Expectations about plant edibility in 6-month-old infants

Running Title: Plant edibility expectation

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Research highlights:

- We examined 6-month-olds' edibility expectations using a violation of expectation paradigm in which infants viewed an actor eating parts of two different items.
- In Experiment 1, we show that infants expect plants, relative to feature-matched artifacts, to be sources of food, replicating a previous finding.
- In Experiment 2, we find that infants tend to differentially expect fruits to be edible, but not plant leaves.
- The findings underscore that there is selectivity in infants' edibility inferences that facilitate social learning about foods, even in the first year of life.

Abstract

Learning what to eat is not easy. Here we examined 6-month-olds' expectations about what kinds of entities are likely to be edible using a violation-of-expectation setup in which infants viewed an actor eating parts of two different items. In Experiment 1 (N=40, 20 females), infants expected plants, relative to feature-matched artifacts, to be edible, replicating a previous finding. In Experiment 2 (N=40, 23 females), infants tended to differentially expect fruits to be edible, but not leaves. However, infants' expectations about fruits presented on their own were attenuated relative to their expectations for whole plants. These findings suggest that there is selectivity in infants' edibility inferences and the kinds of resources prioritized in human diets have shaped infants' food learning.

Keywords: food learning; infancy; social information; edibility cues; replication; plants

Introduction

Learning what to eat is not easy. Infants are born into a world replete with objects that have different colors, shapes, and odors. Infants see adults interacting with these objects, including putting some objects into their mouths. The tricky part is, only some of the objects that go into adults' (and infants') mouths are edible. For example, pretzel sticks are edible, but chopsticks are not. It's a lot for an infant to sort out in a relatively short amount of time. This complexity is why, apart from few common taste preferences (Beauchamp et al., 1986; Rozin & Todd, 2016; Steiner, 1979) and widespread food-related aversions and fears (e.g., disgust, contamination or food neophobia; Cashdan, 1998; DeJesus et al., 2015; Lafraire et al., 2016; Rioux, 2019; Rozin 1987), infants largely learn what to eat from other people (see DeJesus et al., 2018; Herman, 2015; Shutts et al., 2013 for reviews). Indeed, research investigating food learning processes in infancy and early childhood highlights the importance of social information for guiding children's food selection (e.g., Addessi et al., 2005; Birch, 1980; DeJesus et al., 2018; Harper & Sanders, 1975; Hendy & Raudenbush, 2000; Laureati et al., 2014; Liberman et al., 2016; Lumeng et al., 2008; Nicklaus & Monnery-Patris, 2018; Shutts et al., 2009; Wertz & Wynn, 2014a, 2019). This work shows that observing what other individuals eat is a particularly influential social cue (e.g., seeing an adult eating an unfamiliar food increases toddlers' willingness to taste that food; Addessi et al., 2005). However, as the example above illustrates, simply observing what others put in their mouths is insufficient for learning about what is edible. Instead, infants need some selectivity in their food learning inferences.

It is well known that not all information is equally learnable or useful and instead learning systems can selectively utilize information that is most relevant to the problem at hand (Barrett & Broesch, 2012; Seligman, 1970; see also Kendal et al., 2018 for a review). Threat learning is one well-studied example of the interaction between the content of

information and how it is learned (e.g., Barrett et al., 2015; Broesch et al., 2014; Lobue et al., 2010). For example, when learning about animals, children and adults show preferential retention of learned danger information compared to habitat or diet information (Barrett & Broesch, 2012; Broesch et al., 2014). The authors argue that danger information is better retained for animals because of the recurrent threats that predators posed to humans over evolutionary time. However, to our knowledge, studies that investigate content-specific social learning mechanisms in the food domain have been few and far between. Additionally, there has been surprisingly little investigation of the ways humans acquire information about food over the course of development, despite the ubiquity of food selection in daily life and its importance for our survival (Rozin & Todd, 2016). One notable exception is the study of Wertz and Wynn (2014a; see also Liberman et al., 2016).

Wertz and Wynn (2014a) provided the first evidence that infants possess selective social learning strategies that enable them to safely identify edible plants. They predicted that, because humans have relied on gathered plant resources throughout our evolutionary history, the same social cues of edibility would be interpreted differently for plants than other types of entities (see also Wertz, 2019). To test this prediction, they showed 18-month-olds events in which an adult demonstrated the same social cue of edibility with a plant and an artifact. The actor first picked a fruit from the plant and put it in their mouth while saying, “*Hmmmm*”. The actor then performed the same action with the artifact. After these events, a second experimenter offered infants the fruits picked from both object types and asked which one they could eat. Despite seeing an adult eating fruits picked from both object types, infants reliably selected fruits from the plant over fruits from the artifact as something they could eat. However, infants chose equally between the plant and the artifact when the actor demonstrated a different non-food relevant action (i.e., placing the fruit behind their ear), suggesting that plant selectivity was limited to socially conveyed information about edibility.

Wertz and Wynn (2014a) also tested this prediction with 6-month-old infants, who have far less experience with solid food items than 18-month-olds do. Instead of asking these younger infants to make a choice, they measured the time infants spent looking at different types of events using a violation-of-expectation paradigm in which infants look longer at events that violate their underlying expectations (e.g., Baillargeon et al., 1985; Dunn & Bremner, 2016; Rubio-Fernandez, 2019). As predicted, the 6-month-olds looked longer when the actor placed fruits from an artifact in their mouth than fruits from a plant, but did not show differential looking time when the actor placed the fruits behind their ear, providing convergent evidence for the findings with older infants. Taken together, these findings revealed that infants selectively identify plants over artifacts as sources of food and provided the first evidence for content-specific social learning mechanisms that enable infants to safely identify edible plants.

One important point to note about Wertz and Wynn's findings is that they do not rule out that infants would consider objects taken from an artifact to be food under different circumstances. Research investigating food learning processes has established that seeing an individual eating an object is a powerful cue for infants to subsequently treat the object as food and make food-based inferences (e.g., Liberman et al., 2016; Ruba et al., 2019; Shutts et al., 2009; Wertz & Wynn, 2019). For example, in Liberman and colleagues' study (2016), infants considered the same object, an opaque bowl, differently depending on what type of action was performed on it. When an adult ate from the bowl, infants construed the contents of the bowl as food. However, when the adult simply lifted the bowl, infants no longer made food-based inferences (Liberman et al., 2016). Therefore, if infants only saw an adult eat from the artifact control object (and not concurrently from the plant) in Wertz and Wynn (2014a), it is likely that infants would consider the artifact to be a food source. In fact, in their everyday lives, infants often see others eat food that is taken from artifacts (e.g., out of refrigerators,

cooking pots, or from utensils). What Wertz and Wynn's findings reveal is that there is something special about plants that makes them *more likely* to be perceived as a candidate food source than artifacts; Wertz and Wynn argue that this selective attention to plant edibility stems from humans' long evolutionary history of foraging wild plant resources (e.g., Hardy & Kubiak-Martens, 2016; Henry et al., 2014).

