The Impact of Quality and Familiarity on Dogs' Food Preferences

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Abstract

Past work has found that dogs perceive and respond to certain characteristics of items, specifically an object's familiarity and quality when making choices. However, in the real world, these characteristics don't exist in isolation, and understanding the interaction between familiarity and valuation as they relate to object choice can provide insight into how dogs make decisions. We aimed to explore how item familiarity and quality intersect to form dogs' preferences for one food over another in a two-alternative forced choice task. We found that dogs' choices were driven only by the quality of the food item, and the familiarity of the item did not impact choice behavior. Determining what motivates dogs and contributes to their preferences has implications for understanding decision-making at large, as well as for advancing canine science.

Keywords: Domestic Dog; Decision Making, Preferences; Canine Cognition

Introduction

How do dogs make decisions about what items to interact with, and what factors contribute to dogs' preferences? Like other species, dogs regularly make decisions, ranging from what to eat (i.e., a piece of their kibble or a mystery food found on a walk) or what to play with (i.e., a kong or a ball). In making these decisions, it's beneficial to evaluate the characteristics of the objects at hand. For instance, choosing to eat or interact with a novel item, like a new food found on a walk, carries some degree of risk, but may provide a valuable resource if that is a new delicious food source. Making value-based decisions requires trading off the potential risks of interacting with the object (e.g., the likelihood the food will cause illness) with the potential benefits (e.g., discovering a new high-calorie food source that can now be exploited). Real-world decision making requires integrating multiple characteristics of an object to form a preference and make the resulting choice.

As social, domestic carnivores who have evolved alongside human beings, dogs exist at a potentially unique evolutionary intersection of cognitive abilities. Comparing dogs to their closest living genetic ancestor (wolves) has provided insights into the effects of domestication on decision making. For example, dogs perform worse on numerical reasoning tasks than wolves, as evidenced by dogs showing a comparatively weaker preference for larger quantities of a desirable food (Range et al., 2014). In addition, while distantly related genetically, dogs regularly interact with human social partners, and their social decision-making and preferences are often evaluated relative to those exhibited by human children. For instance, in the social domain dogs, like human children, prefer to interact with or follow gestures given by people who were previously accurate, helpful to others, and knowledgeable (Silver et al., 2020; Catala et al., 2017; Pelgrim et al., 2021), providing evidence that a preference for reliable social informants is not unique to humans.

Individual differences in preferences, which then drive choice behavior, are found in numerous species. Individual dogs also differ in their preferences, for example, some are particularly food motivated, whereas others prefer social rewards (specifically human praise) (Cook et al., 2016). Understanding dogs' preferences provides an important context for understanding their cognitive abilities. This is particularly important because dogs are relied on in a variety of service roles such as guiding visually impaired individuals or alerting to changes in medical status. Understanding what motivates dogs and how they form preferences can help to advance canine science and improve training for working dogs.

Dogs' Decision Making

Some features of items are preferentially chosen by dogs over others. For example, dogs prefer and subsequently choose items based on their quantity (as discussed previously). Dogs also form preferences about items based on the items' familiarity. When deciding what object to play with, dogs display a preference for novel items. Given a choice of toys, two of which are familiar and one is new, dogs prefer the novel object (Kaulfuss and Mills, 2008). A preference for new things, known as *neophilia*, is not unique to dogs. Neophilia has previously been explored in a variety of species including nonhuman primates (Kendal et al., 2005) and birds (Heinrich, 1995). Neophilia is associated with innovation, and neophilic individuals are more likely to discover novel solutions to problems and may be able to exploit new resources (Amici et al., 2019). However, a preference for novelty comes with risk. New items may be harmful or dangerous, and acquiring those items may expose the individual to elevated risks of predation or injury. Individuals who avoid this risk,are *neophobic*. They display a strong preference for familiar items and rarely interact with new foods or objects. Critically, preferences for novelty can vary based on context, meaning an individual may be neophilic in one domain (i.e., choosing a toy), but be neophobic in another (i.e., choosing a food)

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(Kuczaj, 2017; Amici et al., 2019). While dogs are neophilic when selecting toys, it's not currently known how they think about novel items in other domains, such as foods.

