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Sensitivity to major versus minor musical modes is bimodally distributed in young infants

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ABSTRACT:
The difference between major and minor scales plays a central role in Western music. However, recent research using random tone sequences ("tone-scrambles") has revealed a dramatically bimodal distribution in sensitivity to this difference: 30% of listeners are near perfect in classifying major versus minor tone-scrambles; the other 70% perform near chance. Here, whether or not infants show this same pattern is investigated. The anticipatory eye-movements of thirty 6-month-old infants were monitored during trials in which the infants heard a tone-scramble whose quality (major versus minor) signalled the location (right versus left) where a subsequent visual stimulus (the target) would appear. For 33% of infants, these anticipatory eye-movements predicted target location with near perfect accuracy; for the other 67%, the anticipatory eye-movements were unrelated to the target location. In conclusion, six-month-old infants show the same distribution as adults in sensitivity to the difference between major versus minor tone-scrambles. https://doi.org/10.1121/10.0001349

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I. INTRODUCTION

As emphasized by theories of composition, the qualities that music can achieve by variations in scale are central to its meaning (Rameau, 1971; Schoenberg, 1978; Tymoczko, 2011). For example, to many listeners, music in the major scale sounds "happy," whereas music in the minor scale sounds "sad" (Blechner, 1977; Crowder, 1984, 1985; Dalla Bella *et al.*, 2001; Gagnon and Peretz, 2003; Gerardi and Gerken, 1995; Heinlein, 1928; Hevner, 1935; Kastner and Crowder, 1990; Temperley and Tan, 2013). Because of this striking qualitative difference, the major and minor scales have come to play a central role in Western music. Surprisingly, however, many listeners have difficulty discriminating major versus minor scales (Crowder, 1985; Halpern, 1984; Halpern *et al.*, 1998; Leaver and Halpern, 2004). In fact, as shown in Fig. 1, experiments using randomly ordered tone sequences ("tone-scrambles") have revealed a bimodal distribution in sensitivity to the difference between major versus minor scales (Chubb *et al.*, 2013; Dean and Chubb, 2017; Mednicoff *et al.*, 2018). In the "three-task," all tone-scrambles contain thirty-two 65-ms pure tones, including eight each of the notes G_5, D_6, and G_6 to establish G as the tonic. In addition, major (minor) tone-scrambles contain eight copies of the note B_5 (Bb_5); thus, major (minor) tone-scrambles contain the notes of an (octave-doubled) G major (minor) triad. On each trial, the listener hears either a major or a minor tone-scramble and attempts (with trial-by-trial feedback) to guess which type was presented. Figure 1 shows the histogram of the proportion correct (across 293 listeners) over 50 trials (after a minimum of 40 trials of training). As Fig. 1 shows, three-task performance is bimodal with one mode near 55% correct and another near 100% correct. Thus, most listeners (≈70%) hear little or no difference between major versus minor tone-scrambles, whereas others are highly sensitive to this difference.

Several possible explanations of the difference between high- versus low-performing listeners in the three-task have been ruled out. First, the difference is not explained by musical training. Although musical training correlates positively with performance in the three-task, $r = 0.35$ for the listeners in Fig. 1, this correlation is driven mainly by a large group of listeners with no musical training who perform poorly. Strikingly, however, the findings of Chubb *et al.* (2013) revealed that there also exist (1) many listeners with little or no training who perform near perfectly, as well as (2) many other listeners with substantial musical training who perform near chance; this argues that musical training is neither necessary nor sufficient to achieve high performance in the three-task. Second, one might wonder whether the critical skill separating high- from low-performers is the ability to extract scale-defined qualities from the very rapid sequences of tones used by Chubb *et al.* (2013) and Dean and Chubb (2017). The answer is no. Performance in the three-task remains the same regardless of the rate at which tone-scrambles are presented (Mednicoff *et al.*, 2018). So, what is the source of the striking bimodal distribution of three-task performance across listeners?

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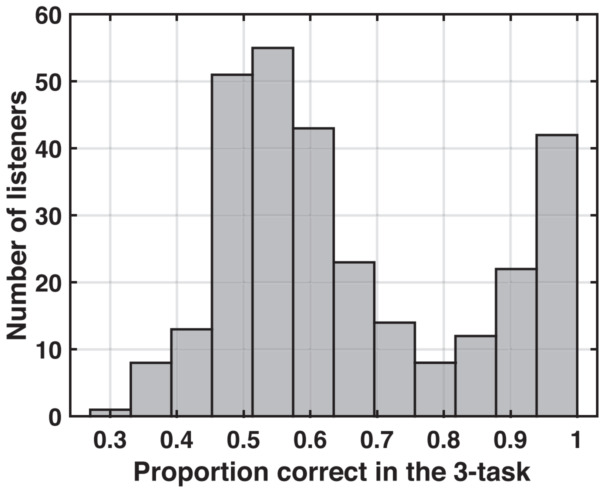

FIG. 1. Histogram of performance in the 3-task across 293 listeners pooled from Chubb *et al*. (2013), Dean and Chubb (2017), and Mednicoff *et al*. (2018).