Here, we can draw a parallel with the literature on threat detection, a different set of fitness-relevant abilities. Infants detect threatening entities (e.g., snakes) faster than non-threatening ones (e.g., frogs; for reviews see e.g., LoBue et al., 2010; LoBue & Rakinson, 2013), and both low-level features of threatening objects (e.g., the curvilinear shapes of snakes) and object information (e.g., how the objects are presented) play a key role in rapid detection of these threats (Lobue, 2014). It is not yet clear whether selective edibility inferences are tied to particular features of plants. Wertz and Wynn's plant stimuli were leafy plants with fruits that looked like they were growing out of soil in a pot. Therefore, we do not yet know whether it is necessary for infants to be confronted with a whole plant to make these kinds of inference, or if infants would make similar selective edibility inferences about subcomponents of plants (e.g., fruits and leaves) when they are presented separately. Recent work has shown that for other types of behaviors toward plants (i.e., an initial reluctance to touch; Wertz & Wynn, 2014b; Włodarczyk et al., 2018), infants show a similar, albeit attenuated, response to plant parts relative to whole leafy plants (Rioux & Wertz, 2021). Therefore, we may see some evidence of selective edibility inferences for plant parts. In addition, it is possible that infants would expect fruits, more than leaves, to be candidate food items, because cross-cultural and comparative work shows that when it comes to plant food foraging humans specialize in roots, fruits, and nuts rather than leaves (Cordain et al., 2000; Hardy & Kubiak-Martens, 2016; Ungar & Sponheimer, 2011).

To test this, in the current study, we pared the whole plant from Wertz and Wynn (2014a) into its component parts—its fruits and leaves—and examined 6-month-old infants' expectation of edibility towards each part. We focused on younger infants because compared to 18-month-olds, 6-month-old infants have typically only just begun consuming solid foods, usually as purees, and have less experience with food in general (Prell & Koletzko, 2016). In addition, 6-month-olds have expectations about the form and goal of typical eating actions (Kochukhova & Gredebäck, 2010; Gredebäck & Melinder, 2009). Across a series of two experiments, we used a violation of expectation paradigm in which infants tend to look longer at unexpected events. Experiment 1 was a direct replication of Wertz & Wynn's (2014a) experiment with 6-month-olds. We began by testing the robustness of these initial findings because of the very limited number of attempts to investigate selective social learning strategies in the food domain. In Experiment 1, infants watched an actor perform an action on a whole leafy plant with fruits, then watched the same action performed on a feature-matched artifact. The actor performed either a food-relevant action (i.e., eating a fruit picked off the objects), or a food-irrelevant action (i.e., putting the fruit picked off the objects behind their ear). In Experiment 2, we assessed infants' expectations about the component parts of the whole plant. Infants in Experiment 2 watched an actor perform an eating action on fruits (Fruit Condition) or on leaves (Leaf Condition) presented on their own and then watched the same action performed on feature-matched artifacts. Following Wertz and Wynn (2014a), we predicted that if 6-month-olds differentially expect plants to be food sources, they should look longer when a food-relevant action is performed on an artifact compared to a plant (Experiment 1) or a plant's component parts (Experiment 2).

Experiment 1 – Replication of Wertz & Wynn (2014a)

Methods

Participants were 40 healthy, full term 6-month-old infants (20 female, mean age = 6 months, range = 5;15 - 6;14), divided evenly across two independent conditions. They were recruited from a predominantly White population living in a large city in Germany and tested in the institution's BabyLab. This sample size was chosen based on a power analysis (*wp.rmanova* function from the R package *WepPower*; Zhang & Yuan, 2018) using Wertz & Wynn's (2014a) results from their looking time experiment (Experiment 4, $\eta_p^2 = 0.34$ for the first experimenter's action and $\eta_p^2 = 0.47$ for the second experimenter's action; see Wertz & Wynn, 2014a, Experiment 4 for details). Three additional infants were tested but excluded due to fussiness (i.e., crying during test session). The study was approved by the local Ethics Committee and parents gave written consent for their child's participation. Parents were compensated with 10 Euros and infants were given a participation certificate.

Our stimuli were the same ones used in Wertz and Wynn's original study (2014a): a realistic-looking artificial plant and a silvery artifact that matched many low-level perceptual features of the plant (e.g., size, shape, and presence of leafy parts) but did not itself look like a plant (see Fig. 1). Both objects had four removable dried fruits attached (either orange apricots or dark purple plums). We counterbalanced across participants which dried fruit type was placed on the plant versus the artifact (see Supporting Information section 1.1 for a full description of the stimuli). We chose dried fruits we thought would be unfamiliar to infants, and our questionnaire measures confirmed our assumption (see SI section 1.7 for details of the questionnaire).

During the session, infants sat on their parent's laps. Parents were instructed not to direct their infant's behavior and asked to keep their eyes closed throughout the session so they would remain blind to event type. Infants were presented with a video-recorded show

displayed on a TV screen (Samsung LED TV 126 cm) located approximately 125 cm away from them. The screen was positioned such that the actor appeared to be sitting within our presentation stage and presenting the events in person. A curtain placed in front of the screen was raised at the beginning of each event and lowered when the event terminated, which further added to the illusion that the infant was watching a live actor. A coder seated outside of the infant's view recorded how long infants looked at the presentation screen during each event.

The show began with two introduction events. First the curtain opened to reveal on the screen the two objects placed on the stage, approximately 70 cm apart. The location of the objects (plant on left side vs. right side) was counterbalanced across participants. After the live coder determined that the infant looked at both objects (i.e., the infant had looked at both the left and the right side of the screen) the event terminated. Then, the curtain opened to reveal Experimenter 1 (E1) sitting between the two objects (see Fig. 1) while saying "*Hi!*" in German ("*Hallo!*"). This second introduction event lasted for approximately 10 seconds. The show continued with six test events during which E1 performed the same action on the plant and artifact. Three test events were directed at the plant and three test events were directed at the artifact. Each participant saw the actor alternate between plant and artifact events, and which object E1 acted on first was counterbalanced across participants. Half of the infants saw a food-relevant action (In-Mouth Condition): the curtain opened, E1 said "*Hi!*" in German ("*Hallo!*"), turned toward the plant/artifact, removed a fruit, paused while looking at the fruit, then placed the topmost part of it into her mouth while saying "*Hmmm*" in a neutral voice and looking down. This action lasted for approximately 15 seconds. After each action, the video was paused showing E1 motionless on the screen and infants' looking time was recorded. Infants in the other condition saw a control action (Behind-Ear Condition), which was the same as the In-Mouth action, except that E1 placed the topmost part of the fruit

behind her ear (see Video S1 and S2 for an example video from each condition and SI section 1.2 for details of the recording procedure).

Test events terminated when either (i) the infant looked away from the screen for 2 consecutive seconds, or (ii) 30 seconds elapsed. Looking times were determined online by a live coder, seated behind the stage, who was blind to the event type (i.e., action performed on the plant vs. the artifact), using the JHab software (Casstevens, 2007). A second blind coder evaluated the looking times of all the participants using the video recordings of each session. In case of a disagreement between the two coders (absolute looking time difference greater than 2 seconds) a third tie-breaker coder, who was also blind to event type, coded the trial to settle on which coded looking time value should be used. Twenty-nine individual trials (out of 240) were excluded from the analysis, either due to the live coder ending the trial too early (14 trials), infants not looking at the action during the trial (11), parental interference (1), and procedure error (3; see SI sections 1.3-1.5 for a detailed description of the coding procedure and exclusion criteria). At the end of the session, parents filled in two questionnaires related to their infant's (i) prior experience with plants (the Plant Experience questionnaire, Rioux & Wertz, 2021; Wertz & Wynn, 2014a; 2014b), notably their experience of watching their parent eat fruit off a plant and (ii) familiarity with both dried apricots and plums (see SI section 1.7 for details of these questionnaires).

