Fine-Grained Measures of Dogs’ Eating Behavior in Single-Pan and Two-Pan Tests

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SMITH, J. C., M. E. RASHOTTE, T. AUSTIN AND R. W. GRIFFIN. Fine-grained measures of dogs’ eating behavior in single-pan and two-pan tests. NEUROSCI BIOBEHAV REV 8(2) 243-251, 1984.—The feeding behavior of dogs in one-pan and two-pan tests was measured in the usual way (total food intake in the test) and at a fine-grained level (cumulative amount eaten on a moment-by-moment basis during the test). The four experiments reported studied dogs’ reactions to different dry foods, and to semi-moist and canned foods. The fine-grained measures were informative about the dogs’ reactions to the foods in several ways that could not be derived from the usual intake measure. The main value of the fine-grained measurements seems to be that they suggest new directions for research on feeding behavior that may improve the understanding of performance in one- and two-pan tests.

<table>
<thead>
<tr>
<th>Fine-grained measurement</th>
<th>Feeding</th>
<th>Single-pan test</th>
<th>Two-pan test</th>
<th>Dogs</th>
<th>Dry food</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-moist food</td>
<td>Canned food</td>
<td></td>
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</table>

BY using modern electronic and computer technology, it is possible to obtain very detailed measurements of the moment-by-moment eating behavior of dogs in traditional one- and two-pan “consummatory” tests [3]. It remains to be determined, however, whether such fine-grained measures of eating contribute to the understanding of dogs’ reactions to foods studied in the test. Four experiments reported in the present paper explore the ways detailed measures of feeding behavior relate to measures of total food intake which are typically made in “consummatory” tests. In order to assess the usefulness of fine-grained measurements under a range of test conditions, the different experiments include single-pan and two-pan (choice) test procedures, and tested different foods from the same category (two dry foods) and foods from different categories (semi-moist burger type food vs. canned food).

EXPERIMENT 1

A dog’s initial reaction to a new food-item may depend on the kind of food it has been accustomed to eating. The single-pan test provides a controlled way to quantify the effects of such a change in diet. In this case, the feeding behavior of animals preferred on Food A for a known period of time is measured prior to shifting their diet to Food B. Then, the reaction of the dogs to Food B is studied at various times following the shift, and is compared to the reaction of a control group that has been fed Food B for an extended period. This experimental arrangement has the potential to identify cases in which feeding behavior depends on an interaction between feeding history and the properties of the foods. It also represents a laboratory stimulation of circumstances in the home where a dog-owner introduces a new food product. In this sense, the laboratory experiment might provide guidance about the way dogs would react to a change of diet in the home (but see [2]).

The present experiment studied the effects of a change in diet from one commercially-available dry dog-food to another. The experimental design included a number of features that allow pre-feeding effects to be assessed with confidence, and the experimental methodology provided fine-grained measures of feeding behavior before and after the shift that could be compared with conventional measures of food intake.

METHOD

Subjects

The subjects for this experiment were eleven male beagle dogs between about 1 and 6 years of age and weighing about 29 kg. on the average. The dogs were housed in outdoor runs with water continuously available, and they were fed a dry-food diet once a day according to the experimental plan described below. The amount of food fed each dog was tailored to maintain an appropriate caloric intake for the dogs according to the package instructions accompanying the food.

Apparatus

The apparatus has been described in detail elsewhere in
### TABLE 1

**DESIGN OF THE PROCEDURE FOR EXPERIMENT I**

<table>
<thead>
<tr>
<th>Group</th>
<th>N (27 days)</th>
<th>(7 days)</th>
<th>Shift Phase (7 days)</th>
<th>(7 days)</th>
<th>(7 days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
<td>Food A</td>
<td>A ⏱️&gt; A</td>
<td>B ⏱️&gt; B</td>
<td>A</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
<td>Food B</td>
<td>A ⏱️&gt; A</td>
<td>A ⏱️&gt; B</td>
<td>B ⏱️&gt; B</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>shifts</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Each of the two groups of dogs were given a 27-day pre-feeding period with different foods, followed by the shift (or control non-shift) to the alternate food for seven days. The four shifts from one food to the other are indicated by the solid arrows and the non-shifted controls for each condition are indicated by the dotted arrows.

