20.4	17.0	17.3	17.2	13.1	17.2
	6	11.5	16.4	24.2	19.2	17.0	21.9	18.6	19.4
	7	6.5	10.4	14.2	18.3	18.1	19.1	19.7	20.0
	$\bar{x}$	8.2	11.3	16.3	17.6	16.9	19.5	17.9	19.1
	8	7.7	19.3	17.8	21.1	19.9	20.2	20.1	20.7
	9	9.5	12.5	17.0	21.2	19.3	20.5	16.3	14.6
	10	3.9	9.2	11.4	18.6	18.2	19.3	17.0	17.0
N	11	8.6	5.1	0.0	22.9	21.7	21.5	4.9	21.1
	12	1.0	5.7	10.9	17.5	16.7	19.1	17.4	18.8
	13	4.3	6.5	0.4	11.3	15.8	14.0	18.5	16.3
	14	9.0	3.7	16.5	21.4	19.3	22.1	23.1	21.9
	$\bar{x}$	6.3	8.9	10.6	19.1	18.7	19.5	16.8	18.6
	15	15.1	18.0	16.3	17.6	17.7	20.3	18.5	19.9
	16	0.4	0.7	0.5	1.3	0.5	0.9	0.5	1.4
	17	0.1	0.2	0.0	0.2	0.6	2.5	11.1	13.6
S	18	0.1	0.2	0.4	2.6	1.4	2.3	9.6	8.6
	19	0.4	0.8	0.0	0.0	0.0	3.4	9.9	0.0
	20	0.3	0.1	0.0	0.4	0.3	0.3	0.2	0.3
	21	0.2	0.3	0.0	0.3	0.2	0.0	0.2	0.2
	$\bar{x}$	2.4	2.9	2.5	3.2	3.0	4.2	7.1	6.3

EXPERIMENT 3

CONSUMPTION MEASURES (in mls) FOR TWENTY N/S PRE-EXPOSURES GROUPS

Flavour group	Subject	P-Tr	Exp 1	Exp 2	Exp 3	Exp 4	Exp 5	Exp 6
	1	10.1	6.4	16.9	17.4	18.8	15.1	19.6
	2	8.9	12.6	17.4	16.0	17.3	17.7	17.5
	3	9.3	8.7	19.1	16.2	18.3	18.0	18.3
N/S	4	9.4	15.0	19.9	15.6	20.3	17.9	19.9
	5	10.1	17.2	20.0	17.4	19.8	19.1	18.8
	6	9.5	17.2	21.0	13.0	21.5	21.6	19.7
	7	10.1	20.1	23.7	19.7	18.4	18.6	20.5
	$\bar{x}$	9.6	13.9	19.7	16.5	19.2	18.3	19.2
	8	9.6	12.2	19.2	15.7	21.0	20.4	17.0
	9	10.3	12.6	22.3	17.7	14.1	22.5	22.2
	10	12.2	14.9	15.0	16.7	15.9	13.7	15.2
N	11	10.9	14.2	22.1	17.1	19.5	20.2	18.4
	12	11.8	16.4	18.7	16.6	25.2	18.7	20.0
	13	8.6	14.4	21.6	17.6	23.5	20.2	21.7
	14	11.7	19.9	22.8	18.8	23.1	19.4	18.7
	$\bar{x}$	10.7	14.9	20.2	17.2	20.3	19.3	19.0
	15	12.3	4.7	9.8	11.4	21.5	14.4	21.1
	16	12.4	11.3	23.0	18.0	22.0	14.5	18.2
	17	12.8	14.0	23.2	19.4	24.2	20.4	19.1
S	18	12.2	7.3	17.7	17.8	22.6	17.7	17.5
	19	18.0	23.0	21.5	17.0	20.3	21.1	18.6
	20	13.7	19.9	28.1	21.8	23.8	20.1	20.1
	21	10.5	16.3	18.4	12.3	15.8	16.3	12.1
	$\bar{x}$	13.1	13.8	20.2	16.8	21.5	17.8	18.1
overall	$\bar{X}$	11.2	14.2	20.1	16.8	20.3	18.5	18.8

(Experiment 3 continued)

Flavour group	Subject	Exp 7	Exp 8	Exp 9	Exp 10	Exp 11	Exp 12	Exp 13
	1	18.3	16.9	21.4	18.2	18.1	15.8	16.0
	2	13.3	21.8	19.6	9.2	19.7	18.0	18.3
	3	18.5	20.5	19.0	17.6	15.8	17.4	16.1
N/S	4	20.3	22.9	22.2	18.1	20.1	15.7	19.6
	5	22.0	25.0	22.9	22.5	22.3	18.1	19.8
	6	22.9	17.8	19.4	17.6	16.6	20.1	21.5
	7	21.9	24.0	24.3	18.0	23.8	17.2	20.4
	$\bar{x}$	19.6	21.3	21.3	17.3	19.5	17.5	18.8
	8	15.5	21.4	18.0	17.8	16.9	17.5	20.3
	9	24.3	4.8	11.1	13.4	23.4	16.1	12.5
	10	19.0	22.7	17.5	16.9	20.1	18.8	18.8
N	11	18.2	25.1	23.0	11.2	22.8	18.9	19.9
	12	21.3	24.6	24.8	25.1	17.8	19.8	22.2
	13	19.7	29.8	23.7	18.5	23.4	20.0	23.4
	14	17.4	16.2	21.2	19.3	25.6	23.8	24.3
	$\bar{x}$	19.3	20.7	19.9	17.5	21.4	19.3	20.2
	15	15.5	12.7	20.4	19.1	24.8	19.0	20.1
	16	18.5	21.1	22.6	18.9	20.1	19.5	16.9
	17	24.9	27.3	22.1	20.0	21.7	18.4	20.3
S	18	19.3	23.1	22.5	22.9	21.9	20.1	20.8
	19	19.8	24.7	20.5	20.0	20.1	0.0*	10.5*
	20	22.6	23.2	22.3	19.1	19.0	20.9	22.0
	21	11.4	16.6	14.4	14.0	16.9	16.6	17.6
	$\bar{x}$	18.9	21.2	20.7	19.1	20.6	16.4	18.3
overall	$\bar{X}$	19.3	21.1	20.6	18.0	20.5	17.7	19.1

* subject injured on upper "lip", penicillin administered i.m.

(Experiment 3 continued)

Flavour group	Subject	Exp 14	Exp 15	Exp 16	Exp 17	Exp 18	Exp 19	Exp 20
	1	18.7	12.9	19.1	18.3	21.5	19.1	20.5
	2	19.1	19.1	20.2	19.9	17.1	19.6	17.9
	3	15.6	19.5	18.8	16.0	17.6	17.1	17.7
N/S	4	18.8	21.3	14.1	19.4	14.3	21.1	19.1
	5	19.8	22.5	20.5	20.8	22.0	22.3	21.8
	6	23.0	23.6	12.8	22.0	23.2	21.7	21.9
	7	20.5	22.6	20.5	23.4	21.0	20.8	23.3
	$\bar{x}$	19.4	20.2	18.0	20.0	19.5	20.2	20.3
	8	20.6	20.0	22.2	20.1	18.6	19.8	21.1
	9	24.2	22.0	25.0	19.1	23.7	20.0	16.6
	10	19.9	19.1	20.0	20.1	20.3	20.7	20.1
N	11	22.7	21.5	22.8	22.3	16.3	17.4	22.5
	12	22.9	24.4	26.3	20.2	21.3	24.4	22.5
	13	26.7	25.2	23.7	20.6	24.0	25.3	23.7
	14	22.6	24.0	23.4	24.2	27.4	26.4	27.5
	$\bar{x}$	22.8	22.3	23.3	20.9	21.7	22.0	22.0
	15	20.3	14.2	22.1	22.6	22.5	22.0	23.5
	16	19.3	21.4	19.1	22.8	21.1	21.5	20.9
	17	22.4	20.4	23.7	21.1	22.2	18.8	21.7
S	18	21.3	21.3	22.9	17.5	9.7	21.2	22.0
	19	9.4*	9.0*	10.7*	11.7*	14.3	29.9	19.0
	20	23.2	15.0	21.2	16.3	23.4	22.2	23.8
	21	15.8	17.7	17.9	17.5	17.2	17.5	17.8
	$\bar{x}$	18.8	17.0	19.7	18.5	18.6	21.9	21.2
overall	$\bar{X}$	20.3	19.8	20.3	19.8	19.9	21.4	21.2

* recovering from injury

(Experiment 3 continued)

Flavour group	Subject	b.w.	Tr 1	b.w.	Tr 2	b.w.	Tr 3	b.w.
	1	305	19.0	307	15.4	283	4.1	261
	2	293	21.8	303	22.1	310	20.5	294
	3	320	19.2	323	16.9	308	12.3	298
N/S	4	314	19.9	331	15.9	321	6.2	321
	5	352	20.4	367	18.6	349	13.7	343
	6	367	24.2	373	19.1	380	21.6	364
	7	362	21.7	370	18.6	357	14.1	352
	$\bar{x}$		20.9		18.1		13.2	
	8	336	15.4	339	11.6	335	5.1	334
	9	364	15.8	367	2.6	366	0.9	367
	10	309	12.3	312	7.1	316	7.4	308
N	11	354	10.6	353	4.1	353	0.8	348
	12	387	11.3	392	2.7	379	3.1	370
	13	375	16.7	376	2.2	368	2.5	363
	14	330	15.6	337	7.4	336	4.6	328
	$\bar{x}$		14.0		5.4		3.5	
	15	344	8.0	334	1.1	331	0.3	329
	16	338	11.6	329	2.5	328	0.5	322
	17	370	9.3	363	1.2	360	0.2	350
S	18	386	8.7	394	3.1	388	0.2	382
	19	211	4.6	200	1.5	199	2.0	196
	20	375	14.6	370	2.9	366	0.3	362
	21	324	7.0	322	0.4	315	0.3	310
	$\bar{x}$		9.1		1.8		0.5	
overall	$\bar{X}$	339		341		336		329

(Experiment 3 continued)

Flavour group	Subject	Tr 4	b.w.	Tr 5	b.w.	Tr 6	Des	Des
	1	1.6	274	1.3	273	4.1	10.3	14.1
	2	10.5	290	1.7	290	5.0	10.4	13.1
	3	1.5	297	1.2	297	1.1	9.5	13.2
N/S	4	4.6	334	7.8	323	2.1	14.0	16.0
	5	1.6	347	0.4	353	0.2	12.1	17.1
	6	7.6	362	1.4	362	3.8	10.7	17.8
	7	5.8	374	15.5	370	3.1	9.7	18.5
	$\bar{x}$	4.7		4.2		2.8	11.0	15.7
	8	1.1	336	0.5	335	0.3	3.0	12.4
	9	0.5	371	0.3	365	0.4	5.8	12.6
	10	1.4	303	0.5	310	0.4	15.2	18.6
N	11	0.0	349	0.2	353	0.2	2.0	2.4
	12	0.2	373	0.7	350	0.6	6.7	15.2
	13	0.3	364	0.4	374	0.3	9.8	12.9
	14	0.4	328	0.5	339	0.5	8.8	19.1
	$\bar{x}$	0.6		0.4		0.4	7.3	13.3
	15	0.4	334	0.4	341	0.4	3.1	9.0
	16	0.8	320	0.1	313	0.1	0.3	0.3
	17	0.3	354	0.3	361	0.3	2.1	0.4
S	18	0.1	378	0.2	383	0.3	0.6	0.2
	19	2.5	199	2.2	190	0.1	5.2	0.6
	20	0.1	373	0.1	372	0.2	0.4	7.0
	21	0.0	309	0.0	314	0.2	5.8	13.4
	$\bar{x}$	0.6		0.5		0.2	2.5	4.4
overall	$\bar{X}$		332		332			

(Experiment 3 continued)

Flavour group	Subject	Des	Des	Des	Des	Ex 1	Ex 2	Ex 3
	1					0.4	1.9	3.3
	2					2.4	4.0	9.2
	3					0.5	0.7	6.4
N/S	4					0.7	0.8	3.3
	5					0.3	1.0	5.9
	6					1.3	2.0	6.6
	7					0.5	2.2	6.3
	$\bar{x}$					0.9	1.8	5.9
	8	13.0				0.1	0.0	1.7
	9	18.5				0.2	0.2	2.8
	10	17.9				1.2	4.9	7.0
N	11	10.7				0.4	0.4	0.5
	12	16.1				0.1	0.5	0.5
	13	14.2				0.3	0.4	0.3
	14	20.3				0.4	0.1	1.3
	$\bar{x}$	15.8				0.8	0.9	2.0
	15	12.6	15.2	13.3	15.9	0.5	0.1	0.3
	16	2.5	12.4	13.6	16.9	0.4	0.2	0.2
	17	0.6	0.3	0.7	8.4	0.4	0.4	0.0
S	18	0.0	0.4	0.2	0.2	0.2	0.0	2.1
	19	1.8	0.6	9.4	12.7	0.3	0.2	0.4
	20	18.5	16.6	14.5	19.4	0.2	0.2	0.1
	21	13.3	16.6	14.2	15.6	0.3	0.6	0.2
	$\bar{x}$	7.0	8.9	9.4	12.7	0.3	0.2	0.5