This procedure differs from the original Wertz and Wynn (2014a) study in two important ways. First, in the present experiment, infants watched the actor on a pre-recorded video displayed on a large TV screen instead of seeing a live show. This methodology was adopted to allow for more precise control of E1's actions across events and infants. The timing of E1's actions was equated across videos and the soundtrack was recorded separately and added to every video so that E1's vocalizations were identical across all event types (see

SI section 1.2 for details of the video recording procedure). The same two videos used for each infant's test session (plant vs. artifact with appropriately counterbalanced fruit color) were alternated across the six test events, further reducing inconsistency across events. The second important difference is that the present experiment only involved events performed by one experimenter (E1). In the original study, infants viewed a two-part live show in which E1 acted on the plant and artifact and then a second experimenter (E2) acted on fruits that had been removed from the plant and artifact so that E2 would be blind to the event type during the show (see Wertz & Wynn, 2014a, Experiment 4 for a complete description of the original procedure). The current experiment included only repeated presentations of E1's actions. We decided to do this prior data collection to shorten the overall test session and remove any potential difficulties caused by infants needing to track and remember the fruit identity between E1 and E2 actions in a less engaging video setup.

In the current experiment, we ensured prior to testing that there were no systematic behavioral differences between E1's actions toward the plant and artifact in the videos. To do this, E1's behavior in the test events was coded by coders who were blind to event type. Due to the counterbalancing of the stimuli across infants (i.e., placement side on the stage and the fruit type on each object) there were 4 different stimuli setups recorded (e.g., plant with orange fruits on left side of the stage, plant with dark purple fruits on the right side of the stage, etc.). Within each setup, we recorded two test videos, corresponding to the two different test events (i.e., action performed on the plant and action performed on the artifact). Therefore 8 video versions were created for each condition (In-Mouth and Behind-Ear Conditions). In order to have a sufficiently powered analysis, five independent coders were given this set of 8 videos to rate twice (16 ratings per coder). The parts of the videos that showed the stimulus objects were masked so that the coders remained blind to event type, and the coders were unaware of the repeated events. The coders guessed which object type E1 was acting upon

(plant vs. artifact) in each video based on E1's facial expressions and movements only. If E1 did not exhibit systematically different behaviors toward the plant and artifact, we would expect the coders' ratings to be around chance levels. A binomial test aggregating all the coders' guesses showed that the total proportion of correctly rated trials was not significantly different from chance in either condition (55%; $p > 0.05$ for the In-Mouth Condition and 46%; $p > 0.05$ for the Behind-Ear Condition; see SI section 1.6 for details on the individual coders), indicating that E1 did not exhibit systematically different behaviors across the plant and artifact events.

Results and Discussion

In order to test whether 6-month-old infants view plants as more probable food sources than other types of objects, we followed Wertz & Wynn's analysis (2014a, Experiment 4) and first assessed infants' average looking time toward each object type in the two conditions (In-Mouth Condition and Behind-Ear Condition) independently and then compared the two conditions. All analyses were performed in the R environment using a linear mixed-effects approach (Bates et al., 2015) with infant participants as a random factor to account for shared variances within subjects. We computed a model in each condition with Object Type (plant vs. artifact), Order (E1 act on plant first vs. artifact first), and the Object Type x Order interaction modeled as fixed effects.

Preliminary analysis revealed that Fruit Type (orange apricot vs. purple plum) did not influence infants' looking time, therefore this control variable was not entered in the model (see SI section 2.1 for details). We report the ANOVA output results for the models throughout and in Table 1. The means and standard deviations in the text and the graphs report the raw data for comparability across different analyses.

The results for the In-Mouth Condition revealed a significant effect of Object Type ($\chi^2(1) = 4.27, p = .039$), replicating Wertz & Wynn's original findings. As predicted, infants looked longer at In-Mouth actions performed on the artifact ($M = 12.56, SD = 6.17$) compared to the same action performed on the plants ($M = 10.31, SD = 5.12, b = 3.23, SE = 1.56, z = 2.07, p = .039$; see Fig. 2). A similar effect size (approximately 2s difference) was found between infants' looking time during the repeated presentation of E2's In-Mouth actions in Wertz & Wynn's original study. This result suggests that infants expect whole leafy plants, more than artifacts, to be sources of food.

The analysis of the Behind-Ear Condition revealed no significant effect of Object Type ($p > .05$), again replicating Wertz & Wynn and demonstrating that there was no general tendency for infants to look longer at any action performed with the artifact. Quite the contrary: under some conditions we found evidence that infants tended to look longer at the plant. Specifically, we found an Order effect ($\chi^2(1) = 6.71, p = .0096$), indicating that infants overall looked longer when E1 performed her Behind-Ear action on the plant first ($M = 14.35, SD = 6.60$) compared to on the artifact first ($M = 9.55, SD = 5.28, b = 6.77, b = 6.98, SE = 2.69, z = 2.59, p = .0096$, see Fig. 2). We also found an Object Type x Order interaction effect ($\chi^2(1) = 4.41, p = .036$). Infants looked marginally longer at the plant ($M = 15.78, SD = 6.63$) compared to the artifact ($M = 12.91, SD = 6.59$) when the Behind-Ear action was performed on the plant first ($b = 2.86, SE = 1.47, z = 1.95, p = .052$). In addition, within the plant events, infants looked longer when E1 performed the Behind-Ear action on the plant first ($M = 15.78, SD = 6.63$) compared to plant events when E1 had first acted on the artifact ($M = 8.80, SD = 5.12, b = 6.98, SE = 2.69, z = 2.59, p = .0096$, see Fig. 2).

The results of the comparison between conditions revealed a marginally significant Object Type x Condition interaction effect ($\chi^2(1) = 3.74, p = .053$), mirroring the effect found within each condition. Infants looked longer at the artifact events compared to the plant events

($b = 2.44$, $SE = 1.12$, $z = 2.01$, $p = .044$) in the In-Mouth Condition, but did not exhibit significantly different looking times for plant and artifact events in the Behind-Ear Condition ($b = .68$, $SE = 1.12$, $z = .61$, $p = .54$; see SI section 2.2 for details).

Infants' looking times were not related to their prior experience with plants in general or with the particular fruits used in this study in either condition (see SI section 2.3 for details).

Taken together, these replicate the previous findings of Wertz & Wynn (2014a) and suggest that preverbal infants differentially expect plants to be sources of food. Additionally, our results from the Behind-Ear Condition suggest that infants may be surprised to see a food-irrelevant action after an actor picked a fruit from a plant. Importantly, the Behind-Ear Condition results bolster our interpretation that the In-Mouth Condition results suggest that infants expect adults to eat fruits from whole leafy plants.

Experiment 2

In Experiment 2, we tested whether infants' differential expectation of plant edibility extends to its component parts, or only applies to a whole leafy plant with the fruits attached. To do this, across two independent conditions, we pared the whole plant from Experiment 1 into its component parts: its fruits (Fruit Condition) and leaves (Leaf Condition). We showed infants an actor performing the food-relevant In-Mouth action from Experiment 1 on a fruit plucked from a bunch (Fruit Condition) or a leaf picked off a leaf bouquet (Leaf Condition) contrasted with an In-Mouth action performed on similar fruits and leaves taken from feature-matched artifacts. We assessed infants' looking times for these event types. Following the results of Experiment 1, we predicted that if infants differentially expected either the fruits or leaves of plants to be edible, they would look significantly longer at the artifact events. We further expected that, if infants differentiated between the different component parts of plants,

they would be more likely to have a differential edibility expectation for the fruits than the leaves given that human diets tend to rely more heavily on fruits, roots, and nuts than leaves (Hardy & Kubiak-Martens, 2016; Henry et al., 2014).

