CHOICE BETWEEN STIMULI

PREVIOUSLY PRESENTED SEPARATELY

CHOICE BETWEEN STIMULI ASSOCIATED

WITH DIFFERENT HISTORIES OF REINFORCEMENT

WHEN PRESENTED SEPARATELY

by

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A Thesis

Submitted to the Faculty of Graduate Studies

in Partial Fulfilment of the Requirements

for the Degree

Doctor of Philosophy

McMaster University

October, 1969

DOCTOR OF PHILOSOPHY (1969)   McMASTER UNIVERSITY
Psychology   Hamilton, Ontario

TITLE: Choice Between Stimuli Associated with Different
           Histories of Reinforcement when Presented Separately

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NUMBER OF PAGES: vii, 206

SCOPE AND CONTENTS: Four experiments are reported in which
choice behavior was examined in the pigeon. An apparatus was
used in which each of two adjacent keys could be lit with
either a red or a green dot. In each experiment, subjects
received trials of fixed length with one color at a time
(single-stimulus training) before receiving trials with both
keys lit together (choice test). On choice tests in Exp. 1,
2, and 3, birds pecked at a higher rate to the stimulus in which
a higher number of reinforcements had been received per unit
time with the stimulus present, but differences between stimuli
in reinforcements per session did not reliably affect choice
behavior and differences in proportion of trials followed by
reinforcement had only weak effects. In Exp. 4, a brief daily
choice test was used to evaluate recency effects. It was found
that several sessions of experience with only one color were
often necessary to reliably shift choice to that color.

PREFACE

This thesis reports research carried out from October 1968 to June 1969. The organization of the thesis allows it to be read both by those who are familiar with recent research on choice behavior in animal subjects, and by those who are not familiar with this research. The reader who wishes a straight-forward report of the procedures and results of the research may read Chapter 2, which is written in the style of a journal article. For readers desiring a more general introduction, Chapter 1 describes the background of the problem and some of the recent research on choice behavior. In addition, appendices contain some subsidiary arguments, more detailed descriptions of the apparatus, and more detailed data than are reported in the text.

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CHAPTER 1

SOME EXPERIMENTAL APPROACHES TO THE STUDY OF CHOICE

Each of the four experiments reported in this thesis employed a situation which has been used in a large number of experiments on choice. In that basic situation, an animal is presented with two stimuli, and can respond to either of those stimuli. The question asked is this: what aspects of its prior experience with those two stimuli will cause the animal to respond to one stimulus more than to the other? Put another way, what aspects of the animal's experience with those stimuli will cause it to "choose" one stimulus over the other?

In the present experiments, pigeons were used as subjects and the response was pecking at one of two response keys. Each response key could be lit either red or green, and in each experiment the question was whether the pigeons would reliably peck one color more than another as a result of prior experience with these colors. The pecking response of the pigeon has been used in many previous experiments, and its use here had the advantage of making relevant a large body of practical information concerning the pigeon, the pecking response, and the sorts of variables that affect that response. As a simple example, we know from previous experiments that color discrimination in the pigeon is very good, and the design of the present experiments is based upon this knowledge.

Organization of this Chapter

The four experiments are reported in Chapter 2. This introductory chapter has three purposes. One purpose is to offer a general background for the experiments to be reported later; this will be done by describing some of the different experimental approaches that have been used to study choice. A second purpose is to give specific criticisms of two currently popular approaches to the study of choice. A third purpose of this chapter is to introduce the particular experimental approach that was used in the experiments to be reported. That approach will be described near the end of this chapter, and some of its advantages will be pointed out.

No attempt will be made in this chapter to survey the very large number of experiments that have dealt with choice behavior. Nor will mention be made of all the different experimental approaches that have been used in the study of choice. Instead of such a general survey, this chapter will present a more detailed look at two particular approaches to the study of choice. A considerable amount of interest has been generated by each of these two approaches, and each has been employed in a large number of recent experiments. To allow convenient reference, we will refer to these experiments as employing either the "concurrent schedules design" or the "two-link choice design." In the first section that follows, the concurrent schedules design will be introduced and discussed and some complexities in that design will be pointed out. In the second

section, the two-link choice design will be described, and a number of difficulties in interpreting results obtained with experiments of that design will be considered. These problems of interpretation with the two-link choice design will be discussed at some length, since the widespread use of that design suggests that a detailed consideration of it will be of value. In a final section, the experimental approach used in the present experiments will be introduced, with particular emphasis on the ways in which that approach avoids difficulties found in the first two approaches.

The Concurrent Schedules Design

In this section the concurrent schedules design is presented by describing a sample experiment that uses that design. After the major features of the concurrent schedules design are made clear, some of the advantages of that design will be mentioned. Finally, some complexities of the design will be discussed.

Sample Experiment Using the Concurrent Schedules Design

An experiment by Herrnstein (1961) will serve as an example of the concurent schedules design. In that experiment, pigeons were used in a two-key experimental chamber with the response keys 4.5 inches apart (center to center). The left key was always red, and the right key was always white. Pecks

to each key were reinforced with food according to two different
variable-interval schedules of reinforcement. In a variable
interval (VI) schedule, reinforcement is presented for the
first peck after a given, but variable, period of time following
the previous reinforcement. For instance, in a VI 3 minute
schedule, reinforcement is presented on the average every three
minutes, although the actual intervals used may vary from only
a few seconds to many minutes. In Herrnstein's experiment, the
VI schedule for one key was independent of the schedule for the
other. Thus, at any given moment, reinforcement could be avail-
able on neither key, on one of the keys, or on both keys. A
reinforced response on one key had no effect on the schedule
of reinforcements for the other key.

Herrnstein varied the values of the VI schedules on the
two keys in such a way that the overall frequency of reinforcement,
for the two keys taken together, was held constant at an average
of one reinforcement every 1.5 minutes. What he found was that
the relative frequency of responding on a particular key was
very close to the relative frequency of reinforcement on that
key. In other words, the number of responses on one key, taken
as a proportion of the total responses to either key, was very
close to the number of reinforcements received for responses to
that key, taken as a proportion of total reinforcements received
for responses to either key.

This experiment exemplifies some of the major features
of the concurrent schedules design. First, there are two responses
(pecks to the left key and pecks to the right key), and both of

these responses are concurrently available. Second, each of the two responses is reinforced according to a different and independent schedule of reinforcement. (We will see below that this independence is not always maintained.) Third, although this is not necessary, most of the research using this design has used pigeons in a two response-key situation just as Herrnstein did. A large number of experiments using the concurrent schedules design have been reviewed by Catania (1966).

The concurrent schedules design seems to have some valuable features. One advantage of that design is that a great deal is now known about the effects of reinforcement schedules in the single-key situation. A number of experimenters feel "knowledge concerning the properties of behavior to a single response key in this type of experimental situation has reached a level sufficiently advanced to make possible a fruitful evaluation of the complexities that arise from the addition of a second key" (Herrnstein, 1958, 35-36). A second advantage of the concurrent schedules design is its apparent simplicity. The design of an experiment involves simply treating each of two responses as if they were independent, and reinforcing each according to its own schedule of reinforcement. However, experiments using this design soon showed that this simplicity was only apparent, as will be described below. A third possible advantage of the concurrent schedules design is that its findings may be directly relevant to parallel situations in everyday life.

However, there is not much agreement among different researchers on the extent to which parallels of the concurrent schedules experiments exist in non-laboratory situations.

Complexities in the Concurrent Schedules Design

What is reinforced? One complexity in the concurrent schedules design is that reinforcement programmed to follow one response may also closely follow other responses, so that it affects them as well. For example, if a bird pecks the left key, then pecks the right key, and then receives food, it may be argued that each of three responses has been reinforced either directly or with a slight delay: a response to the left key, a response to the right key, and a response of "switching" from the left key to the right key. Evidence relevant to the possibility that "switching" may be a separate response that can be reinforced has been discussed by Catania (1966).

Independence of schedules. In order to prevent reinforcements programmed for responses to one key from also reinforcing responses to the other key and "switching" responses, experiments using the concurrent schedules design often include a "changeover delay" contingency. When a changeover delay is used, a response to a particular key may be reinforced only if a certain interval of time has passed during which only that key has been pecked. A 1.5 second changeover delay was employed during most of the experiment by Herrnstein (1961) reported above.

The use of the changeover delay increases complexity, since
when it is used the schedule of reinforcement for responses
to one key is no longer independent of responses to the other
key.

In the experiment by Herrnstein (1961) described above,
when each key was on a VI schedule, there was an additional
relation between the schedules on the two keys that is not at
first apparent. Because of the nature of variable-interval
schedules, whenever a bird was responding on one key, rein-
forcement for a response on the other key was becoming more
likely. This fact encourages switching back and fourth between
keys, and is another reason for the use of the changeover delay
contingency (Catania, 1966).

Variables affecting choice. As noted above, it is not
always clear what response is reinforced in a concurrent schedules
design. However, even if we could be sure that reinforcements for
responses to each key had no effect on responses to the other key
or on "switching", it would still be difficult to be sure what
variables were affecting choice in the concurrent schedules
situation. Let us consider Herrnstein's (1961) experiment again,
In particular, we will ask what variables might have caused more
responding to the left key than the right key when the left key
was associated with a VI 2.25 minute schedule and the right key
was associated with a VI 4.5 minute schedule. The following
factors might have been important in causing more responses
to the left key: (a) Pecks to the left key received a higher

number of reinforcements per session. (b) Pecks to the left key received a higher number of reinforcements per unit time with the left key available. In other words, it might be that total number of reinforcementsis not important in determining choice, but only number of reinforcements per unit time with the stimulus present. These two variables were confounded in Herrnstein's experiment. (c) Pecks to the left key may have received a higher number of reinforcements per unit time that the bird spent responding to that key. (d) The degree to which the left key was pecked more than the right key on any given day may have been influenced by the fact that more time was spent pecking the left key than pecking the right key on previous days.

Some of these variables do not seem to make much sense in the concurrent schedules design, because they cannot possibly be isolated within that design. For instance, no experiment within the concurrent schedules design could differentiate between relative reinforcements per session on each key (sometimes termed number of reinforcements) and relative reinforcements per unit time on each key (sometimes termed rate of reinforcement). These variables must covary in concurrent schedules experiments because in these experiments the two keys are always present for the same length of time, so that relative rate and relative number must be identical. This point will be made again in Chapter 2, where these variables will be defined more clearly. For now the point is simply that some potentially important variables are dfficult or impossible to evaluate within the concurrent schedules design.

The Two-Link Choice Design

The two-link choice design is considerably more complex than the concurrent schedules design, and this section may be omitted without causing the reader difficulty in understanding the experiments reported in Chapter 2. However, since a large number of recent experiments on choice have been carried out with this design, and since there do seem to be problems with it, it will be evaluated here in some detail. Variables examined using this design include rate of reinforcement (Herrnstein, 1964a; Schneider, 1968), number of reinforcements (Fantino & Herrnstein, 1968), immediacy of reinforcement (Davison, 1968), magnitude of reinforcement (Schwartz, 1969), required rates of response (Fantino, 1968; Killeen, 1968a), and the distribution of intervals in interval schedules of reinforcement (Davison, 1969; Herrnstein, 1964b; Killeen, 1968b).

Sample Experiment Using the Two-Link Choice Design

An experiment by Herrnstein (1964a) will serve as an example of the two-link choice design. Pigeons were again used as subjects in a two-key experimental chamber. The basic procedure is represented schematically in the diagram on the following page. Each box drawn in solid lines contains one of the three possible states of the two keys (L for left key, R for right key). At the start of a session, both keys were lit white (left box in the

Schematic representation of the two-link choice design
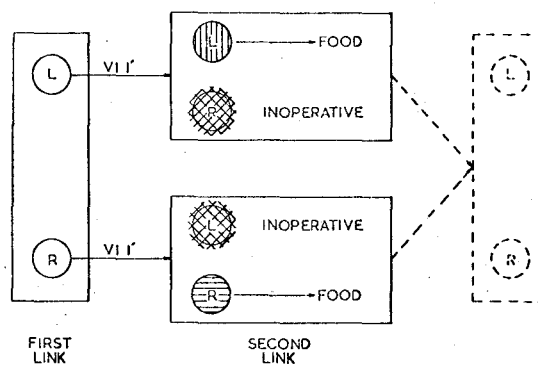
diagram). Herrnstein termed this the "first link" of the procedure. First-link pecks on either key occasionally caused the stimuli to alter as shown in the second links. Pecks on the left key occasionally caused that key to turn red and the other key to darken; pecks on the right key occasionally caused it to turn yellow and the left key to darken. Then, in the second link, pecks on the key that remained lit produced food according to some schedule of reinforcement. In Herrnstein's (1964a) experiment, the first link stimuli were reinstated after two food presentations on the particular second-link schedule that was in effect. Only one of the second-link schedules could be in effect at any given time. As indicated in the diagram, the occurrence of the two second links was governed by two independent VI 1 minute schedules, one for pecks to the left key and one for pecks to the right key.

To summarize, first-link pecks occasionally produced a change in stimuli. In the second link, continued pecking on the key that remained lit then produced food according to some schedule of reinforcement. One way to describe this procedure is to say that first-link pecks were reinforced by changes in key color from white to either red or yellow. The secondary reinforcing effect of the red and yellow key illuminations was in turn determined by the schedule that governed how often food was received in the presence of those colors. Several of the experimenters who have used the two-link choice design have described it in this way, by saying that first-link pecks received

secondary reinforcement. However, we will see below that the degree to which secondary reinforcement is involved in the two-link choice design is not certain.

This experiment exemplifies some of the major features found in all of the two-link choice experiments cited above. First, a two-key apparatus is used and the procedure is divided into two alternating links. Both keys are lit concurrently in the first link, but keys are lit separately (only one at a time) in the second link. Different schedules of reinforcement determine when food is presented in the second link. First link pecks are never followed by food, but only have the effect of causing one of the two second-link procedures to begin. All of the two-link experiments cited above used concurrent VI 1 minute schedules to determine movement from the first link to the second link. In addition, all but three of those experiments had both keys lit the same color in the first link, but each key lit a different color in second links.* Finally, all of those experiments used pigeons as subjects.

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*The exceptions to this generalization are experiments by Schwartz (1969), who used a center key in the second link, and Davison (1968, 1969), who lit both keys the same color in the second link. These exceptions are discussed further in the next section.

Complexities in the Two-Link Choice Design

Secondary reinforcement. The complexities in the two-
link choice design are best understood by asking a single question:
is it necessary to interpret first-link responding in the two-
link choice experiments as resulting from secondary reinforcement?
This question may be immediately subdivided into two further
questions: Is it likely that secondary reinforcement is involved
in these experiments? And is it necessary that secondary reinforce-
ment is involved in these experiments -- that is, could differential
responding to the two first-link keys be explained on some other
basis?

First, it is indeed likely that secondary reinforcement
affects first-link responses. The basis of the experimental
design is that first-link responses occasionally produce a change
in key color from white, in which pecks are never directly
followed by food, to either red or yellow, in which pecks are
occasionally followed by food. We know from many other exper-
iments that the changes in key color from white to red or yellow
are likely to have secondary reinforcing effects (Kelleher, 1966).

However, although secondary reinforcement is likely to
play a role in the two-link choice design, there are at least
two other ways in which first-link responding could be affected
in that design. Since these other ways exist, it is impossible
to be certain of the degree to which secondary reinforcement is
involved in the two-link choice experiments.

Delayed reinforcement. One other way in which first-link responses could be maintained in the two-link choice design is by delayed primary reinforcement. In the two-link design, first-link pecks are occasionally followed, after some delay, by the occurrence of food. It is possible that this delayed primary reinforcement directly affects first-link responses. To make this point clearer, imagine that the experimental situation were changed as follows. Instead of one of the keys turning a different color in the second link and the other being darkened, suppose that both keys were darkened. Further, imagine that the bird did not peck the darkened keys, but despite this we presented food at those points in the second link when we knew food would have been received if the pigeon had been pecking. It is possible that these food presentations, occurring with some delay following a first-link peck to a lighted key, would maintain pecks in the first link. Furthermore, since the schedules of reinforcement in the second links were different for each key, such a procedure might cause the two first-link keys to be pecked at different rates.

Although this example has suggested how first-link pecks might be affected by delayed primary reinforcement, it should be noted that even in the imaginary experiment just described both secondary reinforcement and delayed primary reinforcement would probably be involved. In the imaginary experiment, the darkening of both keys might well have secondary reinforcing effects, since it would be associated with the presentation of food. However, it would be difficult to argue that the darkening of both keys would

have a _differential_ effect, since responding to each key in
the first link would occasionally be followed by the _same_
stimulus (both keys dark). Therefore, if the two first-link
keys were pecked at different rates in our imaginary experiment,
it would be reasonable to assume that these different rates were
caused by the different delays of primary reinforcement associated
with the two second-link schedules.

There are a number of ways that the two-link design
might be modified so that secondary reinforcement for first-
link pecks was retained, but delayed primary reinforcement was
either removed or equated for the two keys. What is necessary
is to separate the presentation of the second-link colors in
their secondary reinforcing capacity, and the pairing of those
colors with primary reinforcement. For instance, suppose that
first-link pecks occasionally produced either red (for pecks
to the left key) or yellow (for pecks to the right key), and
these colors were maintained for, e.g., five seconds. To this
point, no food would be presented, and only secondary reinforcement
could be involved. After five seconds with the left key red or
the right key yellow, we could then illuminate a _center_ key either
red or yellow, and present food for responses to this key according
to the appropriate schedule of reinforcement. The crucial element
in this procedure would be that we would present either red or
yellow on the center key _entirely at random_, without regard to
which of these colors had just been presented as a secondary
reinforcer. In this way, delayed primary reinforcement, although

it would still occur for first-link pecks, would be equated for the left and right key.

We have pointed out the possibility that delayed primary reinforcement, as well as secondary reinforcement, might affect first-link responding in the two-link choice design. Is there any data that suggests how likely such an effect is in the experiments that have been carried out? There is one experiment which, although it is only suggestive, should be mentioned. That is an experiment by Davison (1968), who found that when rate of reinforcement in the second link was varied, it was the time until the _first_ reinforcement in the second link that exerted the strongest effect. That result suggests that delayed primary reinforcement for first-link pecks may be important in the two-link choice design. However, Davison's (1968) result does not clearly demonstrate that delayed primary reinforcements affected first-link responses, since his result can also be interpreted in another way. It could simply be said that the secondary reinforcing effect of a second-link stimulus is most heavily determined by the time that passes until the first food presentation in that stimulus.

We conclude that there is no firm evidence on how important delayed primary reinforcement is in the two-link choice design. However, an effect due to delayed reinforcement certainly remains possible. Until such an effect is ruled out by appropriate design changes, we cannot be certain that secondary reinforcement is the only factor affecting relative rate of response to the two keys in the first link.

Response strength to left and right keys. In the two-link design, there is an alternation between periods with both keys lit and periods with only one key lit. Describing these periods as the "first link" and the "second link" serves the function of reminding us that the occurrence of the second link is contingent upon responses in the first link. However, that terminology tends to obscure the fact that the links alternate. To emphasize that both links are repeatedly presented, and that first links follow second links as well as the other way around, the schematic diagram illustrating the basic procedure has been redrawn on the following page. In that diagram, the terms "first link" and "second link" are replaced by "two-key period" and "one-key period"; this new terminology will simplify the points made below.

In the two-link design, pecking the left key is reinforced according to one schedule and pecking the right key is reinforced according to another schedule during one-key periods. This suggests that differential "strengths of response" to the left and right keys might develop during one-key periods. If that were the case, responding in two-key periods might be a function of the relative strengths of response to the left and right keys established during one-key periods. This interpretation of the two-link choice design will be called the "competing response strength" interpretation. According to this interpretation, the fact that one-key periods are contingent on responding during two-

Alternative representation of the two-link choice design

ONE-KEY
PERIOD

TWO-KEY
PERIOD
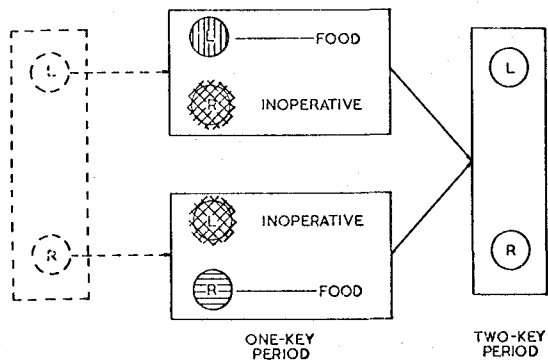
key periods is not of major importance in the two-link design.
More important is the fact that there is a consistent relation
between the key the bird pecks during one-key periods and the
schedule of reinforcement he encounters. This consistent
relation between key and reinforcement schedule might affect
which key is pecked during later two-key periods.

In summary, it is possible to view responding during
two-key periods as at least partially determined by the dif-
ferent schedules experienced with each key during preceding
one-key periods. How reasonable is this point of view?

First, let us recall that in the two-link design the
two schedules of reinforcement that occur during one-key periods
are associated not only with different keys, but also with dif-
ferent key colors. Could it be argued that the bird is more
likely to associate the schedules with the different key colors
than with the different keys? This is possible, of course, but
it should be noted that during two-key periods, when both keys
are the same color, the differences in responding that are observed
must necessarily be based on left-key versus right key. It would
be difficult to argue that a bird who is required to differentiate
keys during two-key periods would ignore key differences during one-
key periods. It is possible that the association between schedule
and key during one-key periods may be diminished by the fact that
only one key is lit, and it is lit a distinctive color. However,
there is no way to be certain that different response strengths

are not associated with the two keys in the two-link choice design as it has been described.

An even stronger case for the competing response strength interpretation can be made in some of the two-link choice experiments whose design was slightly different from the one described above. In those experiments (Davison, 1968, 1969), both keys were the same color during one-key periods (e.g., whichever key was lit was green), as well as being the same color during two-key periods (e.g., both keys were lit red). In those experiments, the competing response strength interpretation seems especially reasonable, since the different one-key periods had to be differentiated in terms of key, not color.*

We turn now to an observation that initially seems to argue against the competing response strength view, but in fact is not evidence against it. That observation is that rates of response to the two keys during one-key periods are usually highly similar in two-link choice experiments (e.g. Herrnstein, 1964a). If responses to two keys occur at the same rate when only one key is lit, could it be argued that "response strength" to these

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*Schwartz (1969) used a center key in the second link, but changed first-link colors so that they corresponded to second-link colors. This change leaves the competing response strength argument intact, except that response strengths would be to colors instead of to keys.

two keys must be almost identical, so that there could be no
strong preference for either key during two-key periods? This
argument would not be valid. As will be shown in the experiments
reported in Chapter 2, it is quite possible for responses to occur
at the same rate to two stimuli when those stimuli are presented
separately, but for one stimulus to be strongly preferred when
both stimuli are presented together. This is the reason for
our use of the term"response strength" above. The statement
that there may be different strengths of response to the two
keys in the two-link choice design is meant to suggest that,
despite similar rates of response to each key when only one key
is lit, there might be strong preferences for one key when both
keys are lit together. This might be possible, for instance, if
rate of response to each key were asymptotically high when only
one key was lit, so that different response strengths could not
be revealed during one-key periods. While the concept of "response
strength" has not been precisely defined here*, the relevant
empirical observation is well supported. Despite similarity in
rates of response to two stimuli when only one stimulus is presented
at a time, it is still possible for strong preferences to appear
when both stimuli are presented together. Evidence for such a
relationship was found in each of the first three experiments
reported in Chapter 2.

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*See Appendix 1 and Appendix 2.

To summarize, it is possible that responding during two-key periods in the two-link choice design is influenced by response strengths established to each key during previous one-key periods. Furthermore, the fact that rates of response to the two keys were highly similar during one-key periods does not argue against this possibility. There is some further evidence that might or might not argue against this view (see Fantino, 1968; Killeen, 1968a), but the interpretation of that evidence is too complex to go into here. Even if that evidene were discussed, our conclusion would remain that the competing response strength interpretation of the results obtained with two-link choice designs cannot be ruled out without further evidence.

Design of the Present Experiments

We have seen that both the concurrent schedules design and the two-link choice design involve complexities that make results obtained with those designs difficult to evaluate. It must be noted that in this chapter the emphasis has been on the complexities of these designs, not on their advantages. Complexities and difficulties of interpretation can be found in almost any experimental situation if it is examined in sufficient detail; the complexities discussed in relation to the concurrent schedules design and the two-link choice design do not mean that nothing can be learned from these designs. However, these discussion do suggest that other approaches to the study of choice might prove

valuable. The general approach used in the present exper-
iments was in many ways simpler than the approaches that have
been described so far.

Before describing the major features of the design
used in the present experiments, some practical aspects of
these experiments must be mentioned. As in the experiments
described above, pigeons were used as subjects in a two-key
apparatus. Each of the two keys could be lit with either a
red dot or a green dot. In the present experiments, it was
responding to a particular color that was of interest, rather
than responding to a particular key. Throughout each of the
experiments, each color occurred equally often on each of the
two response keys. All manipulations in these experiments
were made with respect to red versus green; the key on which a
particular color occurred was always varied and irrelevant.
These experiments examined responses to a particular color
instead of responses to a particular key so that, if more
responses to a particular color were found, it could not be
claimed that this preference was mediated by the bird's standing
in a particular position in the experimental chamber. The
importance of this shift in focus from responses to a particular
key to responses to a particular color is not easily determined
within the present experiments. It is sufficient here to note
that, when we speak of choice below, we refer to a difference
in rate of response to the red and green dot, not to the left
and right key.

We turn now to three major features of the present design that were intended to reduce or eliminate complexities found in the concurrent schedules design and the two-link choice design. These features were (<u>a</u>) the separation of single-stimulus training and choice tests, (<u>b</u>) the use of isolated trials during single-stimulus training, and (<u>c</u>) the lack of any differential feedback for the two responses on the choice test. These features will be referred to collectively as the <u>separate test design</u>.

The most important feature of the separate test design was the separation of "single-stimulus training" and "choice tests". During <u>single-stimulus training</u>, trials occurred with only one color present at a time. In the present experiments, trials of brief duration were used, and reinforcement occurred or did not occur at the end of the trial according to a schedule that was different for each of the two colors. The critical aspect of single-stimulus training was that throughout such training the two colors were never presented together.

After several sessions of single-stimulus training, during which time pecks to red and pecks to green were reinforced according to different schedules of reinforcement, red and green were presented simultaneously in a <u>choice test</u>. In the present experiments, choice tests usually consisted of a single session in which all trials had both keys lit together, one red and one green. The function of the choice test was to examine the effects of the different schedules used with each stimulus during single-

stimulus training, on responding to these stimuli when they were presented together. The experimental questions asked within the separate test design may be phrased as follows: what aspects of a bird's experience with each color during single-stimulus training would affect its responding on the choice test? By manipulating different variables during single-stimulus training, and then observing whether one color was pecked more than the other on the choice test, it was possible to evaluate a large number of variables that may affect choice.

The major feature of the separate test design is that the two stimuli never occur together prior to the choice test. There are two other important features of the separate test design. First, it is important that trials with the different colors during single-stimulus training be separated from each other by time intervals of at least several seconds. This requirement reduces the possibility that delayed or secondary reinforcement for responses to one stimulus will occur when the next trial with the other stimulus is presented. In the experiments reported below, intertrial intervals ranging from 24 to 198 seconds were used. Second, it is important that there be no differential feedback for responses to the two stimuli on the choice test. This is necessary so that responding to the two stimuli on the choice test reflects only the bird's differential experience with these stimuli during single-stimulus training. In the experiments reported below, most choice tests

were presented in extinction.

In summary, the separate test design involves presenting two stimuli on separate, isolated trials during single-stimulus training, and then evaluating choice on a separate test designed for that purpose. The separate test design seems to avoid many of the complexities found in the concurrent schedules design and in the two-link choice design. One advantage of the separate test design is that when reinforcement is presented for a response to a particular color prior to the choice test, it is certain that responses to the other color or "switching responses" have not been reinforced at a short delay. Since colors are presented only one at a time on isolated trials during single-stimulus training, these other responses cannot occur. A second advantage of the separate test design is that secondary and delayed reinforcement seem likely to play a less prominent role. During single-stimulus training this is the case because red and green trials do not occur in close temporal conjunction. During choice tests, delayed reinforcement can play no part at all, since choice tests occur in extinction.

Finally, a third advantage of the separate test design is that the two stimuli can be presented for unequal lengths of time during single-stimulus training. This is not possible in the concurrent schedules design, since both stimuli are always presented together for the same length of time in that design. The advantages of being able to present the stimuli for unequal lengths of time cannot be fully described here. When the individual

experiments are reported below, it will become clear that the ability to present the two stimuli for unequal lengths of time allows the manipulation of variables that otherwise could not be isolated. One simple example of such a variable is probability of presentation of each of the stimuli during single-stimulus training.

Conclusions

To summarize, it is possible that the separation of single-stimulus training and choice tests may have several advantages for the study of choice. Whether or not the separate test design does prove to be valuable will depend, of course, on the particular experimental designs employed, and on whether or not additional complexities arise. No claim is made that the separate test design is the best approach to the study of choice, or that it is better than the other designs discussed. It does seem, however, that the separation of single-stimulus training and choice tests may be a reasonable tactic to pursue in an attempt to avoid some of the complexities of the concurrent schedules design and the two-link choice design.

We turn now to a description of four experiments in which the separate test design was employed. In the next chapter, the basic feature of that design is first introduced in a slightly different way. Then some of the variables that might affect choice are defined, and the general method used in the four experiments is described. Finally, each of the experiments is

presented in detail. We will find that the separate test
design makes it possible to isolate each of a large number
of variables that might affect choice.

CHAPTER 2

FOUR EXPERIMENTS ON CHOICE

Although there have been a large number of experiments
examining choice, a factor common to almost all of those exper-
iments is that the subject is allowed considerable control over
his own experience. As an example, consider a probability
learning experiment in which a rat is rewarded 60% of the time
if he turns left and 40% of the time if he turns right. While
the experimenter controls the probability of reward given each
response, he frequently does not control the number of times
the rat turns left and the number of times the rat turns right.
This means that the number of rewards received for turning left
or turning right, as opposed to the probability of reward given
that a left turn or a right turn has occurred, is not under the
direct control of the experimenter. Since the subject chooses
which alternative response to make, he determines to a considerable
extent the pattern of his experience with the contingencies arranged
by the experimenter.

In the present experiments the degree to which the
subject determined his own experience was minimized by exper-
imentally controlling the availability of each response alt-
ernative before choice was evaluated. Pigeons were used in a
two-key chamber in which each key could be lit either red or

green. The basic structure of the experiments involved presenting red and green on separate trials for a number of sessions, and controlling the subject's experience with each stimulus. During this single-stimulus training, pecks to red and pecks to green were reinforced according to different schedules of reinforcement. After several sessions of single-stimulus training, subjects received a choice test, in which both keys were lit on every trial, one red and one green. The function of the choice test was to examine whether the different schedules used with red and green during single-stimulus training would affect responding to these stimuli when they were presented together. The use of single-stimulus training prior to the choice test allowed closer control over the subject's experience with each stimulus than is possible when both stimuli are presented together throughout all training.

The explicit separation of single-stimulus training and choice tests in order to examine the variables affecting choice does not seem to have been reported before. Such a separation was used by Divak & Elliott (1967), but their experiment was intended as an examination of the partial reinforcement effect. In addition, D'Amato, Lachman & Kivy (1958) examined secondary reinforcement in an experiment similar to those reported here, and Neuringer (1967) has discussed the relation between single-stimulus training and choice tests. Several other experiments bearing some similarity to the ones reported here examined simultaneous discrimination learning following experience with single stimuli (Birch, 1955; Denny & Dunham, 1951; Fitzwater, 1952; Grice, 1948). However, in each of those

experiments the focus was on the rate of learning the simultaneous discrimination, not on the distribution of responses to the two stimuli the first time they were presented together.

In the present experiments, choice test responding was examined following single-stimulus training with each of several different variables differentiating the two stimuli. These experiments allowed investigation of a number of variables that might affect choice when single-stimulus training and choice tests are separated.

Variables Affecting Choice

To illustrate some of the variables that might affect choice when single-stimulus training and choice tests are separated, we will consider the treatment received by one of the groups (Group OS) in the first experiment. The conditions for Group OS are shown in the bottom row of Table 1. A trial situation was used in which all trials were fixed at 6.2 sec long. Positive trials were followed by reinforcement if one or more responses occurred, while reinforcement never occurred following negative trials. In Group OS, 12 S_1 trials were presented in each session, and all S_1 trials were positive, but 36 S_2 trials were presented in each session and only 24 of them were positive.

In describing the differences between S_1 and S_2 in Group OS, we could point to the following variables as possibly being important in determining choice. (a) _Presentation probability_. Three-fourths of all trials during single-stimulus training for

Group OS were S_2 trials. At any given time the probability of occurrence of an S_2 trial was higher than that of an S_1 trial, and it is possible that this would influence choice between S_1 and S_2 when they were presented together on the choice test. (b) <u>Proportion of trials followed by reinforcement</u>. All S_1 trials were positive for Group OS, but only two-thirds of all S_2 trials were positive. The probability that a given trial would terminate in reinforcement was higher on S_1 trials than on S_2 trials. (c) <u>Number of reinforcements received per overall time (rft/overall time)</u>. Group OS received more positive S_2 trials than positive S_1 trials. This means that in any given period of time during a session, more reinforcements were received on the average with S_2 than with S_1. It also means that, given the occurrence of a reinforcement, the conditional probability that S_2 was present when that reinforcement occurred was higher than the conditional probability that S_1 was present when it occurred. (d) <u>Number of reinforcements received per unit time with the stimulus present (rft/stimulus-on time)</u>. Perhaps the number of reinforcements received with a stimulus is important only in relation to the total amount of time that stimulus was present. The number of reinforcements received per unit time with S_1 present was higher than the number of reinforcements received per unit time with S_2 present for Group OS, since S_1 was present only one third the length of time that S_2 was present. (e) <u>Number of reinforcements</u>

received per response (rft/response). It has just been pointed out that rft/stimulus-on time in Group OS was higher for S_1 than S_2. However, birds responded at similar rates to S_1 and S_2 during single-stimulus training, so that the higher rft/stimulus-on time in S_1 meant the proportion of S_1 responses followed by reinforcement was higher than the proportion of S_2 responses followed by reinforcement. This might also be described by saying that the probability of reinforcement was higher for responses to S_1 than for responses to S_2. (f) <u>Trial length</u>. Although in Exp. 1 and 2 trial lengths were the same for S_1 and S_2, in Exp. 3 trial lengths were different for S_1 and S_2. It is possible that a preference for a stimulus associated with shorter trial lengths might appear even though other factors, such as rft/stimulus-on time, were the same for both stimuli.

Three of the variables examined in these experiments were rft/stimulus-on time, rft/overall time, and rft/response. We pause here to define more formally what is meant by those terms. In a two-stimulus choice situation there are two stimuli (S_1 and S_2), two responses (responses to S_1 and responses to S_2), and two classes of reinforcement (reinforcements following responses to S_1 and reinforcements following responses to S_2). For i=1,2, let A_i represent the number of responses made to S_i in a session, F_i represent the number of food presentations following responses to S_i in a session, and T_i represent the total time that S_i was present in a session. Then for a particular stimulus S_i we define rft/stimulus-on time in that session as

F_i/T_i, rft/overall time in that session as F_i, and rft/response in that session as F_i/A_i. In order to compare two different stimuli with respect to these measures, we may also calculate relative measures. Focusing now on the stimulus S_1, we define relative rft/stimulus-on time for responses to S_1 as $(F_1/T_1)/(F_1/T_1+F_2/T_2)$, relative rft/overall time for responses to S_1 as $F_1/(F_1+F_2)$, and relative rft/response for responses to S_1 as $(F_1/A_1)/(F_1/A_1+F_2/A_2)$. This notation also allows clear definition of the major dependent variables of this report. Rate of response to S_i, which will be termed R_i, is simply A_i/T_i. Relative rate of response to S_1 is $(A_1/T_1)/(A_1/T_1+A_2/T_2)$, or more simply, $R_1/(R_1+R_2)$.

In the literature, what we have called rft/stimulus-on time has sometimes been referred to as "rate of reinforcement" or "time rate of reinforcement." These terms are not used here because they do not differentiate between rft/stimulus-on time and rft/overall time. These two different variables, rft/stimulus-on time and rft/overall time, have often been confounded in experiments on choice. In any choice experiment where S_1 and S_2 are always presented together, for instance, $T_1=T_2$ and therefore relative rft/stimulus-on time and relative rft/overall time are equal. This makes these factors completely confounded in many choice experiments (e.g. Hernstein, 1961).

For this reason, Exp. 1 and 2 were designed to allow the separate evaluation of rft/stimulus-on time and rft/overall time in different groups. These variables could be manipulated separately here because single-stimulus training, during which S_1 and S_2 were presented for unequal amounts of time, preceded the choice tests. Exp. 1 also allowed evaluation of the degree to which presentation probability during single-stimulus training affected choice behavior. In Exp. 3, rft/stimulus-on time and proportion of trials followed by reinforcement were varied separately. These factors had varied together in Exp. 1 and 2. In Exp. 4, a daily choice test was used to allow observation of gradual changes in choice, and an attempt was made to see whether differences in recency of reinforcement would affect choice behavior.

General Method

Before the individual experiments are reported, a number of features common to all four experiments will be described.

Subjects and Apparatus

In each of the four experiments, subjects were experimentally naive, male While King pigeons. They were 5-7 years old and were maintained at 75-85% of free feeding weight.

Six Lehigh Valley Electronics pigeon chambers were modified so that the front panels contained two 1.1 in. (28mm)

square holes, horizontally adjacent to each other with their edges .2 in. (4mm) apart. Behind each hole was a translucent response key that was masked off from behind except for a .26 in. (7mm) diameter spot in the center of the key; during trials these spots could be illuminated from behind with red or green light. The two keys were closer together than those on a standard pigeon panel so that pecks on more than one key would be feasible on the short trials used. Only a small dot in the center of each key was lit so that, if pecks were localized around these dots, there would be a reduction in both (a) the number of pecks going unrecorded because the beak hit the panel instead of the key, and (b) the number of pecks on which the upper beak hit one key and the lower beak hit the other, causing a peck to be recorded on each key.

Trials were presented and responses recorded using relay circuitry. Trial types were determined independently for each experimental chamber.

General Procedures

In Exp. 1, 2, and 4, trials were 6.2 sec long ($\pm$.03 sec), and time between trial onsets averaged 72 sec (range: 24 to 132 sec). In Exp. 3, trials could be 3.2, 6.2, or 12.2 sec long ($\pm$.03 sec in each case), and time between trial onsets averaged 108 sec (range: 36 to 198 sec). A background masking noise (75-80 db) was replaced by a 1000 Hz tone (75-80 db) during all trials. Trials were prearranged to be either positive or

negative. If a trial was positive, and if one or more pecks had occurred on the trial, reinforcement was presented immediately at the offset of the trial. Reinforcement was not presented following positive trials on which no peck occurred, and was never presented following negative trials.

Two unusual aspects of these contingencies should be noted. First, although there was a requirement that one or more responses be made on positive trials in order that a programmed reinforcement be delivered, this requirement was a minimal one and was almost always met. These procedures will therefore be described in terms of number of positive trials - that is, number of trials on which reinforcement was <u>available</u> - since that number corresponds very closely to the number of trials on which reinforcement was actually delivered. Second, it should be noted that responses had no effect on trial length in any of these experiments.

Throughout these experiments, contingencies were arranged with respect to the color of the stimulus, not the key on which it occurred. For all birds, whatever colors were presented occurred equally often on each key in every experimental session, so that key was always varied and irrelevant. Although occasional birds showed key preferences, the data reported here will be responses to a particular color summed across keys.