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This monograph [3]. Briefly, a computer-controlled feeding station was employed to present food to the dog. The station included three feeding-ports which each housed a pan attached to a service which allowed the weight of the pan and its contents to be monitored continuously by a computer. Each port was fronted by a motorized door that controlled access to the pan. Two experimental rooms were equipped with feeding stations, and the software was written so that two dogs could be run simultaneously in the adjacent rooms.

**Procedure**

Each day a pair of dogs was brought to the testing area where they were weighed and placed into the respective testing rooms. The dogs were allowed to accustom themselves to the rooms for three minutes, at which time a 20-minute eating test began, initiated by raising the three port-doors. In these tests, one port contained a food, one contained water, and a third contained an empty pan. The position of the water-pan was fixed across days, but the position of the food was varied quasi-randomly between the two remaining pan positions across days.

The dogs were assigned to two groups in order to counterbalance the order of testing with the two foods. The design of the experiment is shown in Table 1. In the Prefeeding Phase, the groups were fed daily with a single dog food for 27 days prior to beginning the shift phase. Group 1 (N=6) was fed Food A. Group 2 (N=5) was fed Food B during this pre-feeding period. At the end of the pre-feeding period the dogs began the Shift Phase in which they all experienced a shift from Food A to Food B, and from Food B to Food A. The dogs in Group 2 were first shifted to Food A for 14 days, then to Food B for 14 days. After their pre-feeding period on Food A, the dogs in Group 1 remained on Food A for seven more days, switched to Food B for 14 days and then back to Food A for the final seven days. The timing of the shifts was out-of-phase for the two groups so that when one group shifted the second group always served as an 'unshifted' control group. For example, Group 2 is the first to shift (from Food B to Food A) and Group 1 stays unshifted on Food A. In this manner we could separate the effects of the shift to a new food from the effects of other variables such as an abrupt temperature or humidity change in the outdoor runs that might have affected the dogs' feeding behavior at the time of the shift. If such variables operated, then changes in feeding behavior would be noticeable also in the unshifted control groups.

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**RESULTS AND DISCUSSION**

The mean amount of food consumed by each group on each of the last four days before a shift, and on the first four days after the shift, are shown for Shifts 1–4 seen in four panels of Fig. 1. The group that shifted from one food to another is always shown as a solid line and the unshifted control is illustrated by a dotted line. It is clear that there were no orderly effects when the dogs shifted from one food to the other as measured by the quantity eaten during the 20-minute feeding test. In cases like Shifts 3 and 4 where it appears that there is a trend toward eating less food after a shift is made, it is clear that the unshifted controls showed the same trend, indicating that some factor other than changing food caused the apparent change.

By using the moment-by-moment measurements of feeding behavior made with the feeding stations, detailed descriptions of the dogs' eating were made in the form of cumulative grams of food eaten across the test-period. Figure 2 presents the data of two dogs which are representative of performance in this experiment. The upper panel of Fig. 2 shows the eating behavior of one dog for the last four sessions with Food B; the second panel shows the first four days after the shift to Food A. The curves in Fig. 2 indicate that the pattern of eating did not change in a systematic fashion after the shift from B to A for this dog. The average consumption of Food B by this dog across these four days was 288 g. Following the shift to Food A, consumption increased to 326 g averaged across the four days shown. In the lower two panels of Fig. 2, the behavior of a second dog is illustrated. Here again it can be seen that the fine-grained measures of feeding behavior revealed no systematic effect of the change from Food B to Food A. This second dog ate approximately the same quantity of Food B (299 g) as did the dog in the upper panels. The fine-grained measures reveal a striking difference in how these two dogs ate essentially the same amount of food. The dog in the upper panels ate steadily at a low rate for the entire 20-minute session whereas the dog in the lower panels would finish the meal in 4 to 7 minutes by eating at a high rate.