One possibility is that the sensitivity required for the three-task is either innate or formed by early experience. The current study investigates this possibility by testing 6-month-old infants with the Visual Expectation Cueing Paradigm (Baker *et al.*, 2008; Comishen and Adler, 2019; Comishen *et al.*, 2019). In this paradigm, infants must discriminate the perceptual parameter that distinguishes centrally presented cues in order to correctly anticipate the spatial location of subsequent target stimuli. If 6-month-old infants can discriminate major versus minor tone-scrambles, then they will be able to correctly anticipate the location of subsequent targets above chance performance when there is a reliable association between tone-scramble type and target location. As 6-month-olds are highly unlikely to have any formal training or experience with major versus minor scales beyond passive incidental exposure to music, any capacity to discriminate major versus minor tone-scrambles would be suggestive of innate mechanisms.

II. METHOD

A. Participants

Thirty 6-month-old infants (16 male, 14 female) who ranged in age from 169 to 208 days [$M = 186.6$ days, standard deviation (SD) = 10.9] participated in experiment 1. The infants were of Caucasian ($n = 18$), Asian ($n = 3$), African ($n = 2$), Hispanic ($n = 2$), and other ($n = 5$) ethnic backgrounds and came predominately from families having middle social economic status (SES). An additional 22 infants participated in the study but were excluded due to general fussiness and inattentiveness (i.e., provided data on less than 65% of the viewed trials; $n = 19$) or experimental error (e.g., eye-tracker failed to detect eye movements; $n = 3$). In experiment 2, an independent group of twenty 6-month-old infants (ten male, ten female) who ranged in age from 168 to 203 days ($M = 186.2$ days, SD = 10.3) participated. The infants were of Caucasian ($n = 11$), Asian ($n = 4$), Hispanic ($n = 1$), and other ($n = 4$) ethnic backgrounds and came predominately from families having middle SES. An additional eight infants participated in the study but were excluded due to general fussiness and inattentiveness (i.e., provided data on less than 65% of the viewed trials). All infants were born at full-term, in good health, and with no apparent visual, auditory, neurological, or other abnormalities as documented by parental recording. Infant recruitment and experimental testing protocols followed the guidelines set out and approved by the York University ethics review board.

B. Stimuli and apparatus

Tone-scrambles, identical to those in experiment 1 of Chubb *et al*. (2013), were used to isolate effects due to differences in major versus minor modes from other aspects of musical structure. Stimuli were composed of 65-ms pure tones windowed by a raised cosine function with a 22.5 ms rise time. All tone-scrambles were presented at 55 dB sound pressure level (SPL). This is above the 45 dB SPL level of human speech and comparable to the levels experienced by the listeners in Chubb *et al*. (2013), in which listeners were allowed to adjust stimulus loudness individually to a comfortable level. We note, however, that infants are less sensitive to pure tone stimuli than adults (Bargones *et al*., 1995; Nozza and Wilson, 1984; Trehub *et al*., 1980); in the frequency range of the stimuli used in the current study, thresholds for amplitude-modulated, pure-tone stimuli are around 22 dB SPL for six-month-old infants versus around 8 dB SPL for adults (Berg and Smith, 1983). It is, thus, likely that the stimuli were softer for the infants than they were for the adults in previous studies. However, there is no reason to think that performance in the tone-scramble classification task depends on stimulus intensity as long as all stimuli are superthreshold. Five different notes were used, all from the standard equal-tempered chromatic scale: G_5 (783.99 Hz), Bb_5 (932.33 Hz), B_5 (987.77 Hz), D_6 (1174.66 Hz), and G_6 (1567.98 Hz). To establish G as the tonic on all trials, every tone-scramble contained eight copies of each of the notes G_5, G_6, and D_6 (degree 5 of both the G major and G minor scales). In addition, the remaining eight tones of every major tone-scramble were B_5's (degree three of the G-major scale), whereas the remaining eight tones of every minor tone-scramble were Bb_5's (degree three of the G-minor scale). On each trial, the 32 tones were presented in random order (duration 2.08 s).