Methods

Our participants were 40 healthy, full term 6-month-old infants (23 female, mean age = 6 months, range = 5;15 - 6;15) divided evenly across two independent conditions. They were recruited from a predominantly White population living in a large city in Germany and tested in the institution's BabyLab. This sample size was chosen to match the In-Mouth condition of Experiment 1. Six additional infants were tested but excluded due to fussiness during the testing session (5) or failure to watch one event type across all its repetitions (1). Ethical approval and consent procedures were the same as Experiment 1.

In the Fruit Condition, our stimuli were a bunch of cherry tomatoes still on their green vine and an artifact that shared many perceptual features with the fruit stimuli (e.g., size, shape and presence of round, colorful parts) but did not itself look like a bunch of fruit (see Fig. 1). Both objects had six removable round objects attached (either red or yellow cherry tomatoes). The color (red vs. yellow) paired with the plant vine and the artifact was counterbalanced across participants. In the Leaf Condition, our stimuli were a bouquet of green leaves and an artifact that shared many of the perceptual features of the leaf bouquet (e.g., size and overall shape), but with a metallic color and handle attached so as not to look plant-like (see Fig. 1). The stimuli each had two removable leaves attached (light or dark green for the leaf bouquet and silver or gold for the artifact) that the actor could remove and place in her mouth. The removable leaf color paired with each object was counterbalanced, with the constraint that the light and dark green leaves were only placed on the leaf bouquet and the silver and gold leaves on the artifact (see SI section 1.1 for a full description of the

stimuli). The plant part stimuli—the cherry tomato vine and the leaf bouquet—were chosen because they were food items infants likely would not have experience eating themselves. Our questionnaire measures confirmed this assumption (see SI section 1.7 for details).

The study procedure was identical to the Experiment 1 In-Mouth Condition, except that in the Fruit Condition the stimulus objects were each placed on an elevated base that was tilted slightly forward to ensure the infants could see the stimuli well in the study videos (see Fig. 1). Thirty-five individual trials (out of 240) were excluded from the analysis due to the live coder ending the trial too early (16 trials), infants not looking at the action (15), parental interference (1), and procedure error (3). Using the procedure described in Experiment 1, based on E1's facial expressions and movements only, five coders per condition who were blind to event type rated the test event videos by guessing the object type (plant part vs. artifact) that was acted upon in each video. A binomial test aggregating all the coders' guesses indicated that the total proportion of correctly-rated objects was not significantly different from chance in either condition (53%; $p > 0.05$ for the Fruit Condition and 59%; $p > 0.05$ for the Leaf Condition; see SI section 1.6 for details on individual coders), indicating that E1 did not exhibit different behavior toward the plant part and artifact.

Results and Discussion

To test whether 6-month-olds differently expect the component parts of plants to be edible, we assessed whether they looked longer when the food-relevant In-Mouth action was performed on our artifact stimuli compared to fruits (Fruit Condition) and leaves (Leaf Condition). Within each condition, we used the same analysis procedure as in Experiment 1. We report the ANOVA output results for the models throughout and in Table 2. In

Experiment 2 we did not directly compare the Fruit and Leaf Conditions, due to the difference in stimuli across the conditions.

In the Fruit Condition, preliminary analysis revealed that Fruit Color (red vs. yellow cherry tomato) did not influence infants' looking time, therefore this control variable was not included in the model (see SI section 2.1 for details). Our main analysis did not find an overall effect of Object Type. Instead, the results revealed a significant interaction between Object Type x Order ($\chi^2(1) = 5.39, p = .020$). For the shows where E1 acted on the artifact stimulus first, infants looked marginally longer at the In-Mouth actions performed on the artifact ($M = 13.71, SD = 5.94$) compared to the same action performed on the plant part ($M = 11.15, SD = 3.80, b = 2.56, SE = 1.44, z = 1.78, p = .076$; see Fig. 3). The looking time difference in the artifact-first order was similar to Experiment 1 (approximately 2s). However, we did not observe looking time differences between the plant part ($M = 10.48, SD = 7.90$) and artifact when E1 acted on the plant stimulus first ($M = 8.31, SD = 7.84, b = 2.17, SE = 1.44, z = 1.51, p = .13$; see Fig. 3). These results were not related to infants' prior experience with plants in general, or cherry tomatoes specifically (see SI section 2.3 for details). Although infants' looking times were in the predicted direction in the artifact-first order, the difference between plant part and artifact events was marginal. Therefore, these results provide limited evidence that infants differentially expect plant fruits presented on their own to be edible.

In the Leaf Condition, in contrast to the Fruit Condition, preliminary analysis revealed that Artifact Leaf Color (silver vs. gold leaves) influenced infants' looking time such that infants looked longer at golden leaves, therefore this control variable was entered in the model; Leaf Bouquet Leaf Color (light vs. dark green leaves) did not influence infants' looking time (see SI section 2.1 for details). Overall in the Leaf Condition, infants did not exhibit different looking behavior for leaves ($M = 12.90, SD = 8.00$) and artifacts ($M = 11.25,$

SD = 7.18; see Fig. 3). We found no significant effects of Object Type, Order or Object Type x Order interaction. In general, infants' looking behavior in this experiment was not related to their prior experience with plants, but infants who had seen herbs before (17 infants out of 20) looked significantly longer at the leaf bouquet ($M = 14.15$, $SD = 7.98$) compared to infants who had not previously seen herbs ($M = 5.82$, $SD = 3.88$, $t = 3.03$, $p = .020$) (see SI section 2.3 for details). Overall, the results of this condition do not provide any evidence that infants differentially expect plant leaves presented on their own to be edible.

General Discussion

Learning what to eat is a challenge all infants face over the course of development. Simply observing what others put in their mouths is insufficient because not everything that goes into another person's mouth is edible. Instead, some selectivity is necessary to guide learning about food. For example, Wertz and Wynn (2014a) showed that infants identify plants over artifacts as sources of food after seeing social cues of edibility applied to both object types. This kind of content-specific social learning mechanism enables infants to rapidly and safely identify edible plants, an essential component of human diets over evolutionary time (e.g., Hardy & Kubiak-Martens, 2016). The aim of the current study was twofold (i) to attempt to replicate Wertz & Wynn's (2014a) finding that 6-month-old infants selectively identify plants over artifacts as food sources and (ii) to examine whether selective edibility inferences are tied to particular features of plants (i.e., fruits and leaves).

The results from Experiment 1 showed that, in a violation-of-expectation paradigm, 6-month-old infants looked longer at a food-relevant action (i.e., an actor placing a fruit in their mouth) performed with an artifact compared to the same action performed with a plant. In contrast, when the actor performed a food irrelevant action (i.e., placing a fruit behind their ear) with the same stimulus objects, infants did not exhibit an overall difference in looking

time for plant and artifact events. Infants' looking times were not explained by prior experience with plants in general or the dried fruits used on the stimuli. This pattern replicates the results with 6-month-olds from Wertz & Wynn (2014a) and provide further evidence that preverbal infants differentially expect people to eat from whole plants compared to feature-matched artifacts. These results are also consistent with previous studies showing that young infants have expectations about eating actions. For example, 6-month-olds anticipate that food will be brought to the mouth when they observe an adult's eating action, while they fail to anticipate an action's goal for non-food related actions (e.g., a combing action; Kochukhova & Gredebäck, 2010). Additionally, 7-month-olds are surprised to see feeding sequences in a disturbed order (e.g., bringing the hand to the mouth before grasping a spoon; Maffongelli et al., 2018).