Dogs also form preferences for items based on their quality. It's intuitive to think that a high quality item (e.g., something rich in fat or with high caloric value) will be preferred over a low quality item. When considering food items, dogs do prefer higher quality foods. Past preference tasks in dogs have found ordered food item preferences, showing that dogs' preferences for food also predict how effective the food will be as a reinforcer during learning tasks (Vicars et al., 2014). Dogs have preferences for foods and make consistent choices based on these preferences (Vicars et al., 2014; Cameron et al., 2021). Dogs are also willing to work harder, as measured by running speed, for food rewards that are higher quality (Riemer et al., 2018).

Surprisingly, when presented with direct comparisons between high and low quality items in a forced-choice task, dogs may either have comparatively weak preferences or else may find it challenging to act on their preferences (Espinosa et al., 2021). When presented with two food items, one low and one high quality, dogs chose the high quality item approximately 60% of the time, which, while above chance, is weaker than the rates of choosing the higher quality item found in other species on similar tasks (e.g., 86% in capuchin monkeys, (Felsche et al., 2023)). This could be due to information gathering or decision-making failures in dogs, such as challenges with inhibitory control. However, it may also be that dogs' preferences for foods are formed from a combination of the item's quality and familiarity. Specifically, dogs may be assigning value to both the familiarity of the items and the quality of the items, and making choices based on those value judgments.

For example in Espinosa et al. (2021), the low quality item was unfamiliar to the dog, whereas the high quality item was generally familiar to dogs. Since some dogs, like humans, have a preference for variety in their foods (Bremhorst et al., 2018; Ratner et al., 1999), this may have led them to sometimes choose the lower quality food items. In particular, some dogs will choose a location that provides varied foods (one of which is their favorite) significantly more than a location that provides only their favorite food. However, the majority of dogs either significantly preferred the location with the consistently preferred food reward or showed no preference (Bremhorst et al., 2018). Further, as in (Espinosa et al., 2021), the food items used in this study did not differ by individual dog. It is possible that, in addition to individual differences in neophilia that may exist between dogs, the dogs may also have differed in their familiarity with the specific food items themselves.

Taken together, past work has explored how dogs respond to familiarity and item quality, however, these features have been explored in relative isolation. Dogs may choose high-quality items at lower rates than other species on 2-alternative forced choice tasks because they integrate multiple features of objects when forming preferences, and before making a decision about, for example, which food to choose We aimed to explore how item familiarity and item quality, two features known to individually impact dogs' choices between food items, intersect in dogs' choice of one food over another in a two-alternative forced choice task. We presented dogs with a total of four distinct food items (high quality familiar & unfamiliar; low quality familiar & unfamiliar) across six possible pairings, allowing for the exploration of the impact of familiarity and quality in isolation, as well as their combined impacts (i.e., if dogs are willing to take a risk on an unfamiliar food when the alternative is of low quality).

This study was conducted via Zoom with dog guardians acting as experimenters. Previous studies of dog preferences have often been conducted in the lab, which may have impacted dog preferences. By testing dogs in their daily environment (their homes) we aimed to increase the ecological validity of our results. Further, we were not constrained geographically and could reach a broader population that is more likely to generalize to pet dogs as a whole. Food items were selected for each dog by their guardian, as past work in homes has shown that dog guardians are highly accurate at predicting their dog's ranked order preferences for food items (Vicars et al., 2014). This allowed for the exploration of dogs' preferences for novel vs. familiar foods, and for their subjectively high vs. low food items, something that would be logistically challenging to do in-lab. This study was pre-registered. [1]

Methods

Participants

Participants were 38 dogs (Mean_{Age} = 60 months, 21 Female) who completed all pairings of testing[2]. In accordance with our pre-registration, an additional 8 dogs were excluded from initial analyses due to experimenter error (n = 5), or because the dog was unwilling to participate in all pairings (n = 3).

Procedure and Materials

Prior to participating in this study, all dogs participated in a simple object choice task between a plate with a treat on it and an empty plate. This pre-visit was conducted over Zoom with dog guardians acting as experimenters. This task has previously been performed in lab settings, and dogs perform extremely well on this task on average (M = 83%) (Espinosa et al., 2021). This task provided a baseline for each dog's choice performance, which we evaluated as a predictor for dogs' preferences. It also allowed us to compare dog performance at home with guardian experimenters to the performance we see in the lab with trained researchers. Dogs were

[1]This study was pre-registered on the Open Science Framework. The link to the pre-registration can be found here: https://osf.io/mr7yn