Color assignments were always counterbalanced within an experimental group, but remained constant for an individual bird. The term "S_1 trial" will be used to refer to a trial on

which one key was lit red (or for some birds, green) and the other key unlit; "S_2 trial" will refer to a trial on which one key was lit green (or for some birds, red) and the other key unlit; and "S_1S_2 trial" or "choice trial" will refer to trials with both keys lit, one red and one green. During single-stimulus training only S_1 trials and S_2 trials occurred. During choice tests only S_1S_2 trials occurred. Except in Exp. 4 reinforcement was never available on choice trials.

The birds in each experiment were first trained to peck the key by the method of autoshaping (Brown & Jenkins, 1968). Each bird was autoshaped during the first few sessions of Phase 1 of an experiment, using the same contingencies and schedules of trial presentation used throughout Phase 1 of that experiment, except that in the autoshaping sessions reinforcement occurred following positive trials whether or not a peck occurred. Note that during autoshaping a fixed trial length was used, and negative trials occurred for some birds, so that for some birds up to half of the trials during autoshaping were not followed by reinforcement.

Experiment 1: reinforcements per stimulus-on time
    and reinforcements per overall time

In Exp. 1 rft/stimulus-on time and rft/overall time were manipulated separately in different groups. The variable rft/ stimulus-on time was manipulated by varying the proportion of

trials followed by reinforcement. When all trials with a given
stimulus were positive, rft/stimulus-on time for that stimulus
was high; when only some trials with a given stimulus were
positive, rft/stimulus-on time for that stimulus was lower.
In Exp. 1, therefore, rft/stimulus-on time and proportion of
trials followed by reinforcement were confounded. The experiment
is described in terms of rft/stimulus-on time, however, since
previous experiments have suggested that that variable strongly
determines choice behavior. We will find that the results of
Exp. 3, where rft/stimulus-on time and proportion of trials
followed by reinforcement were separated, lend support to this
way of describing Exp. 1.

Design and Procedure

The number of positive and negative trials presented
during single-stimulus training in Exp.1 is shown in Table 1.

INSERT TABLE 1 ABOUT HERE

That table also shows rft/stimulus-on time and rft/overall time
for each stimulus in each group. Three groups were run, with
six birds in each group. Group names are based on the variable
that differentiated S_1 and S_2 in each group. In Group S, the
stimuli differed in rft/stimulus-on time during single-stimulus
training, but were identical in rft/overall time. In Group O, the
stimuli differed in rft/overall time, but were identical in
rft/stimulus-on time. In Group OS, the stimuli differed in

TABLE 1

Design of Exp. 1

Group	Number of positive (+) and negative (-) trials				rft/stimulus-on time		rft/overall time	
	S_1+	S_1-	S_2+	S_2-	F_1/T_1	F_2/T_2	F_1	F_2
S	12	-	/12	24	9.7	3.2	12	12
O	12	-	36	-	9.7	9.7	12	36
OS	12	-	24	12	9.7	6.5	12	24

Note.- Rft/stimulus-on time is expressed in rft/min; rft/overall time is expressed in rft/session.

both rft/stimulus-on time and rft/overall time, with S_1 having
the higher rft/stimulus-on time and S_2 having the higher rft/
overall time. All groups received 12 S_1 trials and 36 S_2 trials
in every session so presentation probability was higher for S_2
than for S_1 in each group. Each group received 16 sessions
of single-stimulus training as shown in Table 1. In the next
session each group received half of a normal single-stimulus
session, then 20 nonreinforced S_1S_2 trials, then the second
half of a normal session, then a further 20 nonreinforced S_1S_2
trials. The left key was red and the right key green on half
the S_1S_2 trials, and stimuli were reversed on the remaining
S_1S_2 trials. The 40 nonreinforced S_1S_2 trials taken together
will be referred to as the choice test.

Results and Discussion

All 18 birds autoshaped successfully during the first
two sessions. Starting with the third session, one or more
responses had to occur for reinforcement to be delivered following
a positive trial. However, birds responded on almost all trials,
so that reinforcement was received on most positive trials. The
response requirement was met and reinforcement was delivered on
an average of 98% of positive trials (range: from 93% to 99%
for individual birds) during the last ten sessions of single-
stimulus training.

Mean rate of response to each stimulus in each group
is shown in Fig. 1. Response rates rose gradually for all

INSERT FIGURE 1 ABOUT HERE

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groups during single-stimulus training. It is interesting to
note that the rise in response rate seemed to be more closely
related to total number of trials (or sessions) than to number
of trials with a particular stimulus. If response rate to S_i
were determined only by number of trials with S_i, or by number
of reinforcements received for responses to S_i, then in Group O
the curve for S_2 would have risen three times as fast as the
curve for S_1. However, the difference between average rate of
response to S_1 and average rate to S_2 was not this large,
suggesting either that there was generalization between S_1
and S_2, or that some common factor was affecting rate of response.
Although mean rate of response to S_2 was somewhat higher than
mean rate of response to S_1 in Group O, a consistent difference
in this direction occurred in only four of the six birds.

Rates of response to S_1 and S_2 remained quite close
throughout all phases of single-stimulus training for Groups
S and OS. For all groups, Fig. 1 shows that rates of response
to S_1 and S_2 did not differ greatly during phases of single-
stimulus training, but differed considerably on the choice test.
It should be noted that since both stimuli were present together
during choice tests, total rate of response on a choice test is
the sum of rate of response to S_1 and the rate of response to S_2.

Fig. 1. Mean rate of response to S_1 (open figures) and to S_2 (filled figures) during single-stimulus training (circles) and choice test (triangles) in Exp. 1. Each point is a mean for six birds.

Figure 1

Total rates of response during nonreinforced S_1S_2 trials on the choice test were not consistently lower than rates during single-stimulus training.

Data for individual birds on the last five sessions of single-stimulus training and on the choice tests are shown in Fig. 2. Each line in the figure connects points showing relative rates of response to S_1 for a given bird. Relative rates above .5 indicate a higher rate of response to S_1, while

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INSERT FIGURE 2 ABOUT HERE
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relative rates below .5 indicate a higher rate of response to S_2. During the last five sessions of single-stimulus training, some birds showed consistently higher rates to S_1, and some birds showed consistently higher rates to S_2, but in none of the groups was there a consistent trend in favor of either stimulus across all birds in the group.

During the choice test, responding was most often confined to only one color throughout a trial. Of the 40 choice trials, the average number on which only one color was pecked was 30 (range: from 12 to 40 for individual birds). A high relative rate of response to S_1, then, usually indicates not that the time between two successive responses to S_1 was shorter than the time between two successive responses to S_2, but rather that on the majority of choice test trials it was S_1 that was pecked, not S_2. Note that, since S_1 and S_2 were

Fig. 2. Relative rate of response to S_1 for each

bird in Exp. 1 during the last 5 sessions of single-stimulus

training (0) and on   the   choice test (1). Filled

triangles indicate statistically significant preferences

for S_1 or for S_2.

Figure 2
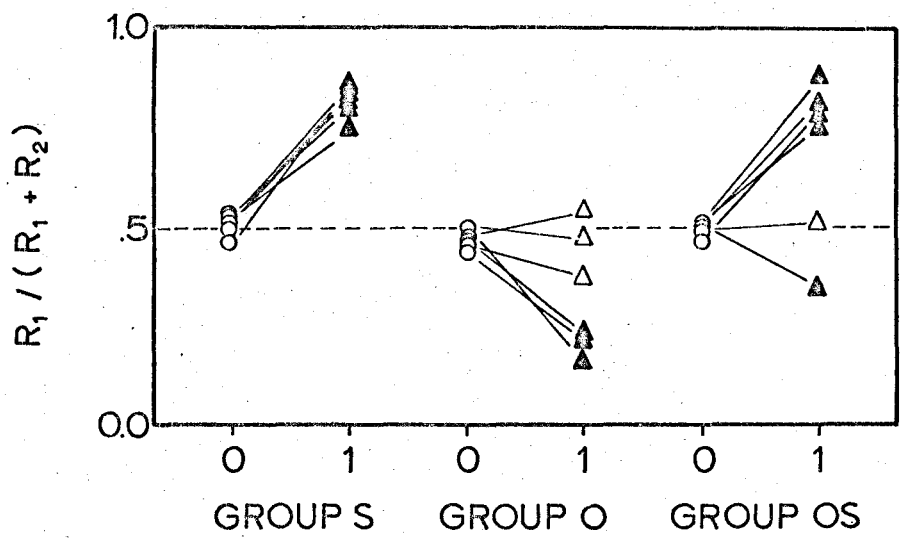
present for the same length of time during choice tests $(T_1 = T_2)$, relative rate of response to S_1 on a choice test is the same as the proportion of total responses made to S_1 $\left[(R_1/(R_1+R_2) = A_1/(A_1+A_2) \right]$.

In order to estimate the reliability of choice test behavior on a single choice test for individual birds, the subset of trials on which an unequal number of responses was made to S_1 and S_2 was considered. The proportion of these trials in which more responses were made to S_1 than S_2 was calculated, and a sign test was used to determine whether this proportion was significantly different from .50. Choice test behaviors for which this test showed significance at $p < .05$ (two-tailed) are indicated by filled triangles in Fig. 2, 4, and 6.

As shown in Fig. 2, relative rates of response on the choice test were not closely related to relative rates of response at the end of single-stimulus training. Rank order correlation coefficients between mean relative rate of response to S_1 over sessions 12 to 16 and relative rate of response to S_1 on the choice test were -.54 in Group S, +.03 in Group O, and +.49 in Group OS. Choice test responding was strongly affected, however, by the schedule used in single-stimulus training. All six birds in Group S showed a preference for S_1, showing that differences in rft/stimulus-on time during single-stimulus training influenced responding on a subsequent choice test. Similarly, five of the six birds in Group O showed a preference for S_2, suggesting that differences in rft/overall time may also influence choice test responding. The preference in Group O,

however, was neither as strong within individual birds nor as consistent across birds as the preference in Group S, which suggests that rft/stimulus-on time may be a stronger determinant of choice than rft/overall time. Consistent with this interpretation, five of the six birds in Group OS, where rft/stimulus-on time and rft/overall time were effectively competing, showed a preference for the stimulus which had received a higher number of rft/stimulus-on time.

In summary, it was found in Exp. 1 that manipulation of rft/stimulus-on time had a strong effect on choice, although it should be recalled that in Exp. 1 rft/stimulus-on time was confounded with proportion of trials followed by reinforcement. Rft/overall time also seemed to affect choice, although the effect of that variable was weaker and was not statistically significant since it occurred in only five of six birds. Presentation probability had little or no effect on choice, since choice test responding was very different in different groups even though presentation probabilities were the same in each group

Experiment 2: Further Examination of
Reinforcements per Overall Time

In Exp. 1, rft/stimulus-on time had a strong and consistent effect on choice, but the effect of rft/overall time was less clearcut. Since the finding of an effect due to rft/overall

time, with rft/stimulus-on time held constant, would have implications for the interpretation of a number of experiments on choice, a further examination of this variable seemed important. In addition, it seemed possible that an effect due to rft/overall time, if it existed, might not hold across the full range of rft/stimulus-on time. For this reason two groups of birds were run. Within each group S_1 and S_2 differed only with respect to rft/overall time, but in Group O(H) both stimuli received the same high number of rft/stimulus-on time that was used with Group O in Exp. 1, while in Group O(L) both stimuli had a much lower value of rft/stimulus-on time. Both groups received more single-stimulus training than was given in Exp. 1 in order to ensure that response rates on single-stimulus trials were asymptotic at the time of the choice test.

The first choice test of Exp. 2 showed no reliable effect due to rft/overall time. After that test, presentation schedules were reversed for all birds, so that S_1 instead of S_2 received the higher rft/overall time. It was felt that this manipulation would allow a more sensitive test for an effect due to rft/overall time, since the choice of each bird following the shift could be compared to its own previous choice, and even a small shift away from S_2 in each bird would reveal an effect. However, once again no effect due to rft/overall time was found. Finally, all birds were presented with the schedule received by Group S in Exp. 1 in order to see whether differences in rft/stimulus-on time, which had a large effect in Exp. 1, would reliably affect

choice even following a considerable amount of other training.

Design and Procedure

The number of positive and negative trials presented in Phase 1 of Exp. 2 is shown in Table 2. There were nine birds

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INSERT TABLE 2 ABOUT HERE
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in Group O(H) and six birds in Group O(L). Both groups started on the same schedule, but Group O(H) remained on the initial schedule with a high number of rft/stimulus-on time throughout Phase 1, while Group O(L) was shifted gradually to a low number of rft/stimulus-on time. Group O(H) received Phase 1 for 26 sessions; Group O(L) received part a of Phase 1 for seven sessions, part b for six sessions, part c for five sessions, and part d for eight sessions. Each group received a choice test in the 27th session. In that session the only trials presented were 40 non-reinforced $S_1 S_2$ trials.

In Phase 2, the schedules for all birds were changed so that S_1 received the higher number of rft/overall time. Numbers of trials presented were the same as indicated in Table 2 for the final part of Phase 1, but S_1 and S_2 were simply reversed. After ten sessions of Phase 2 training, both groups received a second choice test identical to the first. Following the second choice test all birds were given 16 sessions of single-stimulus training identical to that received by Group S in Exp. 1.

TABLE 2

Design of First Phase of Exp. 2

Group	Number of positive (+) and negative (-) trials programmed				rft/stimulus-on time		rft/overall time	
	S_1+	S_1-	S_2+	S_2-	F_1/T_1	F_2/T_2	F_1	F_2
O(H)	8	-	40	-	9.7	9.7	8	40
O(L) a	8	-	40	-				
b	4	4	20	20				
c	2	6	10	30				
d	1	7	5	35	1.2	1.2	1	5

Note.- Rft/stimulus-on time is expressed in rft/min; rft/ overall time is expressed in rft/session.

All birds then received a final choice test identical to the first two choice tests.

Results and Discussion

Autoshaping was begun with 17 birds, but one bird had a physical impairment and one never ate from the food tray. All of the remaining birds autoshaped successfully.

Fig. 3 shows that rates of response to S_1 and S_2 remained close throughout all phases of single-stimulus training. The

INSERT FIGURE 3 ABOUT HERE

individual data in Fig. 4 show no consistently higher rate of response to S_1 or S_2 across birds either at the end of Phase 1, or on the first choice test, or on the second choice test, in either group. On the first choice test a total of only 9 of the 15 birds pecked S_2 at a higher rate than S_1, so the manipulation of rft/overall time during single-stimulus training in Phase 1 had only a very weak effect on choice behavior, if indeed it had any effect at all.

INSERT FIGURE 4 ABOUT HERE

After the first choice test the possibility remained that rft/overall time was having an effect, but that this effect was competing against strong color preferences in individual birds. To test this possibility, birds were given further single-stimulus training in which S_1 instead of S_2 now received the higher number of rft/overall time. According to the hypothesis

Fig. 3.   Mean rate of response to S_1 (open figures) and to S_2 (filled figures) during single-stimulus training (circles) and choice tests (triangles) in Exp. 2.   Points for Group O(H) are means for nine birds, while points for Group O(L) are means for six birds.

Figure 3
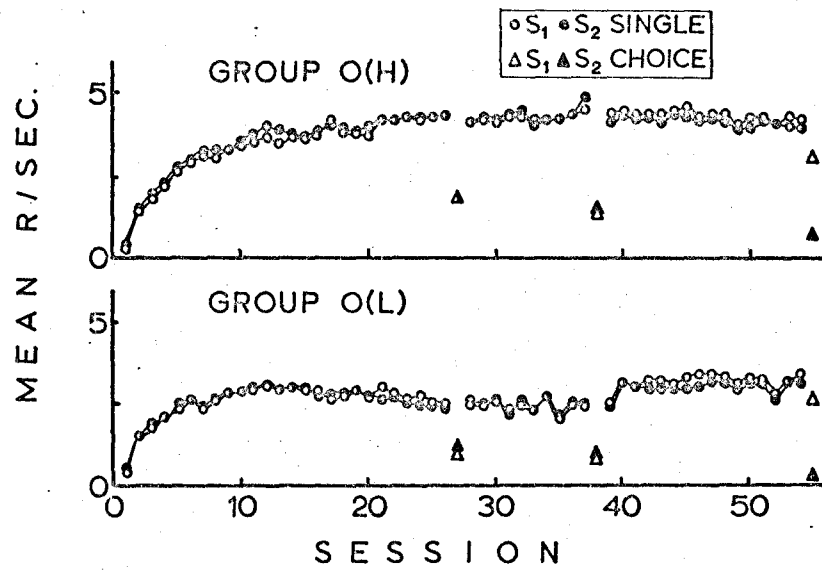
Fig. 4. Relative rate of response to S_1 for each bird in Exp. 2 during the last 5 sessions of Phase 1 (0), on the first choice test (1), on the second choice test (2), and on the final choice test (3). Filled triangles indicate statistically significant preferences for S_1 or for S_2.

Figure 4
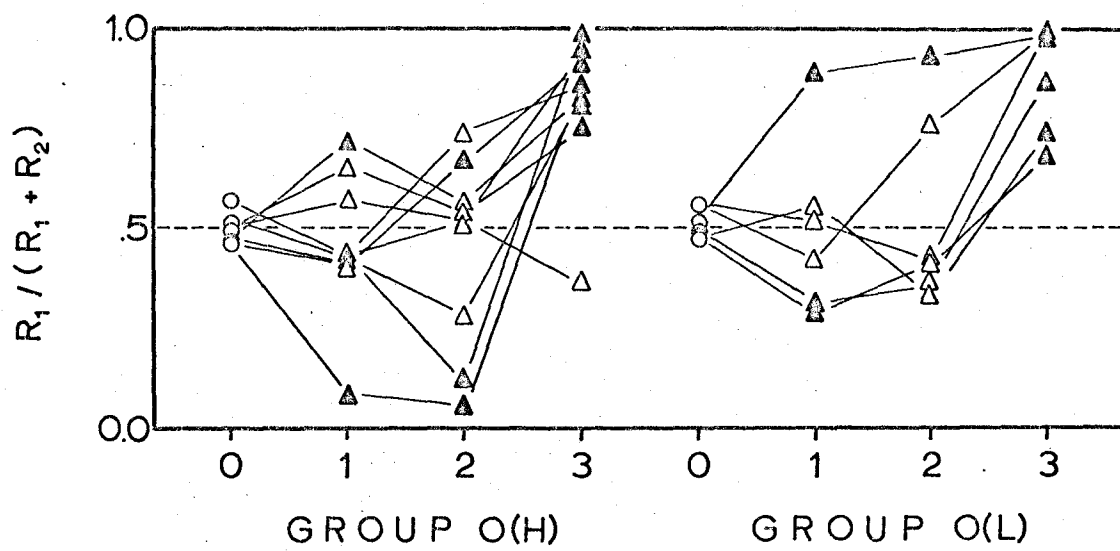
of competing color preferences, birds that preferred S_1 in the first choice test because of a color preference should now prefer S_1 even more strongly, while birds that preferred S_2 in the first choice test might still prefer S_2, but should prefer it less strongly. That is, according to the hypothesis relative rate of response to S_1 should rise for all birds. As shown in Fig. 4, behavior on the second choice test offered no support for this view. Combining the two groups, relative rate of response to S_1 increased in seven birds but decreased in eight birds from the first to the second choice test.

Following the second choice test, all birds received single-stimulus training in which S_1 was associated with a higher value of rft/stimulus-on time than S_2. Behavior on the third choice test was strongly affected by this manipulation, since 14 of 15 birds responded at a higher rate to S_1 than to S_2, and the preference for S_1 was significant (two-tailed $p < .05$ by the test described earlier) for all 14 of these birds.

In Exp. 2, as in Exp. 1, relative rates of response on choice tests were not closely related to relative rates of response during the single-stimulus training that preceded those choice tests. Combining the two groups, rank order correlations between relative rate of response on a choice test and mean relative rate of response during the 5 preceding single-stimulus sessions were +.29 for the first choice test, +.28 for the second choice test, and +.43 for the third choice test. Even on the first and second choice tests, when choice did not seem to be affected by the independent variable manipulated, choice test behavior was not

closely predicted by response rates during single-stimulus training.

In summary, no evidence was found in Exp. 2 for any effect of rft/overall time on choice, even when a within-subject test was used that should have been quite sensitive to such an effect. Presentation probability was also found to have no effect on choice in Exp. 2, since there was no significant preference for S_2 on the first choice test even though S_2 had been presented five times as often as S_1 prior to the test. As in Exp. 1, however, manipulation of rft/stimulus-on time during single-stimulus training strongly affected responding on the choice test in Exp. 2. That manipulation had a strong effect in this experiment even following a considerable amount of other training.

Experiment 3: Reinforcements per Stimulus-on Time
and Proportion of Trials Followed by Reinforcement

In both Exp. 1 and Exp. 2, manipulation of rft/stimulus-on time strongly affected choice behavior. However, in both of those experiments rft/stimulus-on time was manipulated by varying the proportion of trials followed by reinforcement, so that rft/stimulus-on time and proportion of trials followed by reinforcement were confounded in those experiments. In Exp. 3, different trial lengths were used with S_1 and S_2 in order to isolate these factors.

Design and Procedure

Three groups of birds were run, with 10 birds in each group. Table 3 shows the trial lengths and numbers of positive and negative trials received by each group. In Group S-Only, stimuli differed in rft/stimulus-on time, but were the same in

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INSERT TABLE 3 ABOUT HERE

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proportion of trials followed by reinforcement. In Group P-Only, stimuli differed in proportion of trials followed by reinforcement, but were similar in rft/stimulus-on time. In Group SP, stimuli differed in both rft/stimulus-on time and proportion of trials followed by reinforcement, just as they had when rft/stimulus-on time was manipulated in Exp. 1 and 2.

After 16 sessions of single-stimulus training, all birds were given 12 daily choice test sessions, each consisting of 24 nonreinforced $S_1 S_2$ trials. The first choice test session allowed examination of the effects of the independent variables on choice; the remaining choice test sessions allowed examination of the extent to which choice would be maintained throughout extinction. In each choice test session, half the trials were 3.2 sec long and half were 12.2 sec long, in a mixed order. Both short and long trials were used in the choice test sessions in order to evaluate shifts in preference as a trial progressed; such shifts would be revealed by differences in average rates of response on short and long trials.

TABLE 3

Design of Exp. 3

Group	Trial length and number of + and - trials programmed				rft/stimulus-on time (in rft/min)		Proportion of trials followed by reinforcement	
	S_1		S_2					
	number	length	number	length				
	S_1+ S_1-	(sec)	S_2+ S_2-	(sec)	F_1/T_1	F_2/T_2	for S_1,	for S_2
S-Only	8 -	6.2	8 -	12.2	9.7	5.0	1.0	1.0
P-Only	8 -	6.2	8 8	3.2	9.7	9.4	1.0	0.5
SP	8 -	6.2	8 8	6.2	9.7	4.8	1.0	0.5

Results and Discussion

All 30 birds autoshaped successfully during the first three sessions of Phase 1. Mean rate of response to S_1 and S_2 for each group is shown in Fig. 5. Since trial lengths for S_1 and S_2 differed in this experiment, mean rates of response can be misleading. Suppose a bird had a latency of 2 sec, but pecked at a rate of 5 responses per sec after his first peck. Average rate of response for that bird on a 3-sec trial would be 5 responses in 3 sec or 1.7 responses per sec, while average rate of response on a 6-sec trial would be 20 responses in 6 sec or 3.3 responses per sec. In general, given that latency was

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INSERT FIGURE 5 ABOUT HERE

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greater than interresponse time, even though latencies were equal and interresponse times were equal on two trials of different length, average rate of response would be lower on the shorter trial. Latencies were considerably longer than interresponse times in the present experiments, and it is likely that the effect just described explains most of the differences during single-stimulus training shown in Fig. 5 and 6 for Group P-Only, where eight of ten birds

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INSERT FIGURE 6 ABOUT HERE

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pecked at a higher average rate to S_1 than to S_2. However, such an effect cannot explain the higher average rate to S_1 than to S_2 observed in Group S-Only, since S_1 trials were shorter than S_2 trials in Group S-Only. Such an effect could not occur at all

Fig. 5. Mean rate of response to S_1 (open figures) and to S_2 (filled figures) during single-stimulus training (circles) and choice tests (triangles) in Exp. 3. Each point is a mean for 10 birds.

Figure 5
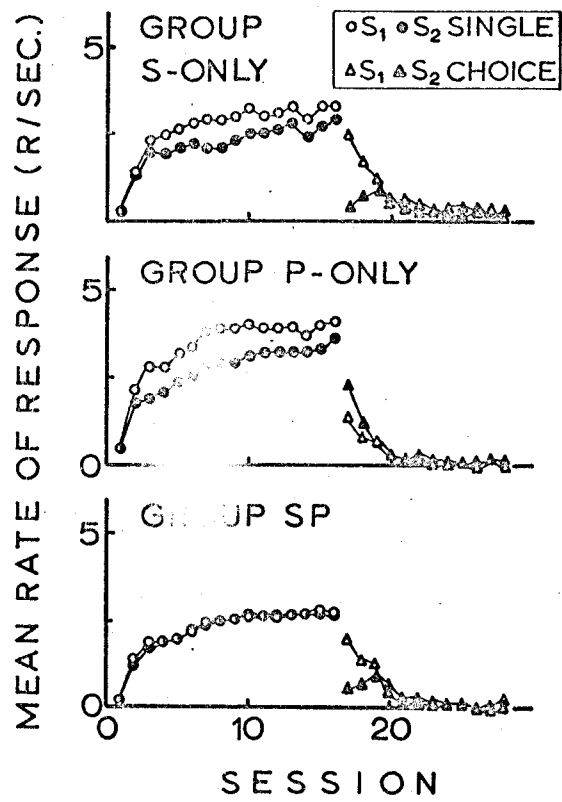
Fig. 6. Relative rate of response to S_1 for each bird in Exp. 3 during the last 5 sessions of single-stimulus training (0) and on the first choice test session (1). Filled triangles indicate statistically significant preferences for S_1 or for S_2.

Figure 6
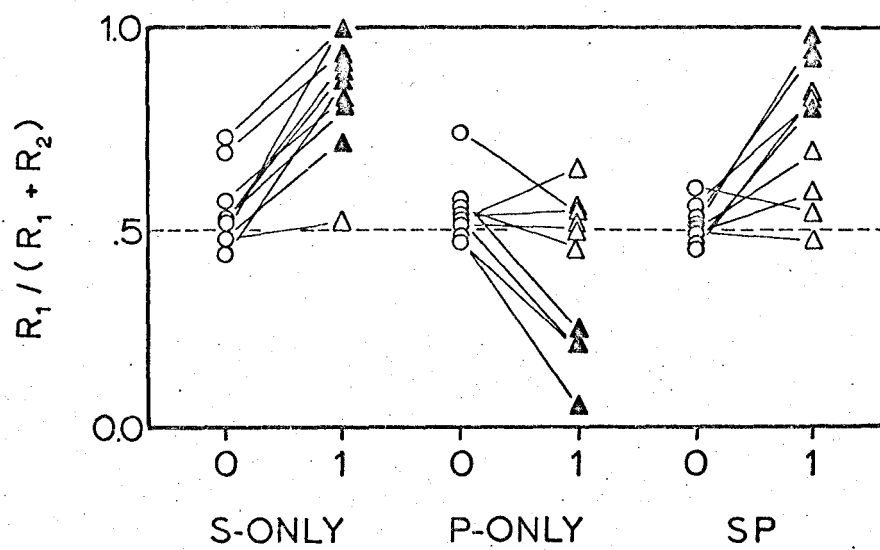
in Group SP, since trial lengths for S_1 and S_2 were equal in
that group. Nor could it affect the data of any group during
the choice tests, where S_1 and S_2 were always present for the
same lengths of time.

Responses on short and long trials were recorded sep-
arately during the first choice test. However, there were no
significant differences between relative rates of response to
S_1 on short trials and relative rates of response to S_1 on long
trials in any group, so both short and long trials were considered
together for the points plotted in Fig. 5 and 6. For both of those
figures, response rates were calculated by simply dividing total
responses to a stimulus by total time that the stimulus was present
during the session.

In the first choice test session, all ten birds in Group
S-Only responded at a higher rate to S_1 than to S_2. For two of
the birds, there was also a much higher rate of response to S_1
than to S_2 during single-stimulus training. When the stimuli
differed in rft/stimulus-on time, but not in proportion of trials
followed by reinforcement, the birds showed a strong preference
for the stimulus associated with the higher value of rft/stimulus-
on time.

In Group P-Only, seven of ten birds responded at a higher
rate to S_2 than S_1. Moreover, all of the four birds whose choice
test behavior was significant by the test described earlier
responded at a higher rate to S_2 than to S_1. When the stimuli
differed in proportion of trials followed by reinforcement, but

not in rft/stimulus-on time, there was no evidence for a
preference for the stimulus associated with a higher proportion
of trials followed by reinforcement. The slight preference for
S_2 in Group P-Only showed that when stimuli were associated
with different trial lengths, even though they were similar in
rft/stimulus-on time, there was a weak preference for the stimulus
associated with the shorter trial length.

In Group SP, nine of ten birds responded at a higher
rate to S_1 than to S_2. This result is in agreement with the
previous results for Group S in Exp. 1 and for all groups in
the last phase of Exp. 2. In each of these cases S_1 was associated
with both a higher value of rft/stimulus-on time than S_2, and a
higher proportion of trials followed by reinforcement than S_2.

As in Exp. 1 and 2, choice test behavior in Exp. 3 was
not closely related to behavior at the end of single-stimulus
training. Rank order correlation coefficients between mean
relative rate of response to S_1 over sessions 12 to 16 and
relative rate of response to S_1 in the first choice test session
were +.51 in Group S-Only, +.18 in Group P-Only, and +.13 in
Group SP.

Data for the remaining eleven choice test sessions
showed a loss in preference over the first few sessions in
all groups. In Group S-Only, where all ten birds pecked more
to S_1 than S_2 in the first choice test session, only seven birds
did so in the second choice test session, seven birds in the
third, and four birds in the fourth. In Group P-Only, where

seven of ten birds pecked more to S_2 than to S_1 in the first
choice test session, eight birds did so in the second choice
test session, four in the third, and six in the fourth. In
Group SP, where nine of ten birds pecked more to S_1 than S_2
in the first choice test session, nine birds did so in the second
choice test session, six in the third, and four in the fourth.
For some birds in Groups S-Only and SP, where there were strong
preferences in the first choice test session, the weakening
preferences over the second and third choice test sessions were
accompanied by an increase in the absolute rate of response to
the less preferred stimulus (Fig. 5). However such an increase
did not occur in all birds: an increase in rate of response to
S_2 from session 17 to session 18 or 19 occurred in five of the
ten birds in Group S-Only and in seven of the ten birds in Group
SP. When total responses in the 12 extinction sessions were
considered, there were no significant differences between total
responses to S_1 and S_2 in any group, and there were no significant
differences between any two groups in total responses to both
stimuli.

Conclusions from Experiments 1, 2, and 3

These experiments showed that several of the independent
variables described earlier had little or no effect on choice
behavior. Presentation probability had no effect on choice in
Exp. 1 or 2. Proportion of trials followed by reinforcement

had no effect on choice in Exp. 3, where presentation prob-
ability was manipulated independently of rft/stimulus-on time.
Trial length, when manipulated independently of rft/stimulus-on
time in Exp. 3, had only a weak effect on choice behavior.
Finally, there was no consistent evidence for an effect of
rft/overall time on choice behavior in these experiments. In
Exp. 2, even though five times as many reinforcements were
presented for responses to S_2 as were presented for responses
to S_1, there was no consistent preference for S_2 across subjects
on the choice test. There was a stronger suggestion of an effect
due to rft/overall time in Exp. 1, and it is interesting that the
choice test was given earlier in that experiment. Possibly
differences in rft/overall time will have a significant effect
on choice behavior if the choice test is given early in training:
two pilot birds, tested after seven sessions on the schedule used
with Group O(H) in Phase 1 of Exp. 2, made 89% and 91% of their
responses to S_2 on the choice tests. However, Exp. 2 shows that
when response rates during single-stimulus training are asymptotic,
rft/overall time seems not to affect choice test behavior.

One variable manipulated in these experiments, however,
did have a strong and consistent effect on choice behavior. In
all three experiments, stimuli associated with a higher value of
rft/stimulus-on time during single-stimulus training were preferred
on choice tests. In Exp. 1, this effect was found in all 6 birds
in Group S and in 5 of 6 birds in Group OS; in Exp. 2, the effect
was found in 14 of 15 birds even after a considerable amount of
prior training; in Exp. 3, the effect was found in 9 of 10 birds

in Group SP. In each of these cases, rft/stimulus-on time was manipulated by varying the proportion of trials followed by reinforcement. In Group S-Only of Exp. 3, however, rft/stimulus-on time was manipulated without varying the proportion of trials followed by reinforcement; all 10 birds in that group pecked at a higher rate on the choice test to the stimulus associated with the higher number of rft/stimulus-on time.

In summary, every manipulation that had a strong effect on choice behavior in these experiments involved differences in rft/stimulus-on time, and each of the other variables just described had either no effects or only very weak effects when not confounded with rft/stimulus-on time. These experiments suggest, then, that rft/stimulus-on time is a major determinant of choice. However, there is one other variable that covaried with rft/stimulus-on time in each of these experiments. Whenever rft/stimulus-on time was varied in Exp. 1, 2 or 3, rft/response also differed for the two stimuli. Since in each experiment birds pecked S_1 and S_2 at nearly the same rate during single-stimulus training, changes in the number of reinforcements received per unit time with the stimulus present also changed the number of reinforcements received per response. These experiments do not allow a decision whether rft/stimulus-on time, rft/response, or both of these factors were the important variables determining choice in Exp. 1, 2, and 3.

Experiment 4:   Use of Daily Choice Tests

to Determine the Importance of Recency

At this point we turn our attention away from
the particular variables examined in the previous exper-
iments, and ask instead the more general question of whether
the experimental approach used in those experiments can be
improved. The separation of single-stimulus training and
choice tests in the first three experiments was certainly
useful, since it allowed the examination of a large number
of variables possibly affecting choice. However, the previous
experiments had the limitation that choice was examined only
at infrequent points in each experiment. Day to day changes
in choice due to single-stimulus training were not observed,
since choice tests were given only after single-stimulus
training had continued for many sessions and responding on
single-stimulus trials appeared asymptotic. A major purpose
of the present experiment was to examine the feasibility of
giving a brief choice test in every session, so that changes
in choice from session to session could be observed. If it
proved feasible to introduce a daily choice test while still
keeping single-stimulus trials and choice trials separated,
this would extend the usefulness of the present experimental
approach.

During the daily choice test, the subject would of course determine what responses would occur. Since this is so, a daily choice test could not be given without losing some of the high degree of control over the subject's experience that had been possible during single-stimulus training in the previous experiments. However, an attempt was made to reduce the effects of subject-determined behavior during choice trials by presenting only four choice trials in each 48-trial session, and by using only nonreinforced choice trials in most phases of the experiment. The decision to use only a small number of nonreinforced choice trials in each session raised the possibilities that (a) reliable choice data would not be obtained with so few choice trials, or (b) birds would stop pecking on choice trials since pecks on choice trials were consistently nonreinforced. Neither of these potential problems in fact arose.

The particular variable examined in Exp. 4 was recency. Even if reinforced responses occurred equally often to each of two stimuli, choice test behavior might be strongly determined by which reinforced response occurred most recently. To examine this possibility, S_1 and S_2 were treated identically throughout Exp. 4, but the order of presentation of these stimuli

was arranged so that one stimulus had occurred more recently at the time of a choice test. It was originally expected that the stimulus present on the last few trials prior to the choice test might strongly determine choice, but there was little evidence for a strong short-term recency effect of this sort. In order to examine recency effects over longer periods, single-stimulus trials of only one color were presented for several sessions, and then single-stimulus trials of the other color were presented for several sessions, while shifts in choice were observed on the daily choice tests.

Design and Procedure

Each of six birds was autoshaped with an equal number of S_1 and S_2 trials, all reinforced, in the first 3 sessions of the experiment. The structure of all further sessions was as follows. The first 40 trials consisted of one or more types of single-stimulus trials, in a mixed order. Following the 40th single-stimulus trial, four choice trials were presented, with S_1 always occurring once on the left key and once on the right key in each pair of choice trials. Unlike single-stimulus trials, the choice trials were presented with a fixed interval of 72 sec between trial onsets. Following the fourth choice trial, four further single-stimulus trials were presented, with the same proportion of trials of each type that had been presented in the first 40 single-stimulus trials of that session.

The types of single-stimulus trials presented in each phase of Exp. 4 are shown across the top of Fig. 7. Autoshaping

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INSERT FIGURE 7 ABOUT HERE

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took three sessions, Phases 1, 2, and 3 took eight sessions each, and Phases 4 and 5 took six sessions each. Throughout the experiment, all single-stimulus trials were positive. Red was S_1 for birds 1, 2, and 3 and green was S_1 for birds 4, 5, and 6. In Phase 1, S_1 and S_2 were presented equally often in each session in order to determine initial color preferences. In the remaining phases, only one stimulus was presented on single-stimulus trials throughout the phase, and all single-stimulus trials were positive. Choice trials were nonreinforced throughout Phases 1, 2, and 3, but in Phases 4 and 5 all choice trials, as well as all single-stimulus trials, were positive.

Results and Discussion

Throughout the experiment, rates of responding during both single-stimulus trials and choice trials rose gradually for all birds. Despite the fact that responding on choice trials was nonreinforced from sessions 4 to 27, response rates on choice trials remained similar to response rates on single-stimulus trials for all birds. Response rates in the 27th session ranged from 4.4 to 8.4 responses per sec on single-stimulus trials and from 4.1 to 8.0 responses per sec on choice trials.

Fig. 7. Relative rate of response to S_1 for each
bird on the daily choice tests throughout Exp. 4.

Figure 7
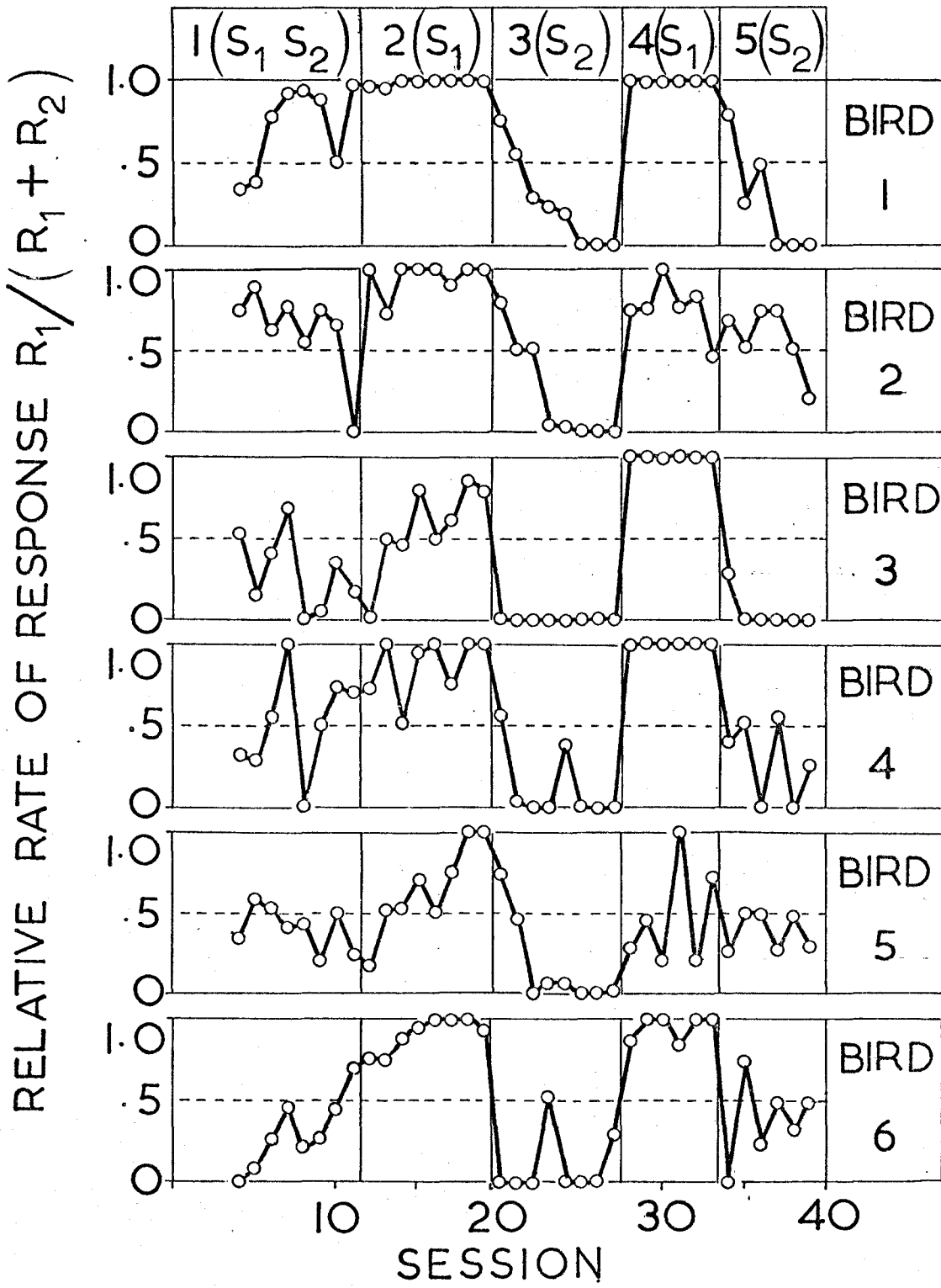
Relative rates of response on the choice tests are shown for each bird in Fig. 7. It was most often the case, especially after the first few choice tests, that birds pecked only one color throughout a choice trial. This was the case, for example, in 89% of all choice trials for all birds combined in Phase 2.