(Experiment 3 continued)

Flavour group	Subject	Ex 4	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10
	1	6.1	8.7	15.6	15.3	20.1	18.8	17.5
	2	9.7	14.8	15.4	17.2	19.5	18.1	18.5
	3	4.7	7.4	10.8	13.9	16.8	17.4	19.2
N/S	4	4.4	6.9	11.1	15.5	17.1	19.6	16.1
	5	6.9	10.1	14.0	16.8	18.6	18.8	18.3
	6	9.8	13.8	16.6	19.6	18.0	18.0	20.1
	7	6.5	8.7	14.5	19.7	20.2	21.0	18.2
	$\bar{x}$	6.9	10.1	14.0	16.9	18.6	18.8	18.3
	8	10.0	16.1	13.5	11.8	14.5	10.0	10.3
	9	3.8	11.1	12.3	13.5	12.3	11.6	12.8
	10	0.6	2.0	2.5	2.9	6.7	9.3	9.5
N	11	0.3	0.2	0.2	0.3	0.5	1.6	6.7
	12	0.3	0.3	0.6	1.3	2.7	4.7	8.2
	13	0.1	0.2	0.3	0.4	0.2	0.1	0.4
	14	2.0	5.3	10.0	9.4	14.3	9.8	12.5
	$\bar{x}$	2.5	5.0	5.6	5.7	7.3	6.7	8.6
	15	0.3	1.3	6.3	11.9	12.4	10.0	8.8
	16	0.4	0.4	1.0	0.1	0.6	0.9	7.4
	17	0.1	0.0	0.2	0.0	0.1	0.0	0.0
S	18	0.2	1.4	6.4	10.0	11.5	11.3	11.7
	19	0.3	0.9	3.7	4.2	5.3	5.1	5.5
	20	0.0	0.0	0.1	0.0	0.1	0.0	0.0
	21	0.9	2.1	8.4	2.9	7.2	8.3	5.3
	$\bar{x}$	0.3	0.9	3.7	4.2	5.3	5.1	5.5

EXPERIMENT 3

PERCENT NEOPHOBIA WHERE VALUES REPRESENT 100 x (amt. consumed of N/S, N or S on first presentation/amt. of N/S consumed on last pre-exposure trial).

Flavour group	Subject	Pre-exposure group N/S_2	N/S_{10}	N/S_{20}
N/S	1	88.7 %	101.5 %	92.7 %
	2	108.2	112.4	121.8
	3	104.6	130.5	108.5
	4	101.6	101.5	104.2
	5	108.1	99.5	93.6
	6	118.8	110.3	110.5
	7	103.6	94.4	93.1
	$\bar{x}$	104.8	107.2	103.5
N	8	116.2	61.8	73.0
	9	93.2	68.9	95.2
	10	122.7	76.7	61.2
	11	110.6	88.5	47.1
	12	107.8	57.3	50.2
	13	134.9	88.3	70.5
	14	95.2	61.0	56.7
	$\bar{x}$	110.1	71.8	64.8
S	15	84.4	66.4	34.0
	16	99.5	50.7	55.0
	17	104.3	73.2	42.9
	18	90.1	64.4	39.5
	19	94.9	70.1	24.2
	20	86.0	45.8	61.3
	21	69.3	43.5	39.3
	$\bar{x}$	89.8	59.2	42.4

EXPERIMENT 3

TRIALS TO CRITERION DURING CONDITIONING PHASE

Flavour group	Subject	Pre-exposure group N/S$_2$	N/S$_{10}$	N/S$_{20}$
N/S	1	1	3	2
	2	3	3	6
	3	2	3	3
	4	2	4	5
	5	2	3	3
	6	2	2	4
	7	1	3	5
	$\bar{x}$	1.9	3.0	4.0
N	8	1	3	3
	9	1	3	1
	10	3	2	3
	11	2	3	1
	12	2	3	1
	13	3	3	1
	14	2	1	2
	$\bar{x}$	2.0	2.6	1.7
S	15	1	1	1
	16	1	2	1
	17	1	1	1
	18	1	1	1
	19	2	3	1
	20	1	1	1
	21	1	2	1
	$\bar{x}$	1.1	1.6	1.0

EXPERIMENT 3

RATE OF EXTINCTION INDICES FOR ALL GROUPS IN EXPERIMENT 3

Flavour group	Subject	Pre-exposure group N/S_2	N/S_{10}	N/S_{20}
	1	2.23	1.90	2.05
	2	1.90	1.94	2.25
	3	0.79	2.32	1.88
N/S	4	1.80	2.89	1.85
	5	1.13	2.25	2.19
	6	1.00	2.66	2.28
	7	2.00	2.34	2.21
	$\bar{x}$	1.55		2.10
	8	0.07	2.63	1.55
	9	0.59	2.32	1.50
	10	2.11	2.15	0.81
N	11	1.87	2.02	0.25
	12	2.28	2.09	0.43
	13	1.77	1.73	0.04
	14	0.22	2.59	1.23
	$\bar{x}$	1.27	2.22	0.83
	15	1.02	2.54	1.06
	16	1.11	0.11	0.26
	17	1.09	0.68	0.01
S	18	1.03	0.35	1.13
	19	1.26	0.32	0.53
	20	0.33	0.03	0.01
	21	1.43	0.03	0.71
	$\bar{x}$	1.04	0.58	0.53

APPENDIX 4

DATA FOR EXPERIMENT 4

EXPERIMENT 4

CONSUMPTION MEASURES (in mls) FOR 1:1 PARTIAL REINFORCEMENT GROUPS

Flavour group	Subject	P-Tr	b.w.	Tr 1	Exp 1	Exp 2	b.w.	Tr 2
	1	8.9	248	19.4	2.3	8.7	245	16.8
	2	10.4	213	14.6	4.6	11.8	206	14.5
	3	15.3	279	1.9	12.4	14.0	254	18.1
N/S	4	12.7	289	17.9	1.8	7.4	274	15.2
	5	14.3	284	21.9	2.4	16.1	282	18.0
	6	17.3	340	0.7	16.1	20.2	292	18.9
	7	14.5	280	16.8	9.3	13.6	281	16.5
	$\bar{x}$	13.3		13.3	7.0	13.1		16.9
	8	13.9	285	17.4	1.4	6.5	271	14.5
	9	12.3	276	15.6	3.7	11.1	275	13.6
	10	11.6	235	15.4	2.0	5.6	221	13.7
N	11	13.1	301	18.2	1.8	7.4	274	12.8
	12	7.7	291	13.1	3.4	9.0	277	16.4
	13	14.4	255	15.2	6.2	11.2	246	16.3
	14	12.6	216	14.4	7.2	12.8	217	16.5
	$\bar{x}$	12.2		15.6	3.7	9.1		14.8
	15	12.8	265	16.7	1.7	6.3	252	15.1
	16	12.1	260	20.9	2.8	10.5	273	13.5
	17	8.9	279	16.3	0.8	3.3	253	12.6
S	18	12.9	236	15.3	3.6	11.6	237	18.9
	19	11.2	248	18.8	11.9	15.7	264	19.3
	20	8.4	268	4.7	1.3	1.1	241	1.0
	21	14.3	288	21.8	0.0	1.8	317	12.2
	$\bar{x}$	11.5		16.4	3.2	7.2		13.2
overall	$\bar{X}$	12.4	268	15.1	4.6	9.8	260	15.0

(Experiment 4 continued)

Flavour group	Subject	Exp 3	Exp 4	b.w.	Tr 3	b.w.	Tr 4	Exp 5
	1	6.3	8.4	258	10.5	226	1.3	0.2
	2	6.3	10.8	213	13.6	200	1.8	0.1
	3	1.7	4.0	266	8.2	251	0.2	0.6
N/S	4	4.0	8.5	295	13.0	284	2.2	0.7
	5	16.5	19.6	304	20.8	286	3.2	0.3
	6	10.1	23.2	312	20.5	301	12.4	0.5
	7	5.7	13.2	295	15.5	260	2.0	0.1
	$\bar{x}$	7.2	12.5		14.6		3.3	0.4
	8	2.1	4.3	287	5.5	270	0.8	0.4
	9	4.1	5.3	294	8.6	261	0.5	0.7
	10	3.5	5.8	243	9.2	237	0.4	0.6
N	11	2.0	4.3	280	4.9	269	0.2	0.5
	12	4.0	5.6	290	4.9	268	0.6	0.2
	13	4.5	0.0	261	6.2	252	0.5	0.2
	14	7.0	10.2	238	14.8	227	3.9	5.3
	$\bar{x}$	3.9	5.1		7.7		1.0	1.1
	15	0.1	3.1	270	0.1	263	4.9	0.0
	16	0.3	0.8	285	2.0	277	0.2	0.0
	17	0.3	0.5	274	0.3	263	0.3	0.4
S	18	5.9	7.4	265	12.4	254	0.3	0.0
	19	3.6	6.4	268	12.7	259	1.5	0.2
	20	0.2	0.8	257	4.5	247	0.4	0.1
	21	0.3	1.1	336	2.3	302	0.3	0.0
	$\bar{x}$	1.5	2.9		4.9		1.1	0.1
overall	$\bar{X}$	4.2	6.8	276	9.1	260	1.8	0.5

(Experiment 4 continued)

Flavour group	Subject	Exp 6	b.w.	Tr 5	Exp 7	Exp 8	b.w.	Tr 6
	1	0.3	229	0.2	0.4	0.4	224	0.0
	2	0.4	195	0.3	0.1	0.2	198	0.3
	3	0.4	245	0.1	0.0	0.3	247	0.0
N/S	4	0.6	274	1.2	0.3	0.9	281	0.8
	5	0.4	282	0.5	0.6	0.6	288	0.0
	6	2.1	296	6.2	0.3	1.5	294	0.3
	7	0.1	243	0.1	0.0	0.1	258	0.0
	$\bar{x}$	0.6		1.2	0.2	0.6		0.2
	8	0.2	260	0.6	0.0	0.1	273	0.4
	9	0.5	264	0.4	0.1	0.5	284	0.4
	10	0.7	234	0.4	0.3	0.5	238	1.9
N	11	0.5	265	0.3	0.1	0.5	264	0.0
	12	0.2	260	0.3	0.5	0.7	270	0.1
	13	0.1	247	0.0	0.0	0.8	240	0.2
	14	5.7	220	9.6	1.1	1.0	234	2.9
	$\bar{x}$	1.1		1.7	0.3	0.6		0.8
	15	4.1	233	6.2	0.0	1.6	259	3.1
	16	0.4	269	0.0	0.1	0.7	280	0.0
	17	0.7	261	0.2	0.0	0.6	262	0.1
S	18	0.1	250	0.0	0.0	0.2	259	0.0
	19	0.4	253	0.0	0.0	0.1	265	0.0
	20	0.3	240	0.0	0.1	0.1	244	0.0
	21	0.3	308	0.3	0.3	0.4	330	0.1
	$\bar{x}$	0.9		1.0	0.1	0.5		0.5
overall	$\bar{X}$	0.9	254	1.3	0.2	0.6	262	0.5

(Experiment 4 continued)

Flavour group	Subject	Exp 9	Exp 10	b.w.	Tr 7	b.w.	Tr 8	b.w.
	1	0.2	0.6	223	1.0	252	0.2	241
	2	0.0	0.2	196	0.2	194	0.4	199
	3	0.1	1.1	248	0.7	250	0.0	247
N/S	4	0.5	1.1	282	0.7	277	0.1	287
	5	0.0	1.2	288	1.4	291	0.6	286
	6	0.2	1.0	298	0.3	306	1.3	299
	7	0.3	0.5	258	0.4	270	0.3	255
	$\bar{x}$	0.2	0.8		0.7		0.4	
	8	0.2	0.3	272	0.6	279	0.0	281
	9	0.7	0.6	282	0.6	272	0.2	250
	10	0.0	0.5	241	0.6	250	0.4	242
N	11	0.4	0.2	261	0.3	257	0.2	264
	12	0.5	0.3	269	0.5	269	0.0	270
	13	0.1	0.4	246	0.2	260	0.0	245
	14	0.1	0.5	236	0.8	236	0.0	238
	$\bar{x}$	0.3	0.4		0.5		0.1	
	15	0.9	2.1	254	0.1	254	2.0	239
	16	0.2	0.3	266	0.2	251	0.0	276
	17	0.1	0.6	261	0.3	260	0.3	263
S	18	0.0	0.2	263	0.1	246	0.1	249
	19	0.1	0.2	267	0.6	232	0.0	266
	20	0.1	0.2	242	0.1	243	0.3	235
	21	0.1	0.5	332	0.4	338	0.0	330
	$\bar{x}$	0.2	0.6		0.3		0.4	
overall	$\bar{X}$	0.2	0.6	261	0.5	261	0.3	233

(Experiment 4 continued)