The data from this experiment provide no evidence that a shift between the dry foods employed here occasioned an initial or a long-lasting effect in feeding behavior in a single-pan test. Total food-intake measures and fine-grained measures of eating behavior agree in this case in showing that these two dry foods are treated essentially the same by the dogs. The only additional information provided by the fine-grained
FIG. 1. The results of each of the four shifts designated in Table 1 are illustrated in the four panels of this figure. The mean amount of food consumed is plotted on the Y-axis and the last four days before the shift and the first four days after the shift are plotted on the X-axis. The shifts from one food to the other are designated by solid lines and the non-shifted controls are designated by the dotted lines.

measures was a quantified description of the fact that dogs can differ substantially in the rate at which they consume the food in a single-pan test, yet not differ in the amount consumed. This kind of observation may help quantify individual differences in feeding behavior which may be useful to document in some testing circumstances.

EXPERIMENT 2

In several of the experiments reported in this Monograph [1.2] pre-feeding a single food has been found to influence the choice behavior of the dog in a subsequent two-pan test between that food and a novel food. In the present experiment, dogs received a two pan test with the two dry foods described in Experiment 1. Food A and Food B, following either a period of feeding with Food A alone (Group 1) or Food B alone (Group 2). The dogs were run in the special feeding apparatus described in Experiment 1, so that a moment-by-moment analysis of eating in the choice test could be made.

METHOD

Subjects and Apparatus

The eleven beagles and the feeding-stations used in Experiment 1 were employed in the present experiment.

Procedure

The dogs were assigned to two groups that ultimately received 13 test sessions in which the feeding-stations made available in a simultaneous choice test both of the dry foods used in Experiment 1. The pre-feeding manipulation was actually part of Experiment 1. Immediately prior to the choice test, these animals had participated in the single-pan study summarized in Experiment 1. By reference to Table 1 in that experiment, it can be seen that Group 1 (N=6) was pre-fed only Food A for seven days immediately before the choice-test and Group 2 (N=5) was pre-fed only Food B for 14 days. Furthermore, Table 1 indicates that during the 55-day period prior to the two pan test, Group 1 had Food A on 41 of those days, and Food B on the other 14 days; Group 2 had Food B on 41 of those days, and Food A on the other 14 days. Thus, both groups had experience with Foods A and B, but the amount of that experience and its temporal distribution differed for the groups.

The two-pan tests were run for 20 minutes each day. The dog was brought from the holding cage, weighed and placed in the experimental room for a three minute period. At the end of this waiting period all three doors in the feeding panel were opened presenting the animals with three choices in the different pans: Food A, Food B or water. The position of the water was the same in every session, but the positions of Food A and B were varied quasi-randomly across sessions. The amount of food weighed into each pan at the beginning of the session was twice the amount recommended for each dogs' weight in the package instructions for each food. At the end of the 20 minute eating session the dog was returned to the kennel and the amount of each food and water consumed was determined by weighing the remaining food in the pans. These two-pan tests were conducted for 13 consecutive days.
RESULTS AND DISCUSSION

Preference scores were calculated for each choice session in the traditional manner by the formula Food B consumed/ (Food A consumed + Food B consumed). Mean preference scores for each of the 13 days are shown for the two groups in Fig. 3. An ANOVA with repeated measures was run on these data and the difference between the two groups was not significant, F(1,9) = 2.48, largely because of variability in the performance of the individual dogs which is shown in Fig. 4. It can be concluded from the preference-ratio measure that pre-feeding with either of these dry foods has little, if any, systematic effect on the subsequent choice behavior of the dogs in the two-pan tests. Figure 4 indicates that the dogs in Group 1 varied from showing exclusive choice of Food B to almost exclusive choice of Food A. In Group 2 the variability was not as extreme, but here also the dogs’ performance ranged from exclusive choice of Food B to indifference between the foods.