Infants' looking times in the Behind-Ear Condition of Experiment 1 indicate that infants did not look longer in general at events performed with our artifact stimulus, a more unfamiliar object that might have attracted infants' attention because of its novelty or more interesting visual features (e.g., its shiny silver color). Instead, infants in our study tended to look longer at the Behind-Ear action performed on the plant when the actor acted on this object first. While less robust than the predicted finding that infants differentially expect adults to eat from plants, this result in the Behind-Ear Condition might suggest that infants were initially surprised to see a food-irrelevant action performed with a fruit directly picked from the plant. This interpretation is consistent with previous findings showing that 6-month-old infants are more surprised to observe irrational feeding actions (e.g., a feeder placing a food on the back of a recipient's hand) compared to rational feeding actions (e.g., a feeder moving a spoon to a recipient's mouth; Gredebäck & Melinder, 2009). A non-mutually-exclusive explanation of our Behind-Ear result is that infants simply may be more familiar with actions that bring artifacts near an adult's ear (e.g., talking on phones, brushing hair, etc.).

Building on the results of Experiment 1, Experiment 2 tested whether 6-month-olds differential expectations of plant edibility are tied to specific parts of plants by paring our plant stimulus into its component parts, namely fruits (Fruit Condition) and leaves (Leaf Condition). The results from the Fruit Condition provided some indication that infants differentially expected fruits presented on their own to be edible. We found a significant Object Type by Order interaction that was driven by infants looking marginally longer at the action performed on the artifact than the action performed on the fruit, but only when the experimenter acted on the artifact first. This difference in looking time was not explained by prior experience with plants in general or the cherry tomatoes used on the stimuli. Although we observed only marginal differences in infants' looking time, the looking time differences were in the predicted direction and of similar size to Experiment 1. The results from the Leaf Condition, however, did not provide any evidence that infants differentially expected leaves presented on their own to be edible. Infants looked equally long at the leaf bouquet and its feature-matched artifact. In this case, infants' looking times were independent of their experiences with plants in general, but most of the infants had seen herbs before and those infants actually looked longer at the show overall. This suggests that the results from the Leaf Condition cannot be explained by a lack of experience with leafy herbs early in life. The absence of looking time difference between the leaf bouquet and its feature-matched artifact suggest instead that infants did not selectively identify picked leaves as good candidate food sources as they do for whole leafy plants.

The results of Experiment 2 suggest that, relative to feature-matched artifacts, 6-month-olds tend to differentially expect fruits to be edible, but not leaves. However, their expectations about fruits presented on their own are attenuated relative to whole leafy plants with fruits growing out of pots. The different pattern of findings across the Fruit and Leaf Conditions is in line with the literature showing that humans specialize in foraging and

consuming the fruits, roots, and nuts of plants rather than the leaves (Cordain et al., 2000; Hardy & Kubiak-Martens, 2016; Henry et al., 2014; Ungar & Sponheimer, 2011). This is also convergent with recent findings showing that older infants engage in more social looking to adults when confronted with leaves compared to fruits (Rioux & Wertz, 2021), suggesting that infants view fruits and leaves differently in other contexts. Importantly, this finding suggests that it is not the green color of the whole plants alone that triggers differential edibility expectations, similar to other results showing that avoidance and social looking behaviors directed towards plants are not only due to their green color (e.g., Elsner & Wertz, 2019; Wertz & Wynn, 2014b; Włodarczyk et al., 2018).

Taking together, the findings from Experiments 1 and 2 demonstrate that preverbal infants without extensive experience with solid foods differentially expect whole plants to be food sources and suggest that these edibility inferences are more likely tied to fruits than leaves. These results demonstrate the robustness of the original findings with 6-month-olds from Wertz and Wynn (2014a), add to the growing literature highlighting the role of social learning in the development of food behaviors (for a recent review see DeJesus et al., 2018), and converge with research showing an interaction between the content of social information and how that content is learned (e.g., Barrett et al., 2012; 2015). It is not yet clear why infants' differential edibility expectations are stronger for whole plants than fruits presented separately. Yet recent work has shown that other aspects of infants' behavior toward whole plants (i.e., behavioral avoidance and social looking strategies; see Wertz, 2019 for a review) extend to fruits and leaves presented on their own, albeit to a lesser degree (Rioux & Wertz, 2021), mirroring the present findings. Interestingly, this work has also shown that infants' avoidance of whole plants is attenuated for whole plants with fruits, compared to whole plants without fruits (Rioux & Wertz, 2021), while other visible plant parts (e.g., thorns) do not substantially affect infants' avoidance behaviors (Włodarczyk et al., 2018), suggesting that

whole plants with fruits may have a special status for infants.

Limitations and Future Directions

The current results give some indication that infants differentially expect fruits but not leaves to be edible, but that whole leafy plants with fruits more strongly trigger an edibility expectation. It is possible that the attenuated edibility expectation observed for fruits presented on their own could stem from the fact that foraging wild plant resources necessarily involves making initial decisions about whether or not a particular plant is edible while confronted with the whole living plant, before any processing steps are taken (i.e., before the whole plant is separated into component parts), but alternative explanations could account for the results of Experiment 2.

First, in both conditions, infants may not have been able to easily distinguish between the plant part stimulus (a cherry tomato vine in the Fruit Condition, and a leaf bouquet in the Leaf Condition) and its respective feature-matched artifact because of their high perceptual similarity, see Fig. 1). Similar to the original Wertz and Wynn (2014a) stimuli used in Experiment 1, we designed our artifact control stimuli in Experiment 2 to share perceptual features with the individual plant parts while still looking un-plantlike. However, these stimulus objects were smaller than those used in Experiment 1 (see Fig. 1), which may have made the difference between the plant and artifact stimuli in each condition difficult for infants to see. This was especially true for the Fruit Condition because the parts excluding the actual cherry tomato fruits represented only a small portion of the stimuli, yet we still found some indication that infants viewed the fruit stimuli differently than the control artifact. This is less of a concern in the Leaf Condition because we chose our feature-matched artifact because infants in a previous study were able to distinguish this particular artifact from whole leafy plants in pots (Gerdemann & Wertz, 2021). Nevertheless, it could still be the case that

infants found it difficult to distinguish this artifact from picked leaves arranged in a bouquet.

Second, it is possible that infants had difficulty inferring that the plant-part stimuli in the Fruit and Leaf Conditions were actually parts of plants. The stimuli in Experiment 2 were presented without any context and infants may simply not have always recognized that these were plant parts. Recent work suggests that infants can recognize fruits and leaves presented on their own (Rioux & Wertz, 2021), but in that study actual fruits and leaf bouquets were placed directly in front of infants, whereas in the current study they were shown only as part of a larger video display. Future studies can examine whether the results we observed in Experiment 2 originate from our stimuli being difficult to distinguish. For instance, including a familiarization event before the eating events where infants observe the actor removing the fruit bunch and leaf bouquet from a whole plant (and their respective feature-matched artifacts from a larger artifact) would provide infants with clear information about the origin and identity of the objects and could directly test these alternative explanations.