Flavour group	Subject	Tr 9	b.w.	Tr 10	Des	Ex 1	Ex 2	Ex 3
	1	0.2	257	0.3	11.5	0.6	0.6	0.3
	2	0.5	192	0.5	11.7	0.8	0.3	0.3
	3	1.0	252	0.1	12.7	1.7	0.2	0.4
N/S	4	0.5	270	0.1	15.3	1.0	0.9	0.8
	5	1.2	291	0.2	11.7	0.8	0.8	1.6
	6	2.2	308	1.5	10.1	0.8	0.8	0.7
	7	0.9	271	0.2	13.9	1.0	0.6	0.7
	$\bar{x}$	0.9		0.4	12.4	1.0	0.6	0.7
	8	0.7	260	0.1	10.3	1.2	1.6	2.2
	9	0.9	275	0.5	9.7	3.8	2.4	5.3
	10	3.5	256	0.5	9.0	1.1	1.3	1.1
N	11	1.3	255	0.1	12.0	1.7	1.7	2.1
	12	1.4	260	0.4	15.9	1.3	1.7	1.3
	13	0.9	260	0.2	16.2	2.1	1.2	0.6
	14	0.7	242	0.4	12.0	0.6	1.7	2.1
	$\bar{x}$	1.3		0.3	12.2	1.7	1.6	2.1
	15	0.7	251	0.2	10.0	3.7	6.0	9.6
	16	0.9	259	0.1	14.4	6.9	6.6	15.0
	17	1.0	258	0.3	12.4	0.2	6.2	8.4
S	18	0.0	246	0.1	12.0	3.2	6.2	10.2
	19	0.0	239	0.1	13.4	3.0	5.5	9.1
	20	0.7	250	0.5	13.2	2.9	7.4	11.0
	21	0.7	339	0.2	12.2	1.0	0.3	0.4
	$\bar{x}$	0.6		0.2	12.5	3.0	5.4	9.1
overall	$\bar{X}$	1.0	261	0.3	12.4			

(Experiment 4 continued)

Flavour group	Subject	Ex 4	Ex 5	Ex 6	Ex 7	Ex 8	Ex 9	Ex 10
	1	0.5	1.0	0.9	1.8	1.1	3.7	0.8
	2	0.5	0.6	0.1	0.2	0.6	0.1	0.5
	3	0.4	0.7	0.6	0.2	0.2	0.2	0.3
N/S	4	0.4	0.5	0.6	0.5	0.6	0.2	0.8
	5	1.5	1.1	2.8	2.5	5.2	8.6	17.1
	6	0.2	0.4	0.1	0.4	0.6	0.7	0.3
	7	0.6	0.7	0.9	0.9	1.4	2.3	3.3
	$\bar{x}$	0.6	0.7	0.8	0.9	1.3	2.3	3.3
	8	10.0	12.7	14.4	13.0	12.0	16.3	16.9
	9	11.1	13.2	15.4	21.3	20.2	14.8	18.9
	10	0.2	2.0	3.7	4.5	6.8	11.9	16.6
N	11	4.3	6.7	9.1	11.4	13.4	14.9	16.4
	12	1.6	7.3	11.5	17.2	16.8	17.6	15.7
	13	1.0	2.0	4.2	4.9	10.2	11.7	14.7
	14	1.9	3.1	5.3	7.7	14.2	16.9	15.5
	$\bar{x}$	4.3	8.5	9.1	11.5	13.4	15.0	16.4
	15	8.8	9.8	9.3	11.7	11.7	13.3	15.7
	16	16.9	16.0	17.6	18.4	19.0	22.0	15.8
	17	9.5	10.9	11.8	12.9	13.8	17.2	17.6
S	18	12.4	9.6	13.4	14.3	14.5	13.7	18.9
	19	9.7	10.5	11.9	13.7	14.6	17.3	17.1
	20	9.8	15.2	14.7	18.6	14.8	15.7	15.1
	21	0.9	1.6	4.3	6.5	13.9	21.7	19.3
	$\bar{x}$	9.7	10.5	11.9	13.7	14.6	17.3	17.1

EXPERIMENT 4

CONSUMPTION MEASURES (in mls) FOR 2:1 PARTIAL REINFORCEMENT GROUPS

Flavour group	Subject	P-Tr	Exp 1	b.w.	Tr 1	Exp 2	Exp 3	b.w.
	1	11.6	12.8	215	14.7	10.7	14.0	220
	2	13.7	13.5	245	16.6	12.2	16.1	250
	3	12.2	17.5	285	16.8	6.3	14.3	290
N/S	4	15.7	17.6	284	21.0	9.8	14.7	280
	5	13.1	13.7	240	19.1	5.0	16.8	242
	6	14.3	15.4	258	11.3	2.9	8.7	260
	7	13.0	16.7	237	8.4	14.0	0.1	242
	$\bar{x}$	13.4	15.3		15.4	8.7	12.1	
	8	11.0	14.8	237	16.9	3.8	2.0	239
	9	11.8	15.4	289	18.4	6.3	13.0	292
	10	12.8	16.8	280	15.5	1.1	12.6	281
N	11	11.4	11.2	297	16.5	1.1	7.7	300
	12	9.5	14.1	247	12.8	7.0	18.1	245
	13	11.4	11.8	201	17.8	6.4	12.5	205
	14	15.8	12.4	302	14.1	17.7	20.0	306
	$\bar{x}$	12.0	13.8		16.0	6.2	12.3	
	15	16.0	18.2	292	11.8	3.6	0.1	297
	16	13.4	15.7	279	19.4	7.8	12.2	279
	17	16.2	15.5	299	23.0	19.6	0.0	298
S	18	13.8	13.4	264	11.9	13.8	18.1	269
	19	9.5	10.6	234	5.1	0.7	3.4	238
	20	10.4	2.5	247	11.8	5.3	13.6	253
	21	15.4	2.5	290	18.6	2.4	5.8	292
	$\bar{x}$	13.5	11.2		14.5	7.6	7.6	
overall	$\bar{X}$	13.0	13.4	263	15.3	7.5	10.7	266

(Experiment 4 continued)

Flavour group	Subject	Tr 2	Exp 4	Exp 5	Exp 6	b.w.	Tr 3	Exp 7
	1	9.3	15.2	15.4	16.2	239	12.0	0.2
	2	15.1	16.1	19.3	19.8	262	17.4	7.0
	3	18.1	6.6	9.8	13.6	289	16.3	4.0
N/S	4	17.8	9.2	11.8	15.2	303	16.8	6.8
	5	17.4	5.4	11.8	15.0	262	16.7	9.0
	6	7.4	8.2	6.2	13.8	269	15.5	9.4
	7	0.1	18.4	20.0	17.7	251	19.8	14.2
	$\bar{x}$	12.2	11.3	13.5	15.9			
	8	12.7	3.6	0.1	5.3	224	6.8	1.2
	9	18.5	0.0	5.0	9.7	287	13.9	2.4
	10	0.2	18.8	0.1	23.5	276	0.0	21.1
N	11	12.8	5.1	11.3	11.7	324	14.9	4.4
	12	20.6	4.7	10.9	14.9	279	14.2	7.0
	13	16.8	2.6	5.5	8.8	230	12.9	5.1
	14	19.9	13.8	19.2	23.5	309	0.0	19.5
	$\bar{x}$	14.5	6.9	7.4	13.9			
	15	12.5	0.0	0.3	0.9	281	1.4	0.2
	16	16.2	3.4	6.6	7.7	276	9.0	1.6
	17	0.2	22.5	22.7	0.1	324	22.2	0.1
S	18	0.1	0.0	14.1	15.0	272	0.0	0.0
	19	3.3	0.6	1.4	2.5	225	3.7	1.4
	20	0.2	17.2	20.6	18.8	281	10.8	12.9
	21	10.6	0.3	0.2	0.1	265	1.1	0.3
	$\bar{x}$	6.2	6.3	9.4	6.4			
overall	$\bar{X}$	10.9	8.2	10.1	12.1	273	10.7	6.1

(Experiment 4 continued)

Flavour group	Subject	Exp 8	b.w.	Tr 4	Exp 9	b.w.	Tr 5	Exp 10
	1	11.5	245	14.5	1.0	234	2.9	0.5
	2	15.2	269	17.8	14.8	272	13.0	5.1
	3	7.0	288	9.3	1.5	280	2.5	0.2
N/S	4	9.4	300	12.8	5.0	293	3.3	0.1
	5	11.5	268	14.3	4.2	258	5.3	1.2
	6	10.3	277	14.1	3.5	270	5.5	1.5
	7	15.8	261	19.1	6.4	243	1.7	6.9
	$\bar{x}$	11.5		14.6	5.2		4.9	2.2
	8	0.0	212	2.0	0.0	220	0.5	0.0
	9	4.4	288	4.7	1.4	289	1.2	0.3
	10	25.1	309	17.1	16.4	311	18.1	15.8
N	11	10.1	330	10.5	1.3	320	2.0	0.1
	12	11.6	283	14.0	4.8	270	6.0	0.0
	13	5.9	235	9.5	2.5	229	1.0	0.3
	14	21.6	339	21.3	14.4	335	16.3	2.2
	$\bar{x}$	11.2		11.3	5.8		6.4	2.7
	15	0.0	269	0.1	0.1	258	0.4	0.0
	16	3.7	264	2.1	0.2	256	0.4	0.0
	17	25.3	339	25.9	8.8	326	10.0	0.1
S	18	20.9	300	21.8	6.3	297	10.3	9.9
	19	1.4	224	2.3	0.3	232	0.5	0.1
	20	15.2	293	15.0	2.8	284	3.8	0.1
	21	0.6	261	0.1	0.0	273	0.2	0.1
	$\bar{x}$	9.6		9.6	2.6		3.7	1.5
overall	$\bar{X}$	10.8	279	11.8	4.6	274	5.0	2.1

(Experiment 4 continued)

Flavour group	Subject	Exp 11	b.w.	Tr 6	Exp 12	b.w.	Tr 7	Exp 13
	1	2.3	234	0.1	0.7	238	7.5	1.9
	2	9.3	278	9.9	2.7	260	3.1	0.5
	3	0.6	280	0.3	0.7	271	0.0	0.2
N/S	4	0.2	288	0.6	0.1	290	0.0	0.4
	5	2.0	259	1.9	0.3	255	0.8	0.3
	6	2.4	272	2.1	0.5	266	1.1	0.5
	7	0.2	256	6.4	3.6	252	5.6	2.0
	$\bar{x}$	2.4		3.0	1.2		2.6	0.8
	8	0.2	217	0.3	0.4	211	0.1	0.1
	9	2.0	288	0.8	0.2	289	1.9	0.2
	10	0.1	286	0.2	0.0	307	13.6	0.1
N	11	1.2	314	0.5	0.2	311	0.7	0.3
	12	3.3	276	0.2	0.0	263	0.0	0.1
	13	0.4	232	0.6	0.1	232	0.2	0.2
	14	4.3	313	8.3	0.7	297	2.0	0.5
	$\bar{x}$	1.6		1.6	0.2		2.6	0.2
	15	0.0	276	0.3	0.0	283	0.1	0.2
	16	0.4	258	0.1	0.0	232	0.4	0.1
	17	2.4	321	2.5	0.4	294	0.4	0.2
S	18	0.0	306	11.2	4.3	297	0.0	12.8
	19	0.2	236	0.2	0.0	234	0.0	0.1
	20	0.6	287	0.1	0.0	279	0.0	0.1
	21	0.0	271	0.6	0.0	252	0.0	0.2
	$\bar{x}$	0.5		2.1	0.7		0.1	2.0
overall	$\bar{X}$	1.5	274	2.3	0.8	267	1.8	1.0

(Experiment 4 continued)

Flavour group	Subject	Exp 14	Exp 15	b.w.	Tr 8	Exp 16	Exp 17	Exp 18
	1	2.5	3.2	244	0.1	2.6	4.9	8.6
	2	0.8	0.8	269	5.2	1.3	0.9	1.6
	3	1.0	0.2	284	0.5	0.3	0.4	0.1
N/S	4	1.0	1.4	305	0.3	0.4	0.8	0.2
	5	0.8	0.8	268	0.7	0.3	0.6	0.2
	6	1.1	0.5	280	0.5	0.9	1.5	0.7
	7	2.4	3.2	257	3.4	1.3	1.2	2.5
	$\bar{x}$	1.4	1.4		1.5	1.0	1.5	2.0
	8	0.7	0.5	229	0.2	0.3	0.7	0.0
	9	1.2	0.6	297	0.3	0.8	0.9	1.1
	10	2.3	4.2	311	5.3	1.2	0.0	1.6
N	11	0.6	1.1	309	0.8	0.2	0.5	0.4
	12	2.4	2.8	291	3.1	1.1	0.9	0.3
	13	0.6	0.4	248	0.3	0.3	0.9	0.3
	14	0.3	0.2	279	1.3	0.4	0.1	0.1
	$\bar{x}$	1.2	1.4		1.6	0.6	0.6	0.5
	15	0.9	0.2	291	0.4	0.2	0.8	0.1
	16	0.0	0.1	250	0.3	0.2	0.4	0.1
	17	0.5	0.0	292	0.2	0.1	0.8	2.0
S	18	12.1	16.4	292	0.1	3.5	5.1	18.4
	19	0.2	0.3	237	0.2	0.2	0.4	0.0
	20	0.0	1.5	290	1.4	0.2	0.0	0.0
	21	0.1	0.3	272	0.3	0.2	0.3	0.2
	$\bar{x}$	2.0	2.7		0.4	0.7	1.1	3.0
overall	$\bar{X}$	1.5	2.5	276	1.2	0.8	1.1	1.8