[2]This is 2 more dogs than pre-registered. The additional 2 dogs were already scheduled at the time of completion of data collection. Our sample size was determined via a power analysis based on an estimated effect size from past work - see the pre-registration for further details.

invited to participate in the current study after completing all 12 trials of the baseline task, as long as there were no significant guardian-experimenter errors, and the dog chose the treat (vs. the empty plate) on at least 7 out of the 12 trials. [3] Dogs then completed two sessions to test their food preferences. The structure of these two sessions was identical but with different food pairings. Foods were chosen individually for each dog by their guardian (for more details see Preference Sessions). Dogs' choices could be driven by the quality of the item alone, in which case we would expect that they would choose the high (vs. low) quality items in all pairings where that comparison is present. We would also expect they when the items did not differ in quality, they would choose between the two at chance levels. Dogs could also make choices driven by the familiarity of the item alone, in which case, we would expect that they would show strong preferences when comparing familiar and unfamiliar items, but when comparing items of equal familiarity we would expect choices at chance levels. Dogs may also display a ranked preference that is dependent on both factors where, for example, dogs most prefer one item and may rarely choose another item. Finally, they might not show strong enough preferences as measured by our choice metric.

Prior to sessions, dog guardians were instructed to ensure their dog had not eaten for a few hours. During the sessions, dogs were presented with a choice between food items on plates. Dog choices were defined throughout our study as making physical contact with either the food item or the plate the food item was on. Choices were recorded by the experimenter on Zoom. In the event that a dog failed to make a choice for 30 seconds, the trial was repeated (this occurred on 3 out of 1824 trials). Dogs waited approximately 1m away from their guardian while the guardian placed down plates with treats as instructed by a researcher over Zoom. When a second person was available, dogs were held in their waiting position by this second person. Otherwise, guardians were instructed to have their dog stay at the waiting position using the command their dog would respond to best. After the guardian completed the placement of plates, they released their dog to make a choice between the two plates.

Pre-Visit To familiarize dogs and guardians with the procedure, we first conducted warm-up trials. During warm-up trials, dogs were shown a single plate with a treat on it that was placed directly in front of their guardian. Once the plate was on the ground, the guardian verbally released their dog from the waiting position to eat the treat off of the plate. We repeated this procedure for a minimum of 3 trials, or until both guardians and dogs were comfortable (maximum of 6 trials observed in our sample). After completing warm-up trials, the guardian presented two plates, placed just in front of their knees. Plates were located approximately 0.75m apart from each other. The guardian placed the plates, one of which had a treat on it and the other which was empty, sequentially, as directed by an experimenter over Zoom. The order of placement (treat or empty plate placed first) as well as the side the treat was on was counterbalanced. After placing both plates onto the ground, the guardian verbally released their dog. If the dog chose the plate with the treat on it, they were allowed to eat the treat. If the dog chose the empty plate, the plate with the treat was removed, and they did not receive any treats on that trial. This was repeated for 12 trials.

Preference Sessions Across two sessions dogs were each presented with 4 types of food items, high quality familiar (HF), low quality familiar (LF), high quality unfamiliar (HU), and low quality familiar (LU). Food items were presented in 6 pairings (3 per session) to explore the impact of familiarity alone (HF vs. HU, LF vs. LU), quality alone (HF vs. LF, HU vs. LU), and the two interacting (HF vs. LU, HU vs. LF). Dog guardians selected food items for their dogs as past work has shown that they are accurate at predicting which foods their dogs will find valuable (Vicars et al., 2014).

To begin their visit, dog guardians presented their dogs with all the foods that would be used in the session. Using the same format of the warm-up trials from the pre-visit baseline task, guardians placed a piece of food onto a plate and then placed the plate directly in front of them. Dogs were then allowed to approach and consume the food. This procedure was repeated twice for each food in each session, and the order of the foods was counterbalanced across dogs.

As mentioned previously, dogs completed 3 pairings of foods per session for a total of 6 pairings of trials. During trials, guardians presented both food items sequentially to their dogs as instructed by the experimenter over Zoom. The procedure was the same as that in the baseline task from the pre-visit, except instead of an empty plate and a plate with a treat on it, dogs had the choice of two food items. The order of foods being presented (which food was placed down first) as well as which side the foods were placed on was counterbalanced. Dogs were only allowed to consume the food on the plate that they chose, and as soon as they made their choice guardians removed the un-chosen plate to prevent dogs from eating both items on a trial. This procedure was repeated for 8 trials for each pairing.