The visual stimuli were computer-generated images approximately 4.5° in diameter. A green and red bull's-eye stimulus, paired with the tone-scrambles, served as the visual cue to anchor eye position in a central location, whereas the target stimuli presented to the left or right of center were publicly available faces of six characters from the popular children's television series, "Bubble Guppies."

The infants were laid supine in a specialized crib surrounded with black felt curtains and viewed the stimuli on a 19-in. liquid crystal display (LCD) color monitor (1024 × 768 pixel resolution) mounted 48 cm overhead. Located on either side of the monitor were two speakers that emitted the tone-scrambles. A 30 × 30 cm infrared-reflecting, visible-transmitting mirror was positioned between the infant and the monitor. A remote, pan-tilt infrared eye-tracking camera with a recording rate of 60 Hz (model 504, Applied Science Laboratories,[1] Bedford, MA) emitted infrared light that was reflected off the mirror and into the infant's eye. The infrared light that was reflected from the infant's retina produced a backlit white pupil. The infrared light emitted by the eye-tracker also produced a point of reflection on the cornea. Using proprietary software (Applied Sciences Laboratories, Bedford, MA), the eye fixation position was calculated as the relation between the centroid of the backlit pupil and the corneal reflection. The eye-tracker was calibrated to the screen location by having each infant view a continuous loop of shapes and colors at two known locations on the screen. All subsequently recorded eye-tracker fixation values were filtered through the calibration file to produce measures of eye position data.

Two Dell computers (Round Rock, TX) were used to control the experiments. The first generated and presented the stimuli using the program Direct RT (Empirisoft Inc., New York[2]), which were displayed on the LCD monitor that was above the crib. The second computer was used to control and record data from the eye-tracker. The stimulus-generating computer sent a unique, time-stamped numerical code, indicating the onset and type of trial, through a parallel port to the data-collecting computer. Synchronization of the unique code with the eye-movement data allowed for the coordination of the eye-movement sequences to specific stimuli and their onsets.

C. Procedure

Following successful calibration, each infant was presented 60 experimental trials. In experiment 1, the relation between the particular tone-scramble, major versus minor, predicted with 100% validity the location at which a target would subsequently appear. For example, a major tone-scramble always indicated that the subsequent target would appear on the left, whereas a minor tone-scramble always indicated that the subsequent target would appear on the right, or vice versa. The predictable tone-scramble–target location relation was counterbalanced across participants. In experiment 2, which served as an expectation-learning control, in contrast to experiment 1, the tone-scrambles did not reliably predict the location of subsequent targets. For example, on one trial, a major tone-scramble might be followed by a target on the left, and on the subsequent trial, the major tone-scramble might be followed by a target on the right.

Figure 2 shows a schematic of the trial sequences in experiments 1 and 2. Each trial in both experiments started with either a major or minor tone-scramble being presented with the central stimulus cue for a duration of 2080 ms. The tone-scramble presented on any given trial was selected at random under the constraint that every infant be exposed to each tone-scramble type for a total of 30 trials. The tone-scramble and cue offset was followed by an interstimulus interval (ISI) of 2500 ms during which the screen was blank. After the ISI, one of six target stimuli was randomly selected and presented either on the left or right side of the screen at a visual angle of 5.5° from the center of the screen. The target remained fixed on the screen for 1500 ms. At target offset, the screen remained blank for an ISI of 2500 ms, followed by the appearance of the central stimulus cue paired with a tone-scramble, signalling the onset of the next trial (see Fig. 2). The total time of each experimental session during which eye-movement data were collected was ∼8.6 mins.

D. Data reduction and analysis

The raw digital data recorded by the eye-tracker were imported into a MATLAB toolbox (The MathWorks, Natick, MA) called ILAB for analysis (Gitelman, 2002). ILAB separated each individual eye movement into its horizontal and vertical components, displaying them on a trial-by-trial basis. ILAB also displayed the scan path of the eye, which allowed eye movements to be analyzed based on their