Although there was a fair degree of variability in relative rates of response during Phase 1, consistent color preferences appeared in some birds. Bird 1, for example, made more than 75% of his choice test responses to S_1 in five of the last six sessions of Phase 1, and Bird 2 made more responses to S_1 than to S_2 on seven of the eight Phase 1 choice tests. Birds 3 and 6 made more responses to S_2 than to S_1 on six and seven of the eight Phase 1 choice tests, respectively. Despite consistent color preferences in some birds, none of the birds confined their responses solely to one color on more than two of the eight choice tests during Phase 1.

In the first session of Phase 2, only one color (S_1) was presented on the 40 single-stimulus trials preceding the choice test. If there were a short term recency effect, we would expect all birds to peck S_1 more than S_2 on the first choice test of Phase 2. However, only four of the six birds pecked more to S_1 than to S_2 on that choice test, and only two of the six birds had a relative rate of response to S_1 greater than .76. There was no strong short term recency effect in this experiment.

However, a recency effect did appear when longer periods
of time were examined. During Phases 2 and 3, when only one color
was presented during single-stimulus trials for several sessions,
all birds eventually came to respond more to that color on the
choice tests. For some birds this shift was quite gradual. There
was considerable variability across birds in the number of sessions
that passed in each phase before the stimulus present during
single-stimulus training was pecked consistently on the choice
test. The number of sessions that passed before the appearance
of a consistent preference was related to each bird's initial
color preference. Birds 1 and 2 showed a preference for S_1 in
Phase 1, and shifted very rapidly to S_1 in Phase 2 but very slowly
to S_2 in Phase 3. Birds 3 and 6 showed a preference for S_2 in Phase
1, and shifted slowly to S_1 in Phase 2 but rapidly to S_2 in Phase 3.
Bird 4, who showed no strong preference in Phase 1, shifted to S_1
and to S_2 at approximately equal rates in Phases 2 and 3.

Although the shifts in preference during Phases 2 and
3 may have been due to recency, there is another explanation
which must be considered. In Phase 2, for example, along with
single-stimulus training in which responses to S_1 were reinforced,
birds also received four choice trials per session in which
responses to S_2, if they occurred, were nonreinforced. Perhaps
birds gradually shifted to S_1 not because of the many trials on
which responses to S_1 were reinforced, but because of the few
trials on which responses to S_2 were nonreinforced. Such an
account is particularly plausible in cases where several sessions
passed before a bird reliably preferred S_1 on the choice test.

In order to examine whether such discrimination training contributed to the shifts in preference observed in Phases 2 and 3, all choice trials were made positive in Phases 4 and 5. The birds responded on all choice trials in these phases, so that reinforcement was actually delivered following all of the 288 positive choice trials that occurred. The rate at which shifts in preference occurred in Phases 4 and 5, however, was similar to the rate at which they had occurred in Phases 2 and 3. This may be seen in Fig. 7, which shows that although some birds (2 and 5) had weaker preferences in Phases 4 and 5 than in Phases 2 and 3, other birds (1 and 3) shifted preferences more rapidly in Phases 4 and 5 than in Phases 2 and 3. Figure 8, which shows mean relative rate of response for all birds in sessions 2, 3, 4, and 5, shows that average rates of shift in Phases 4 and 5 were similar to average rates of shift in Phases 2 and 3.

INSERT FIGURE 8 ABOUT HERE

The data in Fig. 8 also show that choice test behavior was not determined simply by the total number of trials a bird had experienced with S_1 and S_2. This would explain preferences for S_1 at the ends of Phases 2 and 4, since more S_1 trials S_2 trials had been received at these points. However, it cannot explain the preferences for S_2 that occurred at the ends of Phases 3 and 5, since an equal number of S_1 trials and S_2 trials had occurred at those points.

The data of this experiment show that it is not only the total number of reinforcements for responses to S_1 and

Fig. 8. Mean relative rate of response to S_1 for each session of Phases 2 and 4, and relative rates of response to S_2 for each session of Phase 3 and 5, for all birds in Exp. 4. Points connected by dotted lines show mean relative rate of response on the last session of the previous phase.

Figure 8
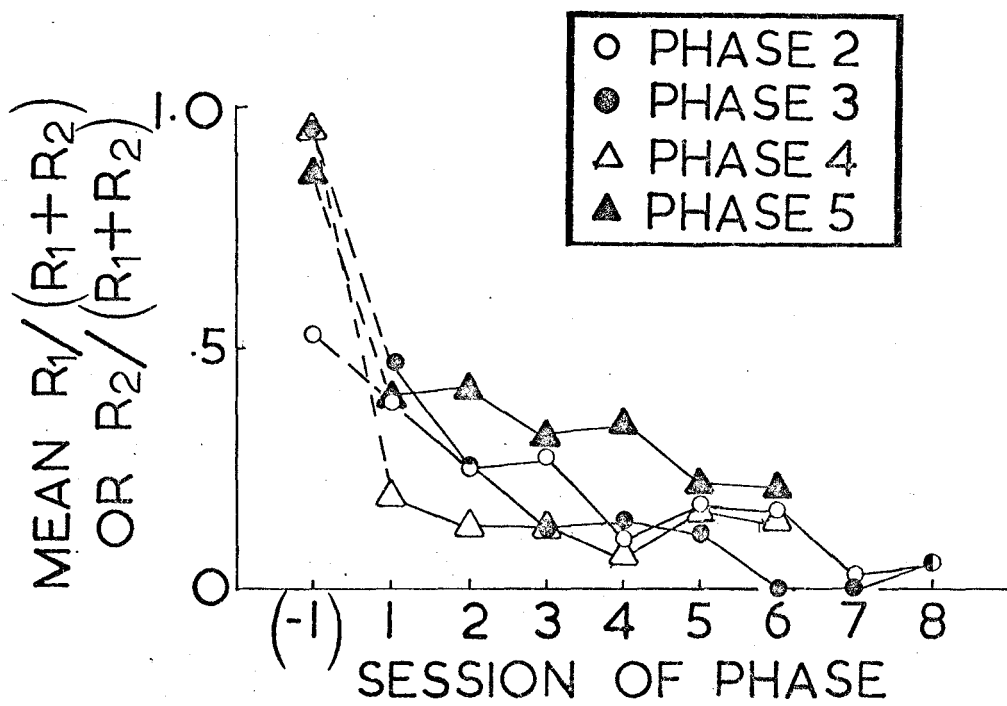
responses to S_2 that is important in determining choice behavior, but the order in which these reinforcements are received. In particular, if responses to one stimulus have been reinforced more recently than responses to another stimulus, even though both responses have been reinforced equally often at the time of the test and both stimuli are associated with equal rates of reinforcement, then the response that has been reinforced most recently will occur at a higher rate on the choice test. This recency effect may have implications for the formulation of a model of choice behavior. It may prove necessary to incorporate into such a model some mechanism of forgetting, so that recent experience is weighted more heavily than early experience in determining choice.*

The more general finding of this experiment is that a daily choice test is indeed feasible in a situation where single-stimulus trials and choice trials are separated. Even though

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* It is in fact possible to predict the data of Phases 2, 3, 4, and 5 without the assumption of diminishing effectiveness, using a relatively simple model in which "tendency to respond to S_1" and "tendency to respond to S_2" increase according to linear operators, if one assumes that (a) there is some generalization between S_1 and S_2, and (b) the degree of generalization diminishes over sessions. See Appendix 2.

only a small number of choice trials was used daily in Exp. 4,
it was possible to get reliable data on choice from session
to session in individual birds. Two birds did not show reliable
choice test behavior in the later phases of the experiment, but
we cannot be sure whether that reflects a lack of sensitivity in
the choice test or a weakness in the independent variable
employed.

The fact that the birds showed no decrease in responding
on the nonreinforced choice trials over a period of 24 sessions
may seem surprising. Throughout this entire period, all trials
with only one key lit were positive and all trials with both
keys lit were negative. Despite this, the birds continued to
respond on trials with both keys lit. Although it may seem
surprising that no discrimination formed between positive and
negative trials, other experiments have also shown that pigeons
will continue to respond to nonreinforced displays if those
displays contain a distinctive feature that is also present
on positive displays (Sainsbury & Jenkins, 1967; Jenkins &
Sainsbury, in press, a,b). Those experiments involved a larger
number of negative trials per session than the present experiment,
but generally involved fewer sessions. Taken with the present
results, they suggest that it may be possible to continue
indefinitely the daily presentation of nonreinforced choice
trials with no loss of responding. If this is so, it increases
the attractiveness of the daily choice test procedure.

In summary, the use of a daily choice test seems quite feasible. Reliable data may be obtained even if only a small number of choice trials is used, and responding on choice trials is likely to continue over a large number of sessions even if responding on choice trials is never reinforced. The use of a large number of single-stimulus trials and a small number of choice trials in each session has the advantage of allowing a high degree of control over the subject's experience with each stimulus while at the same time allowing the observation of day to day changes in choice.

Summary and Conclusions

In each of these four experiments, choice tests were separated from single-stimulus training in order to achieve a high degree of control over the subject's experience before examining choice behavior. Major findings were that ($\underline{a}$) reinforcements per unit time with the stimulus present (rft/stimulus-on time) seemed to be a potent variable affecting choice; ($\underline{b}$) several other variables, including presentation probability, trial length, proportion of trials followed by reinforcement, and rft/overall time had either no effect on choice or only very weak effects when isolated from rft/stimulus-on time; ($\underline{c}$) relative rate of response to a stimulus on a choice test was not closely related to relative rate of response to that stimulus during single-stimulus training; ($\underline{d}$) large differences in rates of response

to S_1 and S_2 in the first choice test session following single-stimulus training were not sustained throughout continued testing of choice in extinction; and (e) when responses to two stimuli were equally often reinforced over all sessions, but in the most recent sessions responses to one stimulus were reinforced and the other stimulus was not presented, then the response most recently reinforced occurred most often on the choice test.

The general tactic of separating single-stimulus training and choice tests appears to offer several advantages for the study of choice. First, the procedure makes possible a high degeee of control over the subject's experience with each stimulus. Second, the procedure allows the separate manipulation of each of a large number of variables that might affect choice. Third, the procedure is sensitive enough so that in these experiments the effects of at least one majr variable, rft/stimulus-on time, were consistently observed. Fourth, the procedure may be extended so that a daily choice test is given, as done here in Exp. 4, allowing the observation of shifts in preference from session to session. Finally, it should be noted that the tactic of separating single-stimulus training and choice tests could easily be extended beyond the trial situation that was used in these experiments. There is no reason why single-stimulus training could not include longer periods with each stimulus on, employing any of the commonly used schedules of reinforcement.

In conclusion, the general tactic of separating single-stimulus training and choice tests has many useful features. It seems likely that a large number of questions concerning choice may profitably be asked by using that general tactic.

THE CONCEPT OF RESPONSE STRENGTH AND SOME DATA

ON EXTINCTION: PREDICTIONS BASED ON WITHIN- AND

BETWEEN-SUBJECT PARTIAL REINFORCEMENT EFFECTS

In this appendix, I (a) suggest that a model for the
present experimental situation might be formulated in terms
of response strength; (b) point out the possible relevance of
previous findings of within- and between-subject partial
reinforcement effects; (c) make some predictions about what
would happen during extinction in the present experiments if
within- and between-subject partial reinforcement effects
occurred; and (d) examine some data on extinction in the
present experiments in order to evaluate these predictions.
Some of the data to be described were discussed earlier from
another point of view, but some of the data have not been
described before.

The Concept of Responses Strength

Consider two approaches to a model for choice behavior
in the present experiments. One approach is to say that as a
result of the variables manipulated during single-stimulus
training, at the end of single-stimulus training there exists a
certain probability of response to S_1 and a certain probability
of response to S_2. On the choice test these probabilities

interact according to some rule that determines the probability of each response when both stimuli are present concurrently. For convenience, we will call this model the probability model. The major feature of the probability model is that it attempts to predict choice behavior from the probabilities of different responses at the end of single-stimulus training.

Now consider an alternative approach to a model for choice behavior in these experiments, which we will call the strength model. One could argue that during single-stimulus training, responses to S_1 and responses to S_2 acquire different "strengths" as a result of their association with different schedules of reinforcement. On choice tests, the interaction of these different strengths would determine which response occurred. The difference between this model and the probability model is that "response strength" is a theoretical term, and response strengths at the end of single-stimulus training need not be directly tied to rates of response at that time. That is, the strength model has a degree of freedom not available to the probability model. According to the strength model, the independent variables of the experiment affect the theoretical "strengths," which in turn affect choice behavior. The model does not require any particular relation between probabilities of response at the end of single-stimulus training and probabilities of response on the choice test.

We could say that the probability model uses the independent variables to predict behavior at the end of single-stimulus

training, and then in turn uses this behavior to predict choice test behavior. The strength model, on the other hand, predicts choice test behavior directly from the independent variables, via the theoretical concept of "response strength." In one sense the strength model is the weaker of the two, since it does not necessarily predict anything about responding during single-stimulus training. But this may also be an advantage for the strength model, since that model does not have to predict a close relation between responding during single-stimulus training and responding during the choice test. The data from the experiments reported in this thesis suggests that this advantage may be an important one.

Three related aspects of the data suggest that the form of model we have called the "probability model" might be difficult to apply to the present experiments. First, in all of the experiments differences in rates of response to the two stimuli were very much smaller during single-stimulus training than during choice tests. Second, variables having consistent effects on choice behavior across birds often had inconsistent effects on behavior during single-stimulus training. In Exp. 2, for example, 14 of 15 birds showed a significant preference for S_1 on the third choice test. During the single-stimulus training immediately prior to that choice test, however, only nine of the 15 birds had shown higher rates of response to S_1 than to S_2. This means that six birds responded at a higher rate to S_2 than to S_1 during single-stimulus training - and some of

these birds did this consistently, session after session - but responded at a higher rate to S_1 than to S_2 during choice tests. Finally, the correlations reported for Exp. 1, 2 and 3 showed that there was no strong relation between relative rate of response during single-stimulus training and relative rate of response during choice tests.

All of these facts show that relative rates of response during single-stimulus training need not be closely related to relative rates of response during choice tests. If what I have called a "probability model" of choice estimated probabilities from observed rates of response, such a model would be faced with the problem of predicting large differences in probabilities of response on a choice test from probabilities that differed only slightly, or not at all, or even in the wrong direction during single-stimulus training. For this reason, a simple model relating probabilities of response during single-stimulus training to probabilities of response during choice tests might not fare well in the present situation.

The approach taken in the "strength model" makes it possible to avoid these difficulties because response strength is a theoretical term, and need not be directly tied to observed rate of response. Using the concept of response strength would leave one room to argue as follows: at the end of single-stimulus training, S_1 and S_2 have different response strengths due to their association with different schedules of reinforcement. However, at this point both response strengths are above some

particular value, so that rates of response to S_1 and S_2 are
each at their maximum and no reliable difference is observed
between them. (In fact, one could even argue here that maximum
rate to S_1 and maximum rate to S_2 may be slightly different,
but unrelated to the different response strengths of S_1 and S_2.)
On choice tests, the argument would continue, relative rate of
response to S_1 would be determined by the relation between
strength of response to S_1 and strength of response to S_2.
In summary, the advantage of the response strength notion is
that it allows strong preferences on choice tests even though
there are no preferences (or perhaps even slight differences
in the other direction) during single-stimulus training.

Relevance of the Partial Reinforcement Effects

We have not offered a precise definition of "response
strength," and indeed such a definition must await a more formal
model of choice behavior*. The use of the term, however, does
suggest the possible relevance of previous findings thought
to affect "response strength." An example of such a finding
is the partial reinforcement effect (PRE). This refers to the
fact that when one stimulus is associated with consistent
reinforcement, and another stimulus is associated with only
occasional reinforcement, responding declines less rapidly to
the latter stimulus during extinction. When two stimuli so
treated are compared with different groups of animals, we observe

*See Appendix 2.

a between-subject PRE; when two stimuli so treated are compared within a given animal, we observe a within-subject PRE. Within-subject PREs have been noticeably more difficult to demonstrate than between-subject PREs (Amsel, 1967).

In terms of our present formulation, we would say that when one stimulus is associated with consistent reinforcement and one with occasional reinforcement, response strength during extinction <u>declines less rapidly</u>* to the stimulus associated with occasional reinforcement. In both Exp. 1 and Exp. 3 some stimuli were associated with less consistent reinforcement than others; we turn now to an examination of data from these experiments to see whether differences expected on the basis of within- and between subject PREs were in fact found.

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*Note we do not say the partially reinforced response "has greater strength", since the term "strength" is not defined here in terms of resistance to extinction. A careful distinction must be made between (<u>a</u>) momentary response tendency and (<u>b</u>) the rate of decline in that tendency during extinction. As used here, "strength" is related to momentary response tendency. The PRE, however has usually referred not to differences in response tendencies at the beginning of extinction, but to differences in the rates at which these response tendencies decline during extinction. Sometimes the PRE has been described by saying the

Data from an Extinction Phase of Exp. 3

The schedules of reinforcement used in Exp. 1 were such that both within- and between-subject partial reinforcement effects might have been expected. Table 1, which shows the design of Exp. 1, is presented again on the next page to allow easy reference. Note that in Group S, all S_1 trials were followed by reinforcement, while only one-third of all S_2 trials were followed by reinforcement. We might therefore expect a within-subject partial reinforcement effect in Group S. A similar analysis could be made for Group OS, where S_1 trials were again always followed by reinforcement, but only two-thirds of all S_2 trials were followed by reinforcement. Finally, if we compare

partially reinforced response has greater "strength", but that use of the term "strength", to mean resistance to extinction, is different from the way the term "strength" is used here. These different uses of the term "strength" do not diminish the fact that the PRE is relevant to the concept of response strength as used here, since it implies more rapid decline in response strength following consistent reinforcement than following occasional reinforcement.

TABLE 1

Design of Exp. 1

Group	Number of positive (+) and negative (-) trials				rft/stimulus-on time		rft/overall time	
	S_1+	S_1-	S_2+	S_2-	F_1/T_1	F_2/T_2	F_1	F_2
S	12	-	12	24	9.7	3.2	12	12
O	12	-	36	-	9.7	9.7	12	36
OS	12	-	24	12	9.7	6.5	12	24

Note.- Rft/stimulus-on time is expressed in rft/min; rft/overall time is expressed in rft/session.

Group 0 to Groups S and OS, we find that in Group 0 all trials were positive, while some trials were negative in Groups S and OS. We might therefore expect a between-subject partial reinforcement effect, with Group 0 making fewer responses in extinction than Groups S and OS.

It should be noted that the above discussion has pointed out differences in reinforcements per trial, not reinforcements per response. Even when all trials were followed by reinforcement, as in Group 0, from 6 to 40 responses were usually made before a reinforcement occurred. However, there are two reasons why we might still expect partial reinforcement effects to occur. First, when reinforcements per trial were lower in one case than another, reinforcements per response were also lower, since about the same number of responses was made on each trial type. Second, if the partial reinforcement effect is produced by the failure of reinforcement to occur when it is "expected" (Amsel, 1958), then the termination of some trials without reinforcement in Groups S and OS might cause partial reinforcement effects.

To test the prediction of within- and between-subject PREs in Exp. 1, following the first choice test all birds were returned to their Phase 1 schedules for a further 11 sessions. Then all birds received five sessions of extinction in which 24 S_1 trials and 24 S_2 trials were presented daily in a mixed order with reinforcement never available. A second choice test was presented following the fifth extinction session. Due to

the low level of responding at that point, the second choice test was unlike the first. The first 20 trials of the second choice test were nonreinforced S_1S_2 trials, as in the first choice test. From two to five minutes after the 20th S_1S_2 trial, however, the food tray was raised for each bird until he ate or until five minutes had passed. Then another 20 nonreinforced S_1S_2 trials were presented. The free tray had the effect of increasing rate of response in 15 of the 17 birds that ate from the raised tray. Note that the free tray was not presented immediately following a trial. In the second choice test, as in the first, reinforcement was never presented for responding on an S_1S_2 trial.

Figure 9 shows mean rates of response to S_1 and S_2 throughout these extra phases of Exp. 1. Recalling that before extinction began all single-stimulus trials were positive in Group O, while only half of all single-stimulus trials were positive in Group S and three quarters positive in Group OS, we might expect that a between-subject PRE would occur, with Group O making less total responses extinction than Groups S or OS. A difference in this direction was found only when the data were analyzed in an unusual way. The groups did not differ significantly in terms of total responses during extinction (sessions 29-33). However, there was considerable variability in response rates from bird to bird, and it remained possible that if some correction were made for this a significant difference

Fig. 9.   Mean rate of response to S_1 (open figures)
and to S_2 (filled figures) during single-stimulus training
(circles) and choice tests (triangles) in Exp. 1.   This figure
is an expansion of Fig. 1 to show the additional training,
extinction, and second choice test.

Figure 9
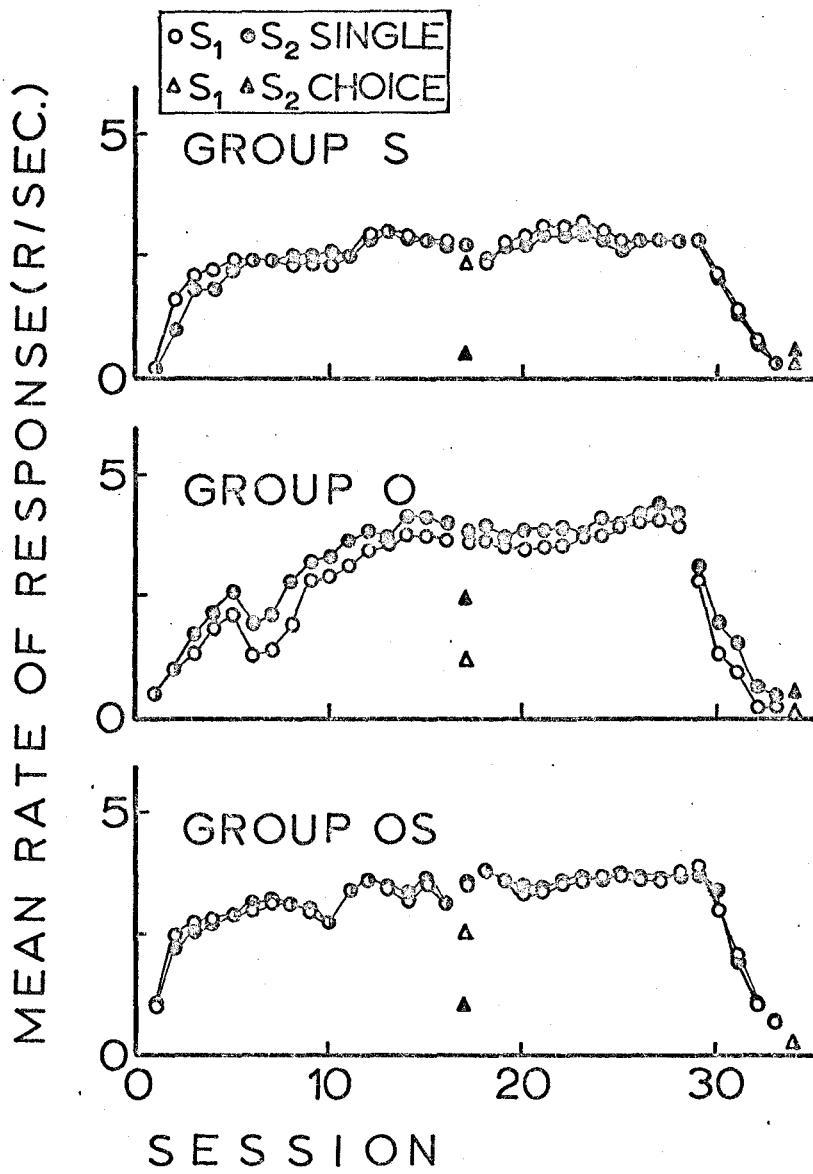
between groups would be found. One tactic that was tried was
to take each bird's total responses in the last four sessions
of extinction as a proportion of that bird's responses in the
first session of extinction. This proportion would be lower
if extinction were more rapid. However, even this measure
showed no significant differences between groups. A third
measure did show significant differences between groups,
however. When each bird's average response rate in the first
session of extinction was subtracted from its average response
rate to S_1 and S_2 on the last session of rewarded training, the
difference was larger in Group O than in Groups S and OS combined
(Mann-Whitney $\underline{U}$=11, two-tailed $\underline{p}$ <.05). That is, rate of response
dropped more rapidly from the last session of rewarded training
to the first session of extinction in Group O than in the other
two groups. Although this difference is in the direction expected
on the basis of a between-subject PRE, it is not highly significant
and is based on an unusual measure.

No evidence at all was obtained for a within-subject
PRE in Group S or in Group OS. Evidence for such an effect
would be fewer responses to S_1 than to S_2 in extinction in
these groups, but this did not occur. There was no significant
difference in either of these groups (or in both groups combined)
in total responses to the two stimuli throughout extinction.
Even when the measure described above was used, and the difference
in rate of response to S_1 in session 28 and 29 was compared to

the difference in rate of response to S_2 in sessions 28 and 29, the drop in rate of response was greater for S_1 than for S_2 in only two of the six birds in Group S and three of the six birds in Group OS.

To this point, only the data for the five single-stimulus extinction sessions have been discussed. Following those sessions, all birds were given a second choice test. This was done for the following reason. It was thought that, if a within-subject PRE occurred, responses to S_1 would extinguish faster than responses to S_2 during the five extinction sessions in Groups S and OS, and birds would choose S_2 on the second choice test. This would be particularly interesting since the birds in these groups had chosen S_1 on their first choice test. However, no within-subject PRE appeared during the single-stimulus extinction sessions, and, as might be expected, there was no evidence for a significant preference for S_2 on the second choice test. Six of the twelve birds in Groups S and OS responded more often to S_2 on the second choice test, and six responded more often to S_1.

In summary, there was no evidence whatsoever for a within-subject PRE in the extinction sessions of Exp. 1. There was only very weak evidence for a between-subject PRE, with extinction more rapid in Group O than in the other two groups. However, that evidence was based on an unusual measure, and the difference observed was of only marginal statistical significance.

Further Analysis of the Extinction Data in Exp. 3

Table 3, showing the design of Exp. 3, and Fig. 5,
showing the results, are presented again on the following two
pages to allow easy reference. Recall that after single-
stimulus training as shown in Table 3, all birds were given
12 sessions of choice tests in extinction.

Note that the extinction sessions in Exp. 3, unlike
those in Exp. 1, involved choice trials only. This makes it
difficult to look for within-subject PRE effects in Exp. 3,
since numbers of responses to S_1 and S_2 in Exp. 3 are affected
not only by resistance to extinction, but also by choice. To
put it another way, if a bird made more responses to S_1 than
to S_2 this might mean either that (a) responses to S_1 were
more resistant to extinction, or (b) there was a strong pref-
erence for S_1, so that very few responses to S_2 could occur.
In terms of a strength model, it could be said that total
responses to a particular stimulus during extinction would
be a joint function of (a) the initial response strength to
that stimulus, (b) the rate at which that strength declined,
and (c) the concurrent value of response strength to the com-
peting stimulus at each point in time throughout extinction.
For these reasons, no strong predictions could be made for
Exp. 3 on the basis of a within-subject PRE. The data showed
that total responses to S_1 and S_2 during extinction did not
differ consistently in favor of either stimulus in any group.

TABLE 3

Design of Exp. 3

Group	Trial length and number of + and – trials programmed					rft/stimulus-on time (in rft/min)		Proportion of trials followed by reinforcement	
	S_1		S_2						
	number	length	number	length					
	S_1+ S_1-	(sec)	S_2+ S_2-		(sec)	F_1/T_1	F_2/T_2	for S_1	for S_2
S-Only	8 –	6.2	8 –		12.2	9.7	5.0	1.0	1.0
P-Only	8 –	6.2	8 8		3.2	9.7	9.4	1.0	0.5
SP	8 –	6.2	8 8		6.2	9.7	4.8	1.0	0.5

Fig. 5. Mean rate of response to S_1 (open figures) and to S_2 (filled figures) during single-stimulus training (circles) and choice tests (triangles) in Exp. 3. Each point is a mean for 10 birds.

Figure 5
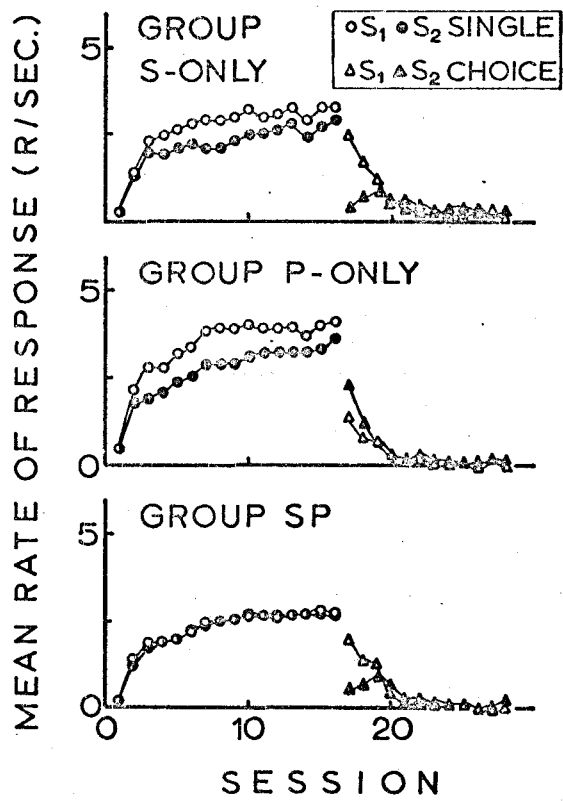
The fact that only choice trials were presented during extinction does not prevent a comparison of groups in total responses, however. As in Exp. 1, we can ask here whether any effects analogous to between-subject PREs occurred by simply comparing groups in total responses during extinction, without regard to what stimulus was responded to. Three analyses on overall response rates were carried out, similar to those carried out in Exp. 1.

First, when total responses in all 12 extinction sessions were considered, there were no significant differences between groups. This had also been found in Exp. 1. However, when responses in the last eleven extinction sessions were taken as a proportion of responses in the first extinction session, this proportion was found to be significantly lower in Group P-Only than in Group S-Only (Mann-Whitney U = 20, two-tailed $p < .05$) and also lower in Group P-Only than in Group SP (Mann-Whitney U = 22, two-tailed $p < .05$). A measure analogous to this measure had shown no significant differences between groups in Exp. 1. A third measure, one that had shown significant differenes in Exp. 1, was the difference between average response rate in the first extinction session and average response rate in the last session of rewarded training. This measure showed no significant differences between groups in Exp. 3.

Only one of the three measures showed significant differences between groups in Exp. 3. Moreover, even those differences were of only marginal statistical significance.

A Mann-Whitney U of 23 or less is required for significance at two-tailed $p < .05$ with the number of subjects used in these comparisons, and the U's described were only slightly below that value. However, assuming that these findings are replicable, how would we interpret them? One difference between Group P-Only and the other groups is that Group P-Only was the only group with 3 sec trials during single-stimulus training. It is difficult to see why that fact alone should cause more rapid extinction in Group P-Only. Another possibility is that the more rapid extinction in Group P-Only was due to its high average value of rft/stimulus-on time. If rft/stimulus-on time is calculated without regard to the distinction between S_1 and S_2, that measure was higher in Group P-Only than in the other two groups. This also means that, on the average, rft/response was higher in Group P-Only than in the other two groups. The differences observed in this experiment are therefore consistent with the argument that the partial reinforcement effect is determined by differences in the probability of reinforcement given a response. They are not consistent with the argument that the termination of a trial without reinforcement is an important factor causing the partial reinforcement effect in this situation, for if that were the case group S-Only would have been the group to extinguish most rapidly.

Conclusions

In summary, there was no evidence for within-subject PREs in either Exp. 1 or Exp. 3. In each experiment, however,

there was weak evidence for an effect consistent with a between-subject PRE. The evidence for such an effect in each experiment should be regarded as tentative, since in each case differences were only found when an unusual measure was employed, and even then the differences were of marginal statistical significance. However, it is of some interest that in each case the differences were in a direction that could be explained by saying extinction is more rapid the higher the number of rft/stimulus-on time, or alternatively, the higher the number of rft/response.

APPENDIX 2

A MODEL OF CHOICE BEHAVIOR

No attempt is made to present a comprehensive model
of choice in this appendix. The model presented is sketched
only in sufficient detail to make a particular point. That
point is this: it is possible for a model to predict "recency"
effects, such as those observed in Exp. 4, without incorporating
any explicit axiom about forgetting. To make this point I will
first sketch a simple model that cannot predict recency. Then
I will show that by adding an extra axiom to that model - an
axiom not apparently related to recency - effects of the sort
found in Exp. 4 can be predicted.

Before the models are described, it is important to
specify exactly what we want to predict. Suppose a subject
receives only reinforced S_1 trials and reinforced S_2 trials
throughout training. Suppose further that he first receives
an equal number of S_1 and S_2 trials intermingled, then a block
of S_1 trials; then another block of S_2 trials. We wish to
predict that, if given a choice test near the end of any of
the four blocks of trials, the subject would choose the stimulus
most recently experienced. Note that we must be able to predict
a choice of S_2 after a block of S_2 trials, despite the fact that
an equal number of reinforced S_1 and S_2 trials will have been

received at that point. This is what is meant by a "recency effect": even though S_1 and S_2 have been experienced an equal number of times, the fact that experience with S_2 has been more recent at the time of the choice test causes responses to S_2 to occur more frequently on that choice test.

Model 1: Strength Model with Linear Operators

Model 1 cannot predict the desired effect, but will be useful as a background for Model 2, which can predict the effect. Both models have two basic theoretical variables, "strength of response to S_1" (V_1) and "strength of response to S_2" (V_2). The values of V_1 and V_2 are determined by the training conditions, and behavior on choice tests is in turn a function of the values of V_1 and V_2. Here are the axioms of Model 1.

AXIOM 1. If trial n is a S_1 trial and is followed by reinforcement, then following that trial, V_1 increases according to the formula

$$V_{1,n+1} = V_{1,n} + A(L - V_{1,n}),$$

and V_2 increases according to the formula

$$V_{2,n+1} = V_{2,n} + BA(L - V_{2,n}),$$

where $0 \leqslant A \leqslant 1$, $0 \leqslant B \leqslant 1$, and $L > 0$.

AXIOM 2. If trial n is a S_2 trial and is followed by reinforcement, then following that trial, V_1 increases according to the formula

$$V_{1,n+1} = V_{1,n} + BA(L - V_{1,n}),$$

and V_2 increases according to the formula

$$V_{2,n+1} = V_{2,n} + A(L - V_{2,n}),$$

where $0 \leqslant A \leqslant 1$, $0 \leqslant B \leqslant 1$, and $L > 0$.

AXIOM 3. If V_1 is greater than V_2 at the time of a choice test, more responses will occur to S_1 than to S_2 on that choice test, and if V_2 is greater than V_1 at the time of a choice test, more responses occur to S_2 than to S_1 on that choice test.

Axioms 1 and 2 describe the way response strengths increase during single-stimulus training. Notice that the appropriate formulas are applied following every trial, not following every response. These axioms are meant for a situation in which trial-lengths are the same for S_1 and S_2, and would have to be modified to take trial lengths into account if S_1 and S_2 had different trial lengths. Also, no axioms are presented for nonreinforced trials; we are concerned only with positive trials in the present situation.

Each of the four formulas employs a linear operator. The formulas are most easily understood if the three parameters are described as follows:

A = learning rate

B = generalization constant

L = limit or asymptotic value of strength

The model simply says that on reinforced trials with a

particular stimulus present, response strength to that

stimulus rises toward its asymptote at a certain rate, and response strength to the other stimulus also rises toward its asymptote, but at a less rapid rate. The difference in rates is determined by parameter B. If B = 1, then generalization is complete, and following a reinforced trial with one stimulus the response strengths to both stimuli rise at the same rate. If B = 0, then there is no generalization, and following a reinforced trial with one stimulus the response strength to the other stimulus is unchanged. The parameters A, B, and L are not given subscrips in this model, since this is not necessary for the point we wish to make. Also, the prediction concerning choice test responding in Axiom 3 is very weak in this model, but again it is sufficient for the point we wish to make.

Model 1 cannot predict the desired recency effect. Rather than making this point formally, we will demonstrate it with a set of examples. In each case we assume that at the end of training on intermingled S_1 and S_2 trials, V_1 and V_2 are equal. Then we follow the strengths V_1 and V_2 through two S_1 trials, two S_2 trials, another two S_1 trials, and another two S_2 trials. It turns out that V_1 and V_2 are equal at the end of each set of S_2 trials, where the total number of times S_1 and S_2 have been experienced are equal.

EXAMPLE 1: Model 1 with A=.20, L=10, B=1.0 (complete general-ization)

INITIAL VALUES:		$V_1 = 5.0$	$V_2 = 5.0$	
TRIALS:	S_1+	6.0	6.0	
	S_1+	6.8	6.8	($V_1 = V_2$)
	S_2+	7.44	7.44	
	S_2+	7.952	7.952	($V_1 = V_2$)
	S_1+	8.3616	8.3616	
	S_1+	8.68928	8.68928	($V_1 = V_2$)
	S_2+	8.951424	8.951424	
	S_2+	9.1611392	9.1611392	($V_1 = V_2$)

This example is not very interesting: due to the complete generalization (B=1.0), V_1 and V_2 are always equal and there cannot possibly be any recency effect.

EXAMPLE 2: Model 1 with A=.20, L=10, B=0 (no generalization)

INITIAL VALUES:		$V_1 = 5.0$	$V_2 = 5.0$	
TRIALS:	S_1+	6.0	5.0	
	S_1+	6.8	5.0	(V_1 larger)
	S_2+	6.8	6.0	
	S_2+	6.8	6.8	($V_1 = V_2$)
	S_1+	7.44	6.8	
	S_1+	7.952	6.8	(V_1 larger)
	S_2+	7.952	7.44	
	S_2+	7.952	7.952	($V_1 = V_2$)

In this example, with no generalization, there is again no recency effect since $V_1 = V_2$ at the critical points.