Results & Discussion

All statistical analyses were conducted in R version 4.1.2 (R Core Team, 2021). On their pre-visit, dogs were generally successful at choosing the plate with the treat over the empty plate. On average, dogs chose the plate with the treat on it significantly more than chance levels (Mean = 10.76 / 12 trials (90%), SD = 1.32; Range = 8 - 12), $t(37) = 22.18$, $p < 0.001$. These in-home results are consistent with past findings in the lab (Espinosa et al., 2021). This suggests that data collected in an in-home environment with guardians as ex-

[3] 7 was chosen so that dogs were numerically above chance at the baseline task, and were also within two standard deviations of the mean performance. At the suggestion of a reviewer, we have re-run our analyses presented in the subsequent sections with only dogs who were statistically significantly above chance at choosing the treat on their pre-visit (10/12 or more), and we find no difference in the pattern of our results.

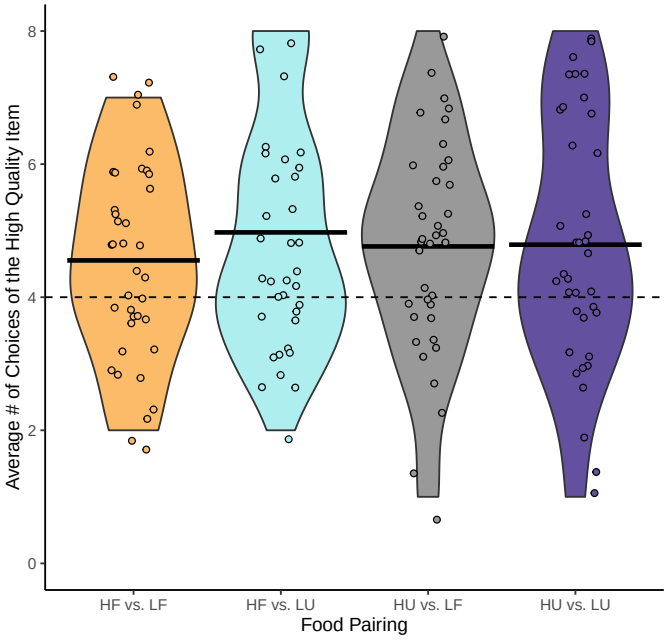

Figure 1: Dogs' preferences for the higher quality item across the four pairings where items differed by quality. Dots indicate data from individual dogs. Overall, dogs preferred the higher quality item at levels greater than chance (chance indicated by the dashed line)

perimenters can be comparable to in-lab data, at least on this task. Further, dogs' near-ceiling performance suggests that they are capable of succeeding at a 2 alternative force choice task, at least when the option is between something (a treat), and nothing.

Impact of Food Quality

First, we can consider the impact of food quality on dogs' preferences, using data from the four pairings that contrasted a high quality versus a low quality item (HF vs. LF, HF vs. LU, HU vs. LU, and HU vs. LF). As pre-registered, we first explored preference for food items as a function of their quality. Specifically, we used a linear model to explore if dogs are overall choosing the higher quality item (over the lower quality item, data centered) at above chance levels and if the familiarity of either item (or an interaction) moderates dogs' choice of the high quality item within each pairing. We found that the intercept differed significantly from chance, $B = .77$, $SE = .19$, $\chi^2(1) = 16.90$, $p < .001$. There was some variance between dogs (SD = 0.90). Across the four pairings with foods of different qualities, dogs, on average, preferred the higher quality item. See Table 1 for summaries of all pairings. From the same model we also found that dogs' choices were not impacted by the familiarity of the high quality item, $\chi^2(1) = .0032$, $p = .95$, the familiarity of the low quality item, $\chi^2(1) = .92$, $p = .34$, or an interaction between the two, $\chi^2(1) = .72$, $p = .40$. Dogs' preferences for the higher quality item can be visualized in Figure 1. This suggests that, at least in the context of these four pairings, the quality or quality of the food drives dogs' choices, and how familiar they are with the food has no impact. Put another way, dogs were equally happy to eat an unfamiliar item and a familiar item, as long as they were both of high quality.