Another important outstanding question is whether other types of social information would be selectively tied to plants. The actor in the current experiments only conveyed information about edibility (i.e., eating fruits picked off the whole plant). Some existing work suggests that infants also engage in selective social learning about plant dangers, which would protect them from the costs of ingesting harmful toxins that plants can contain (e.g., Hagen et al., 2009; Mithöfer, & Boland, 2012; Oña et al., 2019). For example, children show preferential retention of danger information about plant foods compared to seasonality information (Barrett et al., 2015). It remains to be seen whether infants would interpret clear social cues of danger (e.g., information that a plant is toxic) differently for plants than other type of objects. A related question is whether infants might show a negativity bias when learning about plants; that is, whether they would pay more attention to negative than positive social information about plants and generalize one instance of negative information to a

broader array of similar-looking plants. Some of our recent work suggests that infants view physical contact with plants as a cue of plant safety, regardless of whether that contact is followed with a positive vocalization ("Wow!") or a negative one ("Ow!"); Włodarczyk et al., 2020). However, the vocalizations in that study were very closely matched and did not convey information about more costly plant dangers like toxicity or serious physical injury, so this question remains unanswered. Previous work has shown that infants display a negativity bias when learning about novel toys or people (Vaish et al., 2008). Because ingesting a toxic plant is typically a more costly error than missing out on a food opportunity (Haselton & Nettle, 2005), infants may display such a bias when learning about plant foods as well. Some recent evidence supports this view showing that, after observing an adult eat a food, infants are more selective in generalizing positive information about that food (i.e., liking it) compared to negative information (i.e., disliking it) to another individual (Lieberman et al., 2016). There is much that can be gained from future studies testing whether other types of social information are selectively learned about plants specifically and foods in general.

Finally, it is an open question to what degree our current findings would generalize to other cultures. Content-specific mechanisms in social learning in the form of preferential retention of fitness-relevant information, such as danger information about animals, over less fitness relevant information, such as habitat information, was found in both US population and Indigenous communities in Ecuador and Fiji (Barrett, et al., 2012, 2015; Broesch et al., 2014). The original Wertz & Wynn (2014a) study was conducted in the US while the current replication was run in Germany, indicating that the original findings are generalizable to at least one other population. Of course, the US and Germany share many similarities, so it would be of interest to test infants from a wider range of cultures, including non-WEIRD populations (Western, Educated, Industrialized, Rich & Democratic; Henrich et al., 2010). Recent evidence suggests that other aspects of infants' behavior toward plants are present in

these kinds of populations, albeit with interesting cultural differences (e.g., Indigenous iTaukei Fijians; McNamara & Wertz, 2021). It would be informative to test infants' expectations about plant edibility in these populations as well.

Conclusions

Our results demonstrate that 6-month-old infants without extensive experience with solid foods expect whole plants more than other types of objects, to be sources of food. Additionally, we found some evidence that infants show a similar, albeit attenuated, response to fruits presented on their own suggesting that edibility inferences are more likely tied to fruits than leaves of plants. In short, infants selectively identify plants, and perhaps fruits in particular, as edible. Given the complexity of human diets and high risk of individual trial-and-error sampling, it is not surprising that infants predominantly learn from others what to eat. Our findings underscore that there is selectivity in infants' edibility inferences that facilitate social learning about foods, even in the first year of life. The kinds of entities humans specialized in when foraging for food resources in wild environments over evolutionary time appear to have shaped the way infants learn about food.

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Conflict of interest statement:

All authors declare that they have no conflicts of interest.

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Figure 1. Stimulus objects used in the experiments. *Top panel:* Leafy plant with fruits (Experiment 1) and its respective feature-matched artifact. *Bottom panel, from left to right* cherry tomato vine (Experiment 2, Fruit Condition), leaf bouquet (Experiment 2, Leaf Condition), and their respective feature-matched artifact.

Figure 2. Infants' average looking times in the two conditions of Experiment 1, depicted broken up by Object Type (Plant vs. Artifact) and Order (Artifact first vs. Plant first). *Left Panel:* In-Mouth Condition. *Right Panel:* Behind-Ear Condition.

Figure 3. Infants' average looking times in the two conditions of Experiment 2, depicted broken up by Object Type (Plant vs. Artifact) and Order (Artifact first vs. Plant first). *Left Panel:* Fruit Condition. *Right Panel:* Leaf Condition.

Table 1: ANOVA results for the linear mixed-effect models for infants' looking times in Experiment 1.

Effect	In-Mouth Condition		Behind-Ear Condition	
	$\chi^2(df)$	p	$\chi^2(df)$	p
Object Type	4.27 (1)	.039 *	1.05 (1)	.31
Order	.93 (1)	.34	6.71 (1)	.0096 **
Object Type x Order	.80 (1)	.37	4.41 (1)	.036 *

Note. χ^2 -values for effects using Type III Wald chi-square tests. Asterisks indicate significant results.

Table 2: ANOVA results for the linear mixed-effect models for infants' looking times in Experiment 2.

Effect	Fruit Condition		Leaf Condition	
	$\chi^2(df)$	p	$\chi^2(df)$	p
Object Type	3.15 (1)	.076	.77 (1)	.38
Order	.051 (1)	.82	.95 (1)	.33
Object Type x Order	5.39 (1)	.020 *	.15 (1)	.70

Note. χ^2 -values for effects using Type III Wald chi-square tests. Asterisks indicate significant results. In the Leaf Condition, the main effect of Leaf Color was added to the model: ($\chi^2(1) = 1.65, p = .65$).

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1. Methods

1.1. Description of the stimuli

In Experiment 1, the plant stimulus was a realistic-looking artificial plant with 36 dark green fabric leaves. The object overall measures approximately 25 cm high and 25 cm wide. It was arranged in a clay pot with a topper that looked like dirt. Four green wires (25.5 cm, 20 cm, 13 cm, and 9 cm long), visible only at a short distance, were added to attach the dried fruits (4 cm x 3 cm each, either orange apricots and dark black plums), so as to look like fruits were growing on the plant. The artifact stimulus was constructed to match features of the plants without looking plant-like. It was made out of the same 36 leaves that were painted in silver. The branches were stuck onto a styrofoam cylinder (7.5 cm high, 13 cm diameter) covered with manilla paper. The cylinder and branches were then placed inside a transparent glass cylinder (24.5 cm high, 15 cm diameter). Four silver wires of approximately similar length to the green wires were stuck onto the styrofoam to attach the dried fruits. The spatial configuration of the dried fruits was similar for both plant and artifact objects.

In Experiment 2, Fruit Condition, the plant product was a cherry tomato vine. The cherry tomato vine was approximately 15 cm long and 10 cm wide, and contain six cherry tomatoes (2 cm x 2 cm each). The cherry tomatoes were either red or yellow. The feature-matched artifact was made of sliver metal with one central stick (15 cm long) and six smaller ones (12 cm long), at the end of which one cherry tomato was attached. In the Leaf condition, the plant product was eucalyptus plastic leaves attached together with green raffia to form a bouquet, and measured approximately 20 cm long by 15 cm wide. One removable leaf (either dark or light green) was added to the bouquet and measured approximately 2 cm long and 1 cm wide. The feature-matched artifact was made of the same leaves, but painted in silver and gold and measured approximately 20 cm long by 15 cm wide. The leaves were arranged together to form a bouquet, and silver tape was wrapped around the non-leaf part of the

bouquet.

1.2. Video recording procedure

Due to counterbalancing of the stimuli across participants, there were 4 different stimuli setup recorded within each condition of the two experiments (e.g., In-Mouth Condition, Experiment 1: (i) plant with plum fruits on left side, (ii) plant with plum fruits on right side, (iii) plant with apricot fruits on left side, (iv) plant with apricot fruits on right side). Within each setup, we recorded four short films: two introduction events and two test events. The first introduction event (I1) was a still presentation of the two objects on the stage. This first introduction event in itself lasted for exactly 3 seconds, but was paused during test sessions, until the infant had looked at both objects. In the second introduction event (I2) Experimenter 1 was sitting between the two objects while saying “*Hi!*” in German (“*Hallo!*”). This second introduction event lasted for approximately 10 seconds (see Table S1 for the exact length of I2 across the 4 recorded setups). In the first test event (T1), E1 performed the action on the object on her right side, and in the second test event (T2), E1 performed the action on the object on her left side. These test events lasted for approximately 15 seconds (see Table S1 for the exact length of T1 and T2 across the 4 recorded setups). Once we recorded these 4 short films, we edited a final show per recorded setup, which had the following structure: I1-I2-T1-T2-T1-T2-T1-T2.