The fine-grained measures of feeding behavior in this experiment also provided no indication of a prefeeding effect on choice between the two dry foods studied here. However, these measures provide some potentially important information about choice behavior in two-pan tests. Consider first the case in which preference ratios indicate that a dog is indifferent to the foods in the two-pan test. Since this dog eats the same amount of Food A and Food B, the question arises as to how it distributes its eating of these foods across the test session. We have chosen to illustrate this case with the data of the dog represented in Fig. 4 by the solid lines and filled circles in Group 2. Of all the dogs, it appeared to be the most consistently indifferent to the foods. Fine-grained measurement of this dog’s feeding behavior during the 1st, 8th and 13th days of the 2-pan testing is shown in the three panels of Fig. 5. In the upper panel it can be seen that the dog began by eating Food A and finished the session by eating Food B, changing over from one to the other 9 times. In the 8th session, he began with Food B and finished with Food A, changing from one food to the other on 13 occasions. In the 13th session, he began again on Food A, but changed to Food B sooner than before. Here the dog ended the session with a slight preference for Food B over Food A. These data, and the data of other dogs whose preference-ratios indicated “indifference” between the foods, reveal a variety of eating-patterns that underlie indifference. Data from this level of measurement pose questions for future analysis. For example, what are the mechanisms responsible for the animal’s terminating its intake of one food and shifting to the other during the session, and what determined the initial choice between the foods at the beginning of the test? The analysis of such questions may be pertinent to the broader understanding of performance in choice tests.

The second case we consider is one in which there is a strong preference for one food over the other, but in which some of the non-preferred food is eaten. The dog represented in Fig. 4 by the open circles and dotted lines in Group 1 showed such a strong preference for Food A. On the first day of the two-pan test his preference score was 0.92. The fine-grain of his eating behavior in that session can be seen in the upper panel of Fig. 6. Although he nibbled at Food B early in the session, he did not eat a significant amount of that food until about 10 minutes into the test. It appears that the dog periodically “tested” Food B and then quickly returned to Food A. He changed over from one food to the other 17 times during the 20 minute session. By the last of the 13 two-pan sessions (shown in the bottom panel of Fig. 6), this dog almost completely ignored Food B. During this session he changed over only 3 times and his total consumption of Food B was 1 g. Here, in the case of a dog with a strong preference, the change-over behavior, and the timing of eating what is clearly the less-preferred food, which are re-
revealed in the fine-grained measurements of eating pose interesting questions for further analysis.

We note that a reduction in number of changeovers from the early to the late choice session was characteristic of all of the dogs. Across all dogs, the mean number of changeovers on the first of the two-pan sessions was 13 and the average of the last seven sessions was only 7. This difference was significant when tested with an independent t-test ($t = 2.87$).

It is concluded from the data of this experiment, and from Experiment 1, that, when using dry foods, pre-feeding one food has very little effect on subsequent eating behavior of the dog in either a one- or two-pan test. This conclusion is based on traditional measures of the amount of food eaten, as well as the fine-grain measurements of pattern of eating. The apparatus allowed us to compute rate of eating, time spent eating from each pan, changeovers (in the case of two-pan tests), the number of times the animal’s head entered the ports, and the amount of water consumed during the tests. Our analyses indicate that prefeeding the animal one of these dry foods vs. the other had no significant effect on any of the above measures.
TABLE 2
DESIGN OF THE PROCEDURE FOR EXPERIMENT 3

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>Pre-feeding Phase</th>
<th>Shift Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>(4 days)</td>
<td>(4 days)</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>G ———&gt;</td>
<td>A ———&gt;</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>G ———&gt;</td>
<td>G ———&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A ———&gt;</td>
<td>G ———&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>A</td>
</tr>
</tbody>
</table>

shifts | 1 | 2 | 3 | 4 |

Each of the two groups was given a 4-day pre-feeding period with the semi-moist food (G), followed by the shift (or control non-shift) to the alternate food for four days. The four shifts from one food to the other are indicated by the solid arrows. The non-shifted control conditions are indicated by the dotted arrows.