EXAMPLE 3: Model 1 with A=.20, L=10, B=.50 (some generalization)

INITIAL VALUES:	V_1 = 5.0	V_2 = 5.0	
TRIALS: S_1+	6.0	5.5	
S_1+	6.8	5.95	(V_1 larger)
S_2+	7.12	6.76	
S_2+	7.408	7.408	($V_1=V_2$)
S_1+	7.9264	7.6672	
S_1+	8.34112	7.90048	(V_1 larger)
S_2+	8.507008	8.3203840	
S_2+	8.6563072	8.6563072	($V_1=V_2$)

This example shows that even with an intermediate level of generalization, no recency effect is found with Model 1. Whenever an equal number of S_1 and S_2 trials have been received, V_1 and V_2 are equal.

Model 2: a Strength Model with Linear Operators and Diminishing Generalization

Model 2 is identical to Model 1 except that the following axiom is added:

AXIOM 4. The value of the parameter B(the generalization constant) diminishes over trials.

This axiom simply states that generalization from one stimulus to another decreases over trials. Note that we could have chosen to say decreases over time, since trials and time

are confounded in the situation we are concerned with. The
effect of this axiom is to allow the strength of responses to
S_2 to catch up and pass the strength of responses to S_1 during
S_2+ training. In other words, Model 2, with its axiom of
diminishing generalization, predicts the result we have referred
to as a "recency effect."

EXAMPLE 4: Model 2 with A=.20, L=10, and B diminishing over trials

INITIAL VALUES: V_1 = 5.0 V_2 = 5.0

TRIALS:			
S_1+ (B=1.0)	6.0	6.0	
S_1+ (B=.9)	6.8	6.72	(V_1 larger)
S_2+ (B=.8)	7.312	7.376	
S_2+ (B=.7)	7.68832	7.9008	(V_2 larger)
S_1+ (B=.6)	8.150656	8.152704	
S_1+ (B=.5)	8.5205248	8.3374336	(V_1 larger)
S_2+ (B=.4)	8.638882816	8.66994688	
S_2+ (B=.3)	8.720549847	8.935957504	(V_2 larger)

This example shows that a recency effect can be predicted with
Model 2. With that model, V_2 is larger than V_1, and therefore
more responses will occur to S_2 than to S_1 is a choice test is
given, at points where S_1 and S_2 have occurred equally often
but S_2 has occurred most recently. As shown in the example,
the diminishing generalization between S_1 and S_2 allows response
strength to S_2 to grow considerably during early S_1+ trials.
Then, during S_2+ trials, response strength to S_2 continues
to grow but there is not as much generalization to S_1, so
that response strength to S_2 catches up to and passes response

strength to S_1. One might say that, due to diminishing generalization, S_2 gains more from S_1 during early S_1+ training than it gives back to S_1 during later S_2+ training. Moreover, this effect can continue through several alternating blocks of S_1 and S_2 training, so long as generalization continues to diminish.

Conclusions

The point of this appendix has been that recency effects such as those observed in Exp. 4 can be predicted without an explicit axiom about "forgetting." Although Model 2 was sketched is sufficient detail to make this point, the model as it stands is certainly not adequate to explain all of the findings reported in this thesis. Nor do the experiments reported here contain evidence relevant to the central hypothesis of the model, that generalization diminishes over trials. It is interesting to note that some existing models of discrimination learning might predict that generalization would increase, not decrease, over trials. This prediction would be based on the fact that the color of the key predicted nothing about reinforcement in Exp. 4, and therefore might come to be "ignored" as training continued. Evaluation of this and other possibilities must await further experiments. For the moment, all we can say is that the finding of a "recency effect" in Exp. 4 must be interpreted with caution. The results of that experiment do not require the conclusion that previous experience is forgotten as time passes or as further trials are presented.

APPENDIX 3

APPARATUS

The apparatus used in the experiments reported in this thesis was described in the General Method section of Chapter 2. Some additional details are described here.

Experimental Chambers

Six standard Lehigh Valley Electronics pigeon chambers were modified in several ways. The original key hole or key holes on the front panel were replaced by the two adjacent square holes described earlier. Lehigh Valley Electronics pigeon keys with clear plastic paddles were modified by gluing to the back of each key a thin metal mask with a .6 inch diameter hole punched in it, and then covering this hole with a piece of 1/16 inch diffusing plastic. When lit from behind with red or green light, a bright dot with sharp edges could be seen. The entire front panel of the pigeon chamber was painted flat gray. The side of the metal key mask that could be seen through the clear plastic from the inside of the pigeon chamber was also painted flat gray. When no bulbs were lit behind the keys, they appeared to contain black dots somewhat darker than the rest of the key.

Previous experience had suggested that pigeons would tenk to peck red dots more than green dots when the two were presented together. In an attempt to reduce this color preference, the red dot was made dimmer than the green dot. Two

green-filtered bulbs (#GE 1820) behind each key were lit simultaneously to obtain a green dot, while only one red-filtered bulb was lit to obtain the red dot. Moreover, the voltage across the green-filtered bulbs was 21 volts, while the voltage across the red-filtered bulbs was only 15 volts. This succeeded in making the red dot less bright than the green dot. However, while each of several human observers agreed that the red dots were less bright than the green dots, these observers also commented that the red dots nevertheless appeared larger than the green dots and also "denser" or "more saturated" or "more attractive" than the green dots. The use of a dimmer red dot than green dot did seem to reduce color preferences in these experiments. The data shown in Appendix 4 (columns at the far right) show no strong preferences across birds for a particular color either during single-stimulus training or during choice tests.

Probably because of the lower voltage used across the red-filtered bulbs, the green dot seemed to light slightly before the red dot on choice trials. To some observers this difference in onset time suggested apparent movement from red to green as a choice trial came on. However, examination of the choice test data across the four experiments showed that the difference in onset time for red and green seemed to have no strong effect on choice.

Control Apparatus

The control apparatus allowed one basic control unit to present stimuli and record responses from six experimental chambers. Since only brief trials were employed, it was possible for the control apparatus to deal with only one chamber at a time. A five-channel paper tape reader essentially instructed the apparatus which experimental chamber was to be dealt with, and stimuli were then presented to that chamber and responses recorded from it. This mode of operation allowed a large saving of equipment, since large segments of the apparatus were used in common by all experimental chambers. The use of one basic apparatus to control all chambers also had the advantage of making the different chambers identical with respect to a number of timing functions. For example, trial length for all chambers was determined from the same basic timing cycle; tray time for all chambers was determined from the same mechanical timer; and pulse-formers used with responses for all chambers were the same. Pulse formers were BRS CX-207 units, which had a maximum following rate well in excess of ten inputs per second.

The main control apparatus was built with standard relay and timer equipment. The basic time base was taken from a continuously moving synchrounous motor and so was quite accurate. Electromagnetic impulse counters recorded the total number of trials, responses to each key-color combination, and

trays for each chamber. Between-trial responses were not recorded, although we know from earlier experiments and from occasional observation in these experiments that they were extremely infrequent.

As a secondary recording device, an 8-channel paper tape punch driven by BRS logic modules was employed. That device recorded the occurence of every response, along with the time of the response to the nearest 1/10th second. Data from the punched paper tape are not reported in this thesis.

The basic configuration of the control apparatus is shown in Table 4. A basic three-second timing cycle drove the equipment. Within each three-second cycle, the five-channel paper tape reader was advanced and decoded. Then one of four actions was taken depending on the code that was read: either a stimulus was set up, or a trial was turned on in a particular experimental chamber (ie, stimulus presented to that chamber and responses recorded from it), or no action was taken (allowing the trial to continue), or the trial was terminated (stimuli turned off, responses no longer effective, and tray operated if required). In addition, the 1/10 sec timer on the punched paper tape data recording device was activated at the start of each trial and reset at the end of each trial. This timer was just a binary counter containing a code that would be punched along with each peck to indicate the time that the peck occurred on the data tape.

TABLE 4

BASIC STRUCTURE OF CONTROL APPARATUS

TIMING CYCLE	T_1	T_2	T_3		
EVENTS	advance control-tape reader	operate relay tree from control-tape reader	decode relay tree	operate proper set-up-stimulus relay	
				operate proper trial-on-in-box-X relay	start 1/10 sec timer
				present tray to proper box	end trial — stop and reset timer
				turn off set-up stimulus relay and trial-on-in-box-X relay	
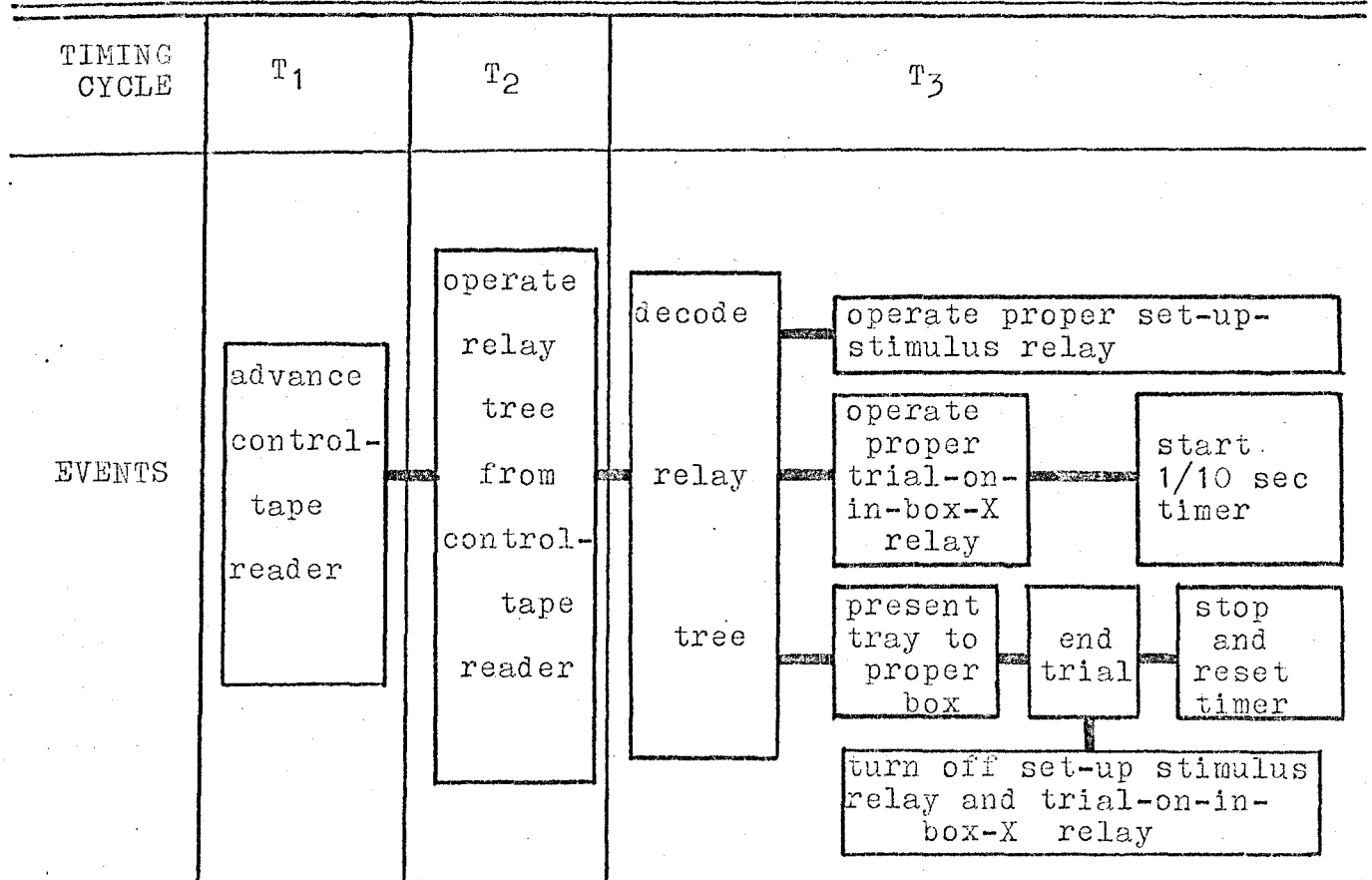
within-cycle timing: |←3 sec→|

T_1..

T_2..

T_3..
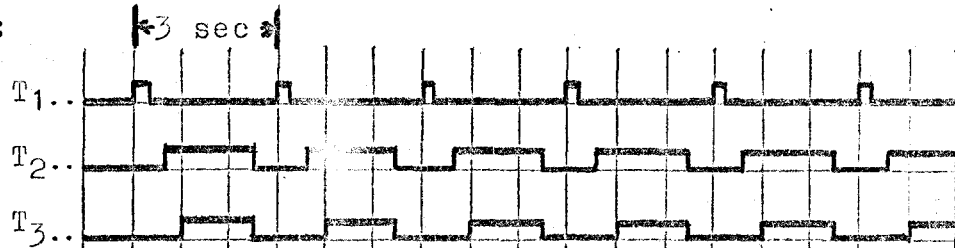
between-cycle timing:

a) control-tape code:
  set up stimulus ....
  set up box ....
  end trial ....

←———— 12 sec ————→

b) events:
  stimulus relay on .....
  box relay on ....
  responses recorded ....
  deliver-tray pulse ....
  tray up ....
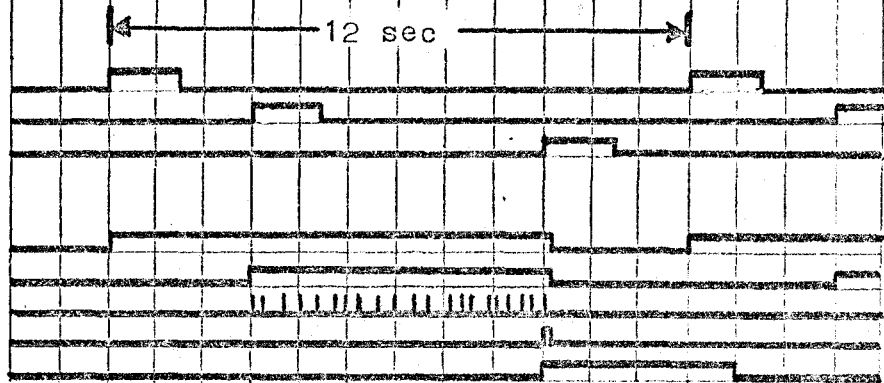
The entire sequence of setting up stimuli, delivering trials to a given chamber, and terminating trials was controlled by a five-channel paper tape. Intertrial intervals for a particular chamber were varied by varying the number of trials to other chambers that intervened between two successive trials to the chamber in question. Since stimuli were set up separately for each trial, the stimuli presented to different chambers were independent. All of these factors meant that the five-channel control tape for a particular session was quite complex, but control tapes were generated and proofread with the aid of a PDP-8 computer.

APPENDIX 4

DATA

The following pages present data from each of the four experiments reported in the text. For each experiment, detailed data from selected important sessions of the experiment are first presented. Next one or more summary data sheets are presented, on which important data for several sessions are collected on one sheet.

It should be noted that since both stimuli were present together during choice tests, total rate of response on a choice test is the _sum_ of rate of response to S_1 and rate of response to S_2. The entries in the column labelled $\frac{R_1 + R_2}{2}$ however, are the _means_ of rate to S_1 and S_2, and therefore must be doubled to be comparable to entries in this same column in sessions of single-stimulus training.

Wherever indices and means are shown on the following pages, the calculation of those numbers was not based on other numbers shown, but was based on those numbers before they were rounded off. Since all calculations were made before rounding, there are occasional slight discrepancies between sets of numbers shown and the mean that is presented for those numbers. In all cases the mean presented is more accurate than the mean that can be recalculated from the rounded numbers shown here.

DATA FROM EXPERIMENT 1

DATA FROM EXPERIMENT 1, SESSION 12

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	1.9	3.1	2.2	2.4	2.0	2.7	2.4	.43	.52	no	no
2	R	4.3	3.9	3.6	4.1	3.9	4.0	4.0	.49	.51	no	no
3	R	6.7	7.1	6.9	6.5	6.8	6.8	6.8	.50	.51	yes	yes
4	G	4.8	3.5	4.9	3.9	3.7	4.8	4.3	.43	.48	no	yes
5	G	3.5	3.1	3.4	3.0	3.0	3.4	3.2	.47	.51	no	yes
6	G	1.2	1.1	1.1	0.7	0.9	1.1	1.0	.45	.56	no	yes
MEAN		3.7	3.6	3.7	3.5	3.4	3.8	3.6	.46	.51	1/6	4/6
GROUP S												
7	R	3.8	3.3	3.7	3.5	3.8	3.4	3.6	.53	.49	yes	yes
8	R	4.5	4.0	4.7	4.0	4.6	4.0	4.3	.54	.49	yes	yes
9	R	1.4	1.6	1.0	1.4	1.2	1.5	1.3	.44	.55	no	no
10	G	2.8	2.4	2.8	2.4	2.4	2.8	2.6	.46	.50	no	yes
11	G	1.7	1.7	1.8	2.0	1.9	1.7	1.8	.52	.47	yes	no
12	G	3.4	3.4	3.3	3.3	3.3	3.4	3.4	.49	.51	no	yes
MEAN		2.9	2.7	2.9	2.8	2.9	2.8	2.8	.50	.50	3/6	4/6
GROUP OS												
13	R	3.5	3.4	3.6	3.4	3.5	3.4	3.5	.51	.50	yes	yes
14	R	6.0	5.6	5.2	5.0	5.6	5.3	5.4	.51	.53	yes	yes
15	R	2.2	2.4	2.5	2.1	2.4	2.2	2.3	.52	.50	yes	yes
16	G	3.6	3.6	3.6	3.7	3.7	3.6	3.6	.50	.50	yes	no
17	G	2.8	2.4	2.2	2.2	2.3	2.5	2.4	.48	.54	no	yes
18	G	4.5	4.0	4.2	4.0	4.0	4.3	4.2	.48	.51	no	yes
MEAN		3.8	3.6	3.6	3.4	3.6	3.6	3.6	.50	.51	4/6	5/6

DATA FROM EXPERIMENT 1, SESSION 13

Group & Bird	S_1=R or G	K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	2.6	3.5	2.4	2.7	2.5	3.1	2.8	.44	.55	no	no
2	R	3.7	3.8	3.6	3.7	3.7	3.7	3.7	.50	.51	no	no
3	R	6.5	5.8	6.7	5.5	6.6	5.7	6.1	.54	.50	yes	yes
4	G	5.2	4.1	4.9	4.2	4.1	5.0	4.6	.45	.50	no	yes
5	G	3.7	3.2	3.6	3.3	3.2	3.6	3.4	.47	.50	no	yes
6	G	1.4	0.9	1.3	1.1	1.0	1.3	1.1	.42	.50	no	yes
MEAN		3.8	3.5	3.7	3.4	3.5	3.7	3.6	.47	.51	1/6	4/6
GROUP S												
7	R	3.5	3.8	3.9	3.9	3.7	3.8	3.8	.49	.48	no	no
8	R	4.8	4.5	4.7	4.6	4.7	4.6	4.6	.51	.50	yes	yes
9	R	2.0	1.7	1.2	1.9	1.6	1.8	1.7	.48	.55	no	no
10	G	2.8	2.6	2.7	3.1	2.8	2.8	2.8	.51	.48	yes	no
11	G	1.8	1.7	1.6	1.9	1.8	1.7	1.7	.51	.50	yes	no
12	G	3.4	3.4	3.4	3.2	3.3	3.4	3.3	.49	.50	no	yes
MEAN		3.1	2.9	2.9	3.1	3.0	3.0	3.0	.50	.50	3/6	2/6
GROUP OS												
13	R	2.9	3.1	3.1	3.1	3.0	3.1	3.1	.49	.49	no	no
14	R	5.4	5.4	5.2	4.5	5.3	5.0	5.1	.52	.52	yes	yes
15	R	2.5	2.4	2.7	2.6	2.6	2.5	2.5	.51	.48	yes	yes
16	G	3.5	3.5	3.5	3.4	3.5	3.5	3.5	.50	.50	no	yes
17	G	2.5	2.5	2.3	2.3	2.4	2.4	2.4	.50	.53	yes	no
18	G	4.7	3.8	4.1	3.6	3.7	4.4	4.1	.46	.52	no	yes
MEAN		3.6	3.5	3.5	3.3	3.4	3.5	3.4	.50	.51	3/6	4/6

DATA FROM EXPERIMENT 1, SESSION 14

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	2.5	4.0	2.7	3.6	2.6	3.8	3.2	.41	.51	no	no
2	R	4.5	4.1	4.0	4.0	4.3	4.0	4.2	.51	.52	yes	yes
3	R	6.7	7.5	7.2	6.8	7.0	7.1	7.1	.49	.50	no	no
4	G	5.0	4.1	5.2	4.5	4.3	5.1	4.7	.46	.49	no	yes
5	G	3.6	3.3	3.4	3.1	3.2	3.5	3.3	.47	.51	no	yes
6	G	1.0	0.9	1.0	1.0	0.9	1.0	1.0	.48	.49	no	yes
MEAN		3.9	4.0	3.9	3.8	3.7	4.1	3.9	.47	.50	1/6	4/6
GROUP OS												
7	R	3.8	3.5	3.6	3.9	3.7	3.7	3.7	.50	.50	yes	yes
8	R	5.0	4.6	5.3	4.9	5.1	4.7	4.9	.52	.48	yes	yes
9	R	2.1	1.5	1.2	1.9	1.6	1.7	1.7	.49	.53	no	no
10	G	1.9	2.1	1.6	2.1	2.1	1.7	1.9	.55	.52	yes	no
11	G	1.4	1.5	1.4	1.8	1.7	1.4	1.5	.54	.48	yes	no
12	G	3.4	3.2	3.3	3.2	3.2	3.4	3.3	.49	.50	no	yes
MEAN		2.9	2.7	2.7	3.0	2.9	2.8	2.9	.52	.50	4/6	3/6
GROUP OS												
13	R	2.8	2.8	3.0	3.1	2.9	3.0	2.9	.49	.48	no	no
14	R	5.5	5.2	4.6	4.7	5.1	4.9	5.0	.51	.54	yes	yes
15	R	2.2	2.1	2.3	2.4	2.3	2.2	2.3	.50	.48	yes	yes
16	G	3.6	3.1	3.7	3.7	3.4	3.7	3.5	.48	.48	no	yes
17	G	2.9	1.9	2.4	2.5	2.2	2.6	2.4	.45	.49	no	yes
18	G	3.8	2.8	4.2	3.9	3.3	4.0	3.7	.45	.45	no	yes
MEAN		3.5	3.0	3.3	3.4	3.2	3.4	3.3	.48	.49	2/6	5/6

DATA FROM EXPERIMENT 1, SESSION 15

Group & Bird	$S_1=R$ or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	2.7	3.9	2.8	3.3	2.8	3.6	3.2	.43	.52	no	no
2	R	4.3	4.0	4.2	4.4	4.3	4.2	4.2	.50	.49	yes	yes
3	R	6.8	7.1	6.3	6.4	6.6	6.8	6.7	.49	.52	no	no
4	G	5.4	4.0	5.7	4.6	4.3	5.5	4.9	.44	.48	no	yes
5	G	3.5	3.2	3.5	3.1	3.2	3.5	3.3	.47	.51	no	yes
6	G	1.1	0.9	1.1	0.8	0.9	1.1	1.0	.45	.51	no	yes
MEAN		4.0	3.9	3.9	3.8	3.7	4.1	3.9	.47	.51	1/6	4/6
GROUP S												
7	R	3.4	3.3	3.8	3.4	3.6	3.4	3.5	.51	.49	yes	yes
8	R	5.6	5.4	5.2	5.3	5.4	5.4	5.4	.50	.51	yes	yes
9	R	1.3	1.7	1.7	1.8	1.5	1.8	1.6	.45	.46	no	no
10	G	1.4	1.3	1.7	2.0	1.7	1.5	1.6	.52	.42	yes	no
11	G	1.0	1.3	1.4	1.5	1.4	1.2	1.3	.54	.44	yes	no
12	G	3.4	3.4	3.2	3.4	3.4	3.3	3.4	.51	.51	yes	no
MEAN		2.7	2.7	2.8	2.9	2.8	2.8	2.8	.51	.47	5/6	2/6
GROUP OS												
13	R	3.2	3.0	3.0	3.2	3.1	3.1	3.1	.50	.50	yes	yes
14	R	6.0	5.6	5.0	4.6	5.5	5.1	5.3	.52	.55	yes	yes
15	R	2.0	2.2	2.2	2.5	2.1	2.4	2.3	.47	.47	no	no
16	G	3.7	3.5	3.7	3.7	3.6	3.7	3.7	.49	.49	no	yes
17	G	2.8	2.5	2.3	2.4	2.4	2.6	2.5	.49	.53	no	yes
18	G	4.9	4.4	4.6	4.2	4.3	4.7	4.5	.48	.51	no	yes
MEAN		3.8	3.5	3.5	3.4	3.5	3.6	3.5	.49	.51	2/6	5/6

DATA FROM EXPERIMENT 1, SESSION 16

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	2.3	3.7	2.7	3.2	2.5	3.5	3.0	.42	.51	no	no
2	R	3.9	3.8	3.6	4.3	3.8	4.0	3.9	.48	.49	no	no
3	R	6.6	6.8	6.5	6.3	6.6	6.6	6.6	.50	.51	--	--
4	G	5.1	4.1	5.6	4.9	4.5	5.4	4.9	.46	.47	no	yes
5	G	3.7	3.4	3.6	3.2	3.3	3.6	3.5	.48	.51	no	yes
6	G	1.1	1.1	1.0	1.0	1.0	1.1	1.1	.49	.51	no	yes
MEAN		3.8	3.8	3.8	3.8	3.6	4.0	3.8	.47	.50	0/5	3/5
GROUP S												
7	R	3.5	3.7	3.8	3.6	3.7	3.6	3.7	.50	.49	yes	yes
8	R	4.9	5.0	5.7	5.1	5.3	5.0	5.2	.51	.48	yes	yes
9	R	1.1	1.4	1.1	1.7	1.1	1.5	1.3	.41	.47	no	no
10	G	1.5	1.8	1.4	2.2	2.0	1.5	1.7	.58	.47	yes	no
11	G	0.8	1.1	1.1	1.3	1.2	1.0	1.1	.55	.44	yes	no
12	G	3.4	3.5	3.2	3.4	3.4	3.3	3.4	.51	.51	yes	no
MEAN		2.5	2.7	2.7	2.9	2.8	2.7	2.7	.51	.48	5/6	2/6
GROUP OS												
13	R	2.0	2.3	3.0	3.1	2.5	2.7	2.6	.49	.41	no	no
14	R	4.7	4.2	5.1	5.1	4.9	4.7	4.8	.51	.47	yes	yes
15	R	2.2	1.8	2.7	2.4	2.5	2.1	2.3	.54	.44	yes	yes
16	G	3.1	3.7	3.8	3.7	3.7	3.4	3.6	.52	.47	yes	no
17	G	1.9	2.0	2.1	2.0	2.0	2.0	2.0	.50	.49	yes	no
18	G	4.0	2.3	4.1	3.9	3.1	4.1	3.6	.43	.44	no	yes
MEAN		3.0	2.7	3.5	3.4	3.1	3.1	3.1	.50	.45	4/6	3/6

DATA FROM EXPERIMENT 1, SESSION 17
(SINGLE-STIMULUS TRAINING)

Group & Bird	S_1=R or G	K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	2.3	3.2	2.5	2.9	2.4	3.1	2.7	.44	.51	no	no
2	R	4.7	4.1	3.9	4.4	4.3	4.3	4.3	.51	.51	yes	yes
3	R	6.7	6.4	6.3	5.9	6.5	6.1	6.3	.52	.52	yes	yes
4	G	4.9	3.9	5.0	4.5	4.2	5.0	4.6	.46	.48	no	yes
5	G	3.7	3.4	3.5	3.2	3.3	3.6	3.5	.48	.51	no	yes
6	G	0.9	0.8	0.8	0.8	0.8	0.8	0.8	.49	.50	no	yes
MEAN		3.9	3.6	3.7	3.6	3.6	3.8	3.7	.48	.51	2/6	5/6
GROUP S												
7	R	3.5	3.6	3.8	3.8	3.7	3.7	3.7	.50	.48	no	no
8	R	4.9	4.1	4.3	4.9	4.6	4.5	4.5	.51	.50	yes	yes
9	R	1.9	1.5	1.0	1.7	1.5	1.6	1.5	.48	.55	no	no
10	G	1.7	1.9	1.9	2.0	1.9	1.8	1.9	.52	.48	yes	no
11	G	1.2	0.9	1.4	1.6	1.2	1.3	1.3	.48	.41	no	yes
12	G	3.5	3.1	3.6	3.4	3.3	3.5	3.4	.48	.49	no	yes
MEAN		2.8	2.5	2.7	2.9	2.7	2.7	2.7	.49	.49	2/6	3/6
GROUP OS												
13	R	3.1	3.2	3.0	3.2	3.1	3.2	3.1	.49	.50	no	no
14	R	6.1	5.9	4.6	4.5	5.3	5.2	5.3	.51	.57	yes	yes
15	R	2.3	2.4	2.7	2.7	2.5	2.6	2.5	.49	.47	no	no
16	G	3.8	3.7	3.7	3.7	3.7	3.8	3.7	.49	.51	no	yes
17	G	2.6	2.6	2.3	2.3	2.5	2.5	2.5	.50	.54	--	--
18	G	4.3	4.0	4.1	3.9	3.9	4.2	4.1	.49	.51	no	yes
MEAN		3.7	3.7	3.4	3.4	3.5	3.6	3.5	.49	.51	1/5	3/5

DATA FROM EXPERIMENT 1, SESSION 17 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	1.1	2.8	0.1	1.5	0.6	2.1	1.3	.22	.71	no	no
2	R	2.1	2.4	1.9	2.3	2.0	2.3	2.2	.47	.52	no	no
3	R	0.8	4.6	0.9	4.1	0.8	4.4	2.6	.16	.52	no	no
4	G	3.0	1.8	2.7	1.6	1.7	2.9	2.3	.37	.53	no	yes
5	G	2.1	2.4	0.9	1.2	1.8	1.5	1.7	.54	.68	yes	no
6	G	0.9	0.3	1.0	0.3	0.3	0.9	0.6	.23	.48	no	yes
MEAN		1.7	2.4	1.3	1.8	1.2	2.4	1.8	.33	.57	1/6	2/6
GROUP S												
7	R	3.7	1.2	2.6	0.3	3.1	0.7	1.9	.81	.63	yes	yes
8	R	3.5	1.1	3.8	1.3	3.7	1.2	2.5	.75	.48	yes	yes
9	R	1.3	0.1	1.3	0.3	1.3	0.2	0.8	.86	.48	yes	yes
10	G	0.0	1.5	0.7	2.7	2.1	0.4	1.2	.85	.31	yes	no
11	G	0.0	0.4	0.4	1.4	0.9	0.2	0.6	.80	.18	yes	no
12	G	0.0	2.1	1.1	3.1	2.6	0.5	1.6	.83	.33	yes	no
MEAN		1.4	1.1	1.7	1.5	2.3	0.5	1.4	.82	.40	6/6	3/6
GROUP OS												
13	R	1.1	2.1	1.1	2.1	1.1	2.1	1.6	.35	.49	no	no
14	R	4.5	0.1	4.9	1.2	4.7	0.7	2.7	.88	.44	yes	yes
15	R	1.4	0.3	2.3	0.9	1.8	0.6	1.2	.75	.35	yes	yes
16	G	0.7	2.9	0.7	2.9	2.9	0.7	1.8	.81	.50	yes	no
17	G	1.6	1.6	0.9	1.0	1.3	1.3	1.3	.51	.63	yes	no
18	G	0.4	2.8	1.3	3.3	3.0	0.8	1.9	.78	.41	yes	no
MEAN		1.6	1.6	1.9	1.9	2.5	1.0	1.7	.68	.47	5/6	2/6

DATA FROM EXPERIMENT 1, SESSION 28

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	3.8	4.1	3.3	3.7	3.6	3.9	3.7	.48	.53	no	no
2	R	5.2	5.3	4.8	4.9	5.0	5.1	5.1	.49	.52	no	no
3	R	7.0	7.4	7.0	7.5	7.0	7.4	7.2	.49	.50	no	no
4	G	5.1	4.7	3.8	3.9	4.3	4.4	4.4	.49	.56	no	yes
5	G	3.7	3.3	3.5	3.3	3.3	3.6	3.4	.48	.51	no	yes
6	G	0.9	0.7	0.9	0.5	0.6	0.9	0.7	.39	.54	no	yes
MEAN		4.3	4.2	3.9	4.0	3.9	4.2	4.1	.47	.52	0/6	3/6
GROUP S												
7	R	3.2	3.1	3.4	3.3	3.3	3.2	3.2	.51	.49	yes	yes
8	R	4.7	4.3	4.5	4.7	4.6	4.5	4.5	.50	.49	yes	yes
9	R	1.8	2.0	0.9	2.4	1.3	2.2	1.8	.37	.54	no	no
10	G	1.9	1.8	2.4	2.3	2.0	2.1	2.1	.49	.44	no	yes
11	G	1.5	1.7	1.5	2.0	1.9	1.5	1.7	.55	.48	yes	no
12	G	3.4	3.4	3.2	3.4	3.4	3.3	3.4	.51	.51	yes	no
MEAN		2.8	2.7	2.6	3.0	2.8	2.8	2.8	.49	.49	4/6	3/6
GROUP OS												
13	R	3.1	3.3	3.3	3.2	3.2	3.2	3.2	.50	.50	--	--
14	R	6.6	6.1	5.1	4.8	5.8	5.4	5.6	.52	.56	yes	yes
15	R	3.1	2.6	3.4	3.4	3.3	3.0	3.1	.52	.46	yes	yes
16	G	3.6	3.4	3.4	3.4	3.4	3.5	3.5	.49	.51	no	yes
17	G	1.9	2.3	2.3	2.0	2.2	2.1	2.1	.51	.50	yes	no
18	G	5.4	4.8	4.7	4.6	4.7	5.0	4.9	.48	.52	no	yes
MEAN		3.9	3.7	3.7	3.6	3.8	3.7	3.7	.51	.51	3/5	4/5

DATA FROM EXPERIMENT 1, SESSION 29(EXTINCTION)

Group & Bird	S_1=R or G	K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	3.0	2.9	3.0	3.0	3.0	2.9	2.9	.51	.49	yes	yes
2	R	4.2	3.7	4.4	4.4	4.3	4.1	4.2	.52	.47	yes	yes
3	R	3.5	3.3	2.9	4.0	3.2	3.6	3.4	.47	.50	no	no
4	G	4.7	2.7	2.6	2.1	2.4	3.7	3.0	.39	.61	no	yes
5	G	3.8	3.5	3.6	3.4	3.4	3.7	3.6	.48	.51	no	yes
6	G	0.5	0.2	0.4	0.4	0.3	0.4	0.4	.41	.47	no	yes
MEAN		3.3	2.7	2.8	2.9	2.8	3.1	2.9	.46	.51	2/6	5/6
GROUP S												
7	R	3.3	2.9	3.5	3.3	3.4	3.1	3.3	.52	.47	yes	yes
8	R	5.2	4.8	4.6	4.3	4.9	4.6	4.7	.52	.53	yes	yes
9	R	1.5	2.0	1.7	2.4	1.6	2.2	1.9	.43	.46	no	no
10	G	1.4	1.2	1.8	1.9	1.5	1.6	1.6	.49	.41	no	yes
11	G	1.9	1.9	1.8	1.9	1.9	1.8	1.9	.51	.51	yes	no
12	G	3.4	3.5	3.4	3.6	3.5	3.4	3.5	.51	.50	yes	no
MEAN		2.8	2.7	2.8	2.9	2.8	2.8	2.8	.50	.48	4/6	3/6
GROUP OS												
13	R	3.1	3.2	3.3	3.1	3.2	3.2	3.2	.50	.50	yes	yes
14	R	6.9	6.3	6.7	5.3	6.8	5.8	6.3	.54	.52	yes	yes
15	R	2.4	2.4	3.0	2.9	2.7	2.6	2.7	.51	.45	yes	yes
16	G	3.8	3.6	3.4	3.2	3.4	3.6	3.5	.49	.53	no	yes
17	G	2.5	2.1	2.2	2.2	2.1	2.3	2.3	.48	.51	no	yes
18	G	4.7	5.0	4.5	5.1	5.0	4.6	4.8	.52	.51	yes	no
MEAN		3.9	3.8	3.9	3.6	3.9	3.7	3.8	.51	.50	4/6	5/6

DATA FROM EXPERIMENT 1, SESSION 30 (EXTINCTION)

Group & Bird	$S_1=R$ or G	RATE OF RESPONSE (responses per second)						$\dfrac{R_1+R_2}{2}$	INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2		$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	0.5	0.4	0.5	0.3	0.5	0.3	0.4	.59	.53	yes	yes
2	R	1.8	1.9	1.4	1.4	1.6	1.6	1.6	.49	.57	no	no
3	R	1.1	3.0	0.9	3.0	1.0	3.0	2.0	.25	.51	no	no
4	G	3.5	2.6	2.1	2.3	2.4	2.8	2.6	.47	.58	no	yes
5	G	3.5	1.5	3.5	2.0	1.8	3.5	2.6	.33	.48	no	yes
6	G	0.1	0.2	0.2	0.2	0.2	0.2	0.2	.56	.44	yes	no
MEAN		1.8	1.6	1.4	1.5	1.3	1.9	1.6	.45	.52	2/6	3/6
GROUP S												
7	R	2.0	2.6	2.5	2.5	2.2	2.6	2.4	.47	.48	no	no
8	R	3.7	3.7	4.1	2.7	3.9	3.2	3.6	.55	.52	yes	yes
9	R	1.7	1.3	0.9	1.6	1.3	1.4	1.4	.47	.55	no	no
10	G	0.5	1.3	0.9	1.3	1.3	0.7	1.0	.64	.44	yes	no
11	G	0.6	0.3	0.8	1.1	0.7	0.7	0.7	.51	.32	yes	no
12	G	3.3	3.4	3.0	2.3	2.9	3.1	3.0	.48	.55	no	yes
MEAN		2.0	2.1	2.0	1.9	2.1	2.0	2.0	.52	.48	3/6	2/6
GROUP OS												
13	R	3.0	3.0	3.1	3.2	3.0	3.1	3.1	.50	.49	no	no
14	R	3.9	5.1	3.6	3.8	3.7	4.5	4.1	.46	.55	no	no
15	R	2.5	2.5	2.8	2.8	2.6	2.7	2.7	.50	.47	no	no
16	G	4.0	3.8	3.3	3.4	3.6	3.6	3.6	.50	.54	no	yes
17	G	1.4	0.6	1.4	0.9	0.7	1.4	1.1	.35	.47	no	yes
18	G	4.9	4.6	5.3	4.3	4.4	5.1	4.8	.47	.50	no	yes
MEAN		3.3	3.3	3.2	3.1	3.0	3.4	3.2	.46	.50	0/6	3/6

DATA FROM EXPERIMENT 1, SESSION 31 (EXTINCTION)