(Experiment 4 continued)

Flavour group	Subject	Exp 19	b.w.	Tr 9	Exp 20	b.w.	Tr 10	Des
	1	11.7	272	11.2	9.4	266	1.8	13.6
	2	1.5	278	1.5	0.9	287	0.8	12.4
	3	0.2	291	0.1	0.1	294	0.2	11.7
N/S	4	0.4	314	0.2	0.2	317	0.2	18.0
	5	0.3	277	0.7	0.5	282	0.3	17.6
	6	0.9	286	2.2	1.0	276	1.6	15.8
	7	2.8	269	4.1	1.1	271	1.1	13.9
	$\bar{x}$	2.5		2.9	1.9		0.9	14.7
	8	0.3	239	0.1	0.1	243	0.4	9.1
	9	1.0	316	1.8	1.5	315	0.8	15.1
	10	1.5	327	2.6	0.6	322	0.7	15.4
N	11	0.2	320	0.4	0.1	319	0.1	14.6
	12	1.1	311	2.7	1.4	310	0.7	18.1
	13	0.4	264	0.3	0.2	264	0.2	12.8
	14	0.4	296	0.3	0.3	306	0.5	11.6
	$\bar{x}$	0.7		1.2	0.6		0.5	13.8
	15	0.2	309	0.4	0.1	313	0.2	12.7
	16	0.0	267	0.5	0.0	270	0.2	10.4
	17	1.6	309	1.9	0.7	312	0.6	9.4
S	18	0.1	330	19.1	8.2	330	5.3	14.7
	19	0.5	252	0.1	0.0	253	0.2	14.0
	20	0.1	282	1.2	0.1	292	0.7	15.4
	21	4.3	299	0.1	0.0	301	0.1	11.0
	$\bar{x}$	1.0		3.3	1.3		1.0	12.5
overall	$\bar{X}$	1.4	291	2.5	1.3	293	0.8	13.7

(Experiment 4 continued)

Flavour group	Subject	Ex 1	Ex 2	Ex 3	Ex 4	Ex 5	Ex 6	Ex 7
	1	0.2	1.0	0.5	1.4	2.8	2.9	3.3
	2	0.1	0.2	0.1	0.7	0.6	0.8	0.8
	3	0.3	0.1	0.1	0.2	0.2	0.3	0.3
N/S	4	0.4	0.7	0.2	0.2	0.4	0.8	0.4
	5	0.9	0.5	0.5	1.0	1.0	0.6	0.7
	6	0.8	1.3	1.4	1.5	3.2	4.1	4.1
	7	0.5	0.6	0.5	0.8	1.4	1.6	1.6
	$\bar{x}$	0.5	0.6	0.5	0.8	1.4	1.5	1.5
	8	1.0	2.0	1.7	2.3	3.0	2.8	8.3
	9	3.2	5.7	6.2	8.5	10.2	10.2	12.3
	10	3.3	2.2	2.7	3.5	6.4	9.8	14.4
N	11	1.4	1.6	1.0	1.4	1.5	1.6	2.2
	12	6.9	13.8	9.9	17.5	19.3	21.1	21.5
	13	2.9	4.7	4.4	6.7	8.0	8.6	10.8
	14	1.3	2.8	5.1	7.2	7.8	6.0	6.0
	$\bar{x}$	2.9	4.7	4.4	6.7	8.0	8.5	10.8
	15	7.1	10.7	9.9	11.1	10.8	10.3	10.8
	16	2.1	2.3	2.2	5.9	6.8	8.1	9.8
	17	9.6	15.3	14.0	14.0	13.8	13.6	13.9
S	18	19.6	27.3	18.1	14.8	18.0	7.8	5.7
	19	3.6	6.6	8.5	10.3	10.8	11.0	12.0
	20	4.7	9.7	11.7	13.9	8.9	14.7	13.3
	21	3.0	3.2	4.8	7.6	6.3	6.4	10.2
	$\bar{x}$	7.1	10.7	9.9	11.1	10.7	10.2	10.8

(Experiment 4 continued)

Flavour group	Subject	Ex 8	Ex 9	Ex 10
N/S	1	3.6	6.0	8.5
	2	2.4	0.2	0.6
	3	0.3	0.3	0.4
	4	0.5	1.0	1.4
	5	0.6	0.5	0.6
	6	4.7	6.2	4.5
	7	2.0	2.4	2.7
	$\bar{x}$	2.0	2.3	2.6
N	8	10.7	12.2	17.1
	9	15.9	14.9	20.6
	10	14.0	17.7	22.5
	11	3.4	4.6	9.1
	12	20.3	21.0	28.3
	13	11.8	12.8	17.5
	14	6.7	6.6	7.4
	$\bar{x}$	11.8	12.8	17.5
S	15	11.9	11.7	13.0
	16	12.3	9.9	11.7
	17	14.5	13.0	11.0
	18	6.5	7.9	8.5
	19	12.3	12.3	15.6
	20	12.3	15.2	16.7
	21	13.3	11.9	14.2
	$\bar{x}$	11.8	11.7	13.0

APPENDIX 5

DATA FOR EXPERIMENT 5

EXPERIMENT 5

CONSUMPTION MEASURES (in mls) FOR ONE N/S PRECONDITIONING TRIAL GROUPS ON EXPERIMENTAL DAYS

Test group	Subject	P-Tr		P-Con 1*		Tr 1		Tr 2	
	1	13.3		10.6		16.1		0.6	
	2	13.8		15.5		14.8		3.9	
	3	13.2		20.0		14.5		0.2	
S_S#	4	10.5		16.6		14.1		0.5	
	5	14.1		18.6		16.2		2.3	
	6	16.4	$\bar{x}$ =	3.3	$\bar{x}$ =	15.2	$\bar{x}$ =	1.2	$\bar{x}$ =
	7	9.4	12.9	11.6	14.2	9.8	14.6	0.3	1.2
	8	12.5		17.6		16.3		0.3	
	9	12.6		16.7		15.8		2.7	
	10	9.5		14.1		12.4		0.3	
	11	16.8		20.6		12.1		0.6	
N_S	12	14.4		19.6		16.4		6.1	
	13	12.7		16.9		12.4		0.0	
	14	12.6	$\bar{x}$ =	12.8	$\bar{x}$ =	16.7	$\bar{x}$ =	0.8	$\bar{x}$ =
	15	14.8	13.4	19.4	17.3	18.2	14.7	0.9	1.5
	16	13.8		18.1		13.9		0.2	
	17	18.8		22.8		22.0		0.1	
	18	15.3		15.1		19.7		8.8	
	19	12.7		14.3		14.4		8.8	
S_N	20	12.9		17.6		17.9		10.0	
	21	13.2		16.7		19.0		8.7	
	22	15.2	$\bar{x}$ =	18.8	$\bar{x}$ =	19.7	$\bar{x}$ =	6.5	$\bar{x}$ =
	23	15.1	14.5	1.0	15.1	20.8	18.9	14.8	7.3
	24	12.8		14.8		17.8		0.8	
	25	10.4		13.9		15.4		6.4	
	26	12.6		19.7		17.7		8.7	
	27	14.4		8.1		16.2		4.9	
N_N	28	12.5		2.0		18.7		10.3	
	29	15.6		16.2		19.5		6.2	
	30	13.6	$\bar{x}$ =	17.6	$\bar{x}$ =	17.3	$\bar{x}$ =	13.9	$\bar{x}$ =
	31	10.4	12.8	13.4	13.8	13.5	16.8	8.0	8.4
	32	13.1		19.2		15.7		8.7	

* P-Con = preconditioning N/S trial
\# Subscripts denote training flavour

(Experiment 5 continued)

Test group	Subject	Tr 3		P-T		Ex 1		Ex 2	
	1	0.4		14.4		0.3		0.1	
	2	0.8		10.9		0.6		0.6	
	3	0.5		11.3		0.6		0.1	
S_S	4	0.5		9.0		0.3		0.6	
	5	0.4		12.5		0.2		0.2	
	6	0.3	$\bar{x}$ =	15.2	$\bar{x}$ =	0.8	$\bar{x}$ =	0.2	$\bar{x}$ =
	7	0.2	0.4	11.4	12.1	0.4	0.5	0.2	0.3
	8	0.4		12.1		0.5		0.4	
	9	0.5		9.2		0.2		11.1	
	10	0.3		10.8		12.4		15.7	
	11	0.3		16.4		17.4		22.2	
N_S	12	0.2		15.0		3.0		20.1	
	13	1.7		10.9		14.9		17.7	
	14	0.3	$\bar{x}$ =	12.3	$\bar{x}$ =	17.0	$\bar{x}$ =	16.2	$\bar{x}$ =
	15	0.6	0.5	9.3	11.9	7.3	9.1	13.7	14.6
	16	0.1		11.5		0.2		0.1	
	17	8.7		15.0		9.0		17.1	
	18	4.0		17.4		2.2		0.0	
	19	1.2		11.5		4.6		13.0	
S_N	20	1.6		13.1		5.8		16.3	
	21	1.7		10.1		4.6		12.5	
	22	0.7	$\bar{x}$ =	15.3	$\bar{x}$ =	4.0	$\bar{x}$ =	11.7	$\bar{x}$ =
	23	10.3	3.6	13.8	12.9	5.8	5.3	12.1	11.1
	24	0.3		7.0		6.0		6.0	
	25	6.2		6.0		0.1		1.3	
	26	0.2		13.8		1.3		1.0	
	27	-0.2		14.5		0.0		0.1	
N_N	28	1.3		13.8		0.0		0.2	
	29	0.3		16.5		0.1		0.1	
	30	3.2	$\bar{x}$ =	14.8	$\bar{x}$ =	0.3	$\bar{x}$ =	0.5	$\bar{x}$ =
	31	0.6	1.6	13.0	13.5	0.0	0.3	0.7	0.5
	32	0.5		15.8		0.3		0.1	

(Experiment 5 continued)

Test group	Subject	Ex 3		Ex 4	
S_S	1	0.1		0.2	
	2	0.6		0.5	
	3	0.4		0.4	
	4	0.1		0.4	
	5	0.2		0.1	
	6	0.4	$\bar{x}$ =	0.4	$\bar{x}$ =
	7	0.2	0.3	0.4	0.3
	8	0.5		0.3	
N_S	9	19.0		18.0	
	10	15.1		16.0	
	11	22.3		21.9	
	12	22.7		18.5	
	13	20.7		18.0	
	14	17.7	$\bar{x}$ =	17.8	$\bar{x}$ =
	15	20.2	17.3	17.3	16.7
	16	0.4		6.2	
S_N	17	7.4		19.3	
	18	11.7		17.5	
	19	8.8		5.5	
	20	19.4		16.6	
	21	14.4		14.6	
	22	17.1	$\bar{x}$ =	17.1	$\bar{x}$ =
	23	15.8	12.6	15.2	15.0
	24	6.1		13.9	
N_N	25	3.2		6.0	
	26	2.9		4.9	
	27	0.1		0.1	
	28	0.3		1.0	
	29	0.0		0.1	
	30	0.3	$\bar{x}$ =	1.0	$\bar{x}$ =
	31	0.7	1.0	0.1	1.7
	32	0.3		0.4	

CONSUMPTION MEASURES (in mls) FOR FOUR N/S PRECONDITIONING TRIALS GROUPS

Test group	Subject	P-Tr	P-Con 1		P-Con 2		P-Con 3	
	1		6.3		14.3		16.9	
	2	*	13.5		16.5		14.9	
	3		16.0		16.0		21.8	
S_S	4		17.1		14.0		20.7	
	5		11.7		16.3		19.7	
	6		14.6	$\bar{x}$ =	17.3	$\bar{x}$ =	16.2	$\bar{x}$=
	7		8.0	11.7	13.4	15.2	17.1	17.8
	8		6.1		14.1		15.1	
	9		18.7		19.5		22.6	
	10		15.8		15.0		23.6	
	11		13.6		17.9		17.9	
N_S	12		20.4		21.6		23.3	
	13		9.4		14.8		7.8	
	14		5.9	$\bar{x}$ =	17.9	$\bar{x}$ =	22.6	$\bar{x}$ =
	15		14.1	14.3	20.4	18.5	21.2	19.9
	16		16.4		21.0		20.1	
	17		14.7		19.8		20.1	
	18		10.6		14.6		22.4	
	19		12.1		18.1		21.7	
S_N	20		15.0		18.2		17.0	
	21		12.2		17.1		24.1	
	22		7.8	$\bar{x}$ =	10.3	$\bar{x}$ =	16.1	$\bar{x}$ =
	23		5.2	11.3	13.6	15.1	22.3	20.3
	24		12.6		9.3		18.8	
	25		14.9		17.6		18.9	
	26		9.6		18.4		18.7	
	27		17.9		15.9		22.7	
N_N	28		11.5		12.0		18.0	
	29		14.4		16.7		16.5	
	30		14.2	$\bar{x}$ =	18.8	$\bar{x}$ =	17.7	$\bar{x}$ =
	31		6.6	12.7	15.3	16.3	18.8	18.7
	32		12.4		15.7		18.4	