In an attempt to determine whether our results were peculiar to the two dry foods used in the experiment reported here, we ran identical experiments with these same dogs using two other dry foods. The unpublished results showed, again, that there was no significant effect of pre-feeding either one of these foods on the behavior of the dogs on single- or two-pan tests. These results stand in contrast to other experiments in this Monograph [1,2]. It is possible that our pre-feeding periods may not have been long enough to have a significant or lasting effect on the behavior of the kennel dog in subsequent feeding tests [2]. Our subjects received choice tests following 7 consecutive days of pre-feeding. Griffin et al.'s [2] shortest exposure was 14 consecutive days. Furthermore, the large dog-to-dog variance in choice behavior may suggest that our design lacked sufficient statistical power to detect differences that may exist. In Griffin et al.'s [2], the smallest group to reach statistical significance included 16 dogs. Such large between-subject variance (as compared to the more traditional rat subject) may warrant separate study itself. But, in the absence of additional data, our conclusion is that shifting from one of the commercially available dry dog-foods to another in a single-pan test, or prefeeding a given dry-food prior to a choice test, has no major effect on feeding behavior. We note, however, that even in the dry-foods case, fine-grained measures of feeding show aspects of performance that encourage analytical studies to improve the understanding of feeding behavior in these tests.

EXPERIMENT 3

It is possible that more robust effects of shifting from one diet to another in a single-pan test would be obtained if the foods employed differed in more ways than the dry foods used in Experiment 1. The present experiment was conducted to provide some information on this possibility. In it, the foods were from two different categories. One food was a semi-moist burger-type product, the other food was a canned product that included meat chunks in a gravy-like fluid. The experimental design allowed comparison of the effects of shifting from the semi-moist to the canned food, and vice versa in the one-pan test procedure. Fine-grained measures of consumption were made along with the usual total-intake measures.

METHOD

Subjects and Apparatus

The same eleven dogs used in Experiments 1 and 2 were employed in this experiment along with two additional beagles that were new to the procedure. The dogs were housed under the conditions described in Experiment 1 and were fed once a day according to the experimental plan described below. The computer-controlled feeding stations described in Experiment 1 were used in the tests.

Procedure

The daily procedure for running the dogs was identical to that described in Experiment 1, except that (1) the foods were different, (2) the sequence of changes in diet followed the plan summarized in Table 2, and (3) the test session lasted only for 10 min which was sufficient for the dogs to eat their daily ration.

The two foods used in this experiment were a semi-moist burger-type product (G) and a canned product (A). The appropriate caloric intake for each dog was determined by using the dogs' current body weight and the instructions given on the package of each type of food. That specific amount of food was placed in the dog's pan each day for the feeding test. For Food G these values ranged from 297-446 grams for the various dogs, and for Food A the values ranged from 610 to 909 grams. It was common that the dogs ate all the food available (see Results).

The dogs were assigned to two groups so that the order of testing could be counterbalanced with the comparison foods. The design of the experiment is shown in Table 2. All of the dogs in both groups were fed the appropriate amount of Food G for the four days in the Pre-Feeding Phase. Group 2 (N=7) was then shifted to Food A for a four-day period while Group 1 (N=6) served as an unshifted control group, remaining on the Food G diet. By this procedure the effects of the shift to a new food could be separated from the effects of other variables, such as abrupt temperature or humidity changes in the outdoor runs that might influence food intake. In the remaining shifts, Group 2 was shifted from Food A to G and From G to A for a second time; Group 1 was shifted from G to A and then served as an unshifted control for Group 2 in the remaining phases. Following a shift, each diet was available for four days. For both groups, the first shift to Food A constituted their first experience ever with a canned-food diet.