Group & Bird	$S_1=R$ or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$\frac{S_1}{S_2}$	$\frac{R}{G}$
GROUP O												
1	R	0.1	0.0	0.0	0.0	0.0	0.0	0.0	.50	.75	--	--
2	R	0.9	0.4	0.7	1.0	0.8	0.7	0.8	.53	.43	yes	yes
3	R	3.7	3.4	3.0	3.7	3.3	3.6	3.5	.48	.52	no	no
4	G	1.3	0.9	0.9	0.6	0.7	1.1	0.9	.39	.58	no	yes
5	G	3.0	0.1	3.5	0.5	0.3	3.2	1.8	.09	.44	no	yes
6	G	0.3	0.2	0.3	0.1	0.1	0.3	0.2	.30	.58	no	yes
MEAN		1.5	0.8	1.4	1.0	0.9	1.5	1.2	.38	.55	1/5	4/5
GROUP S												
7	R	0.7	0.8	1.0	1.1	0.8	1.0	0.9	.45	.41	no	no
8	R	3.6	2.5	3.6	3.4	3.6	3.0	3.3	.55	.47	yes	yes
9	R	1.0	0.9	0.9	0.4	0.9	0.6	0.8	.60	.58	yes	yes
10	G	0.3	0.4	0.2	0.4	0.4	0.3	0.3	.64	.52	yes	no
11	G	0.1	0.1	0.1	0.2	0.2	0.1	0.1	.69	.37	yes	no
12	G	3.3	2.4	2.1	2.7	2.6	2.7	2.6	.49	.54	no	yes
MEAN		1.5	1.2	1.3	1.4	1.4	1.3	1.3	.57	.48	4/6	3/6
GROUP OS												
13	R	3.0	3.1	3.2	2.7	3.1	2.9	3.0	.52	.50	yes	yes
14	R	0.8	1.9	0.7	1.4	0.8	1.7	1.2	.31	.56	no	no
15	R	2.4	2.5	3.2	3.0	2.8	2.8	2.8	.50	.44	yes	yes
16	G	1.4	1.3	0.9	1.6	1.4	1.1	1.3	.55	.53	yes	no
17	G	0.8	0.6	1.4	0.7	0.7	1.1	0.9	.37	.39	no	yes
18	G	2.3	4.0	1.9	3.8	3.9	2.1	3.0	.65	.52	yes	no
MEAN		1.8	2.2	1.9	2.2	2.1	1.9	2.0	.49	.49	4/6	3/6

DATA FROM EXPERIMENT 1, SESSION 32 (EXTINCTION)

Group & Bird	S_1=R or G	\multicolumn{7}{c}{RATE OF RESPONSE (responses per second)}	\multicolumn{4}{c}{INDICES}			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	0.1	0.2	0.0	0.0	0.1	0.1	0.1	.40	1.00	no	no
2	R	0.5	0.3	0.0	0.6	0.3	0.5	0.4	.36	.59	no	no
3	R	0.0	1.2	0.4	1.6	0.2	1.4	0.8	.12	.37	no	no
4	G	0.3	0.2	0.9	0.4	0.3	0.6	0.4	.35	.28	no	yes
5	G	1.5	0.3	0.5	0.0	0.2	1.0	0.6	.14	.77	no	yes
6	G	0.1	0.1	0.0	0.0	0.1	0.1	0.1	.44	.89	no	yes
MEAN		0.4	0.4	0.3	0.4	0.2	0.6	0.4	.30	.65	0/6	3/6
GROUP S												
7	R	0.3	1.4	0.9	1.2	0.6	1.3	0.9	.31	.46	no	no
8	R	2.9	0.9	2.7	0.7	2.8	0.8	1.8	.77	.53	yes	yes
9	R	0.3	0.0	0.0	0.3	0.1	0.2	0.2	.47	.47	no	no
10	G	0.3	0.5	0.4	0.1	0.3	0.4	0.3	.44	.64	no	yes
11	G	0.1	0.0	0.0	0.0	0.0	0.1	0.0	.09	.91	no	yes
12	G	1.0	0.8	1.4	1.0	0.9	1.2	1.1	.43	.42	no	yes
MEAN		0.8	0.6	0.9	0.6	0.8	0.7	0.7	.42	.57	1/6	4/6
GROUP OS												
13	R	2.8	2.9	2.5	2.7	2.7	2.8	2.7	.49	.52	no	no
14	R	0.9	1.0	0.1	0.0	0.5	0.5	0.5	.49	.96	no	no
15	R	1.7	2.3	2.1	2.5	1.9	2.4	2.1	.44	.47	no	no
16	G	0.0	0.1	0.1	0.0	0.0	0.0	0.0	.56	.44	yes	no
17	G	0.2	0.1	0.2	0.1	0.1	0.2	0.2	.38	.55	no	yes
18	G	0.7	0.7	1.3	1.1	0.9	1.0	0.9	.47	.35	no	yes
MEAN		1.0	1.2	1.0	1.1	1.0	1.1	1.1	.47	.55	1/6	2/6

DATA FROM EXPERIMENT 1, SESSION 33 (EXTINCTION)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	0.0	0.2	0.0	0.1	0.0	0.2	0.1	.08	.58	no	no
2	R	0.1	0.7	0.1	0.2	0.1	0.4	0.3	.21	.75	no	no
3	R	0.1	0.2	0.3	0.0	0.2	0.1	0.1	.67	.44	yes	yes
4	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	.00	yes	no
5	G	1.7	0.8	2.1	0.7	0.8	1.9	1.3	.29	.47	no	yes
6	G	0.0	0.1	0.0	0.0	0.1	0.0	0.0	.91	.91	yes	no
MEAN		0.3	0.3	0.4	0.2	0.2	0.4	0.3	.53	.53	3/6	2/6
GROUP S												
7	R	0.1	0.5	0.0	0.3	0.1	0.4	0.3	.17	.64	no	no
8	R	0.3	0.4	0.6	0.4	0.5	0.4	0.4	.54	.44	yes	yes
9	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
10	G	0.8	0.9	0.3	1.4	1.1	0.5	0.8	.68	.49	yes	no
11	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	1.00	yes	no
12	G	0.3	0.3	0.4	0.2	0.3	0.3	0.3	.43	.51	no	yes
MEAN		0.3	0.3	0.2	0.4	0.3	0.3	0.3	.56	.62	3/5	2/5
GROUP OS												
13	R	2.7	2.0	2.4	2.3	2.5	2.2	2.3	.54	.50	yes	yes
14	R	0.8	1.9	1.1	1.6	0.9	1.8	1.4	.35	.49	no	no
15	R	0.4	0.8	0.2	0.4	0.3	0.6	0.4	.32	.66	no	no
16	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
17	G	0.3	0.1	0	0.2	0.1	0.3	0.3	.30	.36	no	yes
18	G	0.0	0.9	0	0.3	0.6	0.2	0.4	.79	.60	yes	no
MEAN		0.7	0.9	0.7	0.8	0.7	0.8	0.8	.46	.52	2/5	2/5

DATA FROM EXPERIMENT 1, SESSION 34 (CHOICE TEST)

Group & Bird	$S_1=R$ or G	K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O												
1	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	---	---	---	---
2	R	0.4	0.2	0.1	0.1	0.2	0.2	0.2	.57	.83	yes	yes
3	R	0.0	0.3	0.1	0.8	0.1	0.6	0.3	.11	.28	no	no
4	G	0.4	0.0	0.4	0.0	0.0	0.4	0.2	.04	.48	no	yes
5	G	1.8	0.0	1.6	0.1	0.1	1.7	0.9	.03	.53	no	yes
6	G	0.2	0.0	0.2	0.0	0.0	0.2	0.1	.13	.58	no	yes
MEAN		0.5	0.1	0.4	0.2	0.1	0.5	0.3	.23	.53	1/5	4/5
GROUP S												
7	R	0.5	0.7	0.0	0.3	0.3	0.5	0.4	.34	.78	no	no
8	R	1.4	0.0	1.2	0.1	1.3	0.1	0.7	.95	.52	yes	yes
9	R	0.3	0.4	0.3	0.4	0.3	0.4	0.3	.41	.45	no	no
10	G	0.3	0.0	0.2	0.0	0.0	0.3	0.1	.14	.57	no	yes
11	G	0.5	0.1	0.5	0.1	0.1	0.5	0.3	.13	.48	no	yes
12	G	2.0	0.0	1.4	0.0	0.0	1.7	0.9	.01	.59	no	yes
MEAN		0.8	0.2	0.6	0.2	0.3	0.6	0.5	.33	.57	1/6	4/6
GROUP OS												
13	R	0.8	0.6	0.5	0.6	0.6	0.6	0.6	.51	.57	yes	yes
14	R	0.5	0.2	0.2	0.1	0.3	0.2	0.2	.66	.67	yes	yes
15	R	0.3	0.3	0.2	0.0	0.2	0.2	0.2	.58	.71	yes	yes
16	G	0.1	0.2	0.3	0.2	0.2	0.2	0.2	.51	.41	yes	no
17	G	0.4	0.0	0.3	0.1	0.0	0.4	0.2	.06	.48	no	yes
18	G	0.0	0.3	0.1	0.7	0.5	0.0	0.3	.93	.32	yes	no
MEAN		0.3	0.3	0.3	0.3	0.3	0.3	0.3	.54	.53	5/6	4/6

SUMMARY DATA FOR EXP. 1

$R_1/(R_1+R_2)$ VALUES FOR INDIVIDUAL BIRDS DURING SINGLE-STIMULUS TRAINING (SST) AND CHOICE TESTS (CT)
(decimal points are omitted to save space)

Bird & Group	S_1=R or G	Single St.Training						mean 12-16	CT 17	SST 28	29	SST(extinction) 30	31	32	33	CT 34
		12	13	14	15	16	17	12-16	17	28	29	30	31	32	33	34
GROUP O								a	a							
1	R	43	44	41	43	42	44	43	22	48	51	59	50	40	08	--
2	R	49	50	51	50	48	51	50	47	49	52	49	53	36	21	57
3	R	50	54	49	49	50	52	50	16	49	47	25	48	12	67	11
4	G	43	45	46	44	46	46	45	37	49	39	47	39	35	100	04
5	G	47	47	47	47	48	48	47	54	48	48	33	09	14	29	03
6	G	45	42	48	45	49	49	46	23	39	41	56	30	44	91	13
MEAN		46	47	47	47	47	48	47	33	47	46	45	38	30	53	23
GROUP S																
7	R	53	49	50	51	50	50	51	81	51	52	47	45	31	17	34
8	R	54	51	52	50	51	51	52	75	50	52	55	55	77	54	95
9	R	44	48	49	45	41	48	46	86	37	43	47	60	47	--	41
10	G	46	51	55	52	58	52	52	85	49	49	64	64	44	68	14
11	G	52	51	54	54	55	48	53	80	55	51	51	69	09	100	13
12	G	49	49	49	51	51	48	50	83	51	51	48	49	43	43	01
MEAN		50	50	52	51	51	49	51	82	49	50	52	57	42	56	33
GROUP OS																
13	R	51	49	49	50	49	49	50	35	50	50	50	52	49	54	51
14	R	51	52	51	52	51	51	51	88	52	54	46	31	49	35	66
15	R	52	51	50	47	54	49	51	75	52	51	50	50	44	32	58
16	G	50	50	48	49	52	49	50	81	49	49	50	55	56	--	51
17	G	48	50	45	49	50	50	49	51	51	48	35	37	38	30	06
18	G	48	46	45	48	43	49	46	78	48	52	47	65	47	79	93
MEAN		50	50	48	49	50	49	49	68	51	51	46	49	47	46	54

[a]Correlations between entries for individual birds (before rounding) in these columns are:

r_s=+.03 in Group O

r_s=-.54 in Group S

r_s=+.49 in Group OS

DATA FROM EXPERIMENT 2

DATA FROM EXPERIMENT 2, SESSION 22

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	6.2	5.8	5.9	6.0	6.1	5.9	6.0	.51	.50	yes	yes
2	R	6.0	5.7	6.7	6.2	6.4	6.0	6.2	.52	.48	yes	yes
3	R	3.7	4.3	3.8	4.1	3.8	4.2	4.0	.47	.51	no	no
4	G	2.6	2.5	2.5	2.5	2.5	2.6	2.5	.50	.50	no	yes
5	G	0.8	1.3	3.1	4.1	2.7	1.9	2.3	.59	.22	yes	no
6	G	4.7	4.2	4.4	4.1	4.1	4.5	4.3	.48	.51	no	yes
13	R	7.4	7.7	6.9	7.9	7.2	7.8	7.5	.48	.51	no	no
14	R	2.7	3.6	2.6	2.7	2.6	3.2	2.9	.45	.54	no	no
15	G	1.4	1.9	2.7	2.1	2.0	2.0	2.0	.49	.40	no	yes
MEAN		3.9	4.1	4.3	4.4	4.2	4.2	4.2	.50	.46	3/9	5/9
GROUP O(L)												
7	R	4.4	4.0	5.9	4.1	5.1	4.1	4.6	.56	.46	yes	yes
8	R	2.5	2.9	2.9	2.9	2.7	2.9	2.8	.48	.48	no	no
9	R	1.1	1.1	1.1	0.8	1.1	1.0	1.0	.54	.54	yes	yes
10	G	2.9	2.7	2.7	2.7	2.7	2.8	2.8	.50	.51	no	yes
11	G	3.4	3.1	3.3	3.2	3.2	3.4	3.3	.48	.50	no	yes
12	G	2.5	2.4	2.0	1.8	2.1	2.2	2.2	.48	.57	no	yes
MEAN		2.8	2.7	3.0	2.6	2.8	2.7	2.8	.51	.51	2/6	5/6

DATA FROM EXPERIMENT 2, SESSION 23

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	5.4	5.8	6.5	6.1	6.0	6.0	6.0	.50	.47	--	--
2	R	6.0	5.4	6.0	5.9	6.0	6.7	5.8	.51	.49	yes	yes
3	R	3.8	4.3	3.9	4.1	3.9	4.2	4.0	.48	.50	no	no
4	G	2.6	2.7	2.6	2.7	2.7	2.6	2.6	.51	.50	yes	no
5	G	0.6	1.5	3.3	3.6	2.5	2.0	2.3	.57	.24	yes	no
6	G	4.7	4.6	4.7	4.0	4.3	4.7	4.5	.48	.52	no	yes
13	R	8.2	7.7	8.6	8.4	8.4	8.0	8.2	.51	.48	yes	yes
14	R	3.1	3.2	2.6	2.9	2.9	3.1	3.0	.48	.54	no	no
15	G	1.6	1.7	2.9	2.3	2.0	2.3	2.1	.47	.39	no	yes
MEAN		4.0	4.1	4.6	4.4	4.3	4.3	4.3	.50	.46	4/8	4/8
GROUP O(L)												
7	R	4.2	3.8	4.0	4.4	4.1	4.1	4.1	.50	.49	--	--
8	R	3.0	2.5	2.4	2.6	2.7	2.6	2.6	.51	.53	yes	yes
9	R	1.3	1.0	1.4	0.7	1.3	0.9	1.1	.61	.53	yes	yes
10	G	2.8	1.7	2.5	2.6	2.2	2.6	2.4	.45	.47	no	yes
11	G	3.2	2.9	3.1	2.9	2.9	3.2	3.0	.48	.50	no	yes
12	G	1.7	2.7	1.6	2.1	2.4	1.7	2.0	.59	.53	yes	no
MEAN		2.7	2.4	2.5	2.6	2.6	2.5	2.5	.52	.51	3/5	4/5

DATA FROM EXPERIMENT 2, SESSION 24

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	6.0	5.3	6.1	5.9	6.0	5.6	5.8	.52	.48	yes	yes
2	R	6.2	5.8	6.1	5.7	6.1	5.8	5.9	.52	.50	yes	yes
3	R	4.2	4.7	3.2	4.5	3.7	4.7	4.2	.44	.54	no	no
4	G	2.7	2.6	2.7	2.6	2.6	2.7	2.7	.49	.50	no	yes
5	G	0.8	1.6	2.8	4.4	3.0	1.8	2.4	.62	.25	yes	no
6	G	4.8	4.1	4.4	4.0	4.1	4.6	4.3	.47	.52	no	yes
13	R	7.4	7.7	8.7	8.7	8.1	8.2	8.1	.50	.47	no	no
14	R	2.5	3.2	2.3	2.5	2.4	2.8	2.6	.46	.54	no	no
15	G	2.0	2.0	3.2	2.3	2.1	2.6	2.4	.45	.42	no	yes
MEAN		4.1	4.1	4.4	4.5	4.2	4.3	4.3	.50	.47	3/9	5/9
GROUP O(L)												
7	R	5.2	3.6	5.9	4.0	5.6	3.8	4.7	.60	.47	yes	yes
8	R	1.2	2.1	2.1	2.1	1.7	2.1	1.9	.44	.43	no	no
9	R	1.0	1.4	0.7	0.6	0.8	1.0	0.9	.45	.65	no	no
10	G	3.0	2.9	2.4	2.6	2.7	2.7	2.7	.50	.54	yes	no
11	G	3.3	3.1	3.3	3.2	3.1	3.3	3.2	.49	.50	no	yes
12	G	1.8	1.7	1.6	2.2	2.0	1.7	1.8	.53	.48	yes	no
MEAN		2.6	2.5	2.7	2.5	2.7	2.4	2.5	.50	.51	3/6	2/6

DATA FROM EXPERIMENT 2, SESSION 25

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	6.0	5.6	6.5	6.0	6.3	5.8	6.0	.52	.48	yes	yes
2	R	6.3	5.9	6.1	5.7	6.2	5.8	6.0	.51	.51	yes	yes
3	R	3.7	4.1	4.1	4.1	3.9	4.1	4.0	.49	.49	no	no
4	G	2.7	2.8	2.7	2.6	2.7	2.7	2.7	.50	.51	yes	no
5	G	0.7	1.4	3.4	3.7	2.6	2.1	2.3	.55	.23	yes	no
6	G	4.7	4.1	4.3	3.2	3.7	4.5	4.1	.45	.54	no	yes
13	R	8.2	7.7	8.5	8.3	8.4	8.0	8.2	.51	.49	yes	yes
14	R	3.3	3.5	2.9	3.1	3.1	3.3	3.2	.49	.53	no	no
15	G	2.1	2.1	3.2	2.3	2.2	2.7	2.4	.45	.43	no	yes
MEAN		4.2	4.1	4.6	4.3	4.3	4.3	4.3	.50	.47	5/9	5/9
GROUP O(L)												
7	R	3.4	3.0	5.3	3.7	4.3	3.4	3.9	.56	.41	yes	yes
8	R	2.2	2.9	2.1	2.6	2.1	2.7	2.4	.44	.52	no	no
9	R	1.5	1.2	1.2	0.6	1.3	0.9	1.1	.60	.61	yes	yes
10	G	2.7	2.3	2.3	2.5	2.4	2.5	2.5	.49	.51	no	yes
11	G	2.9	2.3	3.0	2.9	2.6	3.0	2.8	.47	.46	no	yes
12	G	1.9	1.9	2.1	2.3	2.1	2.0	2.1	.51	.46	yes	no
MEAN		2.4	2.3	2.7	2.4	2.5	2.4	2.5	.51	.49	3/6	4/6

DATA FROM EXPERIMENT 2, SESSION 26

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	6.5	5.4	6.7	6.1	6.6	5.8	6.2	.53	.48	yes	yes
2	R	5.9	5.6	6.5	5.5	6.2	5.6	5.9	.53	.49	yes	yes
3	R	4.0	3.9	3.6	4.3	3.8	4.1	4.0	.48	.50	no	no
4	G	2.6	2.5	2.6	2.5	2.5	2.6	2.5	.49	.50	no	yes
5	G	1.1	1.1	3.5	3.9	2.5	2.3	2.4	.52	.23	yes	no
6	G	4.9	4.5	4.1	3.5	4.0	4.5	4.3	.47	.55	no	yes
13	R	7.3	7.3	8.1	8.6	7.7	8.0	7.8	.49	.47	no	no
14	R	2.9	3.9	2.6	3.3	2.7	3.6	3.2	.43	.53	no	no
15	G	1.8	1.7	3.6	3.0	2.3	2.7	2.5	.46	.35	no	yes
MEAN		4.1	4.0	4.6	4.5	4.3	4.3	4.3	.49	.45	3/9	5/9
GROUP O(L)												
7	R	4.7	2.9	4.2	3.6	4.4	3.2	3.8	.58	.49	yes	yes
8	R	2.5	2.6	2.9	2.3	2.7	2.5	2.6	.52	.49	yes	yes
9	R	1.6	1.2	0.8	0.5	1.2	0.8	1.0	.59	.69	yes	yes
10	G	2.7	2.6	2.1	2.3	2.5	2.4	2.4	.51	.55	yes	no
11	G	3.0	2.0	3.1	2.9	2.4	3.1	2.7	.44	.45	no	yes
12	G	1.9	1.2	1.7	2.1	1.7	1.8	1.7	.48	.45	no	yes
MEAN		2.7	2.1	2.5	2.3	2.5	2.3	2.4	.52	.52	4/6	5/6

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DATA FROM EXPERIMENT 2; SESSION 27 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	1.6	1.9	1.9	2.7	1.7	2.3	2.0	.43	.43	no	no
2	R	0.1	0.9	3.9	4.5	2.0	2.7	2.3	.43	.10	no	no
3	R	2.6	2.9	0.5	1.3	1.5	2.1	1.8	.42	.74	no	no
4	G	0.5	0.9	1.7	2.1	1.5	1.1	1.3	.57	.28	yes	no
5	G	0.9	1.0	1.8	1.1	1.1	1.4	1.2	.43	.40	no	yes
6	G	2.0	4.0	0.5	2.4	3.2	1.3	2.2	.72	.67	yes	no
13	R	6.3	4.2	3.9	1.4	5.1	2.8	4.0	.65	.67	yes	yes
14	R	0.1	2.2	0.3	1.7	0.2	1.9	1.1	.09	.55	no	no
15	G	0.3	0.3	1.9	1.1	0.7	1.1	0.9	.41	.16	no	yes
MEAN		1.6	2.0	1.8	2.0	1.9	1.9	1.9	.46	.45	3/9	3/9
GROUP O(L)												
7	R	1.3	1.6	1.4	2.1	1.3	1.9	1.6	.42	.45	no	no
8	R	1.4	2.7	0.0	0.9	0.7	1.8	1.3	.29	.82	no	no
9	R	0.8	0.7	0.0	0.0	0.4	0.4	0.4	.52	.98	yes	yes
10	G	1.9	0.9	1.5	0.7	0.8	1.7	1.2	.31	.56	no	yes
11	G	1.5	1.8	1.1	1.4	1.6	1.3	1.4	.55	.57	yes	no
12	G	0.2	1.0	0.0	1.0	1.0	0.1	0.6	.89	.55	yes	no
MEAN		1.2	1.5	0.7	1.0	1.0	1.2	1.1	.50	.65	3/6	2/6

DATA FROM EXPERIMENT 2, SESSION 33

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	5.6	5.8	6.1	6.1	5.9	5.9	5.9	.50	.48	no	no
2	R	6.3	5.1	6.4	5.7	6.3	5.4	5.9	.54	.49	yes	yes
3	R	3.8	3.5	4.0	4.3	3.9	3.9	3.9	.50	.47	yes	yes
4	G	2.7	2.5	2.6	2.7	2.6	2.6	2.6	.49	.50	no	yes
5	G	0.7	1.6	2.7	3.5	2.5	1.7	2.1	.60	.27	yes	no
6	G	4.7	4.9	5.0	4.7	4.8	4.9	4.8	.50	.49	no	yes
13	R	7.7	7.0	7.4	7.5	7.6	7.2	7.4	.51	.50	yes	yes
14	R	1.1	1.5	0.8	1.2	0.9	1.3	1.1	.41	.57	no	no
15	G	2.6	2.5	3.3	3.5	3.0	2.9	3.0	.50	.43	yes	no
MEAN		3.9	3.8	4.3	4.3	4.2	4.0	4.1	.51	.47	5/9	5/9
GROUP O(L)												
7	R	4.3	4.1	5.1	4.7	4.7	4.4	4.6	.51	.46	yes	yes
8	R	2.5	2.4	2.5	2.9	2.5	2.7	2.6	.48	.48	no	no
9	R	1.8	1.9	1.2	0.6	1.5	1.2	1.4	.55	.67	yes	yes
10	G	2.3	2.4	2.9	2.4	2.4	2.6	2.5	.49	.47	no	yes
11	G	0.8	0.4	0.7	0.5	0.4	0.7	0.6	.38	.50	no	yes
12	G	1.7	1.9	2.2	2.3	2.1	1.9	2.0	.52	.44	yes	no
MEAN		2.2	2.2	2.4	2.2	2.3	2.3	2.3	.49	.50	3/6	4/6

DATA FROM EXPERIMENT 2, SESSION 34

Group & Bird	$S_1 = R$ or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	5.8	5.7	6.4	6.4	6.1	6.0	6.1	.50	.47	yes	yes
2	R	5.9	5.8	6.3	5.8	6.1	5.8	5.9	.51	.49	yes	yes
3	R	3.8	3.9	3.8	3.7	3.8	3.8	3.8	.50	.50	no	no
4	G	2.5	2.5	2.4	2.7	2.6	2.5	2.5	.51	.50	yes	no
5	G	1.1	1.4	3.3	3.1	2.2	2.2	2.2	.51	.29	yes	no
6	G	4.5	4.8	4.1	4.8	4.8	4.3	4.5	.53	.51	yes	no
13	R	8.1	8.7	7.6	7.9	7.9	8.3	8.1	.49	.52	no	no
14	R	2.1	2.7	1.3	1.9	1.7	2.3	2.0	.43	.60	no	no
15	G	2.0	2.2	3.8	3.3	2.7	2.9	2.8	.49	.37	no	yes
MEAN		4.0	4.2	4.3	4.4	4.2	4.2	4.2	.50	.47	5/9	3/9
GROUP O(L)												
7	R	4.6	4.4	5.1	4.9	4.9	4.7	4.8	.51	.48	yes	yes
8	R	2.9	2.1	2.4	2.8	2.7	2.4	2.5	.52	.49	yes	yes
9	R	2.1	1.7	1.8	1.3	1.9	1.5	1.7	.56	.55	yes	yes
10	G	3.1	2.3	2.5	2.2	2.3	2.8	2.6	.45	.53	no	yes
11	G	3.0	2.7	2.6	3.3	3.0	2.8	2.9	.51	.49	yes	no
12	G	2.2	1.8	1.7	1.8	1.8	2.0	1.9	.48	.54	no	yes
MEAN		3.0	2.5	2.7	2.7	2.7	2.7	2.7	.51	.51	4/6	5/6

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DATA FROM EXPERIMENT 2, SESSION 35

Group & Bird	S_1=R or G	KlR	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	5.7	5.9	5.8	6.4	5.8	6.2	6.0	.48	.49	no	no
2	R	5.7	5.2	5.1	5.0	5.4	5.1	5.3	.51	.52	yes	yes
3	R	4.0	4.7	3.8	3.9	3.9	4.3	4.1	.47	.53	no	no
4	G	2.9	2.7	3.0	2.9	2.8	2.9	2.9	.49	.49	no	yes
5	G	1.7	1.9	2.5	3.3	2.6	2.1	2.3	.55	.39	yes	no
6	G	3.7	4.1	4.6	4.5	4.3	4.1	4.2	.51	.46	yes	no
13	R	8.3	8.1	8.7	7.9	8.5	8.0	8.3	.51	.50	yes	yes
14	R	2.3	2.8	1.9	2.3	2.1	2.5	2.3	.45	.55	no	no
15	G	2.5	2.3	3.1	2.7	2.5	2.8	2.6	.48	.45	no	yes
MEAN		4.1	4.2	4.3	4.3	4.2	4.2	4.2	.49	.49	4/9	4/9
GROUP O(L)												
7	R	4.2	4.4	4.7	5.2	4.5	4.8	4.6	.48	.46	no	no
8	R	2.1	2.2	2.4	1.7	2.3	1.9	2.1	.54	.51	yes	yes
9	R	1.5	1.3	1.2	1.6	1.3	1.4	1.4	.48	.50	no	no
10	G	2.9	2.4	2.6	2.5	2.4	2.8	2.6	.47	.52	no	yes
11	G	0.0	0.1	0.0	0.3	0.2	0.0	0.1	1.00	.34	yes	no
12	G	0.9	1.4	1.9	1.7	1.6	1.4	1.5	.52	.39	yes	no
MEAN		1.9	2.0	2.1	2.1	2.0	2.1	2.1	.58	.45	3/6	2/6

DATA FROM EXPERIMENT 2, SESSION 36

Group & Bird	$S_1=R$ or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	5.7	6.3	6.2	6.4	6.0	6.4	6.2	.48	.49	no	no
2	R	6.1	5.2	5.7	5.1	5.9	5.2	5.5	.53	.51	yes	yes
3	R	3.8	4.7	3.7	3.8	3.7	4.3	4.0	.47	.53	no	no
4	G	2.9	2.5	2.7	2.9	2.7	2.8	2.7	.49	.49	no	yes
5	G	1.6	2.1	3.3	3.6	2.9	2.5	2.7	.54	.35	yes	no
6	G	3.8	4.2	4.7	4.6	4.4	4.2	4.3	.51	.46	yes	no
13	R	8.7	7.7	8.9	8.5	8.8	8.1	8.4	.52	.49	yes	yes
14	R	2.6	3.0	2.4	3.3	2.5	3.2	2.8	.44	.50	no	no
15	G	2.5	2.4	3.9	3.0	2.7	3.2	3.0	.46	.42	no	yes
MEAN		4.2	4.3	4.6	4.6	4.4	4.4	4.4	.49	.47	4/9	4/9
GROUP O(L)												
7	R	5.1	4.6	5.3	5.3	5.2	4.9	5.1	.51	.48	yes	yes
8	R	2.3	2.0	2.3	1.8	2.3	1.9	2.1	.55	.51	yes	yes
9	R	1.6	1.9	0.9	1.1	1.2	1.5	1.4	.45	.64	no	no
10	G	2.6	2.4	2.5	2.4	2.4	2.5	2.5	.49	.51	no	yes
11	G	1.2	2.3	3.2	1.9	2.1	2.2	2.1	.49	.41	no	yes
12	G	1.6	1.4	1.9	1.3	1.3	1.7	1.5	.43	.49	no	yes
MEAN		2.4	2.4	2.7	2.3	2.4	2.5	2.5	.49	.51	2/6	5/6

DATA FROM EXPERIMENT 2, SESSION 37

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$

GROUP O(H)

Group & Bird	S_1=R or G	K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
1	R	5.7	6.2	6.0	6.4	5.9	6.3	6.1	.48	.49	no	no
2	R	6.0	5.9	6.6	5.9	6.3	5.9	6.1	.52	.49	yes	yes
3	R	4.0	4.0	4.2	5.4	4.1	4.7	4.4	.46	.45	no	no
4	G	2.7	2.8	2.9	3.3	3.1	2.8	3.0	.52	.47	yes	no
5	G	2.1	1.9	3.7	3.6	2.7	2.9	2.8	.48	.35	no	yes
6	G	6.4	4.3	4.5	4.4	4.3	5.5	4.9	.44	.54	no	yes
13	R	8.2	8.9	8.7	8.1	8.5	8.5	8.5	.50	.51	no	no
14	R	2.5	3.9	2.4	3.2	2.5	3.5	3.0	.41	.53	no	no
15	G	3.3	2.7	4.2	3.5	3.1	3.8	3.4	.45	.44	no	yes
MEAN		4.6	4.5	4.8	4.9	4.5	4.9	4.7	.47	.47	2/9	4/9

GROUP O(L)

Group & Bird	S_1=R or G	K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
7	R	5.0	5.3	5.5	3.9	5.2	4.6	4.9	.53	.52	yes	yes
8	R	2.9	2.4	2.3	2.7	2.6	2.5	2.6	.51	.51	yes	yes
9	R	1.5	1.5	1.2	1.3	1.3	1.4	1.3	.49	.55	no	no
10	G	2.7	2.3	2.1	2.4	2.3	2.4	2.4	.49	.53	no	yes
11	G	1.6	1.4	2.4	1.7	1.5	2.0	1.8	.43	.43	no	yes
12	G	0.9	1.6	2.8	1.6	1.6	1.9	1.7	.46	.36	no	yes
MEAN		2.4	2.4	2.7	2.3	2.4	2.5	2.5	.49	.48	2/6	5/6

DATA FROM EXPERIMENT 2, SESSION 38 (CHOICE TEST)

Group & Bird	$S_1=R$ or G	K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	0.2	0.7	0.1	1.5	0.2	1.1	0.6	.13	.37	no	no
2	R	1.2	0.0	2.9	1.4	2.1	0.7	1.4	.74	.21	yes	yes
3	R	1.1	1.9	0.3	1.7	0.7	1.8	1.2	.28	.61	no	no
4	G	0.4	0.6	2.4	2.3	1.5	1.4	1.4	.52	.17	yes	no
5	G	0.7	1.1	1.9	1.8	1.4	1.3	1.4	.52	.33	yes	no
6	G	2.6	2.5	0.7	1.6	2.1	1.7	1.9	.56	.69	yes	no
13	R	2.7	2.2	4.2	3.7	3.5	2.9	3.2	.54	.38	yes	yes
14	R	0.1	1.6	0.1	0.8	0.1	1.2	0.7	.06	.65	no	no
15	G	0.1	0.3	0.2	0.3	0.3	0.1	0.2	.67	.36	yes	no
MEAN		1.0	1.2	1.4	1.7	1.3	1.4	1.3	.45	.42	6/9	2/9
GROUP O(L)												
7	R	0.3	0.1	0.0	0.0	0.2	0.1	0.1	.76	.91	yes	yes
8	R	1.8	2.4	0.4	0.8	1.1	1.6	1.4	.41	.78	no	no
9	R	1.0	1.3	0.0	0.0	0.5	0.7	0.6	.42	.98	no	no
10	G	1.9	1.1	1.3	0.7	0.9	1.6	1.3	.36	.59	no	yes
11	G	0.9	0.3	1.2	0.8	0.5	1.1	0.8	.33	.38	no	yes
12	G	0.1	1.3	0.1	1.7	1.5	0.1	0.8	.93	.44	yes	no
MEAN		1.0	1.1	0.5	0.7	0.8	0.9	0.8	.54	.68	2/6	3/6

DATA FROM EXPERIMENT 2, SESSION 50

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$\frac{S_1}{S_2}$	$\frac{R}{G}$
GROUP O(H)												
1	R	6.6	4.8	7.8	6.7	7.2	5.7	6.5	.56	.44	yes	yes
2	R	6.6	4.7	6.5	5.3	6.5	5.0	5.8	.57	.49	yes	yes
3	R	3.6	3.9	3.9	3.5	3.7	3.7	3.7	.50	.50	yes	yes
4	G	2.7	2.8	2.7	2.6	2.7	2.7	2.7	.50	.51	yes	no
5	G	1.8	2.5	2.7	3.5	3.0	2.3	2.6	.57	.41	yes	no
6	G	4.3	3.8	4.3	4.1	3.9	4.3	4.1	.48	.49	no	yes
13	R	7.8	7.9	7.6	8.4	7.7	8.2	7.9	.49	.49	no	no
14	R	1.6	1.3	1.5	1.3	1.5	1.3	1.4	.54	.51	yes	yes
15	G	3.6	2.9	2.7	2.5	2.7	3.1	2.9	.47	.55	no	yes
MEAN		4.3	3.8	4.4	4.2	4.3	4.0	4.2	.52	.49	6/9	6/9
GROUP O(L)												
7	R	6.2	5.5	6.0	5.5	6.1	5.5	5.8	.53	.50	yes	yes
8	R	3.1	3.0	3.1	2.8	3.1	2.9	3.0	.51	.50	yes	yes
9	R	1.9	1.7	1.8	1.3	1.8	1.5	1.7	.55	.54	yes	yes
10	G	3.1	2.9	2.7	2.9	2.9	2.9	2.9	.50	.52	no	yes
11	G	3.0	2.9	3.7	3.4	3.1	3.3	3.2	.48	.45	no	yes
12	G	2.5	2.8	2.4	2.7	2.7	2.5	2.6	.52	.51	yes	no
MEAN		3.3	3.1	3.3	3.1	3.3	3.1	3.2	.52	.51	4/6	5/6

DATA FROM EXPERIMENT 2, SESSION 51

Group & Bird	$S_1=R$ or G	K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	6.4	4.7	7.8	6.6	7.1	5.7	6.4	.56	.44	yes	yes
2	R	6.4	5.7	6.3	5.2	6.3	5.4	5.9	.54	.51	yes	yes
3	R	3.5	4.0	3.7	4.3	3.6	4.2	3.9	.46	.49	no	no
4	G	2.5	2.5	2.7	2.9	2.7	2.6	2.7	.51	.47	yes	no
5	G	2.2	2.9	3.4	3.2	3.0	2.8	2.9	.52	.43	yes	no
6	G	4.8	4.1	4.8	4.3	4.2	4.8	4.5	.47	.49	no	yes
13	R	7.9	7.4	7.4	8.6	7.6	8.0	7.8	.49	.49	no	no
14	R	2.3	1.7	2.0	1.8	2.1	1.7	1.9	.55	.51	yes	yes
15	G	3.4	2.4	2.4	2.2	2.3	2.9	2.6	.44	.56	no	yes
MEAN		4.4	3.9	4.5	4.4	4.3	4.2	4.3	.50	.49	5/9	5/9
GROUP O(L)												
7	R	6.5	5.4	6.1	5.6	6.3	5.5	5.9	.53	.51	yes	yes
8	R	3.0	3.0	2.7	2.7	2.8	2.9	2.9	.50	.53	no	no
9	R	1.5	1.3	1.8	1.1	1.7	1.2	1.4	.58	.49	yes	yes
10	G	3.1	2.5	2.5	2.7	2.6	2.8	2.7	.49	.52	no	yes
11	G	2.4	2.3	3.5	3.5	2.9	2.9	2.9	.50	.40	no	yes
12	G	2.5	2.7	2.5	2.7	2.7	2.5	2.6	.52	.50	yes	no
MEAN		3.2	2.9	3.2	3.1	3.2	3.0	3.1	.52	.49	3/6	4/6

DATA FROM EXPERIMENT 2, SESSION 52

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	5.8	4.8	7.4	6.9	6.6	5.9	6.2	.53	.43	yes	yes
2	R	6.1	5.6	6.1	5.3	6.1	5.4	5.7	.53	.50	yes	yes
3	R	3.8	4.0	4.3	4.3	4.1	4.1	4.1	.50	.48	no	no
4	G	2.8	2.5	2.7	2.7	2.6	2.7	2.7	.49	.49	no	yes
5	G	1.9	2.6	2.8	2.5	2.6	2.4	2.5	.52	.46	yes	no
6	G	4.4	4.3	5.0	4.8	4.5	4.7	4.6	.49	.47	no	yes
13	R	6.7	7.1	6.2	7.4	6.4	7.3	6.8	.47	.51	no	no
14	R	2.4	1.8	2.0	2.0	2.2	1.9	2.1	.53	.51	yes	yes
15	G	2.5	2.3	2.0	2.0	2.1	2.3	2.2	.48	.55	no	yes
MEAN		4.1	3.9	4.3	4.2	4.1	4.1	4.1	.50	.49	4/9	6/9
GROUP O(L)												
7	R	5.8	5.0	6.0	5.1	5.9	5.0	5.5	.54	.49	yes	yes
8	R	2.5	2.9	2.9	2.8	2.7	2.9	2.8	.49	.49	no	no
9	R	2.2	1.2	1.5	1.0	1.9	1.1	1.5	.63	.58	yes	yes
10	G	2.8	2.6	2.6	2.8	2.7	2.7	2.7	.50	.50	no	yes
11	G	1.1	0.9	1.1	1.1	1.0	1.1	1.1	.48	.47	no	yes
12	G	2.5	3.0	2.9	2.6	2.8	2.7	2.8	.51	.50	yes	no
MEAN		2.8	2.6	2.8	2.6	2.8	2.6	2.7	.52	.51	3/6	4/6