Finally, the soundtrack was recorded separated, and the same sound was added to the final shows so that E1’s vocalizations were identical across all videos.

Table S1: Length (in seconds) of introduction (I2) and test events (T1, T2) across conditions and experiments.

Experiment	Condition	Setup	I2 length (s)	T1 length (s)	T2 length (s)
1	In-Mouth	1	9	13	14
		2	9	14	14
		3	9	13	14
		4	8	13	13
	Behind-Ear	1	9	15	15
		2	9	15	14
		3	9	14	15
		4	8	14	14
2	Fruit	1	8	14	14
		2	8	14	15
		3	8	15	13
		4	9	15	14
	Leaf	1	8	15	15
		2	8	16	15
		3	8	16	15
		4	8	16	16
		5	8	15	15
		6	9	14	15
		7	9	15	14
		8	8	14	15

Note. Due to the four possible types of leaf colors (light or dark green for the leaf bouquet and silver or gold for the artifact) in the Leaf Condition, we recorded 8 stimuli setups in this condition.

1.3. Reliability coding

During the test session, looking times were determined by an online coder, seated behind the stage, who was blind to the event type (i.e., action performed on the plant vs. the artifact), using the JHab computer program. A second blind coder evaluated the looking times of all the participants using the video recordings of each session. Prior this second coding, all videos were edited to mask the two objects, to ensure the second coder would be blind to the event type. In case of a disagreement between the two coders (absolute looking time difference greater than 2 seconds for a given test trial) a third tie-breaker coder, who was also

blind to event type, coded the trial to settle on which coded looking time value should be used.

If the tie-breaker coding indicated that the live trial ended too early, this trial was excluded from further analysis. Across Experiments 30 trials (out of 480) were excluded at this stage. If the tie-breaker coding indicated that the live trial ended too late, this trial was *not* excluded and the looking time value from the video coding was used for further analysis. Finally, if the tie-breaker coding indicated that the trial from the video coding ended too late, this trial was *not* excluded and the looking time value from the live coding was used for further analysis.

1.4. Coding whether infants watched test events

A fourth independent coder who was blind to event type (action performed on the food object vs. the artifact object) evaluated the videos to determine whether infants watched the action of E1 during test events. For this evaluation, we used the edited videos (with a mask on food and artifact objects) to ensure the fourth coder would be blind to the event type. Infants were counted as having seen the action when they (i) watched while E1 picked up the fruit or leaf, (ii) watched the majority of the action bringing the fruit or leaf to the mouth/ear (one brief look away was acceptable), and (iii) watched while E1 placed the fruit or leaf in her mouth/behind their ear. When a trial was evaluated as “not seen” the trial was excluded; 26 trials were excluded at this stage. Infants who saw fewer than one pair of test events were *a priori* excluded from the final analyses. One infant was excluded due to this reason (Experiment 2, Leaf condition).

1.5. Coding parental interference

The fourth independent coder also evaluated the videos to determine whether parent intervened during the test session. Parents were counted as having intervened when they (i) turned the baby head or body in direction of the screen or (ii) talked to their infants during the test trials. When a trial was evaluated as “parental interference” the trial was excluded; 2 trial were excluded at this stage.

1.6. Coding the experimenter's behavior

In the current experiment, we ensured prior to testing that there were no systematic behavioral differences between E1's actions toward the plant or plant component and artifact in the study videos. To do this, E1's behavior in the test events was coded by five coders who were blind to event type. The coders guessed which object type E1 was acting upon (plant vs. artifact) in each video based on E1's facial expressions and movements only. If E1 did not exhibit systematically different behaviors toward the plant/plant component and artifact, we would expect the coders' ratings to be around chance levels. All five of the individual coders showed responding that either was significantly below chance or did not differ from chance in all conditions (see Table S2 for individual coders responding across conditions and experiments). This indicates that E1 did not exhibit systematically different behaviors across the plant and artifact events.

Table S2: Individual coders responding across conditions and experiments.

Experiment	Condition	Coder	Number of correct responses	<i>p</i>-value (Binomial test, N= 16 trials)
1	In-Mouth	1	11	.21
		2	8	1
		3	11	.21
		4	7	.80
		5	7	.80
	Behind-Ear	1	2	.0042 (below chance)
		2	3	.021 (below chance)
		3	12	.077
		4	11	.21
		5	9	.80
2	Fruit	1	6	.45
		2	9	.80
		3	11	.21
		4	11	.21
		5	5	.21
	Leaf	1	12	.077
		2	11	.21
		3	8	1
		4	5	.21
		5	11	.21

1.7. Description of questionnaire measures

In order to investigate the potential role of infants' prior experiences with plants in general and with the study objects in particular, parents completed a battery of two questionnaires.

The first questionnaire, the Plant Experience Questionnaire (Elsner & Wertz, 2019; Rioux & Wertz, 2021; Wertz & Wynn, 2014a, 2014b; Włodarczyk et al., 2018) assessed infants' experience with indoor and outdoor plants during the last months and during the last summer months. Parents were asked: (i) how often their infant interacts with plants, (ii) how often parents point out or name different plants for their infant, (iii) how often their infant sees them caring for plants, (iv) how often their infant eats from plants, (v) how often their infant tries to touch plants, (vi) how often they stop their infant from touching plants. Answers were rated on a five-point Likert scale (1 = never to 5 = nearly every day), separately for indoor and outdoor plants as well as two time points (last summer months vs. last month).

Parents filled out a second questionnaire rating the following questions about their infant's experience with the particular stimulus objects: Dried apricot, dried plum, yellow cherry tomato, red cherry tomato, herbs (e.g. parsley, basil), specifically: (i) whether their infant has ever seen X (Yes/No), (ii) whether their infant has ever eaten X (Yes/No), and (iii) whether their infant had liked X, if ever tasted (Yes/No). This questionnaire also asked for the month in which the following foods were introduced into their infant's diet: jarred foods, pureed fruits and vegetables with milk, pureed fruits and vegetables without milk, whole fruits and vegetables, and family food. We chose stimulus objects we thought would be unfamiliar to infants, and our questionnaire measures confirmed our assumption. For Experiment 1, only 6 of our 40 infants had ever seen dried apricots before, and only 4 had seen dried plums. None of the infants had ever eaten dried apricots or plums themselves. For Experiment 2, while many of our infants had already seen cherry tomatoes (from the 20 infants of the Fruit Condition 6 infants had seen a yellow cherry tomato, and 15 had seen a red one), none of the infants had ever eaten yellow cherry tomatoes and only 1 infant had eaten red cherry tomatoes. Similarly, the majority of infants had seen green leafy herbs before (e.g., parsley; 17 infants out of 20 infants in the Leaf Condition) but only 2 had eaten them.

2. Results

2.1. Influence of food color on infants' looking behaviors

In order to check whether features such as fruit or leaf color, which were not the main focus of the present study, influenced infants' looking behaviors, we first assessed the effect of Food Type (orange apricot vs. black plum in Experiment 1 – yellow tomato vs. red tomato in Experiment 2, Fruit condition – dark green vs. light green leaves and silver vs. gold leaves in Experiment 2, Leaf condition) on infants' looking time. The data were analyzed using t. tests.