(Experiment 5 continued)

Test group	Subject	P-Con 4		Tr 1		Tr 2		Tr 3	
	1	16.3		14.9		1.7		0.3	
	2	19.1		12.9		2.0		0.5	
	3	19.3		15.9		1.6		0.0	
S_S	4	17.7		18.7		1.6		0.5	
	5	18.4		17.1		5.6		4.4	
	6	17.8	$\bar{x}$ =	13.6	$\bar{x}$ =	2.5	$\bar{x}$ =	0.6	$\bar{x}$ =
	7	22.5	18.6	17.9	15.3	1.5	2.4	0.5	0.9
	8	17.7		11.2		1.8		0.6	
	9	19.8		13.8		10.7		0.2	
	10	19.7		14.3		0.6		0.3	
	11	16.3		19.5		0.8		1.7	
N_S	12	20.9		21.0		5.6		0.2	
	13	17.1		14.0		2.5		0.2	
	14	18.4	$\bar{x}$ =	12.5	$\bar{x}$ =	0.3	$\bar{x}$ =	0.4	$\bar{x}$ =
	15	21.7	18.8	14.8	15.3	0.2	2.7	0.0	0.4
	16	16.5		12.2		0.6		0.2	
	17	18.9		17.4		8.5		0.3	
	18	16.4		20.0		9.6		0.7	
	19	21.2		20.1		8.6		0.4	
S_N	20	17.5		20.7		12.7		1.2	
	21	17.3		10.7		10.2		8.7	
	22	21.4	$\bar{x}$ =	14.5	$\bar{x}$ =	11.0	$\bar{x}$ =	3.1	$\bar{x}$ =
	23	15.7	18.6	18.6	17.3	7.8	9.7	0.6	2.5
	24	20.0		16.1		9.3		5.2	
	25	16.4		21.4		14.5		1.3	
	26	19.5		21.0		14.8		0.3	
	27	18.3		20.5		5.7		0.5	
N_N	28	18.4		20.6		13.4		1.4	
	29	17.3		19.6		8.2		0.3	
	30	16.5	$\bar{x}$ =	12.6	$\bar{x}$ =	18.2	$\bar{x}$ =	2.2	$\bar{x}$ =
	31	19.9	18.0	19.2	18.1	3.9	11.1	0.4	0.9
	32	18.0		10.1		9.9		0.7	

(Experiment 5 continued)

Test group	Subject	P-T		Ex 1		Ex 2		Ex 3		Ex 4	
	1	7.6		1.2		0.2		0.4		0.1	
	2	11.4		1.3		0.0		0.3		0.3	
	3	14.6		1.7		0.5		0.5		0.1	
S_S	4	12.8		2.2		0.9		0.6		0.2	
	5	14.6		1.4		1.7		0.8		0.5	
	6	10.9	$\bar{x}$ =	1.3	$\bar{x}$ =	0.3	$\bar{x}$ =	0.5	$\bar{x}$ =	0.2	$\bar{x}$ =
	7	10.0	11.9	1.3	1.5	0.2	0.5	0.5	0.5	0.2	0.3
	8	13.0		1.3		0.0		0.3		0.4	
	9	14.5		0.9		0.2		13.0		18.6	
	10	13.5		1.3		0.0		17.4		20.0	
	11	12.6		8.4		6.3		16.3		17.2	
N_S	12	14.5		9.7		11.1		16.4		18.5	
	13	12.7		9.7		7.5		14.3		15.9	
	14	10.9	$\bar{x}$ =	9.7	$\bar{x}$ =	10.8	$\bar{x}$ =	13.9	$\bar{x}$ =	16.7	$\bar{x}$ =
	15	13.2	11.6	0.7	5.5	0.0	6.2	13.6	15.3	20.2	18.6
	16	1.1		3.7		13.8		17.4		21.7	
	17	14.1		3.7		10.6		14.7		18.2	
	18	13.0		6.4		12.5		14.2		17.5	
	19	15.5		0.3		4.3		12.8		17.2	
S_N	20	16.1		8.7		0.0		13.2		15.4	
	21	10.1		1.5		0.8		10.1		14.0	
	22	9.8	$\bar{x}$ =	0.0	$\bar{x}$ =	8.3	$\bar{x}$ =	10.9	$\bar{x}$ =	10.9	$\bar{x}$ =
	23	14.2	13.2	5.2	3.7	0.8	4.8	11.9	11.0	11.9	13.1
	24	12.4		3.9		0.9		0.1		0.0	
	25	13.1		0.8		0.2		0.8		0.1	
	26	14.4		0.4		0.0		0.5		0.5	
	27	13.7		0.2		0.0		0.6		0.9	
N_N	28	11.1		0.1		0.9		0.2		0.6	
	29	13.4		0.7		0.0		0.5		1.4	
	30	9.9	$\bar{x}$ =	0.8	$\bar{x}$ =	0.8	$\bar{x}$ =	0.6	$\bar{x}$ =	0.0	$\bar{x}$ =
	31	11.1	12.5	1.1	0.7	0.9	0.4	0.3	0.5	0.1	0.6
	32	13.5		1.6		0.0		0.4		1.0	

CONSUMPTION MEASURES (in mls) FOR SEVEN N/S PRECONDITIONING TRIALS GROUPS

Test group	Subject	P-Tr		P-Con 1		P-Con 2		P-Con 3	
	1	15.1		17.0		19.6		24.0	
	2	13.1		15.4		20.7		23.8	
	3	10.9		9.2		14.8		16.7	
S_S	4	16.8		14.2		18.8		21.0	
	5	15.0		16.3		17.6		19.0	
	6	10.4	$\bar{x}$ =	11.3	$\bar{x}$ =	14.1	$\bar{x}$ =	17.9	$\bar{x}$ =
	7	13.5	13.4	8.0	13.0	13.9	16.9	18.0	20.2
	8	12.5		12.3		15.8		21.0	
	9	14.3		15.4		19.0		20.8	
	10	15.1		12.0		16.2		19.3	
	11	18.0		2.4		20.7		10.2	
N_S	12	11.0		17.0		17.2		17.4	
	13	4.8		13.8		18.6		19.5	
	14	13.4	$\bar{x}$ =	15.1	$\bar{x}$ =	16.8	$\bar{x}$ =	21.2	$\bar{x}$ =
	15	14.1	13.0	15.3	13.7	20.0	17.0	18.5	17.9
	16	13.5		18.2		7.8		16.6	
	17	11.2		12.5		15.8		16.6	
	18	12.8		13.5		16.7		18.6	
	19	13.2		15.7		17.2		18.1	
S_N	20	15.0		16.3		19.4		20.3	
	21	12.1		9.9		14.4		15.7	
	22	6.5	$\bar{x}$ =	6.9	$\bar{x}$ =	15.9	$\bar{x}$ =	16.7	$\bar{x}$ =
	23	12.0	12.1	8.6	12.2	15.0	16.2	18.1	18.1
	24	14.2		13.8		15.3		20.8	
	25	14.0		4.3		18.5		9.8	
	26	12.1		6.7		15.9		17.9	
	27	16.7		19.1		20.9		22.8	
N_N	28	11.2		15.8		19.5		18.4	
	29	13.1		10.1		18.1		18.0	
	30	9.0	$\bar{x}$ =	13.1	$\bar{x}$ =	14.2	$\bar{x}$ =	16.7	$\bar{x}$ =
	31	6.5	12.1	14.2	11.8	15.8	18.0	18.8	17.6
	32	14.2		11.1		21.3		18.0	

(Experiment 5 continued)

Test group	Subject	P-Con 4		P-Con 5		P-Con 6		P-Con 7	
	1	21.7		21.4		22.9		22.4	
	2	26.2		24.3		25.3		26.4	
	3	20.0		18.4		18.6		19.9	
S_S	4	20.3		19.7		20.9		24.9	
	5	21.1		20.1		20.6		22.7	
	6	19.4	$\bar{x}$ =	19.0	$\bar{x}$ =	19.2	$\bar{x}$ =	19.6	$\bar{x}$ =
	7	20.0	21.3	8.8	18.7	20.0	21.0	19.1	22.2
	8	21.9		18.1		20.7		22.3	
	9	25.3		22.9		18.6		23.6	
	10	25.6		20.0		20.7		20.6	
	11	23.7		21.5		21.0		22.4	
N_S	12	19.2		14.5		18.9		21.7	
	13	24.0		23.0		23.3		22.0	
	14	21.7	$\bar{x}$ =	17.1	$\bar{x}$ =	21.2	$\bar{x}$ =	20.7	$\bar{x}$ =
	15	22.7	23.4	21.4	20.1	20.5	20.8	22.8	22.2
	16	25.3		20.1		21.8		23.9	
	17	19.6		7.2		16.9		24.6	
	18	22.1		19.0		17.9		19.4	
	19	21.9		21.4		20.0		21.1	
S_N	20	21.9		16.6		24.3		24.9	
	21	17.7		17.0		13.6		14.4	
	22	20.1	$\bar{x}$ =	20.8	$\bar{x}$ =	21.3	$\bar{x}$ =	20.5	$\bar{x}$ =
	23	17.2	19.7	17.0	17.4	19.1	19.0	18.1	20.5
	24	17.2		20.0		18.5		20.6	
	25	19.4		14.8		10.1		20.2	
	26	28.0		20.3		18.8		20.5	
	27	26.4		22.4		23.1		26.8	
N_N	28	20.0		19.3		20.1		20.0	
	29	21.5		8.1		21.8		21.1	
	30	12.1	$\bar{x}$ =	17.2	$\bar{x}$ =	14.1	$\bar{x}$ =	15.2	$\bar{x}$ =
	31	20.2	21.1	21.4	18.4	18.3	18.0	20.7	21.0
	32	20.8		23.9		18.0		23.4	

(Experiment 5 continued)

Test group	Subject	Tr 1		Tr 2		Tr 3		P-T	
	1	15.8		0.5		0.4		17.3	
	2	17.5		6.9		0.5		15.5	
	3	11.5		1.0		0.1		16.5	
S_S	4	18.6		3.7		0.4		16.5	
	5	14.1		0.8		0.7		18.9	
	6	6.2	$\bar{x}$ =	3.1	$\bar{x}$ =	1.1	$\bar{x}$ =	13.3	$\bar{x}$ =
	7	12.7	13.0	12.1	3.7	0.5	0.6	13.3	15.6
	8	7.8		1.5		0.7		13.2	
	9	17.0		1.5		0.2		13.8	
	10	16.6		2.1		0.4		13.1	
	11	17.3		3.3		0.5		17.1	
N_S	12	6.6		1.2		0.3		15.7	
	13	7.1		1.0		1.9		16.3	
	14	16.3	$\bar{x}$ =	2.6	$\bar{x}$ =	0.3	$\bar{x}$ =	14.8	$\bar{x}$ =
	15	7.2	12.5	5.7	2.3	0.3	0.5	15.4	15.6
	16	12.0		1.0		0.0		18.4	
	17	12.0		-	#	-		-	
	18	14.7		16.6		8.0		18.1	
	19	14.7		8.6		0.3		11.6	
S_N	20	21.6		13.1		1.8		15.0	
	21	7.9		12.7		10.7		13.9	
	22	13.2	$\bar{x}$ =	21.0	$\bar{x}$ =	6.7	$\bar{x}$ =	13.7	$\bar{x}$ =
	23	12.6	14.3	0.7	12.7	1.8	4.2	14.4	14.5
	24	17.8		16.0		0.4		14.8	
	25	18.1		9.0		0.0		15.2	
	26	17.1		16.9		7.3		11.8	
	27	14.1		19.1		5.9		15.1	
N_N	28	16.0		5.4		0.3		18.5	
	29	14.5		24.3		7.9		18.3	
	30	4.2	$\bar{x}$ =	0.0	$\bar{x}$ =	14.0	$\bar{x}$ =	12.6	$\bar{x}$ =
	31	18.6	14.5	21.0	14.6	5.7	5.9	16.6	15.4
	32	13.2		21.4		6.1		15.4	

due to middle ear infection, animal was removed from study.