DATA FROM EXPERIMENT 2, SESSION 53

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	6.7	5.1	7.5	6.9	7.1	6.0	6.5	.54	.45	yes	yes
2	R	5.7	4.7	5.7	4.8	5.7	4.7	5.2	.54	.50	yes	yes
3	R	3.8	4.2	3.2	4.1	3.5	4.1	3.8	.46	.53	no	no
4	G	2.7	3.0	2.6	2.9	2.9	2.6	2.8	.53	.51	yes	no
5	G	2.4	2.9	3.4	3.5	3.2	2.9	3.0	.52	.43	yes	no
6	G	5.1	4.8	4.7	4.9	4.9	4.9	4.9	.50	.51	no	yes
13	R	7.0	6.6	7.0	7.9	7.0	7.3	7.1	.49	.48	no	no
14	R	2.1	1.7	2.1	1.8	2.1	1.7	1.9	.55	.49	yes	yes
15	G	2.6	3.4	2.9	2.8	3.1	2.7	2.9	.53	.51	yes	no
MEAN		4.2	4.0	4.3	4.4	4.4	4.1	4.3	.52	.49	6/9	4/9
GROUP O(L)												
7	R	5.9	5.0	5.9	5.5	5.9	5.3	5.6	.53	.49	yes	yes
8	R	2.5	2.7	2.6	2.9	2.6	2.8	2.7	.48	.49	no	no
9	R	1.8	1.3	1.9	1.1	1.8	1.2	1.5	.60	.52	yes	yes
10	G	3.4	3.0	3.0	2.4	2.7	3.2	3.0	.46	.55	no	yes
11	G	3.0	3.0	3.9	3.7	3.3	3.5	3.4	.49	.44	no	yes
12	G	2.4	3.1	2.8	3.1	3.1	2.6	2.8	.54	.49	yes	no
MEAN		3.2	3.0	3.3	3.1	3.2	3.1	3.2	.52	.49	3/6	4/6

DATA FROM EXPERIMENT 2, SESSION 54

Group & Bird	$S_1=R$ or G	KlR	KlG	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$\dfrac{S_1}{S_2}$	$\dfrac{R}{G}$
GROUP O(H)												
1	R	7.4	5.4	8.1	6.7	7.7	6.0	6.9	.56	.46	yes	yes
2	R	5.9	5.1	6.6	5.0	6.3	5.0	5.6	.55	.49	yes	yes
3	R	3.5	4.1	4.0	4.0	3.8	4.1	3.9	.48	.49	no	no
4	G	2.7	2.9	2.9	2.9	2.9	2.8	2.9	.51	.50	yes	no
5	G	2.5	3.1	4.0	3.6	3.3	3.2	3.3	.51	.42	yes	no
6	G	4.3	3.7	4.5	3.8	3.8	4.4	4.1	.46	.49	no	yes
13	R	7.1	5.2	5.2	6.5	6.2	5.8	6.0	.51	.51	yes	yes
14	R	2.2	1.7	2.0	1.9	2.1	1.8	1.9	.53	.50	yes	yes
15	G	3.0	2.3	2.8	2.5	2.4	2.9	2.6	.45	.51	no	yes
MEAN		4.3	3.7	4.4	4.1	4.3	4.0	4.1	.51	.49	6/9	6/9
GROUP O(L)												
7	R	6.6	5.3	5.9	5.6	6.2	5.4	5.8	.53	.51	yes	yes
8	R	2.9	3.0	3.1	2.1	3.0	2.6	2.8	.54	.53	yes	yes
9	R	2.3	1.8	2.4	1.6	2.4	1.7	2.0	.58	.51	yes	yes
10	G	3.1	2.7	2.9	2.6	2.7	3.0	2.8	.47	.51	no	yes
11	G	3.2	3.0	3.8	3.4	3.2	3.5	3.3	.48	.46	no	yes
12	G	2.7	2.8	2.8	3.0	2.9	2.7	2.8	.51	.49	yes	no
MEAN		3.4	3.1	3.5	3.1	3.4	3.1	3.3	.52	.50	4/6	5/6

DATA FROM EXPERIMENT 2, SESSION 55 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP O(H)												
1	R	5.5	0.0	6.7	0.1	6.1	0.0	3.1	.99	.45	yes	yes
2	R	3.1	0.0	4.8	1.3	4.0	0.7	2.3	.86	.34	yes	yes
3	R	2.6	0.3	2.9	0.8	2.8	0.6	1.7	.83	.43	yes	yes
4	G	0.1	1.7	0.1	1.7	1.7	0.1	0.9	.95	.49	yes	no
5	G	1.8	1.5	1.3	0.3	0.9	1.5	1.2	.37	.67	no	yes
6	G	0.6	3.0	0.9	3.4	3.2	0.7	2.0	.82	.45	yes	no
13	R	5.0	1.4	5.6	2.2	5.3	1.8	3.6	.75	.45	yes	yes
14	R	1.7	0.4	1.0	0.1	1.4	0.2	0.8	.86	.66	yes	yes
15	G	0.0	2.6	0.4	1.7	2.1	0.2	1.2	.92	.55	yes	no
MEAN		2.3	1.2	2.6	1.3	3.1	0.7	1.9	.81	.50	8/9	6/9
GROUP O(L)												
7	R	5.9	0.1	5.8	0.0	5.9	0.1	2.9	.99	.51	yes	yes
8	R	2.2	1.4	1.2	0.3	1.7	0.8	1.3	.68	.71	yes	yes
9	R	2.1	0.1	1.6	0.0	1.8	0.0	0.9	.98	.57	yes	yes
10	G	0.5	1.9	0.1	2.1	2.0	0.3	1.2	.87	.51	yes	no
11	G	0.3	1.0	0.7	1.7	1.3	0.5	0.9	.74	.34	yes	no
12	G	0.1	3.0	0.0	3.0	3.0	0.1	1.5	.98	.51	yes	no
MEAN		1.8	1.2	1.6	1.2	2.6	0.3	1.5	.87	.53	6/6	3/6

SUMMARY DATA FOR EXP. 2

$R_1/(R_1+R_2)$ VALUES FOR INDIVIDUAL BIRDS DURING SINGLE-STIMULUS TRAINING (SST) AND CHOICE TESTS (CT)

(decimal points are omitted to save space)

Bird & Group	S_1=R or G	SST 22	23	24	25	26	SST mean 22-26 a	CT 27 a	SST mean 33-37 b	CT 38 b	SST mean 50-54 c	CT 55 c
GROUP O(H)												
1	R	51	50	52	52	53	52	43	49	13	55	99
2	R	52	51	52	51	53	52	43	52	74	55	86
3	R	47	48	44	49	48	47	42	48	28	48	83
4	G	50	51	49	50	49	50	57	50	52	51	95
5	G	59	57	62	55	52	57	43	54	52	53	37
6	G	48	48	47	45	47	47	72	50	56	48	82
13	R	48	51	50	51	49	50	65	51	54	49	75
14	R	45	48	46	49	43	46	09	43	06	54	86
15	G	49	47	45	45	46	46	41	47	67	47	92
MEAN		50	50	50	50	49	50	46	49	45	51	81
GROUP O(L)												
7	R	56	50	60	56	58	56	42	51	76	53	99
8	R	48	51	44	44	52	48	29	52	41	50	68
9	R	54	61	45	60	59	56	52	51	42	59	98
10	G	50	45	50	49	51	49	31	48	36	48	87
11	G	48	48	49	47	44	47	55	56	33	49	74
12	G	48	59	53	51	48	52	89	48	93	52	98
MEAN		51	52	50	51	52	51	50	51	54	52	87

[a] Correlations between entries for individual birds (before rounding) in these two columns are $r_s=+.37$ in Group O(H) $r_s=+.09$ in Group O(L)

[b] Correlations in these columns are $r_s=+.43$ in Group O(H) $r_s=-.37$ in Group O(L)

[c] Correlations in these columns are $r_s=+.28$ in Group O(H) $r_s=+.67$ in Group O(L)

DATA FROM EXPERIMENT 3

DATA FROM EXPERIMENT 3, SESSION 12

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	2.9	2.5	2.4	2.1	2.6	2.3	2.5	.54	.54	yes	yes
2	R	4.4	1.2	5.7	2.0	5.1	1.6	3.3	.76	.42	yes	yes
3	R	2.5	3.3	3.2	3.5	2.8	3.4	3.1	.46	.46	no	no
4	G	2.9	3.7	3.5	3.5	3.6	3.2	3.4	.53	.48	yes	no
5	G	2.0	2.5	2.3	2.0	2.2	2.2	2.2	.51	.51	yes	no
6	G	3.7	4.1	3.3	4.3	4.2	3.5	3.9	.55	.50	yes	no
19	R	2.9	1.5	2.2	1.0	2.5	1.3	1.9	.67	.58	yes	yes
20	R	2.1	3.7	2.7	3.2	2.4	3.4	2.9	.41	.50	no	no
21	G	3.2	3.3	3.3	3.1	3.2	3.3	3.3	.49	.51	no	yes
22	G	1.8	2.3	2.0	2.3	2.3	1.9	2.1	.54	.49	yes	no
MEAN		2.8	2.8	3.1	2.7	3.1	2.6	2.9	.55	.50	7/10	4/10
GROUP P-only												
7	R	2.9	2.9	3.0	2.7	3.0	2.8	2.9	.52	.51	yes	yes
8	R	6.7	3.7	6.4	2.5	6.6	3.1	4.8	.68	.54	yes	yes
9	R	5.9	4.0	6.8	8.1	6.3	6.1	6.2	.51	.40	yes	yes
10	G	1.9	1.9	1.9	2.6	2.2	1.9	2.1	.54	.45	yes	no
11	G	6.1	6.4	5.1	5.9	6.1	5.6	5.9	.52	.53	yes	no
12	G	2.9	3.4	2.6	2.7	3.0	2.7	2.9	.53	.55	yes	no
23	R	4.4	3.3	4.9	2.5	4.7	2.9	3.8	.61	.51	yes	yes
24	R	2.3	2.7	2.7	3.1	2.5	2.9	2.7	.46	.47	no	no
25	G	3.1	2.8	1.8	1.8	2.3	2.4	2.3	.49	.62	no	yes
26	G	2.2	2.6	1.5	2.0	2.3	1.8	2.1	.56	.58	yes	no
MEAN		3.9	3.4	3.7	3.4	3.9	3.2	3.6	.54	.52	8/10	5/10
GROUP SP												
13	R	1.7	1.6	1.3	1.7	1.5	1.6	1.6	.48	.53	no	no
14	R	1.9	3.0	4.7	5.4	3.3	4.2	3.7	.44	.33	no	no
15	R	2.7	2.4	2.7	2.5	2.7	2.5	2.6	.52	.49	yes	yes
16	G	4.7	4.5	4.2	3.8	4.1	4.5	4.3	.48	.53	no	yes
17	G	1.0	1.0	1.5	1.9	1.5	1.2	1.3	.54	.37	yes	no
18	G	3.1	2.3	2.6	2.3	2.3	2.8	2.6	.45	.52	no	yes
27	R	3.8	4.1	3.3	4.3	3.5	4.2	3.9	.46	.51	no	no
28	R	1.8	1.8	2.1	2.1	2.0	2.0	2.0	.50	.47	no	no
29	G	3.0	3.0	0.2	2.1	2.5	1.6	2.1	.61	.73	yes	no
30	G	3.1	2.8	2.8	2.5	2.7	2.9	2.8	.47	.53	no	yes
MEAN		2.7	2.6	2.5	2.9	2.6	2.7	2.7	.49	.50	3/10	4/10

DATA FROM EXPERIMENT 3, SESSION 13

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUPS-only												
1	R	2.9	2.3	2.8	1.6	2.8	1.9	2.4	.59	.54	yes	yes
2	R	4.7	2.4	5.5	1.9	5.1	2.1	3.6	.70	.49	yes	yes
3	R	3.1	3.0	3.0	3.5	3.0	3.2	3.1	.49	.49	no	no
4	G	3.3	3.4	3.4	3.7	3.5	3.4	3.4	.51	.49	yes	no
5	G	2.5	1.9	2.5	2.6	2.2	2.5	2.4	.47	.46	no	yes
6	G	4.1	4.3	3.1	4.1	4.2	3.6	3.9	.54	.54	yes	no
19	R	3.0	2.1	2.7	1.1	2.9	1.6	2.3	.64	.58	yes	yes
20	R	3.4	3.8	3.1	3.3	3.3	3.6	3.4	.48	.53	no	no
21	G	3.6	3.7	3.7	3.3	3.5	3.7	3.6	.49	.51	no	yes
22	G	2.0	2.4	2.2	2.5	2.4	2.1	2.3	.53	.48	yes	no
MEAN		3.3	2.9	3.2	2.8	3.3	2.8	3.0	.55	.51	6/10	5/10
GROUP P-only												
7	R	3.1	2.9	2.9	2.8	3.0	2.8	2.9	.51	.51	yes	yes
8	R	7.1	2.2	6.3	0.8	6.7	1.5	4.1	.82	.57	yes	yes
9	R	5.8	4.4	5.7	7.8	5.7	6.1	5.9	.49	.43	no	no
10	G	2.1	1.9	1.7	2.3	2.1	1.9	2.0	.52	.49	yes	no
11	G	6.2	6.6	5.4	5.0	5.8	5.8	5.8	.50	.55	--	--
12	G	3.2	3.6	2.7	3.6	3.6	2.9	3.2	.55	.52	yes	no
23	R	5.2	3.5	5.0	4.7	5.1	4.1	4.6	.55	.47	yes	yes
24	R	2.3	2.5	2.2	2.6	2.3	2.6	2.4	.47	.50	no	no
25	G	2.5	2.9	1.5	1.5	2.2	2.0	2.1	.53	.65	yes	no
26	G	2.2	2.9	1.5	2.3	2.6	1.8	2.2	.59	.57	yes	no
MEAN		4.0	3.3	3.5	3.3	3.9	3.2	3.5	.55	.53	7/9	3/9
GROUP SP												
13	R	1.4	1.4	1.6	1.5	1.5	1.5	1.5	.51	.46	yes	yes
14	R	2.2	2.8	4.5	5.1	3.3	3.9	3.6	.46	.34	no	no
15	R	2.5	2.5	2.2	2.4	2.3	2.5	2.4	.48	.52	no	no
16	G	4.9	5.1	4.3	5.4	5.2	4.6	4.9	.53	.51	yes	no
17	G	1.0	1.5	0.9	1.7	1.6	0.9	1.3	.63	.48	yes	no
18	G	2.9	2.2	2.4	2.9	2.5	2.7	2.6	.49	.49	no	yes
27	R	3.9	4.5	3.2	4.1	3.6	4.3	4.0	.45	.53	no	no
28	R	2.1	1.7	2.0	1.7	2.1	1.7	1.9	.54	.51	yes	yes
29	G	2.9	3.0	0.4	2.1	2.5	1.6	2.1	.61	.70	yes	no
30	G	3.0	2.5	2.7	3.2	2.9	2.9	2.9	.50	.48	no	yes
MEAN		2.7	2.7	2.4	3.0	2.7	2.7	2.7	.52	.50	5/10	4/10

DATA FROM EXPERIMENT 3, SESSION 14

Group & Bird	S_1=R or G	\tK1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	1.5	1.2	1.1	1.0	1.3	1.1	1.2	.53	.57	yes	yes
2	R	4.4	1.4	5.2	1.6	4.8	1.5	3.1	.76	.47	yes	yes
3	R	2.7	3.3	3.3	3.5	3.0	3.4	3.2	.47	.47	no	no
4	G	3.1	3.6	3.4	3.5	3.5	3.2	3.4	.52	.49	yes	no
5	G	0.0	0.7	0.0	0.0	0.3	0.0	0.2	1.00	1.00	yes	no
6	G	3.8	4.2	3.6	4.1	4.1	3.7	3.9	.53	.51	yes	no
19	R	3.3	1.9	2.7	1.0	3.0	1.4	2.2	.68	.58	yes	yes
20	R	2.5	3.6	2.3	3.1	2.4	3.3	2.9	.42	.53	no	no
21	G	3.7	3.4	3.6	3.6	3.5	3.7	3.6	.49	.50	no	yes
22	G	2.0	2.4	2.4	2.5	2.5	2.2	2.3	.53	.47	yes	no
MEAN		2.7	2.6	2.7	2.4	2.9	2.4	2.6	.59	.56	7/10	4/10
GROUP P-only												
7	R	3.2	2.9	3.0	2.3	3.1	2.6	2.8	.55	.54	yes	yes
8	R	7.6	2.5	5.3	2.1	6.5	2.3	4.4	.74	.57	yes	yes
9	R	4.8	4.6	4.6	7.5	4.7	6.1	5.4	.44	.44	no	no
10	G	2.1	1.9	2.0	1.9	1.9	2.1	2.0	.48	.51	no	yes
11	G	5.4	6.7	5.7	5.1	5.9	5.6	5.7	.51	.53	yes	no
12	G	3.4	3.6	2.5	3.3	3.4	2.9	3.2	.54	.55	yes	no
23	R	5.3	4.2	4.9	4.0	5.1	4.1	4.6	.55	.51	yes	yes
24	R	1.8	2.4	2.4	2.5	2.1	2.4	2.3	.46	.47	no	no
25	G	2.8	2.8	1.1	1.5	2.2	1.9	2.1	.53	.68	yes	no
26	G	2.1	2.6	1.7	2.6	2.6	1.9	2.2	.58	.52	yes	no
MEAN		3.8	3.4	3.3	3.3	3.7	3.2	3.5	.54	.53	7/10	4/10
GROUP SP												
13	R	1.8	1.6	2.0	1.7	1.9	1.7	1.8	.53	.48	yes	yes
14	R	2.4	3.3	4.4	5.7	3.4	4.5	3.9	.43	.36	no	no
15	R	2.4	2.3	2.4	2.3	2.4	2.3	2.3	.51	.50	yes	yes
16	G	4.9	4.6	4.1	4.2	4.4	4.5	4.5	.50	.53	no	yes
17	G	1.8	1.3	1.3	2.1	1.7	1.5	1.6	.52	.48	yes	no
18	G	2.2	2.4	1.7	1.6	2.0	1.9	2.0	.51	.58	yes	no
27	R	3.7	4.3	3.5	4.0	3.6	4.1	3.9	.46	.52	no	no
28	R	2.0	1.7	2.0	1.7	2.0	1.7	1.9	.53	.50	yes	yes
29	G	2.9	2.7	0.4	2.1	2.4	1.6	2.0	.60	.70	yes	no
30	G	2.8	2.9	2.8	2.8	2.9	2.8	2.8	.50	.51	yes	no
MEAN		2.7	2.7	2.5	2.8	2.7	2.7	2.7	.51	.51	7/10	4/10

RATE OF RESPONSE (responses per second) — K1R K1G K2R K2G R_1 R_2 $\frac{R_1+R_2}{2}$

INDICES

DATA FROM EXPERIMENT 3, SESSION 15

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	3.1	2.3	2.7	2.0	2.9	2.1	2.5	.58	.53	yes	yes
2	R	4.0	1.1	5.2	2.1	4.6	1.6	3.1	.74	.41	yes	yes
3	R	3.0	3.1	3.2	3.1	3.1	3.1	3.1	.50	.49	yes	yes
4	G	3.2	3.7	3.3	3.5	3.6	3.3	3.4	.53	.50	yes	no
5	G	2.9	2.5	2.4	2.5	2.5	2.6	2.6	.49	.52	no	yes
6	G	4.2	4.4	4.0	4.4	4.4	4.1	4.3	.52	.51	yes	no
19	R	3.5	1.5	3.0	1.3	3.2	1.4	2.3	.70	.54	yes	yes
20	R	3.6	3.5	2.2	3.2	2.9	3.4	3.1	.46	.57	no	no
21	G	3.7	3.4	3.6	3.3	3.4	3.7	3.5	.48	.51	no	yes
22	G	2.3	2.7	1.9	2.0	2.3	2.1	2.2	.52	.56	yes	no
MEAN		3.3	2.8	3.1	2.7	3.3	2.7	3.0	.55	.51	7/10	6/10
GROUP P-only												
7	R	2.9	2.9	3.0	2.8	3.0	2.9	2.9	.51	.50	yes	yes
8	R	6.8	2.5	7.3	2.2	7.1	2.3	4.7	.75	.49	yes	yes
9	R	5.4	3.5	5.6	7.6	5.5	5.5	5.5	.50	.40	no	no
10	G	2.8	2.2	2.1	2.9	2.5	2.4	2.5	.51	.50	yes	no
11	G	5.6	6.8	5.2	5.1	6.0	5.4	5.7	.53	.55	yes	no
12	G	3.6	3.7	3.0	3.4	3.5	3.3	3.4	.52	.53	yes	no
23	R	5.1	4.3	4.8	4.3	4.9	4.3	4.6	.53	.51	yes	yes
24	R	2.5	2.9	2.3	2.9	2.4	2.9	2.6	.45	.51	no	no
25	G	2.3	3.0	1.1	1.6	2.3	1.7	2.0	.58	.66	yes	no
26	G	2.1	2.9	2.3	2.7	2.8	2.2	2.5	.56	.50	yes	no
MEAN		3.9	3.5	3.7	3.5	4.0	3.3	3.7	.54	.52	8/10	3/10
GROUP SP												
13	R	2.0	1.6	1.8	1.7	1.9	1.7	1.8	.53	.50	yes	yes
14	R	3.2	3.1	3.8	4.7	3.5	3.9	3.7	.48	.43	no	no
15	R	2.5	2.4	2.5	2.5	2.5	2.4	2.5	.51	.49	yes	yes
16	G	4.2	4.3	3.7	4.1	4.2	4.0	4.1	.51	.52	yes	no
17	G	1.5	1.8	1.5	1.8	1.8	1.5	1.7	.54	.50	yes	no
18	G	3.2	2.7	2.4	2.6	2.7	2.8	2.7	.49	.54	no	yes
27	R	3.9	4.7	3.7	3.9	3.8	4.3	4.0	.47	.53	no	no
28	R	2.1	1.7	2.3	2.0	2.2	1.9	2.1	.55	.47	yes	yes
29	G	2.9	2.7	0.8	2.7	2.7	1.8	2.3	.60	.61	yes	no
30	G	3.0	2.6	2.8	2.7	2.7	2.9	2.8	.48	.50	no	yes
MEAN		2.9	2.8	2.5	2.9	2.8	2.7	2.7	.52	.51	6/10	5/10

DATA FROM EXPERIMENT 3, SESSION 16

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)						$\frac{R_1+R_2}{2}$	INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2		$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	2.9	2.0	2.7	1.8	2.8	1.9	2.3	.60	.52	yes	yes
2	R	4.6	2.1	5.2	3.0	4.9	2.6	3.7	.66	.45	yes	yes
3	R	2.5	2.9	2.8	3.1	2.6	3.0	2.8	.46	.48	no	no
4	G	3.7	3.6	3.7	3.4	3.5	3.7	3.6	.49	.51	no	yes
5	G	2.9	2.2	2.9	2.4	2.3	2.9	2.6	.44	.49	no	yes
6	G	3.9	4.6	4.1	4.1	4.3	4.0	4.2	.52	.51	yes	no
19	R	3.9	1.7	3.6	0.9	3.8	1.3	2.5	.75	.55	yes	yes
20	R	3.0	3.4	2.1	3.0	2.5	3.2	2.9	.44	.55	no	no
21	G	3.6	3.6	3.9	3.1	3.4	3.7	3.6	.47	.51	no	yes
22	G	2.2	2.9	2.3	2.3	2.6	2.3	2.4	.53	.53	yes	no
MEAN		3.3	2.9	3.3	2.7	3.3	2.9	3.1	.54	.51	5/10	6/10
GROUP P-only												
7	R	3.0	2.7	3.0	2.0	3.0	2.4	2.7	.56	.54	yes	yes
8	R	7.2	3.3	7.0	3.2	7.1	3.3	5.2	.69	.51	yes	yes
9	R	5.2	5.0	5.9	8.1	5.6	6.6	6.1	.46	.42	no	no
10	G	2.6	2.7	2.2	2.8	2.7	2.4	2.6	.53	.51	yes	no
11	G	6.4	5.7	5.7	5.1	5.4	6.1	5.7	.47	.53	no	yes
12	G	3.9	3.9	3.4	3.5	3.7	3.7	3.7	.50	.53	yes	no
23	R	5.3	4.7	5.3	4.8	5.3	4.7	5.0	.53	.50	yes	yes
24	R	2.5	2.1	2.8	2.9	2.6	2.5	2.6	.51	.44	yes	yes
25	G	3.1	2.7	1.1	1.5	2.1	2.1	2.1	.51	.69	yes	no
26	G	2.4	3.3	1.8	2.5	2.9	2.1	2.5	.59	.57	yes	no
MEAN		4.1	3.6	3.8	3.7	4.1	3.6	3.8	.53	.52	8/10	5/10
GROUP SP												
13	R	2.1	2.1	1.8	2.1	1.9	2.1	2.0	.47	.51	no	no
14	R	2.8	3.9	4.2	5.0	3.5	4.5	4.0	.44	.42	no	no
15	R	2.7	2.6	2.8	2.3	2.7	2.5	2.6	.53	.51	yes	yes
16	G	4.3	4.9	3.7	3.8	4.3	3.9	4.1	.52	.55	yes	no
17	G	1.6	2.3	1.7	2.0	2.2	1.7	1.9	.56	.51	yes	no
18	G	2.5	2.4	2.2	2.1	2.2	2.3	2.3	.49	.54	no	yes
27	R	3.4	3.9	2.6	3.5	3.0	3.7	3.3	.45	.54	no	no
28	R	2.1	1.8	2.1	1.9	2.1	1.9	2.0	.53	.50	yes	yes
29	G	3.3	3.1	0.6	2.5	2.8	1.9	2.4	.60	.67	yes	no
30	G	2.9	3.1	3.0	2.9	3.0	2.9	3.0	.50	.50	yes	no
MEAN		2.7	3.0	2.5	2.8	2.8	2.7	2.8	.51	.53	6/10	3/10

DATA FROM EXPERIMENT 3, SESSION 17 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	1.4	0.2	1.3	0.3	1.4	0.3	0.8	.82	.50	yes	yes
2	R	4.5	0.0	4.8	0.0	4.6	0.0	2.3	1.00	.48	yes	yes
3	R	2.9	1.7	1.3	0.1	2.1	0.9	1.5	.71	.77	yes	yes
4	G	0.5	2.8	0.1	2.9	2.9	0.3	1.6	.91	.52	yes	no
5	G	0.5	0.7	0.7	0.6	0.7	0.6	0.6	.52	.47	yes	no
6	G	1.3	3.7	0.2	2.4	3.1	0.8	1.9	.80	.66	yes	no
19	R	3.3	0.3	2.6	0.1	2.9	0.2	1.6	.94	.57	yes	yes
20	R	2.4	0.5	1.1	0.1	1.8	0.3	1.0	.86	.70	yes	yes
21	G	0.0	3.5	0.0	3.3	3.4	0.0	1.7	1.00	.52	yes	no
22	G	0.2	2.1	0.4	2.1	2.1	0.3	1.2	.88	.48	yes	no
MEAN		1.7	1.5	1.3	1.2	2.5	0.4	1.4	.84	.57	10/10	5/10
GROUP P-only												
7	R	0.3	1.9	0.9	2.5	0.6	2.2	1.4	.21	.39	no	no
8	R	4.3	4.1	0.8	0.2	2.5	2.1	2.3	.54	.89	yes	yes
9	R	0.7	4.5	0.0	6.3	0.3	5.4	2.9	.06	.45	no	no
10	G	0.7	1.2	1.0	2.1	1.6	0.9	1.2	.65	.38	yes	no
11	G	2.3	2.7	3.0	2.6	2.6	2.6	2.6	.50	.47	no	yes
12	G	3.1	2.8	0.5	0.6	1.7	1.8	1.7	.49	.85	no	yes
23	R	2.1	2.3	2.5	3.2	2.3	2.8	2.5	.45	.43	no	no
24	R	0.1	1.8	1.2	3.0	0.7	2.4	1.5	.21	.31	no	no
25	G	1.6	1.8	0.5	0.7	1.2	1.0	1.1	.55	.75	yes	no
26	G	2.5	1.1	1.4	0.3	0.7	1.9	1.3	.25	.68	no	yes
MEAN		1.7	2.4	1.2	2.1	1.4	2.3	1.9	.39	.56	3/10	4/10
GROUP SP												
13	R	0.9	0.0	2.4	1.6	1.7	0.8	1.2	.68	.18	yes	yes
14	R	1.4	0.2	4.0	0.9	2.7	0.5	1.6	.83	.24	yes	yes
15	R	2.6	0.2	2.4	0.0	2.5	0.1	1.3	.97	.54	yes	yes
16	G	0.0	3.3	0.4	3.1	3.2	0.2	1.7	.94	.49	yes	no
17	G	0.3	1.4	0.4	1.7	1.5	0.4	0.9	.81	.45	yes	no
18	G	0.4	0.1	1.7	1.7	0.9	1.0	1.0	.47	.14	no	yes
27	R	3.3	1.2	1.6	0.0	2.4	0.6	1.5	.80	.74	yes	yes
28	R	1.8	0.0	2.3	0.3	2.1	0.1	1.1	.93	.41	yes	yes
29	G	1.8	1.6	0.2	0.6	1.1	1.0	1.1	.54	.81	yes	no
30	G	1.1	1.7	1.3	1.7	1.7	1.2	1.4	.59	.49	yes	no
MEAN		1.4	1.0	1.7	1.1	2.0	0.6	1.3	.75	.45	9/10	6/10

DATA FROM EXPERIMENT 3, SESSION 18 (CHOICE TEST)

Group & Bird	S_1=R or G	K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	0.5	0.2	0.2	0.0	0.4	0.1	0.2	.77	.77	yes	yes
2	R	3.9	0.0	5.5	0.0	4.7	0.0	2.4	1.00	.42	yes	yes
3	R	2.6	0.9	2.2	0.4	2.4	0.6	1.5	.80	.58	yes	yes
4	G	1.5	1.5	1.6	1.7	1.6	1.5	1.6	.50	.47	yes	no
5	G	0.1	0.1	0.4	0.2	0.1	0.3	0.2	.33	.32	no	yes
6	G	3.2	2.7	0.7	0.3	1.5	2.0	1.7	.43	.86	no	yes
19	R	2.4	0.4	2.2	0.3	2.3	0.3	1.3	.87	.53	yes	yes
20	R	1.5	0.0	1.1	0.0	1.3	0.0	0.7	.98	.60	yes	yes
21	G	0.3	0.7	2.6	2.5	1.6	1.4	1.5	.53	.17	yes	no
22	G	0.4	0.2	2.0	1.7	1.0	1.2	1.1	.45	.14	no	yes
MEAN		1.7	0.7	1.8	0.7	1.7	0.7	1.2	.67	.48	7/10	8/10
GROUP P-only												
7	R	0.6	0.7	1.2	1.8	0.9	1.3	1.1	.42	.32	no	no
8	R	1.0	1.3	0.0	0.0	0.5	0.7	0.6	.43	.99	no	no
9	R	1.5	2.9	0.8	2.6	1.2	2.8	2.0	.30	.56	no	no
10	G	1.5	0.5	1.3	0.8	0.6	1.4	1.0	.31	.47	no	yes
11	G	2.4	2.1	2.3	1.3	1.7	2.3	2.0	.42	.55	no	yes
12	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
23	R	0.9	1.7	0.1	0.7	0.5	1.2	0.8	.29	.79	no	no
24	R	0.6	0.9	1.0	1.4	0.8	1.2	1.0	.40	.39	no	no
25	G	0.8	1.0	0.2	0.3	0.7	0.5	0.6	.57	.77	yes	no
26	G	1.1	0.6	0.9	0.9	0.7	1.0	0.9	.43	.48	no	yes
MEAN		1.0	1.2	0.8	1.0	0.8	1.2	1.0	.40	.59	1/9	3/9
GROUP SP												
13	R	2.2	0.0	2.2	0.5	2.2	0.3	1.2	.90	.45	yes	yes
14	R	0.7	0.0	3.4	2.0	2.0	1.0	1.5	.67	.11	yes	yes
15	R	1.8	0.3	1.9	0.4	1.9	0.4	1.1	.83	.47	yes	yes
16	G	1.6	3.1	0.8	2.1	2.6	1.2	1.9	.68	.61	yes	no
17	G	0.1	0.3	0.7	1.2	0.7	0.5	0.6	.63	.20	yes	no
18	G	0.4	1.3	0.4	1.3	1.3	0.4	0.9	.76	.50	yes	no
27	R	1.9	1.2	1.0	0.3	1.5	0.8	1.1	.65	.70	yes	yes
28	R	0.8	0.4	0.5	0.7	0.7	0.5	0.6	.55	.51	yes	yes
29	G	1.9	0.9	0.4	0.5	0.7	1.1	0.9	.39	.75	no	yes
30	G	0.9	1.0	0.3	0.4	0.7	0.6	0.7	.55	.73	yes	no
MEAN		1.2	0.9	1.2	0.9	1.4	0.7	1.1	.66	.50	9/10	6/10

RATE OF RESPONSE (responses per second) — INDICES

DATA FROM EXPERIMENT 3, SESSION 19 (CHOICE TEST)

Group & Bird	S_1=R or G	K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	0.2	0.1	0.1	0.1	0.2	0.1	0.1	.54	.60	yes	yes
2	R	3.6	0.0	4.1	0.0	3.9	0.0	1.9	1.00	.47	yes	yes
3	R	2.8	1.2	1.3	0.2	2.0	0.7	1.4	.75	.72	yes	yes
4	G	1.0	0.7	1.6	1.2	1.0	1.3	1.1	.43	.37	no	yes
5	G	0.3	0.0	0.4	0.1	0.1	0.3	0.2	.18	.32	no	yes
6	G	1.6	1.7	0.4	0.5	1.1	1.0	1.1	.53	.77	yes	no
19	R	0.7	0.3	2.0	1.5	1.3	0.9	1.1	.61	.21	yes	yes
20	R	0.7	0.0	0.2	0.0	0.5	0.0	0.2	1.00	.76	yes	yes
21	G	2.2	0.2	2.9	1.2	0.7	2.5	1.6	.22	.37	no	yes
22	G	0.4	0.6	1.3	1.2	0.9	0.8	0.9	.53	.29	yes	no
MEAN		1.3	0.5	1.4	0.6	1.2	0.8	1.0	.58	.49	7/10	8/10
GROUP P-only												
7	R	0.3	0.1	1.9	1.3	1.1	0.7	0.9	.62	.12	yes	yes
8	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
9	R	2.4	1.1	1.6	0.6	2.0	0.9	1.4	.70	.61	yes	yes
10	G	0.7	1.1	0.9	1.5	1.3	0.8	1.1	.61	.42	yes	no
11	G	1.3	0.8	1.4	0.1	0.5	1.4	0.9	.25	.58	no	yes
12	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
23	R	0.0	0.8	0.1	0.8	0.1	0.8	0.4	.09	.46	no	no
24	R	1.1	0.6	1.0	0.3	1.1	0.5	0.8	.69	.58	yes	yes
25	G	0.7	0.4	0.3	0.2	0.3	0.5	0.4	.35	.70	no	yes
26	G	0.4	0.3	0.5	0.5	0.4	0.4	0.4	.49	.43	no	yes
MEAN		0.7	0.5	0.8	0.5	0.7	0.6	0.6	.47	.49	4/8	6/8
GROUP SP												
13	R	1.5	0.0	1.1	0.0	1.3	0.0	0.7	1.00	.56	yes	yes
14	R	0.4	0.1	3.5	3.9	2.0	2.0	2.0	.49	.07	no	no
15	R	1.4	1.2	0.6	0.2	1.0	0.7	0.8	.60	.77	yes	yes
16	G	2.0	1.6	2.0	1.3	1.4	2.0	1.7	.42	.52	no	yes
17	G	0.5	0.3	0.2	0.0	0.2	0.3	0.3	.34	.78	no	yes
18	G	0.3	1.8	1.1	2.3	2.0	0.7	1.4	.75	.37	yes	no
27	R	3.1	2.6	0.9	0.5	2.0	1.5	1.8	.56	.80	yes	yes
28	R	1.7	0.4	1.5	0.1	1.6	0.3	0.9	.86	.57	yes	yes
29	G	1.7	0.6	0.9	0.7	0.6	1.3	0.9	.33	.59	no	yes
30	G	0.4	0.6	0.0	0.4	0.5	0.2	0.3	.73	.72	yes	no
MEAN		1.3	0.9	1.2	0.9	1.3	0.9	1.1	.61	.58	6/10	7/10

DATA FROM EXPERIMENT 3, SESSION 20 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	0.1	0.0	0.1	0.0	0.1	0.0	0.0	1.00	.54	yes	yes
2	R	2.6	0.0	2.7	0.7	2.6	0.4	1.5	.88	.43	yes	yes
3	R	1.5	1.8	0.9	0.9	1.2	1.3	1.3	.48	.65	no	no
4	G	0.1	0.3	0.4	0.4	0.3	0.2	0.3	.57	.31	yes	no
5	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
6	G	1.1	0.3	0.5	0.0	0.2	0.8	0.5	.17	.73	no	yes
19	R	0.0	0.5	0.0	0.7	0.0	0.6	0.3	.05	.41	no	no
20	R	0.4	0.0	0.0	0.0	0.2	0.0	0.1	1.00	1.00	yes	yes
21	G	0.8	0.0	2.6	0.5	0.2	1.7	1.0	.13	.20	no	yes
22	G	0.8	0.3	0.8	0.5	0.4	0.8	0.6	.32	.46	no	yes
MEAN		0.7	0.3	0.8	0.4	0.5	0.6	0.5	.51	.53	4/9	6/9
GROUP P-only												
7	R	0.1	0.0	0.2	0.3	0.2	0.1	0.2	.53	.30	yes	yes
8	R	0.0	0.1	0.0	0.8	0.0	0.4	0.2	.00	.14	no	no
9	R	1.0	0.0	0.7	0.1	0.8	0.1	0.5	.93	.57	yes	yes
10	G	1.1	0.5	0.8	0.5	0.5	0.9	0.7	.34	.53	no	yes
11	G	0.4	0.1	1.2	0.0	0.0	0.8	0.4	.05	.27	no	yes
12	G	0.2	0.7	0.0	0.6	0.6	0.1	0.4	.84	.57	yes	no
23	R	0.2	0.3	0.0	0.4	0.1	0.3	0.2	.22	.54	no	no
24	R	0.3	0.0	0.0	0.0	0.1	0.0	0.1	.92	.92	yes	yes
25	G	0.0	0.2	0.3	0.0	0.1	0.2	0.1	.40	.42	no	yes
26	G	0.1	0.1	0.4	0.0	0.1	0.3	0.1	.16	.30	no	yes
MEAN		0.3	0.2	0.4	0.3	0.3	0.3	0.3	.44	.46	4/10	7/10
GROUP SP												
13	R	0.1	0.0	0.3	0.6	0.2	0.3	0.2	.41	.11	no	no
14	R	0.1	0.0	0.5	0.5	0.3	0.2	0.3	.56	.11	yes	yes
15	R	0.5	0.7	0.0	0.5	0.2	0.6	0.4	.29	.68	no	no
16	G	2.6	0.5	3.1	0.5	0.5	2.9	1.7	.14	.46	no	yes
17	G	0.3	0.0	0.4	0.0	0.0	0.3	0.2	.02	.44	no	yes
18	G	0.7	1.4	0.8	1.0	1.2	0.8	1.0	.61	.54	yes	no
27	R	2.9	1.7	1.0	0.0	1.9	0.9	1.4	.70	.83	yes	yes
28	R	0.4	0.2	0.0	0.0	0.2	0.1	0.2	.71	.95	yes	yes
29	G	0.3	0.0	0.2	0.2	0.1	0.2	0.2	.35	.37	no	yes
30	G	0.3	0.3	0.4	0.0	0.1	0.3	0.2	.30	.62	no	yes
MEAN		0.8	0.5	0.7	0.3	0.5	0.7	0.6	.41	.51	4/10	7/10