RESULTS AND DISCUSSION

The food intake for each dog was converted to the proportion of food eaten from that which was available. The mean proportion eaten by each group is plotted as a function of the testing days in Fig. 1. The points at which each of the
FIG. 7. The mean proportion of the available food which was eaten by each group is plotted for each day in Experiment 3. Group 1 is plotted with the solid line and Group 2 is plotted with the dotted line. G designates that Food G was available and A designates that Food A was available on a given day.

four shifts (or unshifted controls) occurred are indicated by the breaks in the functions. It can be seen that the first shift from Food G to Food A for the dogs in Group 2 (dotted lines) resulted in a marked reduction in the mean proportion of the food eaten. This change from the last day on Food G to the first day on Food A was statistically significant when tested with a matched $t$-test, $t(5) = 2.56$. The first shift for the dogs in Group 1 (solid line) from Food G to Food A (Shift 2) produced a change in the same direction, but this change was not statistically significant. No other shift seen in this figure reached statistical significance.

Table 3 summarizes the first-shift food intakes (Food G to Food A) for individual animals in both groups combined. The animals were ordered by the magnitude of the change in the proportion of food eaten following the shift. It can be seen that the first dog listed increased by one hundredth of a point, the next three dogs did not change, the next two dropped by only one hundredth of a point, and the remainder showed a marked reduction in the proportion of food eaten. When tested with a matched $t$-test the difference between these two days for the two groups combined was significant beyond the 0.01 level of significance, $t(12) = 3.08$.

Close study of the dogs' moment-by-moment eating behavior on the first shift to Food A revealed that all 13 of the dogs showed a marked change in the rate and pattern of eating Food A, regardless of the proportion of the food consumed following the shift (Table 3). This change in eating behavior was usually short lived, lasting only a day or two. Two examples are shown in Fig. 8. Dog No. 3, which ate 0.99 of the Food A which was available on the first shift-day (see Table 3) showed a markedly depressed rate of eating Food A early in the First post-shift test session. Its rate of eating recovered on the remaining three days of exposure to that food. Dog No. 4, which showed a 50% decrease in the proportion of food eaten on the first day with Food A, also ate at a much slower rate on that day, with recovery of the

<table>
<thead>
<tr>
<th>Dog No.</th>
<th>Group</th>
<th>Last Day Food G</th>
<th>First Day Food A</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>1</td>
<td>0.99</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>12</td>
<td>2</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>6</td>
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<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>3</td>
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<td>1.00</td>
<td>0.99</td>
</tr>
<tr>
<td>9</td>
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<td>1</td>
<td>0.39</td>
<td>0.04</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>0.99</td>
<td>0.01</td>
</tr>
</tbody>
</table>

FIG. 8. The cumulative amount of Food A consumed is plotted for the first 10 minutes of the test sessions. Records for the first four days on Food A for Dog 3 are shown in the upper panel, and records for the same period for Dog 4 are shown in the lower panel.
The results of this experiment indicate that the first exposure to a canned food produces a temporary disruption in the feeding behavior of all the dogs. This disruption was seen in the fine-grained measures of feeding and, in some dogs, in the intake measure. It is clear from these data that the fine-grained measure is able to provide information about the dog's reaction to a food which cannot be seen in measures of total food intake. In this instance, the fine-grained measure alone appears to reflect a consistent and important feature of the dog's initial reaction to the canned food. The disruption of eating behavior following the first shift to Food A was short-lived in this experiment, lasting but a day or two at the most. In the second shift from Food G to Food A (Group 2; see Table 2) there was no hint of a disruption in eating in any measure, and the shifts from Food A to Food G in both groups (see Table 2) produced no detectable effect either. Thus, in contrast to Experiment 1 where dry foods were tested in a single-pan test, the present experiment provides evidence that a shift in diet can produce a temporary disruption of eating behavior in this kind of test, but the disruption seems not to be replicable following the first shift.

EXPERIMENT 4

In the present experiment, the dogs received a two-pan test with the semi-moist food (G) and the canned food (A) employed in Experiment 3. The choice test followed a period of feeding with Food G (Group 1) or Food A (Group 2) alone.

METHOD

Subjects and Apparatus

The dogs and the computer controlled feeding stations used in Experiment 3 were employed in this experiment.