Additionally, as pre-registered, we conducted an exploratory analysis to examine whether dogs' preferences changed over trials, and to examine individual differences between dogs. By having dog guardians select items specifically for their dog, the items used were in a sense normed per dog, as they were chosen to be definitely familiar, unfamiliar, and of high or low quality. We generated a series of mixed effects logistic regression models exploring trial number (centered), item pairing, random effects, and slopes. As pre-registered we first included a random slope and intercept for each dog but found that resulted in a singular fit, so we removed the random slope. When considering the pairings where items differed in quality, we found no significant effect of pairing on dogs' choices, $\chi^2(3) = 1.87$, $p = .60$. In keeping with previously reported results, this suggests that dogs tended to choose the higher quality item across pairings. There was a marginally significant effect of trial, $\chi^2(1) = 3.73$, $p = .053$, with dogs being more likely to choose the higher quality item in later trials (Mhigher quality = 56.57% on trial 1 vs Mhigher quality = 67.76% on trial 8). There was also some variance between dogs (SD = 0.53) in their tendency to choose the high quality item.

Impact of Food Familiarity

When considering the familiarity of the items, dogs did not display a preference or avoidance of the familiar items. We repeated the same analyses as conducted for quality pairings, but this time focusing on familiarity for the appropriate pairings (HF vs. HU, HF vs. LU, HU vs. LF, and LF vs. LU). First, we used a linear model to explore if dogs are choosing the familiar item at above chance levels, and to see if the quality of the familiar or unfamiliar item (or an interaction) impacted dogs' choices. We found that the intercept did not differ significantly from zero, $B = .12$, $SE = .1$, $\chi^2(1) = .85$, $p = .36$. We also saw very little difference between dogs (SD = 0.31). We found that the quality of the familiar item was not a significant predictor of dogs' choices, $\chi^2(1) = 1.78$, $p = .18$, however, the quality of the unfamiliar item was a significant predictor of dogs' choices, $\chi^2(1) = 16.91$, $p < .001$. When the unfamiliar item was of high quality, dogs were more likely to choose it, avoiding the familiar item, $M_{familiar} = -.37$, 95% CI [-.72, -.022]. In contrast, when the unfamiliar item was of low quality, dogs tended to choose the familiar item, $M_{familiar} = .61$, 95% CI [.26, .95]. Finally, the interaction of the quality of the familiar and unfamiliar items was of trending significance, $\chi^2(1) = 3.16$, $p = .07$. Results from pairings where the foods differed by familiarity can be seen in Figure 2. This suggests that dogs are not neophilic with foods like they are with toys (in which case we would expect them to avoid the familiar item) but they are also not consistently neophobic.

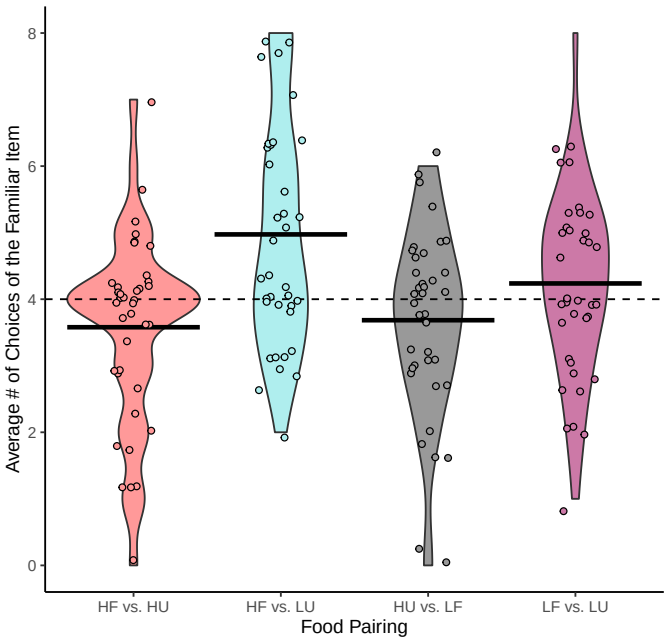

Figure 2: Dogs' preferences for the familiar item across the four pairings where items differed by familiarity. Dots indicate data from individual dogs. Overall, dogs did not prefer or avoid the familiar item at levels different from chance (indicated by the dashed line).