(Experiment 5 continued)

Test group	Subject	Ex 1		Ex 2		Ex 3		Ex 4	
	1	0.9		0.3		0.4		0.8	
	2	1.0		0.6		0.2		0.5	
	3	1.0		0.9		0.3		0.3	
S_S	4	0.9		0.5		0.6		0.2	
	5	0.7		0.8		0.9		0.5	
	6	1.3	$\bar{x}$ =	0.8	$\bar{x}$ =	0.8	$\bar{x}$ =	0.4	$\bar{x}$ =
	7	1.1	1.0	0.6	0.6	0.3	0.5	0.1	0.4
	8	0.9		0.5		0.4		0.1	
	9	10.4		19.1		16.0		20.8	
	10	7.8		15.3		20.3		20.0	
	11	12.1		19.4		22.2		21.4	
N_S	12	9.3		17.3		19.6		8.8	
	13	10.5		19.7		21.3		22.9	
	14	19.1	$\bar{x}$ =	19.5	$\bar{x}$ =	20.7	$\bar{x}$ =	15.0	$\bar{x}$ =
	15	12.5	11.6	19.0	17.7	20.2	20.2	20.5	18.9
	16	10.8		12.1		21.3		22.1	
	17	-		-		-		-	
	18	8.2		10.0		16.7		14.2	
	19	4.5		8.4		13.7		12.7	
S_N	20	6.6		11.5		16.5		18.6	
	21	3.3		11.3		13.7		15.2	
	22	5.8	$\bar{x}$ =	7.6	$\bar{x}$ =	12.4	$\bar{x}$ =	16.2	$\bar{x}$ =
	23	7.5	5.9	14.0	10.7	14.9	15.4	15.3	16.0
	24	5.2		12.3		20.0		20.0	
	25	0.5		0.3		0.3		0.0	
	26	3.7		8.8		13.9		13.7	
	27	1.8		3.5		7.2		11.2	
N_N	28	2.9		0.5		0.2		0.1	
	29	2.5		7.2		12.6		0.0	
	30	0.2	$\bar{x}$ =	3.7	$\bar{x}$ =	12.1	$\bar{x}$ =	12.8	$\bar{x}$ =
	31	0.7	2.0	0.8	4.2	3.8	8.0	7.3	5.6
	32	3.8		8.4		10.0		0.0	

CONSUMPTION MEASURES (in mls) FOR TEN N/S PRECONDITIONING TRIALS GROUPS

Test group	Subject	P-Tr		P-Con 1		P-Con 2		P-Con 3	
	1	16.4		4.5		18.4		22.3	
	2	14.8		6.7		20.6		22.7	
	3	14.2		17.5		23.2		22.5	
S_S	4	16.4		19.6		24.1		22.4	
	5	11.5		18.0		17.0		17.3	
	6	13.4	$\bar{x}$ =	20.8	$\bar{x}$ =	22.1	$\bar{x}$ =	20.2	$\bar{x}$ =
	7	7.1	12.3	4.2	13.2	9.8	19.2	18.2	20.7
	8	4.8		14.4		18.4		19.9	
	9	13.9		17.8		18.6		19.4	
	10	11.7		16.3		19.8		19.3	
	11	13.8		11.2		17.6		18.9	
N_S	12	13.8		15.2		22.4		21.2	
	13	14.0		20.6		21.3		19.0	
	14	12.4	$\bar{x}$ =	10.1	$\bar{x}$ =	18.7	$\bar{x}$ =	18.9	$\bar{x}$ =
	15	12.6	13.5	17.0	15.4	18.2	19.4	16.6	18.7
	16	15.4		15.3		18.8		16.6	
	17	16.5		17.5		20.5		23.2	
	18	14.6		12.5		12.7		21.6	
	19	11.2		7.8		15.2		17.2	
S_N	20	7.7		13.3		19.5		21.2	
	21	9.3		14.1		15.7		15.1	
	22	15.5	$\bar{x}$ =	16.4	$\bar{x}$ =	21.2	$\bar{x}$ =	20.2	$\bar{x}$ =
	23	11.9	12.7	16.6	14.4	20.8	18.3	20.2	19.7
	24	15.0		16.9		20.5		19.1	
	25	13.5		5.7		18.0		16.7	
	26	14.4		15.6		21.8		21.9	
	27	11.6		13.0		19.1		18.4	
N_N	28	11.9		14.8		19.4		17.0	
	29	11.6		12.5		18.9		19.1	
	30	11.1	$\bar{x}$ =	13.7	$\bar{x}$ =	17.9	$\bar{x}$ =	16.7	$\bar{x}$ =
	31	10.8	12.6	14.3	13.2	19.7	19.6	18.5	18.8
	32	15.9		16.0		22.1		22.4	

(Experiment 5 continued)

Test group	Subject	P-Con 4		P-Con 5		P-Con 6		P-Con 7	
	1	19.1		20.9		20.6		20.3	
	2	19.8		23.1		22.7		22.8	
	3	24.7		23.3		26.1		28.1	
S_S	4	22.5		21.0		19.2		24.5	
	5	18.6		20.8		20.4		23.4	
	6	20.5	$\bar{x}$ =	20.3	$\bar{x}$ =	21.3	$\bar{x}$ =	16.6	$\bar{x}$ =
	7	19.3	20.5	17.7	21.0	19.9	21.4	20.5	22.3
	8	19.7		20.6		20.9		22.1	
	9	18.5		18.9		18.6		19.2	
	10	19.6		20.6		20.6		21.9	
	11	16.6		19.9		21.1		19.3	
N_S	12	23.7		22.8		23.9		23.3	
	13	18.9		20.0		20.8		22.2	
	14	19.4	$\bar{x}$ =	20.0	$\bar{x}$ =	20.4	$\bar{x}$ =	21.4	$\bar{x}$ =
	15	17.1	18.7	17.5	19.7	18.8	20.6	19.3	21.0
	16	15.4		17.7		20.8		21.1	
	17	20.5		20.3		22.6		24.5	
	18	20.2		20.9		22.4		22.6	
	19	17.4		19.7		19.1		15.8	
S_N	20	20.2		21.2		21.3		10.1	
	21	15.1		14.9		15.7		16.5	
	22	18.7	$\bar{x}$ =	19.3	$\bar{x}$ =	20.0	$\bar{x}$ =	22.6	$\bar{x}$ =
	23	19.6	18.5	19.1	19.0	22.0	20.1	24.0	19.5
	24	16.5		16.4		17.9		19.8	
	25	17.3		18.3		22.4		18.1	
	26	20.1		20.7		22.9		14.1	
	27	15.8		17.1		16.3		19.8	
N_N	28	16.4		19.1		17.7		20.9	
	29	18.4		11.0		17.0		19.4	
	30	15.6	$\bar{x}$ =	22.8	$\bar{x}$ =	19.2	$\bar{x}$ =	20.7	$\bar{x}$ =
	31	13.6	16.7	9.6	18.4	18.0	19.4	18.6	19.3
	32	16.1		28.4		21.6		22.6	

(Experiment 5 continued)

Test group	Subject	P-Con 8		P-Con 9		P-Con 10		Tr 1	
	1	23.3		24.4		19.6		10.5	
	2	25.0		20.5		22.9		1.2	
	3	16.3		30.6		25.3		8.5	
S_S	4	28.0		18.7		22.3		17.4	
	5	23.7		20.6		18.9		14.9	
	6	25.5	$\bar{x}$ =	25.2	$\bar{x}$ =	22.4	$\bar{x}$ =	12.7	$\bar{x}$ =
	7	21.4	23.2	21.9	23.3	19.6	21.4	13.5	11.1
	8	22.7		24.5		20.4		9.8	
	9	20.3		12.8		16.0		10.2	
	10	23.2		23.7		16.7		15.7	
	11	22.3		19.3		20.7		15.9	
N_S	12	26.0		14.2		20.6		14.2	
	13	25.4		23.1		16.5		14.7	
	14	25.6	$\bar{x}$ =	36.3	$\bar{x}$ =	26.3	$\bar{x}$ =	9.7	$\bar{x}$ =
	15	20.3	23.0	21.0	21.2	16.4	18.9	15.1	13.8
	16	21.0		19.3		18.1		15.2	
	17	24.7		28.8		22.8		15.2	
	18	25.4		26.8		17.2		17.5	
	19	24.1		13.9		20.1		15.6	
S_N	20	24.7		25.4		20.8		17.4	
	21	17.5		19.0		15.9		11.1	
	22	22.0	$\bar{x}$ =	25.3	$\bar{x}$ =	18.7	$\bar{x}$ =	10.8	$\bar{x}$ =
	23	26.1	23.1	9.5	21.2	23.4	19.4	19.0	14.6
	24	20.4		21.1		16.0		10.3	
	25	22.8		20.4		19.7		15.9	
	26	29.1		20.2		25.2		18.8	
	27	20.6		21.1		18.9		13.8	
N_N	28	21.2		20.2		20.5		15.4	
	29	21.4		20.7		17.8		5.9	
	30	21.2	$\bar{x}$ =	18.2	$\bar{x}$ =	17.8	$\bar{x}$ =	12.8	$\bar{x}$ -
	31	8.9	21.3	20.7	20.5	11.9	19.3	6.5	11.1
	32	24.8		22.5		22.9		0.0	

(Experiment 5 continued)

Test group	Subject	Tr 2		Tr 3		P-T		Ex 1	
	1	0.9		0.4		15.5		0.2	
	2	6.0		0.7		15.1		0.4	
	3	1.3		0.3		19.0		0.0	
S_S	4	1.6		0.4		14.9		0.3	
	5	0.4		0.4		15.6		0.1	
	6	4.6	$\bar{x}$ =	0.5	$\bar{x}$ =	14.7	$\bar{x}$ =	0.5	$\bar{x}$ =
	7	1.2	2.4	0.0	0.4	11.7	14.7	0.4	0.3
	8	3.4		0.5		10.7		0.5	
	9	2.0		0.5		14.4		10.2	
	10	6.4		0.6		14.2		15.5	
	11	4.2		0.6		17.4		13.5	
N_S	12	6.6		0.5		12.1		18.5	
	13	2.4		0.0		13.9		19.8	
	14	0.9	$\bar{x}$ =	0.0	$\bar{x}$ =	13.4	$\bar{x}$ =	20.2	$\bar{x}$ =
	15	2.5	3.6	0.0	0.4	14.4	14.6	16.8	15.9
	16	3.5		0.6		17.3		12.5	
	17	7.7		0.5		16.7		19.5	
	18	13.2		1.9		14.6		18.2	
	19	10.2		1.8		14.1		11.3	
S_N	20	13.0		3.9		13.6		14.2	
	21	7.1		2.1		9.9		11.6	
	22	12.2	$\bar{x}$ =	0.6	$\bar{x}$ =	14.8	$\bar{x}$ =	17.1	$\bar{x}$ =
	23	7.8	2.5	0.4	2.2	18.4	14.7	10.0	14.4
	24	9.6		6.7		15.3		13.2	
	25	9.2		2.6		15.0		0.3	
	26	13.0		2.1		15.6		0.4	
	27	13.0		7.5		16.3		1.6	
N_N	28	11.7		3.0		15.6		0.1	
	29	3.2		3.3		14.0		3.1	
	30	9.8	$\bar{x}$ =	0.5	$\bar{x}$ =	14.0	$\bar{x}$ =	0.5	$\bar{x}$ =
	31	12.2	10.7	0.6	3.3	13.5	15.2	0.2	0.8
	32	13.1		6.6		17.4		0.5	

(Experiment 5 continued)

Test group	Subject	Ex 2		Ex 3		Ex 4	
S_S	1	0.2		0.2		0.2	
	2	0.6		0.5		0.8	
	3	0.2		0.3		0.1	
	4	0.5		0.4		0.7	
	5	0.0		0.5		0.2	
	6	0.7	$\bar{x}$ =	0.5	$\bar{x}$ =	0.5	$\bar{x}$ =
	7	0.2	0.3	0.2	0.4	0.3	0.5
	8	0.2		0.8		1.2	
N_S	9	10.4		18.5		22.0	
	10	18.9		16.7		15.1	
	11	16.8		16.6		16.2	
	12	20.3		19.2		18.8	
	13	18.1		18.0		15.0	
	14	17.9	$\bar{x}$ =	20.4	$\bar{x}$ =	21.3	$\bar{x}$ =
	15	16.5	17.2	14.7	17.4	15.7	17.1
	16	18.5		15.4		15.1	
S_N	17	21.3		20.8		20.4	
	18	12.5		18.4		17.5	
	19	9.4		14.3		15.3	
	20	15.8		15.7		15.3	
	21	14.2		11.0		13.8	
	22	18.2	$\bar{x}$ =	16.2	$\bar{x}$ =	15.4	$\bar{x}$ =
	23	18.8	16.1	11.0	15.3	19.1	16.1
	24	18.5		14.7		12.1	
N_N	25	0.4		0.9		3.4	
	26	0.4		0.5		1.6	
	27	6.0		8.0		13.1	
	28	1.0		1.4		4.6	
	29	0.9		0.0		7.7	
	30	1.4	$\bar{x}$ =	2.6	$\bar{x}$ =	5.8	$\bar{x}$ =
	31	1.2	1.6	4.8	2.6	8.1	6.3
	32	1.4		2.8		5.7	

EXPERIMENT 5

Percent neophobia index where values represent 100 x (amt. consumed of N or S on first presentation/amt. of N/S consumed on last preconditioning trial).