Procedures

The dogs began this experiment immediately after Experiment 3 was completed. The pre-feeding and manipulations of the present experiment were, in fact, those for the two groups during Experiment 3 (see Table 2). Immediately before the choice test, Group 1 (N = 6) was pre-fed only Food G for four days. Furthermore, during the 20-day period prior to the two-pan test while Experiment 3 was in progress these dogs had eaten Food G on 16 of the days, and Food A on the other four days. Group 2 (N = 7) was pre-fed only Food A for four days immediately prior to the two-pan test. During the 20-day period prior to this experiment, these dogs had eaten Food A on 8 days and Food G for the other 12 days. The distribution of feeding the two foods across the 20 days is shown for each group in Table 2 of this paper.

The two-pan tests between Food G and Food A were run for six consecutive days. The procedure followed was identical to that described in Experiment 2 except that (1) the semi-moist and canned foods were used, (2) the test sessions were only 10-min long, and (3) in an effort to insure that an adequate supply of each food would be available for the dogs, an amount equivalent to twice the daily recommended diet was placed in each pan. This resulted in available quantities of Food G ranging from 594 to 892 g, and of Food A from 1220 to 1818 g.

RESULTS AND DISCUSSION

Preference scores were calculated by the formula Food G consumed/ (Food G consumed + Food A consumed). If a dog had an exclusive preference for Food G its score would be 1.00; an exclusive preference for Food A would yield a preference score of 0.0. Mean preference scores for each of the 6 test days for the two groups are shown in Fig. 9. It can be seen from this figure that both groups preferred Food A quite strongly, and that there was no difference between the two groups which would indicate an effect of the different pre-feeding diets fed to these groups immediately before the choice test.
The fine-grained measures of feeding behavior provided no indication that the prefeeding diet differentially influenced the dogs' reactions in the choice test. However, in this experiment, as in Experiment 2 with dry foods, several of the dogs were not exclusive eaters of Food A. It is informative to use the fine-grain measurements to describe how these dogs distributed their eating behavior between the foods during the test periods. Two examples are shown in Fig. 10. The first day of two-pan testing is shown for Dog No. 12 (upper panel). It first ate all of Food A (which was twice the daily allotment recommended by the manufacturer), and only then proceeded to eat about half the allotment of Food G. During this test session, Dog No. 12 consumed a total of 1743 g of food. In the early choice tests, most of the other dogs that ate some of Food G, did so only after they had consumed all of Food A, in the manner shown for Dog 12. However, after a few days, the dogs adjusted to the abundance of food and ate less of both foods, but particularly less of Food G, resulting in a slight lowering of the mean preference scores for the last three days of the testing (see Fig. 9). The lower panel of Fig. 10 shows the performance of Dog No. 8 on the second day of preference testing when it had a preference score of 0.33. This dog's distribution of feeding was more typical of the pattern shown with the dry foods (Experiment 2) where switching from one food to the other during the test was quite frequent. This pattern of feeding possibly indicates that the dog prefers a "mixture" of the two foods. We attempted to provide some information on this possibility in subsequent tests where we offered the dogs a mixture of the two foods in one pan vs. each of the foods presented singly in the other pans of the feeding station. In these three-pan tests, the dogs averaged taking 39% of their food from the "mix" pan. However, Dog No. 8, which looked like a strong "mixer" on the basis of the data in Fig. 10, averaged only 21% from the "mix" pan and, in general, mixers identified in the fine-grained measures did not eat exceptionally heavily from the mix pan.

GENERAL DISCUSSION

The present experiments indicate that fine-grained measurements of feeding behavior in one- and two-pan tests can provide quantitative information about (a) individual differences in the feeding styles of dogs (e.g., rapid eaters vs. slow eaters), (b) the ways dogs distribute their feeding between two foods in a choice test, and (c) in some cases, the initial disruptive effects of a new diet. Most of these aspects of performance are difficult or impossible to obtain from the traditional measures of food intake taken in these tests. We think the present data should encourage further studies in which fine-grained measurements of feeding are taken. It is our view that such measures can suggest new problems for study in feeding behavior, and can possibly lead to a more complete understanding of dogs' (and other animals') reactions to foods.

REFERENCES