In order to determine if dogs' had significant preferences for either food item in each pairing, we conducted one-sample t-tests separately for each pairing. We compared dogs' choices to chance (4/8 trials or 50%) in accordance with our pre-registration. Results are summarized in Table 1. For pairings where the food items differed in quality, dogs on average preferred the higher quality item (Figure 1). When considering the two pairings where the items differed only in their quality, dogs preferred the higher quality item both when it was familiar and when it was unfamiliar to them (HF vs. LF, Mean HF choices = 4.55/8, 95% CI [4.07, 5.04], $t(37) = 2.30$, $p = .03$; HU vs. LU, Mean HU choices = 4.79, 95% CI [4.17, 5.41] $t(37) = 2.59$, $p = .01$). This trend continued on the two pairings where items differed on both familiarity and quality. When comparing HF vs. LU, dogs preferred HF, Mean HF choices = 4.97, 95% CI [4.40, 5.54], $t(37) = 3.44$, $p = .001$. When comparing HU vs. LF dogs preferred HU, Mean HU choices = 4.76, 95% CI [4.22, 5.31], $t(37) = 2.85$, $p = .007$. This provides further evidence that the quality of the food is driving dogs' preferences and that they display a significant preference for high, vs. low, quality foods. In contrast, for pairings where the items differed only in their familiarity to the dog, dogs displayed no significant preference for either item.

When comparing both high quality items (HF vs. HU), dogs displayed a weak trending preference for the unfamiliar item, though this was not significant, Mean HF choices = 3.57, 95% CI [3.11, 4.04], $t(37) = -1.82$, $p = .08$. When comparing both low quality items, LF vs. LU, dogs chose between the two at chance levels, Mean LF choices = 4.23, 95% CI [3.79, 4.69], $t(37) = 1.07$, $p = .29$). This provides further evidence that familiarity with the food item does not play a large role in forming dogs preferences for foods, or at a minimum that they do not display the same novelty bias for foods as they do for toys (Kaulfuss and Mills, 2008).In line with our pre-registration, we have also reported the number of dogs who were individually significantly above (≥ 7) or below (≤ 2) chance for each pairing, as determined by a binomial test (See Table 1).

We also conducted an exploratory analysis to explore if dogs' preferences changed over trials and to examine individual differences. We used a mixed-effects model predicting dogs' choices as a function of trial number (centered), pairing, and a random intercept for each dog. When items differed in familiarity, we found a significant effect of pairing $\chi^2(3) = 33.61$, $p < .001$. This is in line with results reported earlier, namely that dogs preferred the higher quality item whether it was familiar or unfamiliar (Table 1). There was no effect of trial, $\chi^2(1) = .18$, $p = .67$, meaning that dogs' preferences were consistent across the task and there was nearly half the variation between participants (SD = 0.30) as seen in the quality analyses, suggesting less individual differences between dogs.

Impact of Other Factors on Choice Behavior

In addition to counterbalancing the order of food pairings, we used a general linear model to evaluate if dogs performed differently on each pairing as a function of when the pairing was presented. We no effect of presentation order for both pairings where quality differed between the items, $\chi^2(1) = 2.67$, $p = .10$, and for the pairings where items differed by familiarity $\chi^2(1) = .04$, $p = .84$.

As pre-registered, we also explored if dogs performance on choice tasks more generally predicted their preference for foods. We used a mixed-effects ANOVA to explore the impact of past performance on the baseline task (between-subjects) and food pairing (within-subjects) and a possible interaction between the two on dogs' food preferences. For the four pairings that differed in quality, there was no difference in dogs choice of the high quality food by pairing, $F(3, 99) = .64$, $p = .59$, past performance on the baseline task, $F(4, 33) = 1.19$, $p = .34$, or an interaction between past performance and pairing, $F(12, 99) = 1.28$, $p = .25$. We conducted the same ANOVA on the pairings where foods differed by familiarity and found no difference in choice of the familiar item by past performance, $F(4, 33) = .07$, $p = .99$, and no interaction between past performance and pairing, $F(12, 99) = .811$, $p = .64$. This suggests that dogs performance on the preference task is not driven by a more general ability on choice tasks. Unlike the quality analyses, however, there was a significant effect of pairing, meaning that dogs chose differently depending on how foods were paired $F(3, 99) = 6.64$, $p < .001$. This is in keeping with findings presented earlier that