DATA FROM EXPERIMENT 3, SESSION 21 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 \gtrless S_2$	$R \gtrless G$
GROUP S-only												
1	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	.00	yes	yes
2	R	1.1	0.5	3.5	2.1	2.3	1.3	1.8	.65	.22	yes	yes
3	R	1.4	0.4	2.5	1.6	2.0	1.0	1.5	.67	.31	yes	yes
4	G	0.1	0.3	1.2	0.4	0.3	0.6	0.5	.32	.21	no	yes
5	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
6	G	0.3	0.0	0.3	0.1	0.0	0.3	0.2	.10	.47	no	yes
19	R	0.4	0.0	0.0	0.1	0.2	0.1	0.1	.81	.81	yes	yes
20	R	0.6	0.0	0.2	0.0	0.4	0.0	0.2	1.00	.72	yes	yes
21	G	0.5	0.0	0.8	0.0	0.0	0.7	0.3	.03	.34	no	yes
22	G	0.0	0.4	0.2	0.1	0.3	0.1	0.2	.71	.61	yes	no
MEAN		0.5	0.2	0.9	0.4	0.6	0.4	0.5	.59	.41	6/9	8/9
GROUP P-only												
7	R	0.2	0.0	0.1	0.2	0.1	0.1	0.1	.51	.37	yes	yes
8	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
9	R	0.4	0.0	0.1	0.1	0.3	0.1	0.2	.81	.67	yes	yes
10	G	0.1	0.3	0.3	0.1	0.2	0.2	0.2	.55	.52	yes	no
11	G	0.5	0.1	0.9	0.5	0.3	0.7	0.5	.26	.31	no	yes
12	G	0.5	0.9	0.3	0.7	0.8	0.4	0.6	.67	.59	yes	no
23	R	0.0	0.0	0.0	0.4	0.0	0.2	0.1	.00	.00	no	no
24	R	0.2	0.0	0.0	0.0	0.1	0.0	0.1	1.00	1.00	yes	yes
25	G	0.0	0.0	0.2	0.0	0.0	0.1	0.1	.13	.13	no	yes
26	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.00	.00	no	yes
MEAN		0.2	0.1	0.2	0.2	0.2	0.2	0.2	.44	.40	5/9	6/9
GROUP SP												
13	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
14	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
15	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
16	G	0.9	0.0	0.8	0.2	0.1	0.9	0.5	.09	.48	no	yes
17	G	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.00	.00	yes	no
18	G	0.1	0.0	0.7	0.2	0.1	0.4	0.3	.17	.13	no	yes
27	R	2.4	3.1	0.1	0.3	1.3	1.7	1.5	.42	.93	no	no
28	R	0.1	0.1	0.0	0.0	0.1	0.0	0.1	.75	.95	yes	yes
29	G	0.0	0.2	0.1	0.1	0.2	0.0	0.1	.78	.49	yes	no
30	G	0.3	0.2	0.0	0.1	0.1	0.1	0.1	.52	.89	yes	no
MEAN		0.4	0.4	0.2	0.1	0.2	0.3	0.3	.53	.55	4/7	3/7

DATA FROM EXPERIMENT 3, SESSION 22 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$\frac{S_1}{S_2}$	$\frac{R}{G}$
GROUP S-only												
1	R	0.0	0.2	0.0	0.0	0.0	0.1	0.1	.14	.86	no	no
2	R	0.2	0.0	1.4	1.3	0.8	0.7	0.7	.54	.08	yes	yes
3	R	2.0	0.6	2.7	1.1	2.4	0.9	1.6	.73	.41	yes	yes
4	G	0.1	0.0	0.1	0.0	0.0	0.1	0.1	.14	.43	no	yes
5	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
6	G	0.2	0.3	0.2	0.0	0.1	0.2	0.1	.46	.72	no	yes
19	R	0.0	0.4	0.0	0.4	0.0	0.4	0.2	.00	.54	no	no
20	R	0.3	0.0	0.0	0.0	0.2	0.0	0.1	.88	.79	yes	yes
21	G	0.4	0.0	0.6	0.0	0.0	0.5	0.3	.02	.40	no	yes
22	G	0.1	0.0	0.3	0.2	0.1	0.2	0.1	.33	.23	no	yes
MEAN		0.3	0.2	0.5	0.3	0.4	0.3	0.3	.36	.50	3/9	7/9
GROUP P-only												
7	R	0.2	0.5	0.1	0.4	0.2	0.4	0.3	.27	.57	no	no
8	R	0.0	0.7	0.0	1.3	0.0	1.0	0.5	.01	.34	no	no
9	R	0.0	0.0	0.0	0.1	0.0	0.0	0.0	.00	.00	no	no
10	G	0.3	0.0	0.1	0.2	0.1	0.2	0.1	.35	.47	no	yes
11	G	0.7	1.1	0.4	0.7	0.9	0.6	0.7	.61	.64	yes	no
12	G	0.5	0.8	0.3	0.1	0.4	0.4	0.4	.53	.76	yes	no
23	R	0.0	0.0	0.1	0.0	0.0	0.0	0.0	.86	.00	yes	yes
24	R	0.1	0.0	0.0	0.3	0.1	0.1	0.1	.26	.24	no	no
25	G	0.0	0.0	0.1	0.0	0.0	0.0	0.0	.00	.00	no	yes
26	G	0.5	0.1	0.1	0.0	0.0	0.3	0.2	.13	.92	no	yes
MEAN		0.2	0.3	0.1	0.3	0.2	0.3	0.2	.30	.39	3/10	4/10
GROUP SP												
13	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
14	R	0.2	0.0	0.0	0.0	0.1	0.0	0.1	1.00	.83	yes	yes
15	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.00	1.00	no	no
16	G	0.2	0.0	0.2	0.0	0.0	0.2	0.1	.12	.49	no	yes
17	G	0.0	0.0	0.1	0.0	0.0	0.1	0.0	.08	.00	no	yes
18	G	0.9	0.4	0.7	0.6	0.5	0.8	0.6	.39	.50	no	yes
27	R	2.4	2.1	0.0	0.0	1.2	1.1	1.1	.53	.99	yes	yes
28	R	0.2	0.4	0.1	0.0	0.1	0.2	0.2	.40	.91	no	no
29	G	0.5	0.3	0.1	0.4	0.3	0.3	0.3	.56	.63	yes	no
30	G	0.0	0.1	0.1	0.4	0.2	0.0	0.1	.88	.20	yes	no
MEAN		0.4	0.3	0.1	0.1	0.3	0.3	0.3	.44	.62	4/9	5/9

DATA FROM EXPERIMENT 3, SESSION 23 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	0.0	0.0	0.4	0.0	0.2	0.0	0.1	.89	.09	yes	yes
2	R	0.0	0.0	0.1	1.0	0.0	0.5	0.3	.05	.00	no	no
3	R	2.1	1.1	2.0	0.9	2.0	1.0	1.5	.68	.52	yes	yes
4	G	0.0	0.0	0.3	0.0	0.0	0.2	0.1	.00	.03	no	yes
5	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
6	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
19	R	0.0	0.1	0.0	0.2	0.0	0.2	0.1	.03	.37	no	no
20	R	0.3	0.0	0.0	0.0	0.2	0.0	0.1	1.00	.93	yes	yes
21	G	0.1	0.0	0.3	0.0	0.0	0.2	0.1	.00	.22	no	yes
22	G	0.0	0.0	0.5	0.1	0.0	0.3	0.1	.12	.05	no	yes
MEAN		0.3	0.1	0.4	0.2	0.3	0.2	0.2	.35	.28	3/8	6/8
GROUP P-only												
7	R	0.1	0.0	0.1	0.0	0.1	0.0	0.0	1.00	.45	yes	yes
8	R	0.0	0.4	0.0	0.3	0.0	0.3	0.2	.00	.61	no	no
9	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.00	.00	no	no
10	G	0.1	0.1	0.1	0.0	0.0	0.1	0.1	.33	.71	no	yes
11	G	0.1	0.2	0.3	0.0	0.1	0.2	0.2	.34	.56	no	yes
12	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
23	R	0.3	0.0	0.0	0.0	0.1	0.0	0.1	1.00	1.00	yes	yes
24	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.00	1.00	no	no
25	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
26	G	0.1	0.0	0.3	0.0	0.0	0.1	0.1	.00	.18	no	yes
MEAN		0.1	0.1	0.1	0.0	0.0	0.1	0.1	.33	.56	2/8	5/8
GROUP SP												
13	R	0.1	0.0	0.1	0.5	0.1	0.2	0.2	.25	.17	no	no
14	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
15	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
16	G	0.2	0.0	0.3	0.0	0.0	0.2	0.1	.07	.41	no	yes
17	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.43	.00	no	yes
18	G	0.1	0.0	0.2	0.3	0.2	0.2	0.2	.50	.15	--	--
27	R	1.9	1.0	0.9	0.4	1.4	0.7	1.1	.65	.69	yes	yes
28	R	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.00	1.00	yes	yes
29	G	0.1	0.3	0.1	0.1	0.2	0.1	0.2	.63	.66	yes	no
30	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.50	1.00	--	--
MEAN		0.3	0.1	0.2	0.1	0.2	0.1	0.2	.50	.51	3/6	4/6

DATA FROM EXPERIMENT 3, SESSION 24 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
2	R	0.0	0.0	0.0	0.4	0.0	0.2	0.1	.07	.00	no	no
3	R	2.3	1.8	0.8	0.8	1.5	1.3	1.4	.54	.73	yes	yes
4	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.00	1.00	no	yes
5	G	0.3	0.0	0.0	0.0	0.0	0.2	0.1	.00	1.00	no	yes
6	G	0.7	0.1	0.3	0.0	0.1	0.5	0.3	.10	.72	no	yes
19	R	0.3	0.4	0.0	0.0	0.1	0.2	0.2	.36	1.00	no	no
20	R	0.1	0.0	0.1	0.0	0.1	0.0	0.1	1.00	.68	yes	yes
21	G	0.0	0.1	0.5	0.1	0.1	0.2	0.2	.24	.17	no	yes
22	G	0.1	0.0	0.4	0.0	0.0	0.2	0.1	.08	.16	no	yes
MEAN		0.4	0.3	0.2	0.1	0.2	0.3	0.2	.27	.61	2/9	7/9
GROUP P-only												
7	R	0.0	0.0	0.0	0.2	0.0	0.1	0.1	.00	.00	no	no
8	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
9	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
10	G	0.1	0.4	0.1	0.3	0.3	0.1	0.2	.77	.55	yes	no
11	G	0.6	0.0	0.2	0.0	0.0	0.4	0.2	.03	.74	no	yes
12	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
23	R	0.0	0.0	0.0	0.2	0.0	0.1	0.1	.11	.11	no	no
24	R	0.1	0.0	0.0	0.0	0.1	0.0	0.0	.79	.79	yes	yes
25	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
26	G	0.0	0.0	0.1	0.0	0.0	0.1	0.0	.07	.07	no	yes
MEAN		0.1	0.0	0.1	0.1	0.0	0.1	0.1	.29	.38	2/6	3/6
GROUP SP												
13	R	0.3	0.3	0.0	0.0	0.1	0.1	0.1	.49	.98	no	no
14	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
15	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
16	G	0.4	0.2	0.8	0.0	0.1	0.6	0.4	.16	.45	no	yes
17	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
18	G	0.1	0.8	0.4	0.4	0.6	0.2	0.4	.70	.51	yes	no
27	R	0.9	0.1	0.1	0.1	0.5	0.1	0.3	.79	.80	yes	yes
28	R	0.0	0.0	0.1	0.0	0.0	0.0	0.0	.70	.10	yes	yes
29	G	0.0	0.0	0.2	0.2	0.1	0.1	0.1	.51	.00	yes	no
30	G	0.0	0.0	0.2	0.0	0.0	0.1	0.1	.09	.00	no	yes
MEAN		0.2	0.1	0.2	0.1	0.1	0.1	0.1	.49	.41	4/7	4/7

DATA FROM EXPERIMENT 3, SESSION 25 (CHOICE TEST)

Group & Bird	S_1=R or G	K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.00	1.00	yes	yes
2	R	0.0	0.0	0.8	1.0	0.4	0.5	0.5	.45	.01	no	no
3	R	0.7	2.6	0.2	2.6	0.4	2.6	1.5	.14	.54	no	no
4	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.00	1.00	no	yes
5	G	0.4	0.9	0.4	0.1	0.5	0.4	0.5	.58	.73	yes	no
6	G	0.5	0.1	0.1	0.1	0.1	0.3	0.2	.24	.79	no	yes
19	R	0.1	0.0	0.0	0.0	0.1	0.0	0.0	.71	.71	yes	yes
20	R	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.00	1.00	yes	yes
21	G	0.1	0.0	0.1	0.0	0.0	0.1	0.1	.22	.44	no	yes
22	G	0.0	0.0	0.1	0.0	0.0	0.1	0.0	.07	.07	no	yes
MEAN		0.2	0.4	0.2	0.4	0.2	0.4	0.3	.44	.63	4/11	7/10
GROUP P-only												
7	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	1.00	yes	yes
8	R	0.0	0.2	0.0	0.0	0.0	0.1	0.0	.00	1.00	no	no
9	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
10	G	0.0	0.0	0.0	0.3	0.1	0.0	0.1	.96	.00	yes	no
11	G	0.0	0.2	0.6	0.1	0.1	0.3	0.2	.29	.19	no	yes
12	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
23	R	0.0	0.0	0.5	0.3	0.2	0.2	0.2	.60	.00	yes	yes
24	R	0.1	1.1	0.3	0.6	0.2	0.9	0.5	.19	.58	no	no
25	G	0.0	0.3	0.0	0.0	0.2	0.0	0.1	1.00	1.00	yes	no
26	G	0.0	0.0	0.1	0.0	0.0	0.1	0.0	.08	.00	no	yes
MEAN		0.0	0.2	0.1	0.1	0.1	0.1	0.1	.51	.47	4/8	4/8
GROUP SP												
13	R	0.3	0.7	0.1	0.1	0.2	0.4	0.3	.33	.81	no	no
14	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
15	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
16	G	0.2	0.5	0.0	0.3	0.4	0.1	0.3	.81	.66	yes	no
17	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
18	G	0.3	1.0	0.0	0.0	0.5	0.2	0.3	.75	1.00	yes	no
27	R	0.4	0.6	0.1	0.5	0.3	0.5	0.4	.34	.62	no	no
28	R	0.0	0.0	0.1	0.0	0.0	0.0	0.0	.45	.36	no	no
29	G	0.4	0.1	0.2	0.4	0.2	0.3	0.3	.41	.49	no	yes
30	G	0.5	0.0	0.2	0.0	0.0	0.3	0.2	.02	.69	no	yes
MEAN		0.2	0.3	0.1	0.1	0.2	0.2	0.2	.44	.66	2/7	2/7

DATA FROM EXPERIMENT 3, SESSION 26 (CHOICE TEST)

Group & Bird	S_1=R or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$\frac{S_1}{S_2}$	$\frac{R}{G}$
GROUP S-only												
1	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
2	R	0.3	0.0	0.2	0.3	0.2	0.1	0.2	.63	.40	yes	yes
3	R	0.9	2.0	1.1	2.4	1.0	2.2	1.6	.30	.46	no	no
4	G	0.0	0.0	0.7	0.4	0.2	0.3	0.3	.37	.05	no	yes
5	G	0.3	0.0	0.3	0.0	0.0	0.3	0.2	.00	.48	no	yes
6	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
19	R	0.4	0.4	0.0	0.1	0.2	0.3	0.2	.46	.90	no	no
20	R	0.3	0.0	0.0	0.0	0.2	0.0	0.1	1.00	.89	yes	yes
21	G	0.0	0.2	0.4	0.0	0.1	0.2	0.1	.37	.31	no	yes
22	G	0.0	0.0	0.2	0.0	0.0	0.1	0.1	.00	.00	no	yes
MEAN		0.2	0.3	0.3	0.3	0.2	0.3	0.3	.39	.44	2/8	6/8
GROUP P-only												
7	R	0.0	0.0	0.0	0.1	0.0	0.1	0.0	.00	.00	no	no
8	R	0.0	0.2	0.0	0.6	0.0	0.4	0.2	.01	.23	no	no
9	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
10	G	0.0	0.1	0.1	0.0	0.0	0.0	0.0	.50	.50	--	--
11	G	0.3	0.1	0.4	0.0	0.0	0.3	0.2	.09	.42	no	yes
12	G	0.4	0.4	0.1	0.0	0.2	0.3	0.2	.46	.87	no	yes
23	R	0.0	0.1	0.0	0.3	0.0	0.2	0.1	.00	.35	no	no
24	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
25	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	1.00	yes	no
26	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.50	.50	--	--
MEAN		0.1	0.1	0.1	0.1	0.0	0.1	0.1	.32	.48	1/6	2/6
GROUP SP												
13	R	0.0	0.1	0.0	0.1	0.0	0.1	0.1	.22	.50	no	no
14	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	1.00	yes	yes
15	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
16	G	0.1	0.0	1.2	1.0	0.5	0.7	0.6	.43	.06	no	yes
17	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
18	G	0.1	0.0	0.0	0.1	0.1	0.1	0.1	.41	.59	no	yes
27	R	0.5	0.2	0.0	0.0	0.2	0.1	0.2	.70	.97	yes	yes
28	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
29	G	0.0	0.1	0.1	0.0	0.1	0.1	0.1	.44	.37	no	yes
30	G	0.1	0.0	0.0	0.0	0.0	0.0	0.0	.14	1.00	no	yes
MEAN		0.1	0.0	0.1	0.1	0.1	0.1	0.1	.48	.64	2/7	6/7

DATA FROM EXPERIMENT 3, SESSION 27 (CHOICE TEST)

176.

Group & Bird	$S_1=R$ or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\frac{R_1+R_2}{2}$	$\frac{R_1}{R_1+R_2}$	$\frac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.00	.00	no	no
2	R	0.8	0.0	3.0	0.7	1.9	0.4	1.1	.84	.19	yes	yes
3	R	1.5	1.7	1.1	1.6	1.3	1.7	1.5	.44	.54	no	no
4	G	0.0	0.0	0.2	0.0	0.0	0.1	0.1	.00	.00	no	yes
5	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
6	G	0.1	0.0	0.1	0.0	0.0	0.1	0.1	.05	.63	no	yes
19	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
20	R	0.2	0.0	0.0	0.0	0.1	0.0	0.1	1.00	1.00	yes	yes
21	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.80	.80	yes	no
22	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
MEAN		0.3	0.2	0.5	0.2	0.3	0.2	0.3	.45	.45	3/7	4/7
GROUP P-only												
7	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
8	R	0.1	0.4	1.1	0.0	0.6	0.2	0.4	.75	.31	yes	yes
9	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
10	G	0.0	0.2	0.0	0.0	0.1	0.0	0.1	.96	.91	yes	no
11	G	0.6	0.2	0.2	0.0	0.1	0.4	0.3	.23	.82	no	yes
12	G	1.8	1.3	0.6	0.9	1.1	1.2	1.1	.47	.67	no	yes
23	R	0.1	0.0	0.0	0.2	0.0	0.1	0.1	.24	.24	no	no
24	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
25	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
26	G	0.0	0.0	0.1	0.0	0.0	0.0	0.0	.00	.00	no	yes
MEAN		0.3	0.2	0.2	0.1	0.2	0.2	0.2	.44	.49	2/6	4/6
GROUP SP												
13	R	0.0	0.0	0.0	0.2	0.0	0.1	0.1	.00	.06	no	no
14	R	0.1	0.0	0.0	0.0	0.1	0.0	0.0	1.00	1.00	yes	yes
15	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
16	G	1.3	0.2	0.0	0.4	0.3	0.7	0.5	.32	.76	no	yes
17	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
18	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
27	R	0.1	0.0	0.0	0.0	0.0	0.0	0.0	.83	1.00	yes	yes
28	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
29	G	0.0	0.0	0.1	0.0	0.0	0.1	0.1	.23	.23	no	yes
30	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
MEAN		0.1	0.0	0.0	0.1	0.0	0.1	0.1	.48	.61	2/5	4/5

DATA FROM EXPERIMENT 3, SESSION 28 (CHOICE TEST)

Group & Bird	$S_1=R$ or G	RATE OF RESPONSE (responses per second)							INDICES			
		K1R	K1G	K2R	K2G	R_1	R_2	$\dfrac{R_1+R_2}{2}$	$\dfrac{R_1}{R_1+R_2}$	$\dfrac{K_1}{K_1+K_2}$	$S_1 > S_2$	$R > G$
GROUP S-only												
1	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.00	1.00	no	no
2	R	0.0	0.0	0.0	0.3	0.0	0.1	0.1	.11	.04	no	no
3	R	0.7	1.8	1.4	1.9	1.1	1.9	1.5	.37	.43	no	no
4	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
5	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
6	G	0.9	0.1	0.6	0.0	0.0	0.8	0.4	.03	.60	no	yes
19	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
20	R	0.3	0.0	0.1	0.0	0.2	0.0	0.1	.98	.77	yes	yes
21	G	0.0	0.0	0.2	0.0	0.0	0.1	0.1	.00	.00	no	yes
22	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
MEAN		0.2	0.2	0.2	0.2	0.1	0.3	0.2	.25	.47	1/6	3/6
GROUP P-only												
7	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
8	R	0.0	0.0	0.0	0.3	0.0	0.2	0.1	.00	.00	no	no
9	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
10	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
11	G	0.2	0.0	0.4	0.0	0.0	0.3	0.1	.00	.30	no	yes
12	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
23	R	0.0	0.1	0.0	0.0	0.0	0.1	0.0	.14	.86	no	no
24	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
25	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
26	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
MEAN		0.0	0.0	0.0	0.0	0.0	0.1	0.0	.05	.39	0/3	1/3
GROUP SP												
13	R	0.0	0.0	0.0	0.2	0.0	0.1	0.1	.14	.29	no	no
14	R	0.0	0.0	0.2	0.0	0.1	0.0	0.1	1.00	.00	yes	yes
15	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
16	G	0.5	0.1	0.8	0.1	0.1	0.7	0.4	.14	.40	no	yes
17	G	0.0	0.0	0.2	0.0	0.0	0.1	0.1	.00	.00	no	yes
18	G	1.3	0.9	0.1	0.1	0.5	0.7	0.6	.43	.93	no	yes
27	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.00	.00	yes	yes
28	R	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
29	G	0.0	0.0	0.2	0.3	0.2	0.1	0.1	.66	.06	yes	no
30	G	0.0	0.0	0.0	0.0	0.0	0.0	0.0	--	--	--	--
MEAN		0.2	0.1	0.1	0.1	0.1	0.2	0.1	.48	.24	3/7	5/7

SUMMARY DATA FOR EXP.3

$R_1/(R_1+R_2)$ VALUES FOR INDIVIDUAL BIRDS DURING SINGLE-STIMULUS TRAINING (SST) AND CHOICE TESTS (CT)

(decimal points are omitted to save space)

Bird & Group	S_1=R or G	12	13	14	15	16	mean 12-16	17	18	19	20	21	22	23	24	25	26	27	28
GROUP S-only							[b]	[b]											
1	R	54	59	53	58	60	57	82	77	54	100	100	14	89	--	100	--	00	00
2	R	76	70	76	74	66	73	100	100	100	88	65	54	05	07	45	63	84	11
3	R	46	49	47	50	46	48	71	80	75	48	67	73	68	54	14	30	44	37
4	G	53	51	52	53	49	52	91	50	43	57	32	14	00	00	00	37	00	--
5	G	51	47	[a]	49	44	48	52	33	18	--	--	--	--	00	58	00	--	--
6	G	55	54	53	52	52	53	80	43	53	17	10	46	--	10	24	--	05	03
19	R	67	64	68	70	75	69	94	87	61	05	81	00	03	36	71	46	--	--
20	R	41	48	42	46	44	44	86	98	100	100	100	88	100	100	100	100	100	98
21	G	49	49	49	48	47	48	100	53	22	13	03	02	00	24	22	37	80	00
22	G	54	53	53	52	53	53	88	45	53	32	71	33	12	08	07	00	--	--
MEAN		55	55	55	55	54	55	84	67	58	51	59	36	35	27	44	39	45	25
GROUP P-only																			
7	R	52	51	55	51	56	53	21	42	62	53	51	27	100	00	100	00	--	--
8	R	68	82	74	75	69	73	54	43	--	00	--	01	00	--	00	01	75	00
9	R	51	49	44	50	46	48	06	30	70	93	81	00	00	--	--	--	--	--
10	G	54	52	48	51	53	52	65	31	61	34	55	35	33	77	96	50	96	--
11	G	52	50	51	53	47	51	50	42	25	05	26	61	34	03	29	09	23	00
12	G	53	55	54	52	50	53	49	--	--	84	67	53	--	--	--	46	47	--
23	R	61	55	55	53	53	56	45	29	09	22	00	86	100	11	60	00	24	14
24	R	46	47	46	45	51	47	21	40	69	92	100	26	00	79	19	--	--	--
25	G	49	53	53	58	51	53	55	57	35	40	13	00	--	--	100	100	--	--
26	G	56	59	58	56	59	57	25	43	49	16	00	13	00	07	8	50	00	--
MEAN		54	55	54	54	53	54	39	40	47	44	44	30	33	29	51	32	44	05
GROUP SP																			
13	R	48	51	53	53	47	50	68	90	100	41	--	--	25	49	33	22	00	14
14	R	44	46	43	48	44	45	83	67	49	56	--	100	--	--	--	100	100	100
15	R	52	48	51	51	53	51	97	83	60	29	--	00	--	--	--	--	--	--
16	G	48	53	50	51	52	51	94	68	42	14	09	12	07	16	81	43	32	14
17	G	54	63	52	54	56	56	81	63	34	02	100	08	43	--	--	--	--	00
18	G	45	49	51	49	49	48	47	76	75	61	17	39	50	70	75	41	--	43
27	R	46	45	46	47	45	46	80	65	56	70	42	53	65	79	34	70	83	100
28	R	50	54	53	55	53	53	93	55	86	71	75	40	100	70	45	--	--	--
29	G	61	61	60	60	60	60	54	39	33	35	78	56	63	51	41	44	23	66
30	G	47	50	50	48	50	49	59	55	73	30	52	88	50	09	02	14	--	--
MEAN		49	52	51	52	51	51	75	66	61	41	53	44	50	49	44	48	48	48

[a]Misleading index based on very few responses is omitted.
[b]Correlations between entries for individual birds in these two columns are $r_s = +.51$ in Group S-only
$r_s = +.18$ in Group P-only
$r_s = +.13$ in Group SP

DATA FROM EXPERIMENT 4

Note: the following data sheets are the printout from
a data analysis program written on FOCAL on the PDP-8 computer.
The sixteen numbers above each table are counter readings,
entered on the teletype by the operator, showing cumulative
responses to left key red, left key green, right key red, and
right key green after trials 40, 42, 44, and 48 of each session.
The main tables show responses per second, and are parallel to
previous tables for Experiments 1, 2, and 3. However, here
for the first time there are examples of responding on individual
choice trials.

The main tables show mean response rates over the first
40 single-stimulus trials, response rates on each of the four
choice trials, mean response rates over the four choice trials,
amd mean response rates over the last four single-stimulus trials.
Although the order of presentation of the choice trials within
trials 41-42 and within trials 43-44 was varied, the computer
program always wrote the data from those trials in the same
fixed order.

Entries in the "ALL" column are equivalent to entries in
the $\frac{R_1+R_2}{2}$ column for previous experiments. Note that this means
the "ALL" column shows mean rate of response to S_1 and S_2 on the
choice test (trials 41-44), not total rate. In order to compare
total rates of response during single-stimulus training and on choice
tests, entries in the "ALL" column in the row labelled "41-4" must
be doubled.

DATA:
:99 :78 :75 :107
:99 :78 :84 :120
:101 :84 :88 :130
:111 :97 :96 :144

DAY:4 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	1.60	1.26	1.21	1.73	1.40	1.49	1.45	0.485	0.485	0.493
41	0.00			2.10	0.00	2.10	2.10	0.000	0.000	0.000
42		0.00	1.45		1.45	0.00	1.45	1.000	1.000	0.000
43	0.32			1.61	0.32	1.61	1.94	0.167	0.167	0.167
44		0.97	0.65		0.65	0.97	1.61	0.400	0.400	0.600
41-4	0.16	0.48	1.05	1.85	0.60	1.17	0.89	0.341	0.341	0.182
45-8	1.61	2.10	1.29	2.26	1.45	2.18	1.81	0.400	0.400	0.511

DATA:
:202 :155 :179 :163
:216 :166 :185 :167
:229 :166 :208 :171
:251 :185 :227 :191

DAY:4 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	3.26	2.50	2.89	2.63	3.07	2.56	2.82	0.545	0.545	0.511
41	2.26			0.65	2.26	0.65	2.90	0.778	0.778	0.778
42		1.77	0.97		0.97	1.77	2.74	0.353	0.353	0.647
43	2.10			0.65	2.10	0.65	2.74	0.765	0.765	0.765
44		0.00	3.71		3.71	0.00	3.71	1.000	1.000	0.000
41-4	2.18	0.89	2.34	0.65	2.26	0.77	1.51	0.747	0.747	0.507
45-8	3.55	3.06	3.06	3.23	3.31	3.15	3.23	0.512	0.512	0.512

DATA:
:156 :201 :31 :99
:161 :201 :33 :103
:175 :215 :33 :103
:194 :240 :36 :107

DAY:4 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	2.52	3.24	0.50	1.60	1.51	2.42	1.96	0.384	0.384	0.733
41	0.81			0.65	0.81	0.65	1.45	0.556	0.556	0.556
42		0.00	0.32		0.32	0.00	0.32	1.000	1.000	0.000
43	2.26			0.00	2.26	0.00	2.26	1.000	1.000	1.000
44		2.26	0.00		0.00	2.26	2.26	0.000	0.000	1.000
41-4	1.53	1.13	0.16	0.32	0.85	0.73	0.79	0.538	0.538	0.846
45-8	3.06	4.03	0.48	0.65	1.77	2.34	2.06	0.431	0.431	0.863

DATA:
:178 :148 :131 :147
:194 :151 :141 :149
:198 :154 :149 :160
:223 :174 :165 :179

DAY:4 BIRD:4 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	2.87	2.39	2.11	2.37	2.49	2.38	2.44	0.512	0.488	0.540
41	2.58			0.32	2.58	0.32	2.90	0.889	0.111	0.889
42		0.48	1.61		1.61	0.48	2.10	0.769	0.231	0.231
43	0.65			1.77	0.65	1.77	2.42	0.267	0.733	0.267
44		0.48	1.29		1.29	0.48	1.77	0.727	0.273	0.273
41-4	1.61	0.48	1.45	1.05	1.53	0.77	1.15	0.667	0.333	0.456
45-8	4.03	3.23	2.58	3.06	3.31	3.15	3.23	0.513	0.488	0.563

DATA:
:57 :36 :95 :29
:61 :38 :96 :29
:71 :44 :96 :29
:80 :53 :106 :35

DAY:4 BIRD:5 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	0.92	0.58	1.53	0.47	1.23	0.52	0.87	0.700	0.300	0.429
41	0.65			0.00	0.65	0.00	0.65	1.000	0.000	1.000
42		0.32	0.16		0.16	0.32	0.48	0.333	0.667	0.667
43	1.61			0.00	1.61	0.00	1.61	1.000	0.000	1.000
44		0.97	0.00		0.00	0.97	0.97	0.000	1.000	1.000
41-4	1.13	0.65	0.08	0.00	0.60	0.32	0.46	0.652	0.348	0.957
45-8	1.45	1.45	1.61	0.97	1.53	1.21	1.37	0.559	0.441	0.529

DATA:
:280 :170 :297 :135
:306 :171 :325 :135
:4-344 :171 :348 :135
:371 :197 :385 :156

DAY:4 BIRD:6 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	4.52	2.74	4.79	2.18	4.65	2.46	3.56	0.654	0.346	0.510
41	4.19			0.00	4.19	0.00	4.19	1.000	0.000	1.000
42		0.16	4.52		4.52	0.16	4.68	0.966	0.034	0.034
43	6.13			0.00	6.13	0.00	6.13	1.000	0.000	1.000
44		0.00	3.71		3.71	0.00	3.71	1.000	0.000	0.000
41-4	5.16	0.08	4.11	0.00	4.64	0.04	2.34	0.991	0.009	0.560
45-8	4.35	4.19	5.97	3.39	5.16	3.79	4.48	0.577	0.423	0.477

```
DATA:
:191 :162 :105 :163
:127 :162 :128 :164
:143 :162 :150 :164
:171 :184 :174 :182
```

DAY:11 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	1.63	2.61	1.69	2.63	1.66	2.62	2.14	0.388	0.388	0.495
41	4.19			0.16	4.19	0.16	4.35	0.963	0.963	0.963
42		0.00	3.71		3.71	0.00	3.71	1.000	1.000	0.000
43	3.39			0.00	3.39	0.00	3.39	1.000	1.000	1.000
44		0.00	3.55		3.55	0.00	3.55	1.000	1.000	0.000
41-4	3.79	0.00	3.63	0.08	3.71	0.04	1.88	0.989	0.989	0.505
45-8	3.71	3.55	3.87	2.90	3.79	3.23	3.51	0.540	0.540	0.517

```
DATA:
:237 :219 :228 :227
:237 :243 :228 :250
:237 :261 :231 :272
:256 :263 :253 :292
```

DAY:11 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	3.68	3.53	3.68	3.66	3.75	3.60	3.67	0.510	0.510	0.501
41	0.00			3.71	0.00	3.71	3.71	0.000	0.000	0.000
42		3.87	0.00		0.00	3.87	3.87	0.000	0.000	1.000
43	0.00			3.55	0.00	3.55	3.55	0.000	0.000	0.000
44		2.90	0.48		0.48	2.90	3.39	0.143	0.143	0.857
41-4	0.00	3.39	0.24	3.63	0.12	3.51	1.81	0.033	0.033	0.467
45-8	3.56	3.55	3.55	3.23	3.31	3.39	3.35	0.494	0.494	0.494

```
DATA:
:346 :317 :223 :237
:348 :317.001 :223.001 :257
:350 :317 :225 :266
:376 :346 :249 :287
```

DAY:11 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	5.58	5.11	3.60	3.82	4.59	4.47	4.53	0.507	0.507	0.590
41	0.32			3.23	0.32	3.23	3.55	0.091	0.091	0.091
42		0.00	0.00		0.00	0.00	0.00			
43	0.32			1.45	0.32	1.45	1.77	0.182	0.182	0.182
44		0.00	0.32		0.32	0.00	0.32	1.001	1.001	0.001
41-4	0.32	0.00	0.16	2.34	0.24	1.17	0.71	0.171	0.171	0.114
45-8	4.19	4.68	3.87	3.39	4.03	4.03	4.03	0.500	0.500	0.550

DATA:
:257 :233 :229 :228
:257 :255 :229 :249
:285 :277 :229 :249
:317 :303 :259 :277

DAY:11 BIRD:4 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	4.15	3.76	3.69	3.68	3.92	3.72	3.82	0.513	0.487	0.517
41	0.00			3.39	0.00	3.39	3.39	0.000	1.000	0.000
42		3.55	0.00		0.00	3.55	3.55	0.000	1.000	1.000
43	4.52			0.00	4.52	0.00	4.52	1.000	0.000	1.000
44		3.55	0.00		0.00	3.55	3.55	0.000	1.000	1.000
41-4	2.26	3.55	0.00	1.69	1.13	2.62	1.88	0.301	0.699	0.774
45-8	5.16	4.19	4.84	4.52	5.00	4.35	4.68	0.534	0.466	0.500

DATA:
:185 :174 :10←195←194 :187
:209 :174 :213 :187
:232 :194 :213 :187
:251 :210 :232 :202

DAY:11 BIRD:5 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	2.98	2.81	3.13	3.02	3.06	2.91	2.98	0.512	0.488	0.485
41	3.87			0.00	3.87	0.00	3.87	1.000	0.000	1.000
42		0.00	3.06		3.06	0.00	3.06	1.000	0.000	0.000
43	3.71			0.00	3.71	0.00	3.71	1.000	0.000	1.000
44		3.23	0.00		0.00	3.23	3.23	0.000	1.000	1.000
41-4	3.79	1.61	1.53	0.00	2.66	0.81	1.73	0.767	0.233	0.779
45-8	3.06	2.53	3.06	2.42	3.06	2.50	2.78	0.551	0.449	0.507

DATA:
:338 :232 :342 :295
:338 :312 :342 :312
:355 :317 :345 :312
:390 :352 :385 :352

DAY:11 BIRD:6 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	5.45	4.55	5.52	4.76	5.48	4.65	5.07	0.541	0.459	0.493
41	0.00			2.74	0.00	2.74	2.74	0.000	1.000	0.000
42		4.84	0.00		0.00	4.84	4.84	0.000	1.000	1.000
43	2.74			0.00	2.74	0.00	2.74	1.000	0.000	1.000
44		0.81	0.48		0.48	0.81	1.29	0.375	0.625	0.625
41-4	1.37	2.32	0.24	1.37	0.81	2.16	1.45	0.273	0.722	0.722
45-8	5.65	5.81	6.45	6.45	6.05	6.13	6.09	0.497	0.503	0.470

DATA:
```
:208 :0 :271 :0
:231 :0 :297 :3
:246 :0 :320 :3
:286 :0 :344 :0
```

DAY:12 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	1.68		2.19		1.93		1.93			0.434
41	3.71			0.48	3.71	0.48	4.19	0.885	0.885	0.885
42		0.00	4.19		4.19	0.00	4.19	1.000	1.000	0.000
43	2.42			0.00	2.42	0.00	2.42	1.000	1.000	1.000
44		0.00	3.71		3.71	0.00	3.71	1.000	1.000	0.000
41-4	3.06	0.00	3.95	0.24	3.51	0.12	1.81	0.967	0.967	0.422
45-8	3.23		1.94		2.58		2.58			0.625

DATA:
```
:493 :0 :462 :0
:517 :0 :490 :0
:543 :0 :516 :0
:596 :0 :565 :0
```

DAY:12 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	3.98		3.73		3.85		3.85			0.516
41	3.87			0.00	3.87	0.00	3.87	1.000	1.000	1.000
42		0.00	4.52		4.52	0.00	4.52	1.000	1.000	0.000
43	4.19			0.00	4.19	0.00	4.19	1.000	1.000	1.000
44		0.00	4.19		4.19	0.00	4.19	1.000	1.000	0.000
41-4	4.03	0.00	4.35	0.00	4.19	0.00	2.10	1.000	1.000	0.481
45-8	4.27		3.95		4.11		4.11			0.520

DATA:
```
:734 :0 :502 :0
:734 :27 :502 :2
:734 :27 :503 :17
:808 :0 :546 :0
```

DAY:12 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	5.92		4.05		4.98		4.98			0.594
41	0.00			0.32	0.00	0.32	0.32	0.000	0.000	0.000
42		4.35	0.00		0.00	4.35	4.35	0.000	0.000	1.000
43	0.00			2.42	0.00	2.42	2.42	0.000	0.000	0.000
44		0.00	0.16		0.16	0.00	0.16	1.000	1.000	0.000
41-4	0.00	2.18	0.08	1.37	0.04	1.77	0.91	0.022	0.022	0.600
45-8	5.97		3.47		4.72		4.72			0.632

DATA:
:0 :497 :0 :507
:0 :497 :28 :532
:0 :520 :28 :557
:0 :586 :0 :612 . .

DAY:12 BIRD:4 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		4.01		4.09		4.05	4.05			0.495
41	0.00			4.03	0.00	4.03	4.03	0.000	1.000	0.000
42		0.00	4.52		4.52	0.00	4.52	1.000	0.000	0.000
43	0.00			4.03	0.00	4.03	4.03	0.000	1.000	0.000
44		3.71	0.00		0.00	3.71	3.71	0.000	1.000	1.000
41-4	0.00	1.85	2.26	4.03	1.13	2.94	2.04	0.277	0.723	0.228
45-8		5.32		4.44		4.88	4.88			0.545

. . .