Test Group	Subject	PC_1		PC_4		PC_7		PC_{10}	
	1	151.9		91.4		70.5		53.6	
	2	95.5		67.5		66.3		5.2	
	3	72.5		82.4		57.9		33.6	
	4	84.9		105.6		74.7		78.0	
S_S	5	87.1		92.9		62.1		78.8	
	6	95.6	$\bar{x}$=	76.4	$\bar{x}$=	31.6	$\bar{x}$=	56.7	$\bar{x}$=
	7	84.5	95.6	79.6	82.4	66.5	58.1	68.9	52.9
	8	92.6		63.3		35.0		48.0	
	9	94.6		69.7		72.0		63.8	
	10	87.9		72.6		75.7		94.0	
	11	58.7		119.6		77.2		76.8	
N_S	12	83.7		100.5		59.7		68.9	
	13	73.4		81.9		32.3		89.1	
	14	130.5	$\bar{x}$=	67.9	$\bar{x}$=	78.7	$\bar{x}$=	36.9	$\bar{x}$=
	15	93.8	87.4	68.2	81.8	31.6	59.7	92.1	75.7
	16	76.8		73.9		50.2		83.9	
	17	96.5		92.1		48.8		66.7	
	18	130.5		122.0		75.8		101.7	
	19	100.7		94.8		69.7		77.6	
S_N	20	101.7		118.3		86.7		83.6	
	21	113.8		61.8		54.9		69.8	
	22	104.8	$\bar{x}$=	67.8	$\bar{x}$=	64.4	$\bar{x}$=	57.8	$\bar{x}$=
	23	109.7	109.8	118.5	94.5	69.5	69.5	81.2	75.4
	24	120.3		80.5		86.4		64.4	
	25	110.8		130.5		89.6		80.7	
	26	89.8		107.7		83.4		74.6	
	27	200.0		112.0		52.6		73.0	
N_N	28	114.0		112.0		80.0		75.1	
	29	120.4		113.3		68.5		33.1	
	30	98.3	$\bar{x}$=	76.4	$\bar{x}$=	28.9	$\bar{x}$=	71.9	$\bar{x}$=
	31	100.7	114.5	96.5	100.6	89.9	68.7	54.6	57.9
	32	81.8		56.1		56.4		0.0	

APPENDIX 6

SUPPLEMENTARY STATISTICAL ANALYSES FOR EXPERIMENTS 1-5

EXPERIMENT 1a (Equivalence of Stimuli)

Two-way analyses of variance on fluid consumption measures for pretraining, training, pretest and test days.

Source	SS	df	MS	*F*	*p*
		PRETRAINING DAY			
Treatment	0.8	1	0.8	0.2	> .75
Flavour	0.7	2	0.4	0.1	> .75
T x F	16.2	2	8.1	1.7	> .10
Within	167.2	36	4.6		
Total	184.9	41			
		TRAINING DAY			
Treatment	2.1	1	2.1	0.3	> .50
Flavour	206.9	2	103.5	16.1	< .001
T x F	39.9	2	19.9	3.1	> .50
Within	230.7	36	6.4		
Total	479.6	41			
		PRETEST DAY			
Treatment	24.2	1	24.2	6.9	< .025
Flavour	2.5	2	1.3	0.3	> .50
T x F	18.7	2	9.4	2.7	> .05
Within	126.9	36	3.5		
Total	172.3	41			
		TEST DAY			
Treatment	1,749.9	1	1,749.9	785.6	< .001
Flavour	6.9	2	3.5	1.5	> .10
T x F	13.8	2	6.9	3.1	> .05
Within	80.2	36	2.2		
Total	1,850.8	41			

EXPERIMENT 1b (N/S aversion overtraining)

One-way analyses comparing consumption measures for the five Overtraining groups on their first pretraining and first training days.

Source	SS	df	MS	*F*	*p*
		FIRST PRETRAINING DAY			
Overtraining gp.	75.09	4	18.77	1.99	>.05
Within gp.	944.95	100	9.45		
Total	1,020.04	104			
		FIRST TRAINING DAY			
Overtraining gp.	130.32	4	32.58	1.21	>.25
Within gp.	2,701.03	100	27.01		
Total	2,831.35	104			

EXPERIMENT 1b

Trends of trial means* comparing acquisition of an N/S aversion by the three Flavour groups in each Overtraining group.

Source	SS	df	MS	*F*	*p*
	1 N/S CONDITIONING TRIAL				
Flavour gp.	138.74	2	69.37	2.92	>.05
Within gp.	427.76	18	23.76		
Total	566.50	20			
	2 N/S CONDITIONING TRIALS				
A:Flavour gp.	9.60	2	4.80	0.59	>.50
S(A):Error (a)	146.36	18	8.13		
T:Trials	1,215.02	1	1,215.02	235.01	<.001
A x T	3.73	2	1.87	0.36	>.50
S(A)xT:Error(b)	92.98	18	5.17		
Total	1,467.69	41			

* one-way ANOVA for 1 conditioning trial group

Experiment 1b (acquisition) continued

Source	SS	df	MS	*F*	*p*
	3 N/S CONDITIONING TRIALS				
A:Flavour gp.	6.49	2	3.25	0.37	> .50
S(A):Error (a)	156.05	18	8.67		
T: Trials	964.22	2	482.11	85.48	< .001
A x T	18.49	4	4.62	0.82	> .50
S(A)xT:Error(b)	203.12	36	5.64		
Total	1,348.37	62			
	6 N/S CONDITIONING TRIALS				
A:Flavour gp.	6.07	2	3.04	0.39	> .50
S(A):Error (a)	140.32	18	7.80		
T:Trials	1,661.86	5	332.37	52.26	< .001
A x T	12.64	10	1.26	0.20	> .75
S(A)xT:Error (b)	572.13	90	6.36		
Total	2,393.02	125			

Experiment 1b (acquisition) continued.

Source	SS	df	MS	*F*	*p*
	10 N/S CONDITIONING TRIALS				
A:Flavour gp.	0.69	2	0.35	0.09	>.75
S(A):Error(a)	73.88	18	4.10		
T:Trials	2,865.86	9	318.40	64.45	<.001
A x T	9.21	18	0.51	0.10	>.75
S(A)xT:Error(b)	800.14	162	4.94		
Total	3,749.78	209			

One-way analysis comparing consumption measures for the five Overtraining groups on the pretest day.

Source	SS	df	MS	*F*	*p*
Overtraining gp.	88.98	4	22.24	3.35	<.025*
Within gp.	663.55	100	6.64		
Total	752.53				

*Difference is attributable to N/S_3 group which drank $\bar{x}$ = 16.6 ml. Groups N/S_1, N/S_2, N/S_6 and N/S_{10} drank $\bar{x}$ = 14.3, 14.8, 14.0 and 14.4 ml respectively. One-way ANOVA's comparing pretest measures for the three Flavour groups within each Overtraining group, were not significant, *p*'s > .10.

EXPERIMENT 1b

Two-way analyses of variance comparing test consumption test consumption of N/S, N or S by the five Overtraining groups during extinction.

Source	SS	df	MS	*F*	*p*
		TOTAL AMOUNT CONSUMED			
Overtraining gp.	220,516.95	4	55,129.24	69.97	< .001
Flavour gp.	65,669.18	2	32,834.59	41.67	< .001
O x F	24,030.38	8	3,003.80	3.81	< .001
Within	70,911.93	90	787.91		
Total	381,128.44	104			
		RATE OF EXTINCTION			
Overtraining gp.	47.16	4	11.79	54.21	< .001
Flavour gp.	22.09	2	11.05	50.79	< .001
O x F	9.37	8	1.17	5.39	< .005
Within	19.57	90	0.22		
Total	98.20	104			

EXPERIMENT 1c (Two-bottle training)

One-way analysis of variance comparing one-bottle and two-bottle groups' consumption of water on the pretraining day.

Source	SS	df	MS	*F*	*p*
No. of bottles	49.94	1	49.94	9.56	<.005
Within	209.04	40	5.23		
Total	258.98	41			

One-way analysis of variance with repeated measures comparing total consumption of training solutions by one- and two-bottle groups on the second training day.

Source	SS	df	MS	*F*	*p*
Subjects (between)	126.34	20			
No. of Bottles	18.60	1	18.60	10.33	<.005
S x N (residual)	36.05	20	1.80		
Total	180.99	41			

EXPERIMENT 1c

One-way analysis of variance comparing one- and two-bottle groups' consumption of water on the pretest day.

Source	SS	df	MS	*F*	*p*
No. of bottles	2.93	1	2.93	0.31	> .50
Within	376.19	40	9.40		
Total	379.12	41			

Two-way analyses of variance comparing test consumption of N/S, N or S by the one- and two-bottle groups during extinction.

Source	SS	df	MS	*F*	*p*
	TOTAL AMOUNT CONSUMED				
No. of bottles	3,784.80	1	3,784.80	2.49	> .10
Flavour gp.	32,647.35	2	16,323.67	10.73	< .005
N x F	2,050.20	2	1,025.10	0.67	> .25
Within	54,766.88	36	1,521.30		
Total	93,249.23	41			

Experiment 1c (extinction) continued.

Source	SS	df	MS	*F*	*p*
	RATE OF EXTINCTION				
No. of bottles	0.88	1	0.88	2.79	>.10
Flavour gp.	8.28	2	4.14	13.13	<.001
N x F	1.07	2	0.53	1.69	>.10
Within	11.36	36	0.32		
Total	21.59	41			

EXPERIMENT 2a (N/S Overtraining + vinegar)

One-way analyses comparing consumption measures for the three Overtraining groups (and one no-drug group) on their first pretraining and first training days.

Source	SS	df	MS	*F*	*p*
	FIRST PRETRAINING DAY				
Overtraining gp.	106.96	3	35.65	6.32	< .001*
Within	451.67	80	5.65		
Total	558.63	83			
	FIRST TRAINING DAY				
Overtraining gp.	233.03	3	77.68	2.87	< .05*
Within	2,166.80	80	27.08		
Total	2,399.83	83			

*N/S_4 drank a greater amount than N/S_6, N/S_{10} and the no-drug group on both days. (pretrain N/S_4 $\bar{x}$ = 13.9 ml versus 11.5, 10.9 and 12.0 ml in other groups; $train_1$ N/S_4 $\bar{x}$ = 14.0 versus 9.8, 11.6, 10.1 in other groups).

EXPERIMENT 2a

Trends of trial means comparing acquisition of an N/S aversion by the three Flavour groups in each Overtraining group (and the no-drug group).

Source	SS	df	MS	*F*	*p*
4 N/S CONDITIONING TRIALS					
A:Flavour gp.	2.93	2	1.47	0.42	> .50
S(A):Error (a)	62.85	18	3.49		
T:Trials	2,861.98	3	953.99	263.53	< .001
A x T	3.30	6	0.55	0.15	> .75
S(A) x T:Error(b)	195.34	54	3.62		
Total	3,126.4	83			
6 N/S CONDITIONING TRIALS					
A:Flavour gp.	5.69	2	2.85	0.28	> .75
S(A):Error (a)	180.68	18	10.04		
T:Trials	1,520.66	5	304.13	44.14	< .001
A x T	19.47	10	1.95	0.28	> .75
S(A) x T:Error (b)	620.05	90	6.89		
Total	2,346.55	125			

Experiment 2a (acquisition) continued

Source	SS	df	MS	*F*	*p*
10 N/S CONDITIONING TRIALS					
A:Flavour gp.	1.20	2	0.60	0.10	> .75
S(A):Error (a)	110.48	18	6.14		
T:Trials	2,423.41	9	269.27	59.44	< .001
A x T	68.55	18	3.81	0.84	> .50
S(A) x T:Error (b)	733.55	162	4.53		
Total	3,337.19	209			
10 N/S NO-DRUG TRIALS					
A:Flavour gp.	141.11	2	70.56	1.73	> .10
S(A):Error (a)	732.92	18	40.72		
T:Trials	1,360.82	9	151.20	15.37	< .001
A x T	367.12	18	20.40	2.07	< .01
S(A) x T:Error (b)	1,594.66	162	9.84		
Total	4,196.63	209			

EXPERIMENT 2a

Trends of trial means comparing consumption of vinegar solution by the three Flavour groups within each Over-training group during the desensitization phase.