Table 1: Summary of Dog Preferences by Food Pairing

Foods Used	Factor Tested	Significant Preference?	Avg. Choice	# of Dogs Different from Chance
HF & LF	Quality	HF, $p = .03$	56.90% HF	8 (4 HF, 4 LF)
HU & LU	Quality	HU, $p = .01$	59.87 % HU	13 (10 HU, 3 LU)
HF & HU	Familiarity	Neither, $p = .08$	55.26% HU	9 (1 HF, 8 HU
LF & LU	Familiarity	Neither, $p = .29$	52.88 % LF	5 (1 LF, 4 LU)
HF & LU	Both	HF, $p = .001$	62.17 % HF	8 (7 HF, 1 LU)
HU & LF	Both	HU, $p = .007$	59.54 % HU	9 (6 HU, 3 LF)

the dogs choose the high value item regardless of it's familiarity.

Conclusion

In our study, we explored the impact of quality and familiarity on dogs' food preferences using a Zoom set-up with guardians acting as experimenters. When evaluating preferences, we found that the quality of the food drives dogs' food choices. Dogs prefer higher quality items relative to lower quality items, choosing the higher quality item significantly more. We also found that when choosing foods familiarity does not play a significant role. Dogs are neither neophobic nor neophilic when choosing between food items. Put another way, in a two-alternative forced choice task dogs choose foods based on their quality alone, choosing the higher quality item no matter how familiar it was to them, or how familiar the alternative was. We also found that past performance on a baseline task between a treat and an empty plate was not predictive of choices on the preference task. Interestingly, as found in prior work, while as a group dogs chose the higher quality food item significantly more often, few dogs individually displayed strong preferences, as measured by choice behavior (Espinosa et al., 2021). Finally, in our pre-test, we found that data collected at home via Zoom is comparable to that found in-lab on two-alternative forced-choice tasks.

While it is possible that dogs do not have as strong of preferences about food items as demonstrated by other species, it remains possible that dogs have a difficult time using item preferences to make decisions in two-alternative forced-choice tasks. Past work has shown that dogs can visually discriminate between high and low quality food items (Espinosa et al., 2021). Anecdotally, dogs did not always consume the lower quality item when they chose it, while they always consumed high quality items, suggesting that the lower quality item was in fact less preferred. Despite this lack of consumption, they sometimes continued to choose the low quality item. It's possible that task demands contribute to dogs' apparent weak preferences (as measured by choice behavior). For example, dogs may have a difficult time with impulse control, resulting in choices that are not in line with their true preferences. Pet dogs may also have low motivation to gather information about food items. Pet dogs often need to locate food in their environment, and perhaps as a result they are skilled at tasks requiring locating a food item. However, evaluating and then choosing between two items may be a much less frequently encountered task in their everyday environment, and may therefore be less ecologically relevant. This may be because there is little pressure on pet dogs to make optimal choices between food items.

Future work could consider exploring food preferences in a different dog population, such as free-ranging dogs, where there may be greater pressures to obtain better foods, and where novel foods may present more risk. Further, all dogs in our sample are pets being presented with food items by their guardian. This was advantageous as it allowed us to customize food choices for individual dogs, however, social expectations and past reward history with their guardian may have impacted dogs' performance. Future work could consider an a-social version of this task to determine if dogs display stronger preference through choice behavior without the presence of a human.

Collecting reliable and valid data over Zoom has significant advantages. Relative to in-lab research, Zoom studies allow for the collection of a more diverse sample. Dogs who are anxious meeting new people or going to new places can also be tested. Zoom studies do have limitations, namely they do not have the same level of control as in-lab research and are not appropriate for all research questions (such as those requiring a complex apparatus). Zoom studies capture pet dogs in their natural environment and may provide more ecologically valid data. They also provide some advantages relative to traditional asynchronous methods of citizen science. Coaching guardians to be experimenters while supervised increases the kinds of protocols that can be done. Working live with guardians requires more time investment on the researcher, meaning a reduction in possible sample size relative to typical citizen science approaches, providing live feedback to guardians allows for quick correction of any errors made (Stewart et al., 2015). While Zoom studies, relative to in-lab studies, require sacrificing some control, the sample may be more representative of dogs as a general population.

In all, we found that familiarity does not play a role in dogs' food preferences, but they do significantly prefer higher quality foods to lower quality foods. These results have an impact on future canine science studies and experimental design, as well as dog training. Finally, this helps us to better understand how dogs make decisions and form preferences about the items in their environment.

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