DATA:
:0 :461 :0 :413
:21 :467 :16 :413
:40 :475 :27 :413
:0 :521 :0 :453

DAY:12 BIRD:5 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		3.72		3.33		3.52	3.52			0.527
41	3.39			0.00	3.39	0.00	3.39	1.000	0.000	1.000
42		0.97	2.58		2.58	0.97	3.55	0.727	0.273	0.273
43	3.06			0.00	3.06	0.00	3.06	1.000	0.000	1.000
44		1.29	1.77		1.77	1.29	3.06	0.579	0.421	0.421
41-4	3.23	1.13	2.18	0.00	2.70	0.56	1.63	0.827	0.173	0.667
45-8		3.71		3.23		3.47	3.47			0.535

DATA:
:0 :654 :0 :646
:0 :654 :30 :684
:0 :684 :30 :709
:0 :761 :0 :773

DAY:12 BIRD:6 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		5.27		5.21		5.24	5.24			0.503
41	0.00			6.13	0.00	6.13	6.13	0.000	1.000	0.000
42		0.00	4.84		4.84	0.00	4.84	1.000	0.000	0.000
43	0.00			4.03	0.00	4.03	4.03	0.000	1.000	0.000
44		4.84	0.00		0.00	4.84	4.84	0.000	1.000	1.000
41-4	0.00	2.42	2.42	5.08	1.21	3.75	2.48	0.244	0.756	0.244
45-8		6.21		5.16		5.69	5.69			0.546

```
DATA:
:158 :0 :155 :0
:182 :0 :164 :0
:209 :0 :193 :0
:239 :0 :210 :0
```

DAY:19 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	1.27		1.25		1.26		1.26			0.505
41	3.87			0.00	3.87	0.00	3.87	1.000	1.000	1.000
42		0.00	1.45		1.45	0.00	1.45	1.000	1.000	0.000
43	4.35			0.00	4.35	0.00	4.35	1.000	1.000	1.000
44		0.00	4.68		4.68	0.00	4.68	1.000	1.000	0.000
41-4	4.11	0.00	3.06	0.00	3.59	0.00	1.79	1.000	1.000	0.573
45-8	2.42		1.37		1.90		1.90			0.638

```
DATA:
:509 :0 :508 :0
:536 :0 :531 :0
:562 :0 :557 :0
:615 :0 :608 :0
```

DAY:19 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	4.10		4.10		4.10		4.10			0.500
41	4.35			0.00	4.35	0.00	4.35	1.000	1.000	1.000
42		0.00	3.71		3.71	0.00	3.71	1.000	1.000	0.000
43	4.19			0.00	4.19	0.00	4.19	1.000	1.000	1.000
44		0.00	4.19		4.19	0.00	4.19	1.000	1.000	0.000
41-4	4.27	0.00	3.95	0.00	4.11	0.00	2.06	1.000	1.000	0.520
45-8	4.27		4.11		4.19		4.19			0.510

```
DATA:
:850 :0 :740 :0
:897 :0 :780 :0
:942 :36 :782 :0
:1023 :0 :850 :0
```

DAY:19 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	6.85		5.97		6.41		6.41			0.535
41	7.58			0.00	7.58	0.00	7.58	1.000	1.000	1.000
42		0.00	6.45		6.45	0.00	6.45	1.000	1.000	0.000
43	7.26			0.00	7.26	0.00	7.26	1.000	1.000	1.000
44		5.81	0.32		0.32	5.81	6.13	0.053	0.053	0.947
41-4	7.42	2.90	3.39	0.00	5.40	1.45	3.43	0.788	0.788	0.753
45-8	6.53		5.48		6.01		6.01			0.544

...

DATA:
:0 :523 :0 :536
:0 :550 :0 :566
:0 :578 :0 :594
:0 :642 :0 :657

DAY:19 BIRD:4 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1÷2	KEY
1-40		4.22		4.32		4.27	4.27			0.494
41	0.00			4.84	0.00	4.84	4.84	0.000	1.000	0.000
42		4.35	0.00		0.00	4.35	4.35	0.000	1.000	1.000
43	0.00			4.52	0.00	4.52	4.52	0.000	1.000	0.000
44		4.52	0.00		0.00	4.52	4.52	0.000	1.000	1.000
41-4	0.00	4.44	0.00	4.68	0.00	4.56	2.28	0.000	1.000	0.487
45-8		5.16		5.08		5.12	5.12			0.504

DATA:
:0 :624 :0 :583
:0 :659 :0 :615
:0 :697 :0 :645
:0 :767 :0 :695

DAY:19 BIRD:5 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1÷2	KEY
1-40		5.03		4.70		4.87	4.87			0.517
41	0.00			5.16	0.00	5.16	5.16	0.000	1.000	0.000
42		5.65	0.00		0.00	5.65	5.65	0.000	1.000	1.000
43	0.00			4.84	0.00	4.84	4.84	0.000	1.000	0.005
44		6.13	0.00		0.00	6.13	6.13	0.000	1.000	1.000
41-4	0.00	5.89	0.00	5.00	0.00	5.44	2.72	0.000	1.000	0.541
45-8		5.65		4.03		4.84	4.84			0.583

DATA:
:0 :272 :0 :254
:4 :302 :0 :258
:5 :330 :0 :260
:0 :370 :0 :306

DAY:19 BIRD:6 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1÷2	KEY
1-40		2.19		2.05		2.12	2.12			0.517
41	0.65			0.65	0.65	0.65	1.29	0.500	0.500	0.500
42		4.84	0.00		0.00	4.84	4.84	0.000	1.000	1.000
43	0.16			0.32	0.16	0.32	0.48	0.333	0.667	0.333
44		4.52	0.00		0.00	4.52	4.52	0.000	1.000	1.000
41-4	0.40	4.68	0.00	0.46	0.20	2.58	1.39	0.072	0.928	0.913
45-8		3.23		3.71		3.47	3.47			0.465

DATA:
:0 :180 :0 :159
:29 :180 :26 :159
:57 :206 :26 :159
:0 :260 :0 :207

DAY:20 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		1.45		1.28		1.37	1.37			0.531
41	4.68			0.00	4.68	0.00	4.68	1.000	1.000	1.000
42		0.00	4.19		4.19	0.00	4.19	1.000	1.000	0.000
43	4.52			0.00	4.52	0.00	4.52	1.000	1.000	1.000
44		4.19	0.00		0.00	4.19	4.19	0.000	0.000	1.000
41-4	4.60	2.10	2.19	0.00	3.35	1.05	2.20	0.761	0.761	0.761
45-8		4.35		3.87		4.11	4.11			0.529

DATA:
:0 :477 :0 :460
:30 :477 :28 :460
:58 :501 :28 :460
:0 :549 :0 :509

DAY:20 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		3.85		3.71		3.78	3.78			0.509
41	4.84			0.00	4.84	0.00	4.84	1.000	1.000	1.000
42		0.00	4.52		4.52	0.00	4.52	1.000	1.000	0.000
43	4.52			0.00	4.52	0.00	4.52	1.000	1.000	1.000
44		3.87	0.00		0.00	3.87	3.87	0.000	0.000	1.000
41-4	4.68	1.94	2.26	0.00	3.47	0.97	2.22	0.782	0.782	0.745
45-8		3.87		3.95		3.91	3.91			0.495

DATA:
:0 :769 :0 :692
:0 :808 :0 :718
:0 :846 :0 :723
:0 :925 :0 :795

DAY:20 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		6.20		5.58		5.89	5.89			0.526
41	0.00			4.19	0.00	4.19	4.19	0.000	0.000	0.000
42		6.29	0.00		0.00	6.29	6.29	0.000	0.000	1.000
43	0.00			0.81	0.00	0.81	0.81	0.000	0.000	0.000
44		6.13	0.00		0.00	6.13	6.13	0.000	0.000	1.000
41-4	0.00	6.21	0.00	2.50	0.00	4.35	2.18	0.000	0.000	0.713
45-8		6.37		5.81		6.09	6.09			0.523

DATA:
:501 :0 :446 :0
:501 :7 :464 :27
:501 :7 :500 :59
:573 :0 :553 :0

DAY:20 BIRD:4 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	4.04		3.60		3.82		3.82			0.529
41	0.00			4.35	0.00	4.35	4.35	0.000	1.000	0.000
42		1.13	2.90		2.90	1.13	4.03	0.720	0.280	0.280
43	0.00			5.16	0.00	5.16	5.16	0.000	1.000	0.000
44		0.00	5.81		5.81	0.00	5.81	1.000	0.000	0.000
41-4	0.00	0.56	4.35	4.76	2.18	2.66	2.42	0.450	0.550	0.058
45-8	5.81		4.27		5.04		5.04			0.576

DATA:
:636 :0 :602 :0
:671 :38 :603 :0
:671 :74 :603 :21
:743 :0 :669 :0

DAY:20 BIRD:5 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	5.13		4.85		4.99		4.99			0.514
41	5.65			0.00	5.65	0.00	5.65	1.000	0.000	1.000
42		6.13	0.16		0.16	6.13	6.29	0.026	0.974	0.974
43	0.00			3.39	0.00	3.39	3.39	0.000	1.000	0.000
44		5.81	0.00		0.00	5.81	5.81	0.000	1.000	1.000
41-4	2.82	5.97	0.08	1.69	1.45	3.83	2.64	0.275	0.725	0.832
45-8	5.81		5.32		5.56		5.56			0.522

DATA:
:663 :0 :656 :0
:699 :0 :689 :0
:703 :0 :716 :0
:766 :0 :775 :0

DAY:20 BIRD:6 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	5.35		5.29		5.32		5.32			0.503
41	5.81			0.00	5.81	0.00	5.81	1.000	0.000	1.000
42		0.00	5.32		5.32	0.00	5.32	1.000	0.000	0.000
43	0.65			0.00	0.65	0.00	0.65	1.000	0.000	1.000
44		0.00	4.35		4.35	0.00	4.35	1.000	0.000	0.000
41-4	3.23	0.00	4.84	0.00	4.03	0.00	2.02	1.000	0.000	0.400
45-8	5.08		4.76		4.92		4.92			0.516

DATA:
:0 :524 :0 :559
:0 :559 :0 :581
:0 :585 :0 :608 .
:0 :631 :0 :664

DAY:27 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1÷2	KEY
1-40		4.23		4.51		4.37	4.37			0.484
41	0.00			3.55	0.00	3.55	3.55	0.000	0.000	0.000
42		5.65	0.00		0.00	5.65	5.65	0.000	0.000	1.000
43	0.00			4.35	0.00	4.35	4.35	0.000	0.000	0.000
44		4.19	0.00		0.00	4.19	4.19	0.000	0.000	1.000
41-4	0.00	4.92	0.00	3.95	0.00	4.44	2.22	0.000	0.000	0.555
45-8		3.71		4.52		4.11	4.11			0.451

DATA:
:0 :560 :0 :551
:0 :589 :0 :578
:0 :618 :0 :606
:0 :675 :0 :663

DAY:27 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1÷2	KEY
1-40		4.52		4.44		4.48	4.48			0.504
41	0.00			4.35	0.00	4.35	4.35	0.000	0.000	0.000
42		4.68	0.00		0.00	4.68	4.68	0.000	0.000	1.000
43	0.00			4.52	0.00	4.52	4.52	0.000	0.000	0.000
44		4.68	0.00		0.00	4.68	4.68	0.000	0.000	1.000
41-4	0.00	4.68	0.00	4.44	0.00	4.56	2.28	0.000	0.000	0.513
45-8		4.60		4.60		4.60	4.60			0.500

DATA:
:0 :839 :0 :859
:0.001 :879 :0 :859.001
:0 :921 :0 :894
:0 :997 :0 :986

DAY:27 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1÷2	KEY
1-40		6.77		6.93		6.85	6.85			0.494
41	0.00			0.00	0.00	0.00	0.00			
42		6.45	0.00		0.00	6.45	6.45	0.000	0.000	1.000
43	0.00			5.65	0.00	5.65	5.64	0.000	0.000	0.000
44		6.77	0.00		0.00	6.77	6.77	0.000	0.000	1.000
41-4	0.00	6.61	0.00	2.82	0.00	4.72	2.36	0.000	0.000	0.701
45-8		6.13		7.42		6.77	6.77			0.452

...

DATA:
:761 :0 :623 :0
:812 :0 :656 :0
:860 :0 :695 :0
:941 :0 :766 :0

DAY:27 BIRD:4 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	6.14		5.02		5.58		5.58			0.550
41	8.23			0.00	8.23	0.00	8.23	1.000	0.000	1.000
42		0.00	5.32		5.32	0.00	5.32	1.000	0.000	0.000
43	7.74			0.00	7.74	0.00	7.74	1.000	0.000	1.000
44		0.00	6.29		6.29	0.00	6.29	1.000	0.000	0.000
41-4	7.98	0.00	5.81	0.00	6.90	0.00	3.45	1.000	0.000	0.579
45-8	6.53		5.73		6.13		6.13			0.533

DATA:
:1204 :0 :888 :0
:1263 :4 :923 :0
:1315 :4 :971 :0
:1439 :0 :1062 :0

DAY:27 BIRD:5 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	9.71		7.16		8.44		8.44			0.576
41	9.52			0.00	9.52	0.00	9.52	1.000	0.000	1.000
42		0.65	5.65		5.65	0.65	6.29	0.897	0.103	0.103
43	8.39			0.00	8.39	0.00	8.39	1.000	0.000	1.000
44		0.00	7.74		7.74	0.00	7.74	1.000	0.000	0.000
41-4	8.95	0.32	6.69	0.00	7.82	0.16	3.99	0.980	0.020	0.581
45-8	10.0		7.34		8.67		8.67			0.577

DATA:
:732 :0 :608 :0 ·
:732 :0 :639 :29
:742 :0 :670 :29
:814 :0 :735 :0

DAY:27 BIRD:6 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	5.90		4.90		5.40		5.40			0.546
41	0.00			4.68	0.00	4.68	4.68	0.000	1.000	0.000
42		0.00	5.00		5.00	0.00	5.00	1.000	0.000	0.000
43	1.61			0.00	1.61	0.00	1.61	1.000	0.000	1.000
44		0.00	5.00		5.00	0.00	5.00	1.000	0.000	0.000
41-4	0.81	0.00	5.00	2.34	2.90	1.17	2.04	0.713	0.287	0.099
45-8	5.81		5.24		5.52		5.52			0.526

DATA:
:433 :0 :381 :0
:468 :0 :410 :0
:490 :0 :436 :0
:557 :0 :503 :0

DAY:28 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	3.49		3.07		3.28		3.28			0.532
41	5.65			0.00	5.65	0.00	5.65	1.000	1.000	1.000
42		0.00	4.68		4.68	0.00	4.68	1.000	1.000	0.000
43	3.55			0.00	3.55	0.00	3.55	1.000	1.000	1.000
44		0.00	4.19		4.19	0.00	4.19	1.000	1.000	0.000
41-4	4.60	0.00	4.44	0.00	4.52	0.00	2.26	1.000	1.000	0.509
45-8	5.40		5.40		5.40		5.40			0.500

DATA:
:552 :0 :536 :0
:579 :0 :564 :0
:606 :27 :564 :0
:661 :27 :620 :0

DAY:28 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	4.45		4.32		4.39		4.39			0.507
41	4.35			0.00	4.35	0.00	4.35	1.000	1.000	1.000
42		0.00	4.52		4.52	0.00	4.52	1.000	1.000	0.000
43	4.35			0.00	4.35	0.00	4.35	1.000	1.000	1.000
44		4.35	0.00		0.00	4.35	4.35	0.000	0.000	1.000
41-4	4.35	2.18	2.26	0.00	3.31	1.09	2.20	0.752	0.752	0.743
45-8	4.44		4.52		4.48		4.48			0.495

DATA:
:948 :0 :882 :0
:993 :0 :925 :0
:1039 :0 :954 :0
:1126 :0 :1046 :0

DAY:28 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	7.65		7.11		7.38		7.38			0.518
41	7.26			0.00	7.26	0.00	7.26	1.000	1.000	1.000
42		0.00	6.94		6.94	0.00	6.94	1.000	1.000	0.000
43	7.42			0.00	7.42	0.00	7.42	1.000	1.000	1.000
44		0.00	4.68		4.68	0.00	4.68	1.000	1.000	0.000
41-4	7.34	0.00	5.81	0.00	6.57	0.00	3.29	1.000	1.000	0.558
45-8	7.02		7.42		7.22		7.22			0.486

DATA:
:0 :723 :0 :604
:3 :764 :0 :624
:3 :797 :0 :656
:0 :874 :0 :717

DAY:28   BIRD:4   (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		5.83		4.87		5.35	5.35			0.545
41	0.48			3.23	0.48	3.23	3.71	0.130	0.870	0.130
42		6.61	0.00		0.00	6.61	6.61	0.000	1.000	1.000
43	0.00			5.16	0.00	5.16	5.16	0.000	1.000	0.000
44		5.32	0.00		0.00	5.32	5.32	0.000	1.000	1.000
41-4	0.24	5.97	0.00	4.19	0.12	5.08	2.60	0.023	0.977	0.597
45-8		6.21		4.92		5.56	5.56			0.558

DATA:
:0 :1116 :0 :726
:33 :1116 :36 :726
:33 :1116 :80 :769
:0 :1224 :0 :842

DAY:28   BIRD:5   (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		9.00		5.85		7.43	7.43			0.606
41	5.32			0.00	5.32	0.00	5.32	1.000	0.000	1.000
42		0.00	5.81		5.81	0.00	5.81	1.000	0.000	0.000
43	0.00			6.94	0.00	6.94	6.94	0.000	1.000	0.000
44		0.00	7.10		7.10	0.00	7.10	1.000	0.000	0.000
41-4	2.66	0.00	6.45	3.47	4.56	1.73	3.15	0.724	0.276	0.212
45-8		8.71		5.89		7.30	7.30			0.597

DATA:
:0 :658 :0 :629
:2 :668 :0 :647
:9 :687 :0 :659
:0 :759 :0 :723

DAY:28   BIRD:6   (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		5.31		5.07		5.19	5.19			0.511
41	0.32			2.90	0.32	2.90	3.23	0.100	0.900	0.100
42		1.61	0.00		0.00	1.61	1.61	0.000	1.000	1.000
43	1.13			1.94	1.13	1.94	3.06	0.368	0.632	0.368
44		3.06	0.00		0.00	3.06	3.06	0.000	1.000	1.000
41-4	0.73	2.34	0.00	2.42	0.36	2.38	1.37	0.132	0.868	0.559
45-8		5.81		5.16		5.48	5.48			0.529

DATA:
:537 :0 :569←560 :0
:563 :0 :590 :0
:589 :0 :619 :0
:642 :0 :678 :0

DAY:33 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	4.33		4.52		4.42		4.42			0.490
41	4.19			0.00	4.19	0.00	4.19	1.000	1.000	1.000
42		0.00	4.84		4.84	0.00	4.84	1.000	1.000	0.000
43	4.19			0.00	4.19	0.00	4.19	1.000	1.000	1.000
44		0.00	4.68		4.68	0.00	4.68	1.000	1.000	0.000
41-4	4.19	0.00	4.76	0.00	4.48	0.00	2.24	1.000	1.000	0.468
45-8	4.27		4.76		4.52		4.52			0.473

DATA:
:547 :0 :556 :0
:575 :0 :570 :0
:575 :24 :570 :26
:632 :24 :631 :26

DAY:33 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	4.41		4.48		4.45		4.45			0.496
41	4.52			0.00	4.52	0.00	4.52	1.000	1.000	1.000
42		0.00	2.26		2.26	0.00	2.26	1.000	1.000	0.000
43	0.00			4.19	0.00	4.19	4.19	0.000	0.000	0.000
44		3.87	0.00		0.00	3.87	3.87	0.000	0.000	1.000
41-4	2.26	1.94	1.13	2.10	1.69	2.02	1.85	0.457	0.457	0.565
45-8	4.60		4.92		4.76		4.76			0.483

DATA:
:865 :0 :819 :0
:909 :0 :858 :0
:951 :0 :903 :0
:1040 :0 :991 :0

DAY:33 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	6.98		6.60		6.79		6.79			0.514
41	7.10			0.00	7.10	0.00	7.10	1.000	1.000	1.000
42		0.00	6.29		6.29	0.00	6.29	1.000	1.000	0.000
43	6.77			0.00	6.77	0.00	6.77	1.000	1.000	1.000
44		0.00	7.26		7.26	0.00	7.26	1.000	1.000	0.000
41-4	6.94	0.00	6.77	0.00	6.85	0.00	3.43	1.000	1.000	0.506
45-8	7.18		7.10		7.14		7.14			0.503

DATA:
```
:0 :734 :0 :737
:0 :782 :0 :782
:0 :821 :0 :820
:0 :901 :0 :897
```

DAY:33 BIRD:4 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		5.92		5.94		5.93	5.93			0.499
41	0.00			7.26	0.00	7.26	7.26	0.000	1.000	0.000
42		7.74	0.00		0.00	7.74	7.74	0.000	1.000	1.000
43	0.00			6.13	0.00	6.13	6.13	0.000	1.000	0.000
44		6.29	0.00		0.00	6.29	6.29	0.000	1.000	1.000
41-4	0.00	7.02	0.00	6.69	0.00	6.85	3.43	0.000	1.000	0.512
45-8		6.45		6.21		6.33	6.33			0.510

DATA:
```
:0 :977 :0 :642
:47 :1022 :0 :642
:47 :1064 :0 :678
:0 :1166 :0 :732
```

DAY:33 BIRD:5 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		7.88		5.18		6.53	6.53			0.603
41	7.58			0.00	7.58	0.00	7.58	1.000	0.000	1.000
42		7.26	0.00		0.00	7.26	7.26	0.000	1.000	1.000
43	0.00			5.81	0.00	5.81	5.81	0.000	1.000	0.000
44		6.77	0.00		0.00	6.77	6.77	0.000	1.000	1.000
41-4	3.79	7.02	0.00	2.90	1.90	4.96	3.43	0.276	0.724	0.788
45-8		8.23		4.35		6.29	6.29			0.654

DATA:
```
:0 :600 :0 :562 .
:0 :638 :0 :594
:0 :675 :0 :630
:0 :744 :0 :709
```

DAY:33 BIRD:6 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		4.84		4.53		4.69	4.69			0.516
41	0.00			5.16	0.00	5.16	5.16	0.000	1.000	0.000
42		6.13	0.00		0.00	6.13	6.13	0.000	1.000	1.000
43	0.00			5.81	0.00	5.81	5.81	0.000	1.000	0.000
44		5.97	0.00		0.00	5.97	5.97	0.000	1.000	1.000
41-4	0.00	6.05	0.00	5.48	0.00	5.77	2.88	0.000	1.000	0.524
45-8		5.56		6.37		5.97	5.97			0.466

DATA:
:0 :390 :0 :502
:29 :390 :31 :502
:57 :415 :31 :502
:0 :470 :0 :555

DAY:34 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		3.15		4.05		3.60	3.60			0.437
41	4.68			0.00	4.68	0.00	4.68	1.000	1.000	1.000
42		0.00	5.00		5.00	0.00	5.00	1.000	1.000	0.000
43	4.52			0.00	4.52	0.00	4.52	1.000	1.000	1.000
44		4.03	0.00		0.00	4.03	4.03	0.000	0.000	1.000
41-4	4.60	2.02	2.50	0.00	3.55	1.01	2.28	0.779	0.779	0.726
45-8		4.44		4.27		4.35	4.35			0.509

DATA:
:0 :554 :0 :549
:16 :554 :28 :556
:42 :580 :28 :556
:0 :639 :0 :615

DAY:34 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		4.47		4.43		4.45	4.45			0.502
41	2.58			1.13	2.58	1.13	3.71	0.696	0.696	0.696
42		0.00	4.52		4.52	0.00	4.52	1.000	1.000	0.000
43	4.19			0.00	4.19	0.00	4.19	1.000	1.000	1.000
44		4.19	0.00		0.00	4.19	4.19	0.000	0.000	1.000
41-4	3.39	2.10	2.26	0.56	2.82	1.33	2.08	0.680	0.680	0.660
45-8		4.76		4.76		4.76	4.76			0.500

DATA:
:0 :861 :0 :761
:45 :903 :0 :761
:45 :940 :0 :800
:0 :1033 :0 :861

DAY:34 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		6.94		6.14		6.54	6.54			0.531
41	7.26			0.00	7.26	0.00	7.26	1.000	1.000	1.000
42		6.77	0.00		0.00	6.77	6.77	0.000	0.000	1.000
43	0.00			6.29	0.00	6.29	6.29	0.000	0.000	0.000
44		5.97	0.00		0.00	5.97	5.97	0.000	0.000	1.000
41-4	3.63	6.37	0.00	3.15	1.81	4.76	3.29	0.276	0.276	0.761
45-8		7.50		4.92		6.21	6.21			0.604

...

DATA:
:744 :0 :625 :0
:744 :0 :659 :29
:753 :0 :697 :53
:836 :0 :772 :0

DAY:34 BIRD:4 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	6.00		5.04		5.52		5.52			0.543
41	0.00			4.68	0.00	4.68	4.68	0.000	1.000	0.000
42		0.00	5.48		5.48	0.00	5.48	1.000	0.000	0.000
43	1.45			3.87	1.45	3.87	5.32	0.273	0.727	0.273
44		0.00	6.13		6.13	0.00	6.13	1.000	0.000	0.000
41-4	0.73	0.00	5.81	4.27	3.27	2.14	2.70	0.604	0.396	0.067
45-8	6.69		6.05		6.37		6.37			0.525

DATA:
:1071 :0 :677 :0
:1136 :55 :677 :0
:1200 :55 :705 :0
:1328 :0 :782 :0

DAY:34 BIRD:5 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	8.64		5.46		7.05		7.05			0.613
41	10.5			0.00	10.5	0.00	10.5	1.000	0.000	1.000
42		8.87	0.00		0.00	8.87	8.87	0.000	1.000	1.000
43	10.3			0.00	10.3	0.00	10.3	1.000	0.000	1.000
44		0.00	4.52		4.52	0.00	4.52	1.000	0.000	0.000
41-4	10.4	4.44	2.26	0.00	6.33	2.22	4.27	0.741	0.259	0.868
45-8	10.3		6.21		8.27		8.27			0.624

DATA:
:640 :0 :605 :0
:673 :0 :634 :0
:705 :0 :663 :0
:766 :0 :734 :0

DAY:34 BIRD:6 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	5.16		4.88		5.02		5.02			0.514
41	5.32			0.00	5.32	0.00	5.32	1.000	0.000	1.000
42		0.00	4.68		4.68	0.00	4.68	1.000	0.000	0.000
43	5.16			0.00	5.16	0.00	5.16	1.000	0.000	1.000
44		0.00	4.68		4.68	0.00	4.68	1.000	0.000	0.000
41-4	5.24	0.00	4.68	0.00	4.96	0.00	2.48	1.000	0.000	0.528
45-8	4.92		5.73		5.32		5.32			0.462

DATA:
:0 :594 :0 :616
:0 :624 :0 :647
:0 :654 :0 :673
:0 :709 :0 :729

DAY:39 BIRD:1 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		4.79		4.97		4.88	4.88			0.491
41	0.00			5.00	0.00	5.00	5.00	0.000	0.000	0.000
42		4.84	0.00		0.00	4.84	4.84	0.000	0.000	1.000
43	0.00			4.19	0.00	4.19	4.19	0.000	0.000	0.000
44		4.84	0.00		0.00	4.84	4.84	0.000	0.000	1.000
41-4	0.00	4.84	0.00	4.60	0.00	4.72	2.36	0.000	0.000	0.513
45-8		4.44		4.52		4.48	4.48			0.495

DATA:
:0 :561 :0 :566
:0 :621 :0 :594
:29 :650 :0 :594
:29 :708 :0 :651

DAY:39 BIRD:2 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		4.52		4.56		4.54	4.54			0.498
41	0.00			4.52	0.00	4.52	4.52	0.000	0.000	0.000
42		9.68	0.00		0.00	9.68	9.68	0.000	0.000	1.000
43	4.68			0.00	4.68	0.00	4.68	1.000	1.000	1.000
44		4.68	0.00		0.00	4.68	4.68	0.000	0.000	1.000
41-4	2.34	7.18	0.00	2.26	1.17	4.72	2.94	0.199	0.199	0.808
45-8		4.68		4.60		4.64	4.64			0.504

DATA:
:0 :956 :0 :922
:0 :1001 :0 :969
:0 :1040 :0 :1012
:0 :1139 :0 :1095

DAY:39 BIRD:3 (S1=R)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40		7.71		7.44		7.57	7.57			0.509
41	0.00			7.58	0.00	7.58	7.58	0.000	0.000	0.000
42		7.26	0.00		0.00	7.26	7.26	0.000	0.000	1.000
43	0.00			6.94	0.00	6.94	6.94	0.000	0.000	0.000
44		6.29	0.00		0.00	6.29	6.29	0.000	0.000	1.000
41-4	0.00	6.77	0.00	7.26	0.00	7.02	3.51	0.000	0.000	0.483
45-8		7.98		6.69		7.34	7.34			0.544

DATA:
:693 :0 :733 :0
:732 :0 :772 :0
:779 :46 :772 :0
:864 :0 :859 :0

DAY:39 BIRD:4 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	5.59		5.91		5.75		5.75			0.486
41	6.29			0.00	6.29	0.00	6.29	1.000	0.000	1.000
42		0.00	6.29		6.29	0.00	6.29	1.000	0.000	0.000
43	7.58			0.00	7.58	0.00	7.58	1.000	0.000	1.000
44		7.42	0.00		0.00	7.42	7.42	0.000	1.000	1.000
41-4	6.94	3.71	3.15	0.00	5.04	1.85	3.45	0.731	0.269	0.772
45-8	6.85		7.02		6.94		6.94			0.494

DATA:
:1236 :0 :444 :0
:1298 :0 :472 :0
:1361 :63 :472 :0
:1482 :0 :542 :0

DAY:39 BIRD:5 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	9.97		3.58		6.77		6.77			0.736
41	10.0			0.00	10.0	0.00	10.0	1.000	0.000	1.000
42		0.00	4.52		4.52	0.00	4.52	1.000	0.000	0.000
43	10.2			0.00	10.2	0.00	10.2	1.000	0.000	1.000
44		10.2	0.00		0.00	10.2	10.2	0.000	1.000	1.000
41-4	10.1	5.08	2.26	0.00	6.17	2.54	4.35	0.708	0.292	0.870
45-8	9.76		5.65		7.70		7.70			0.634

DATA:
:704 :0 :720 :0
:742 :0 :746 :0
:742 :31 :746 :31
:809 :0 :828 :0

DAY:39 BIRD:6 (S1=G)

TRL	K1R	K1G	K2R	K2G	R	G	ALL	R/R+G	1/1+2	KEY
1-40	5.68		5.81		5.74		5.74			0.494
41	6.13			0.00	6.13	0.00	6.13	1.000	0.000	1.000
42		0.00	4.19		4.19	0.00	4.19	1.000	0.000	0.000
43	0.00			5.00	0.00	5.00	5.00	0.000	1.000	0.000
44		5.00	0.00		0.00	5.00	5.00	0.000	1.000	1.000
41-4	3.06	2.50	2.10	2.50	2.58	2.50	2.54	0.508	0.492	0.548
45-8	5.40		6.61		6.01		6.01			0.450

EXPERIMENT 4 SUMMARY DATA

(S = single-stimulus trials, C = choice trials)

S E S S I O N

		PHASE 1								PHASE 2			

Bird #1

		4	5	6	7	8	9	10	11	12	13	14	15
$R_1/(R_1+R_2)$	S	.49	.43	.49	.52	.48	.54	.49	.39	--	--	--	--
$R_1/(R_1+R_2)$	C	.34	.38	.78	.92	.94	.87	.54	.99	.97	.96	1.00	1.00
agree?			yes	yes	no	yes	no	yes	no	no	--	--	--	--
$K_1/(K_1+K_2)$	C	.18	.66	.73	.55	.56	.56	.31	.51	.42	.41	.47	.49
S rate > C rate		no	no	no	no	no	no	no	no	no	no	no	no

Bird #2

		4	5	6	7	8	9	10	11	12	13	14	15
$R_1/(R_1+R_2)$	S	.55	.50	.51	.52	.52	.53	.51	.51	--	--	--	--
$R_1/(R_1+R_2)$	C	.75	.90	.62	.77	.55	.75	.72	.03	1.00	.78	1.00	1.00
agree?			yes	no	yes	yes	yes	yes	yes	no	--	--	--	--
$K_1/(K_1+K_2)$	C	.51	.47	.08	.25	.49	.79	.71	.47	.48	.72	.51	.51
S rate > C rate		no	yes	yes	no	no	no	no	yes	no	yes	no	no

Bird #3

		4	5	6	7	8	9	10	11	12	13	14	15
$R_1/(R_1+R_2)$	S	.38	.43	.46	.50	.50	.50	.52	.51	--	--	--	--
$R_1/(R_1+R_2)$	C	.54	.16	.41	.68	.00	.05	.35	.17	.02	.50	.47	.80
agree?			no	yes	yes	no	yes	no	no	no	--	--	--	--
$K_1/(K_1+K_2)$	C	.85	.84	.95	.68	.59	.57	.30	.11	.60	.79	.80	.93
S rate > C rate		yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes

Bird #4

		4	5	6	7	8	9	10	11	12	13	14	15
$R_1/(R_1+R_2)$	S	.49	.46	.46	.49	.50	.48	.49	.49	--	--	--	--
$R_1/(R_1+R_2)$	C	.33	.29	.55	1.00	.00	.50	.74	.70	.72	1.00	.52	.95
agree?			yes	yes	no	no	no	--	no	no	--	--	--	--
$K_1/(K_1+K_2)$		.46	.87	.94	.41	.48	.01	.25	.77	.23	.49	.47	.37
S rate > C rate		yes	no	yes	yes	no	yes	no	yes	no	no	yes	no

Bird #5

		4	5	6	7	8	9	10	11	12	13	14	15
$R_1/(R_1+R_2)$	SS	.30	.46	.46	.48	.47	.50	.49	.49	--	--	--	--
$R_1/(R_1+R_2)$	C	.35	.59	.53	.43	.44	.20	.51	.23	.17	.52	.53	.71
agree?			yes	no	no	yes	yes	yes	no	yes	--	--	--	--
$K_1/(K_1+K_2)$	C	.96	1.00	1.00	1.00	1.00	.72	1.00	.78	.67	1.00	1.00	.80
S rate > C rate		no	no	no	yes	no	yes	yes	no	yes	no	no	no

Bird #6

		4	5	6	7	8	9	10	11	12	13	14	15
$R_1/(R_1+R_2)$	S	.35	.39	.42	.44	.44	.46	.47	.46	--	--	--	--
$R_1/(R_1+R_2)$	C	.01	.08	.26	.46	.21	.26	.44	.72	.76	.75	.88	.97
agree?			yes	yes	yes	yes	yes	yes	yes	no	--	--	--	--
$K_1/(K_1+K_2)$	C	.56	.33	.36	.01	.33	.28	.48	.72	.24	.73	.43	.61
S rate > C rate		no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

MEAN

		4	5	6	7	8	9	10	11	12	13	14	15
$R_1/(R_1+R_2)$	C	.39	.40	.53	.71	.36	.44	.55	.47	.61	.75	.73	.91

EXPERIMENT 4 SUMMARY DATA (cont'd)

S E S S I O N

		PHASE 2				PHASE 3						

Bird # 1		16	17	18	19	20	21	22	23	24	25	26	27
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1/(R_1+R_2)$	C	1.00	1.00	1.00	1.00	.76	.54	.28	.23	.18	.00	.00	.00
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	.41	.64	.45	.57	.76	.52	.76	.26	.71	.49	.46	.55
S rate>C rate		no	no	no	no	no	no	no	no	no	no	no	no

Bird # 2													
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1/(R_1+R_2)$	C	1.00	.90	1.00	1.00	.73	.49	.51	.05	.03	.00	.00	.00
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	.46	.62	.52	.52	.75	1.00	.53	.50	.57	.49	.50	.51
S rate>C rate		yes	no	yes	no	no	no	no	no	yes	no	no	no

Bird #3													
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1/(R_1+R_2)$	C	.50	.62	.86	.79	.00	.00	.00	.00	.00	.00	.00	.00
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	1.00	.99	.76	.75	.71	.53	.54	.54	.63	.74	.83	.70
S rate>C rate		yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes

Bird #4													
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1/(R_1+R_2)$	C	1.00	.75	1.00	1.00	.55	.04	.00	.00	.39	.00	.00	.00
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	.54	.26	.50	.49	.06	.44	.55	.54	1.00	.53	.59	.58
S rate>C rate		yes	no	no	no	no	no	no	no	yes	no	no	no

Bird #5													
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1/(R_1+R_2)$	C	.50	.75	.99	1.00	.73	.47	.00	.07	.07	.00	.00	.02
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	1.00	.77	.57	.54	.83	.62	.56	.69	.40	.54	.47	.58
S rate>C rate		no	no	no	no	no	yes	yes	yes	yes	no	yes	yes

Bird #6													
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1/(R_1+R_2)$	C	1.00	1.00	1.00	.93	.00	.00	.00	.52	.00	.01	.02	.29
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	.46	.52	.57	.91	.40	.47	.49	.44	.49	.57	.57	.10
S rate>C rate		yes	yes	yes	no	yes	yes	yes	no	no	yes	yes	yes

MEAN													
$R_1/(R_1+R_2)$	C	.83	.84	.97	.95	.47	.26	.13	.15	.11	.00	.00	.05

EXPERIMENT 4 SUMMARY DATA (cont'd)

S E S S I O N

PHASE 4   PHASE 5

		28	29	30	31	32	33	34	35	36	37	38	39
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1^1/(R_1^1+R_2^2)$	C	1.00	1.00	1.00	1.00	1.00	1.00	.78	.26	.48	.00	.00	.00
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	.51	.49	.52	.50	.49	.47	.73	.24	.44	.46	.48	.51
S rate>C rate		no	no	yes	yes	yes	no	no	no	yes	yes	yes	yes

Bird #2

		28	29	30	31	32	33	34	35	36	37	38	39
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1^1/(R_1^1+R_2^2)$	C	.75	.76	1.00	.75	.81	.46	.68	.51	.74	.74	.51	.20
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	.74	.25	.52	.73	.73	.57	.66	.48	.74	.76	.50	.81
S rate>C rate		no	no	yes	yes	--	yes	yes	no	no	no	no	no

Bird #3

		28	29	30	31	32	33	34	35	36	37	38	39
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1^1/(R_1^1+R_2^2)$	C	1.00	1.00	1.00	1.00	1.00	1.00	.28	.00	.00	.00	.00	.00
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	.56	.53	.50	.53	.50	.51	.76	.56	.53	.53	.49	.48
S rate>C rate		yes	yes	yes	yes	yes	no	no	no	--	yes	yes	yes

Bird #4

		28	29	30	31	32	33	34	35	36	37	38	39
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1^1/(R_1^1+R_2^2)$	C	.93	1.00	1.00	1.00	1.00	1.00	.40	.52	.00	.54	.00	.27
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1(K_1+K_2)$	C	.60	.47	.50	.49	.53	.51	.07	.55	.50	.50	.52	.77
S rate>C rate		yes	no	no	no	no	no	yes	yes	no	no	no	no

Bird #5

		28	29	30	31	32	33	34	35	36	37	38	39
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1^1/(R_1^1+R_2^2)$	C	.28	.45	.19	1.00	.22	.72	.26	.50	.49	.27	.49	.29
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	.21	.00	.30	.60	.34	.79	.87	.96	1.00	.89	1.00	.87
S rate>C rate		yes	yes	yes	yes	yes	no	no	no	no	no	no	no

Bird #6

		28	29	30	31	32	33	34	35	36	37	38	39
$R_1/(R_1+R_2)$	S	--	--	--	--	--	--	--	--	--	--	--	--
$R_1^1/(R_1^1+R_2^2)$	C	.87	1.00	1.00	.84	1.00	1.00	.00	.75	.23	.49	.33	.48
agree?		--	--	--	--	--	--	--	--	--	--	--	--
$K_1/(K_1+K_2)$	C	.56	.51	.55	.71	.44	.52	.53	.23	.75	1.00	.33	.55
S rate>C rate		yes	no	no	yes	no	no	yes	no	no	no	yes	yes

MEAN

		28	29	30	31	32	33	34	35	36	37	38	39
$R_1/(R_1+R_2)$	C	.81	.87	.87	.93	.84	.86	.40	.42	.32	.34	.22	.21

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