Source	SS	df	MS	*F*	*p*
	N/S_4 GROUP				
A:Flavour gp.	15.20	2	7.60	1.40	> .25
S(A):Error (a)	97.86	18	5.44		
T:Trials	414.29	2	207.15	29.89	< .001
A x T	12.53	4	3.13	0.45	> .50
S(A) x T:Error (b)	249.49	36	6.93		
Total	789.37	62			
	N/S_6 GROUP				
A:Flavour gp.	44.40	2	22.2	1.09	> .25
S(A):Error (a)	367.21	18	20.4		
T:Trials	345.34	3	115.11	23.21	< .001
A x T	39.49	6	6.58	1.33	> .10
S(A) x T:Error (b)	267.83	54	4.96		
Total	1,064.27	83			

Experiment 2a (desensitization) continued

Source	SS	df	MS	*F*	*p*
	N/S_{10} GROUP				
A:Flavour gp.	0.46	2	0.23	0.02	> .75
S(A):Error(a)	206.28	18	11.46		
T:Trials	300.88	5	60.18	5.74	< .001
A x T	100.59	10	10.06	0.96	> .25
S(A) x T:Error (b)	943.54	90	10.48		
Total	1,551.75	125			
	N/S_{10} NO-DRUG GROUP				
A:Flavour gp.	117.60	2	58.80	3.88	< .05
S(A):Error (a)	272.16	18	15.12		
T:Trials	198.47	5	39.69	16.20	< .001
A x T	18.95	10	1.90	0.78	> .75
S(A) x T:Error(b)	220.18	90	2.45		
Total	827.36	125			

EXPERIMENT 2a

Two-way analyses of variance comparing test consumption of N/S, N or S by the three Overtraining groups during extinction.

Source	SS	df	MS	*F*	*p*
	TOTAL AMOUNT CONSUMED				
Overtraining gp.	12,069.22	2	6,304.61	9.73	<.001
Flavour gp.	97,878.29	2	48,939.15	78.89	<.001
O x T	14,908.62	4	3,727.15	6.01	<.001
Within	33,500.67	54	620.38		
Total	158,356.80	62			
	RATE OF EXTINCTION				
Overtraining gp.	2.41	2	1.20	5.73	<.01
Flavour gp.	30.07	2	15.04	71.57	<.001
O x T	4.00	4	1.00	4.76	<.005
Within	11.35	54	0.21		
Total	47.83	62			

EXPERIMENT 2a

Two-way analyses of variance comparing test consumption of N/S, N or S by the N/S_{10} and N/S_{10} no-drug treatment groups during extinction.*

Source	SS	df	MS	*F*	*p*
	TOTAL AMOUNT CONSUMED				
Treatment	90,053.50	1	90,053.50	213.56	< .001
Flavour	30,334.21	2	15,167.10	35.97	< .001
T x F	40,174.75	2	20,087.37	47.64	< .001
Within	15,180.58	36	421.68		
Total	175,743.04	41			
	RATE OF EXTINCTION				
Treatment	13.00	1	13.00	169.52	< .001
Flavour	10.22	2	5.11	66.61	< .001
T x F	10.70	2	5.35	69.76	< .001
Within	2.76	36	0.08		
Total	36.68	41			

* The α-level was appropriately halved since the N/S_{10} data was analysed previously in conjunction with N/S_4 and N/S_6 data.

EXPERIMENT 2a

Analysis of post-extinction N/S consumption by the Overtraining groups is reported in the text in Table 4. Below is the summary of Scheffé multiple comparisons performed on the data from that analysis.

Post-extinction comparison*				t-value
i)	N_4 (test 10)	vs N-N/S_4	(test 12)	0.47
ii)	N_6 (test 10)	vs N-N/S_6	(test 12)	2.64
iii)	N_{10} (test 10)	vs N-N/S_{10}	(test 12)	7.01 #
iv)	S_4 (test 10)	vs S-N/S_4	(test 12)	0.94
v)	S_6 (test 10)	vs S-N/S_6	(test 12)	7.50 #
vi)	S_{10} (test 10)	vs S-N/S_{10}	(test 12)	7.01 #

* Subscripts refer to Overtraining groups

designates p's < .05 (t'= 7.00)

EXPERIMENT 2b (Selective vinegar effects)

One-way analysis of variance comparing the N/S, N and S conditioning groups' consumption of water on the pretraining day.

Source	SS	df	MS	*F*	*p*
Flavour gp.	9.46	2	4.73	0.86	> .25
Within	45.43	9	5.05		
Total	54.89	11			

Analysis of trends of trial means comparing acquisition of aversions for N/S, N or S.

Source	SS	df	MS	*F*	*p*
A:Flavour gp.	36.65	2	18.33	4.64	< .05
S(A):Error (a)	35.56	9	3.95		
T:Trials	1,493.80	2	746.90	88.10	< .001
A x T	9.79	4	2.45	0.29	> .75
S(A) x T:Error (b)	151.45	18	8.41		
Total	1,727.45	35			

EXPERIMENT 2b

Trends of trial means comparing consumption of vinegar solution by the N/S, N and S conditioning groups during the desensitization phase; and of N/S, N or S during extinction.

Source	SS	df	MS	*F*	*p*
	DESENSITIZATION PHASE				
A:Flavour gp.	12.48	2	6.24	0.39	>.50
S(A):Error (a)	143.05	9	15.89		
T:Trials	99.76	3	33.25	21.18	<.001
A x T	44.76	6	7.46	4.75	<.005
S(A) x T:Error (b)	42.42	27	1.57		
Total	342.47	47			
	EXTINCTION PHASE				
A:Flavour gp.	13.75	2	6.88	0.03	>.75
S(A):Error (a)	1,946.21	9	216.25		
T:Trials	3,765.58	9	418.40	7.56	<.001
A x T	99.03	18	5.50	0.10	>.75
S(A) x T:Error (b)	4,483.37	81	55.35		
Total	10,307.94	119			

EXPERIMENT 3 (Latent inhibition)

One-way analyses of variance comparing consumption between the three Exposure groups on the pretraining (H_2O) day and the first N/S exposure day.

Source	SS	df	MS	*F*	*p*
	PRETRAINING DAY				
Exposure gp.	115.48	2	57.74	11.99*	<.001
Within	288.92	60	4.82		
Total	404.40	62			
	N/S EXPOSURE 1				
Exposure gp.	128.47	2	64.23	3.93#	=.025
Within	980.54	60	16.34		
Total	1,109.01	62			

* Group receiving 2 N/S exposures drank more ($\bar{X}$ = 13.7 mls) than those receiving 10 exposures ($\bar{X}$ = 10.6 mls) and 20 exposures ($\bar{X}$ = 11.2 mls). There were no differences between Flavour groups within each Exposure group, *p*'s > .05.

Group receiving 10 N/S exposures drank less ($\bar{X}$ = 11.1 mls) than those receiving 2 exposures ($\bar{X}$ = 14.1 mls) and 20 exposures (14.2 mls).

EXPERIMENT 3

Two-way analysis of variance comparing level of neophobia displayed to N/S, N or S after 2, 10 or 20 pre-exposures.

Source	SS	df	MS	*F*	*p*
Exposure gp.	12,836.38	2	6,418.19	41.48	<.001
Flavour gp.	18,538.00	2	9,269.00	59.90	<.001
E x F	6,023.92	4	1,505.98	9.73	<.001
Within	8,355.82	54	154.74		
Total	45,754.12	62			

Two-way analysis of variance comparing number of trials to criterion in forming an aversion to N/S, N or S after 2, 10 or 20 N/S pre-exposures.

Source	SS	df	MS	*F*	*p*
Exposure gp.	6.00	2	3.00	4.69	<.025
Flavour gp.	30.86	2	15.43	24.10	<.001
E x F	14.00	4	3.50	5.47	<.005
Within	35.47	54	0.64		
Total	85.43	62			

EXPERIMENT 3

Two-way analysis of variance comparing test consumption of N/S, N or S for the three Exposure groups.

Source	SS	df	MS	*F*	*p*
	TOTAL CONSUMPTION				
Exposure gp.	17,071.26	2	8,535.63	7.56	<.005
Flavour gp.	54,198.20	2	27,099.10	24.01	<.001
E x F	20,019.38	4	5,004.85	4.43	<.005
Within	60,939.98	54	1,128.52		
Total	152,228.82	62			
	RATE OF EXTINCTION				
Exposure gp.	3.52	2	1.76	5.33	<.001
Flavour gp.	17.21	2	8.61	26.09	<.01
E x F	6.86	4	1.72	5.21	<.005
Within	17.89	54	0.33		
Total	45.48	62			

EXPERIMENT 4 (Partial reinforcement)

One-way analyses of variance comparing consumption measures for the two partial reinforcement groups on the pretraining (H_2O) day and the first N/S exposure day.

Source	SS	df	MS	*F*	*p*
	PRETRAINING DAY				
Reinforcement gp.	3.66	1	3.66	0.71	>.25
Within	207.60	40	5.19		
Total	211.26	41			
	N/S EXPOSURE 1				
Reinforcement gp.	29.00	1	29.00	1.12	>.25
Within	1,035.86	40	25.90		
Total	1,064.86	41			

EXPERIMENT 4

Two-way analyses of variance comparing test consumption of N/S, N or S in the two partial reinforcement groups (1:1 & 2:1)

Source	SS	df	MS	*F*	*p*
	TOTAL CONSUMPTION				
Reinforcement gp.	522.93	1	522.93	2.01	>.10
Flavour gp.	11,276.32	2	5,638.16	21.6β	<.001
R x F	258.05	2	129.03	0.49	>.50
Within	9,384.49	36	260.68		
Total	21,441.79	41			
	RATE OF EXTINCTION				
Reinforcement gp.	1.28	1	1.28	1.47	>.10
Flavour gp.	40.85	2	20.43	23.61	<.001
R x F	0.47	2	0.24	0.27	>.75
Within	31.14	36	0.87		
Total	73.74	41			

EXPERIMENT 4 (extinction) continued.

Source	SS	df	MS	*F*	*p*
	TOTAL OF TESTS 1 & 2				
Reinforcement gp.	200.65	1	200.65	4.48	<.05
Flavour gp.	1,006.80	2	503.40	11.23	<.001
R x F	170.19	2	85.10	1.90	>.25
Within	1,612.99	36	44.81		
Total	2,990.63	41			

EXPERIMENT 5 (Sensory preconditioning)

One-way analyses of variance comparing consumption between the four Preconditioning (PC) groups on the pretraining (H_2O) day and the first N/S preconditioning day.

Source	SS	df	MS	*F*	*p*
	PRETRAINING DAY*				
PC gp.	10.26	2	5.13	0.75	>.25
Within	635.36	93	6.83		
Total	645.62	95			
	N/S EXPOSURE 1				
PC gp.	148.36	3	49.45	2.49	>.05
Within	2,459.93	124	19.84		
Total	2,608.29	127			

* Pretraining data for PC_4 group was not collected.

EXPERIMENT 5

Summary of linear trend analysis for neophobia to N and S as a function of PC trials. Comparisons were orthogonal

Source	SS	df	MS	*F*	*p*
Between	43,010.60	15			
Linear:					
Sacc	8,786.43	1	8,786.43	19.16	< .001
NaCl	21,766.80	1	21,766.80	47.47	< .001
S x N	1,447.21	1	1,447.21	3.16	> .05
Within	51,351.68	112	51,351.68		
Total	94,362.28	127	94,362.28		

Summary of trend analysis on summed consumption of N and S during the last two conditioning days. Comparisons were planned and orthogonal.

Source	SS	df	MS	*F*	*p*
Between	4,346.58	15			
Flavour	3,723.85	1	465.48	20.28	< .001
Linear:					
Sacc	20.40	1	20.40	0.89	> .25
NaCl	0.20	1	0.20	0.01	> .75
Quadratic:					
Sacc	9.61	1	9.61	0.42	> .50
NaCl	174.24	1	174.24	7.59	< .01
Within	2,547.54	111	22.95		
Total	6,894.12	126			

EXPERIMENT 5

One-way analyses of variance comparing consumption of tap water between the four PC groups on the pretest day.

Source	SS	df	MS	*F*	*p*
PC gp.	217.62	3	72.54	12.30*	<.001
Within	725.40	123	5.90		
Total	943.02	126			

Summary of analysis for preconditioning effects observed during the first test day are presented in Chapter 5, page 122.

* Groups PC_1 and PC_4 tended to drink less ($\bar{X}$'s = 12.6 and 12.3 mls) than groups PC_7 and PC_{10} ($\bar{X}$'s = 15.3 and 14.8 mls) on the pretest day.

EXPERIMENT 5 (extinction) continued.

Summary of linear and quadratic trend analysis for total consumption of N and S during extinction. Comparisons were planned and orthogonal.

Source	SS	df	MS	*F*	*p*
Between	83,995.91	15	-		
Test gp.*	73,164.60	1	73,164.60	834.74	<.001
Linear:					
S-S	0.05	1	0.05	0.00	-
N-N	632.34	1	632.34	7.21	<.01
N-S	1,921.55	1	1,921.55	21.92	<.001
S-N	1,147.04	1	1,147.04	13.09	<.001
Quadratic:					
S-S	8.57	1	8.57	0.10	>.75
N-N	64.98	1	64.98	0.74	>.25
N-S	1,259.02	1	1,259.02	14.36	<.001
S-N	265.88	1	265.88	3.03	>.05
Within	9,729.35	111	9,729.35		
Total	93,725.26	126	93,725.26		

*Test group refers to conditioned aversion groups (S-S and N-N) and preconditioned aversion groups (S-N and N-S).