In Experiment 1, infants' looking time towards dried apricots ($M = 11.85$, $SD = 6.03$) did not differ from looking time towards dried plums ($M = 10.80$, $SD = 5.42$, $t = .90$, $p = .38$) in the In-Mouth condition. Results were similar in the Behind-Ear condition: Infants' looking time towards dried apricots, $M = 11.67$, $SD = 6.40$; Infants' looking time towards dried plums, $M = 12.11$, $SD = 6.49$, $t = -.38$, $p = .71$.

In Experiment 2, Fruit condition, infants' looking time towards red cherry tomatoes ($M = 11.20$, $SD = 6.49$) did not differ from looking time towards yellow cherry tomatoes ($M = 10.63$, $SD = 6.91$, $t = .50$, $p = .62$). In the Leaf condition, for the leaf bouquet, infants' looking time towards light green leaves ($M = 11.92$, $SD = 7.35$) did not differ from looking time towards dark green leaves ($M = 12.00$, $SD = 6.22$, $t = -.02$, $p = .98$). For the artifact, infants' looking time towards gold leaves ($M = 14.99$, $SD = 8.50$) was significantly longer than towards silver leaves ($M = 9.70$, $SD = 5.06$, $t = 2.51$, $p = .021$).

2.2. Comparison between In-Mouth and Behind-Ear Conditions (Experiment 1)

To directly compare infant's looking times in the two conditions as in Wertz and Wynn (2014a), we computed a model combining infants' looking times data from both conditions, with Object Type (plant vs. artifact), Order (E1 act on plant first vs. artifact first),

Condition (In-Mouth vs. Behind-Ear) and the Object Type x Order and Object Type x Condition interactions modeled as fixed effects.

The results revealed a significant effect of Order ($\chi^2(1) = 6.46, p = .011$) indicating that overall, infants looked longer when E1 performed her action on the plant first ($M = 13.3, SD = 5.89$) compared to the same action performed on the artifact first ($M = 10.1, SD = 5.81, b = 3.23, SE = 1.56, z = 2.07, p = .039$).

The results also revealed a significant effect of the Object Type x Order interaction ($\chi^2(1) = 4.41, p = .036$). Infants looked longer at the artifact ($M = 11.3, SD = 5.88$) compared to the plant ($M = 8.94, SD = 5.63$) when the action was performed on the artifact first ($b = 2.86, SE = 1.47, z = 1.95, p = .052$).

Finally, the results revealed an Object Type x Condition interaction effect approaching significance ($\chi^2(1) = 3.74, p = .053$), mirroring the effect found within each condition. Infants looked longer at the artifact compared to the plant ($b = 2.44, SE = 1.12, z = 2.01, p = .044$) when the In-Mouth action was performed but no difference was found when the Behind-Ear action was performed ($b = .68, SE = 1.12, z = .61, p = .54$).

3. Influence of infants' previous experience (questionnaire measures)

3.1. Infants' previous experience with the study stimuli

We conducted *t.test* to examine whether prior experiences with the study objects influenced infants' looking behaviors.

In Experiment 1, In-Mouth condition infants who had already seen dried apricots or plums ($N = 4$) did not look significantly longer at both the plant ($M = 10.36, SD = 7.26$) and artifact object ($M = 13.38, SD = 3.40$) compared to infants who had not previously seen these objects ($M = 10.30, SD = 4.76, t = .02, p = .99; M = 12.35, SD = 6.76, t = 0.43, p = .68$, respectively for the plant and artifact object). Similar results were obtained for the Behind-Ear

condition. Infants who had already seen dried apricots or plums ($N = 4$) did not look significantly longer at both the plant ($M = 10.90$, $SD = 4.51$) and artifact object ($M = 11.567$, $SD = 6.27$) compared to infants who had not previously seen these objects ($M = 12.64$, $SD = 7.43$, $t = .59$, $p = .57$; $M = 11.62$, $SD = 6.14$, $t = .02$, $p = .99$, respectively for the plant and artifact object).

In Experiment 2, Fruit condition, we obtained similar results. Infants who had already seen red or cherry tomatoes ($N = 15$) did not look significantly longer at both the fruit ($M = 10.46$, $SD = 6.70$) and artifact object ($M = 10.80$, $SD = 7.97$) compared to infants who had not previously seen these objects ($M = 12.25$, $SD = 1.84$, $t = .93$, $p = .36$; $M = 11.98$, $SD = 4.46$, $t = .40$, $p = .69$, respectively for the fruit and artifact object). In the Leaf condition we observed different patterns for the leaf bouquet. Infants who had already seen herbs ($N = 17$) looked significantly longer at the leaf bouquet ($M = 14.15$, $SD = 7.98$) compared to infants who had not previously seen herbs ($M = 5.82$, $SD = 3.88$, $t = 3.03$, $p = .02$). For the artifact object we observe only a trend ($M = 12.11$, $SD = 7.36$; $M = 6.38$, $SD = 3.68$, $t = 2.07$, $p = .088$, respectively for the infants who had seen herbs and infants who did not).

3.2. Infants' previous experience with the plants (PEQ)

We conducted correlational analyses to examine whether prior experiences with plants influenced infants' looking behaviors toward the stimulus objects in this study. All reported tests use Bonferroni-corrected alpha levels to account for multiple comparisons. Analyses revealed that none of the questionnaire measures were related to looking behaviors.

Tables S3-S6 include all the correlations we ran between infants' looking time and their experiences with plants. The Plant Experience Questionnaire has four dimensions: (1) experience with indoor plants, (2) experience with outdoor plants, (3) eat from plants, and (4) parental prohibition from touching plants (Rioux & Wertz, 2021). Therefore we run

correlation analyses between each dimension of the Plant Experience Questionnaire and infants' looking time in each Experiment.

Table S3. Summary of the correlations between infants' experiences with plants (4 dimensions; corrected alpha level 0.0125) and the looking time towards the study objects in Experiment 1, In-Mouth condition. No significant correlations were found.

	Plant	Artifact
How often...		
Infant interacts with indoor plants	.32	.36
Infant interacts with outdoor plants	.08	.12
Infant eats from plants	NA	NA
Parents stop infant from touching plants	.18	.01

Note. No infants in the In-Mouth condition had ever eaten from plants.

Table S4. Summary of the correlations between infants' experiences with plants (4 dimensions; corrected alpha level 0.0125) and the looking time towards the study objects in Experiment 1, Behind-Ear condition. No significant correlations were found.

	Plant	Artifact
How often...		
Infant interacts with indoor plants	.20	-.03
Infant interacts with outdoor plants	.25	.15
Infant eats from plants	-.05	-.30
Parents stop infant from touching plants	.06	.12

Table S5. Summary of the correlations between infants' experiences with plants (4 dimensions; corrected alpha level 0.0125) and the looking time towards the study objects in Experiment 2. No significant correlations were found.

	Fruit	Artifact
How often...		
Infant interacts with indoor plants	.25	.26
Infant interacts with outdoor plants	.32	.02
Infant eats from plants	.13	-.02
Parents stop infant from touching plants	.12	.04

Table S6. Summary of the correlations between infants' experiences with plants (4 dimensions; corrected alpha level 0.0125) and the looking time towards the study objects in Experiment 3. No significant correlations were found.

	Leaf bouquet	Artifact
How often...		
Infant interacts with indoor plants	-.03	.11
Infant interacts with outdoor plants	-.02	.17
Infant eats from plants	-.14	-.06
Parents stop infant from touching plants	.17	.22