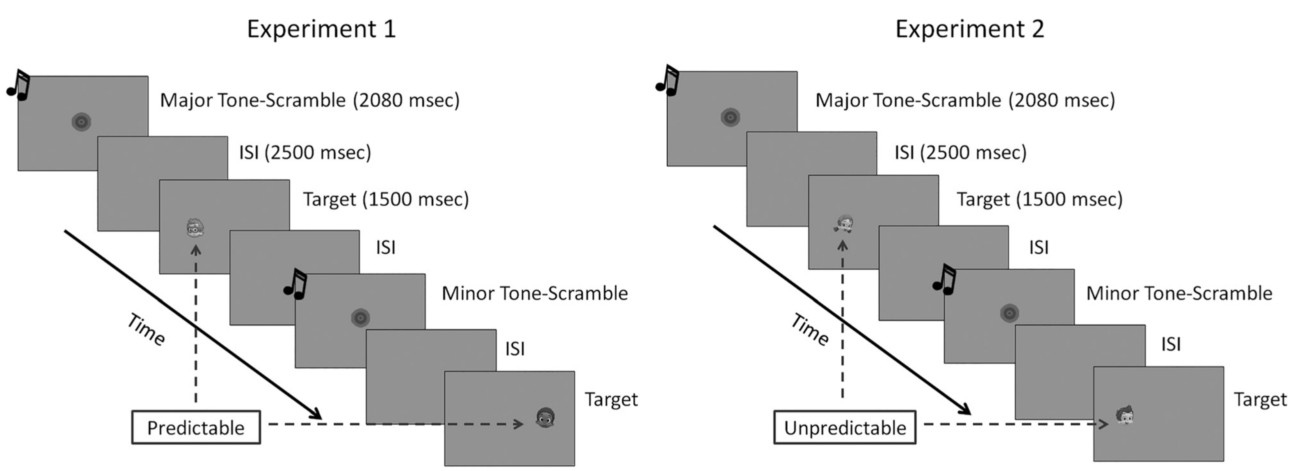

FIG. 2. Example schematic of experiments 1 and 2. In experiment 1, the tone-scrambles reliably predicted the subsequent target's location with complete accuracy. In experiment 2, however, there was no relation between the tone-scrambles and the subsequent target's location (unpredictable).

timing, direction, and distance relative to the stimuli shown on the screen.

For an eye movement to be included in the final data sample, it had to meet a number of criteria. First, for an eye movement to the target to be counted as valid, it had to trace a path that was more than 50% of the distance between the center cue and the target location. The 50% criterion has been used in previous studies using infants' eye movements (Adler and Haith, 2003; Adler and Orprecio, 2006) and is typically taken as an indication that the eye movement was intentional and not random. Second, for an eye movement to be valid, the infant must have been fixating on the center stimulus prior to initiating an eye movement to a target location. Third, a given infant had to provide valid eye-movement responses (i.e., responses that met the above criteria) on a minimum of 65% of the trials they viewed; otherwise, his/her data were excluded from the analysis. This requirement ensured that infants paid adequate attention throughout the task (Adler and Haith, 2003; Adler and Orprecio, 2006).

Valid eye-movement responses were further classified into anticipatory versus reactive responses. A given valid eye movement was classified as anticipatory only if it occurred between 133 ms after central stimulus offset and 133 m after target onset. This latency value was chosen as the anticipation cutoff because it has been previously determined that six-month-old infants cannot make eye movements in reaction to the onset of a stimulus faster than 133 ms (Canfield *et al.*, 1997). If the eye movement occurred between 133 ms after target onset and 133 ms after target offset, it was considered reactive in nature.

III. RESULTS

A. Eye movement and anticipation performance

After removing trials on which an eye signal was not acquired by the eye-tracker, out of the $30 \times 60 = 1800$ trials presented to our infant participants in experiment 1, eye data were recorded on 1275 trials. Out of these 1275 trials, 943 (73.96%) were valid eye-movement trials. Of the 943 trials, 205 (21.75%) were anticipations, and of these 205 anticipations, 111 (54.2%) were on trials in which the tone-scramble was major and 94 (45.9%) were on trials in which the tone-scramble was minor—a difference of 17. Under the assumption that major-trial and minor-trial anticipations are equally likely, the probability of observing a difference of 17 or more is 0.26, which is not significant. In addition, a one-way repeated-measure analysis of variance (ANOVA) with the tone-scramble type (major, minor) as a within-participant factor indicated no significant main effect, $F(1,29) = 0.28$, not significant. We, thus, find no evidence that anticipations were more likely for either tone-scramble type than the other. Furthermore, the overall level of anticipations exhibited is consistent with the typical range of anticipation level exhibited in other studies that have used the visual expectation cueing paradign (e.g., Comishen and Adler, 2019; Comishen *et al.*, 2019)

We also do not find evidence that infants' overall ability to correctly anticipate the target's location differed by the tone-scramble type. Of the 111 anticipations observed on major trials, 68 (61%) were correct, and of the 94 anticipations observed on minor trials, 61 (65%) were correct. An independent samples *t*-test of the null hypothesis that probability correct is equal in the two cases yielded $t(203) = 0.538$, $p = 0.59$. In addition, a Friedman test with the tone-scramble type (major, minor) as a within-participant factor indicated no significant main effect, $\chi^2(1) = 0.00$. We, therefore, find no evidence that infants' overall ability to correctly anticipate the target's location differed by tone-scramble type.

B. Evidence of sensitivity to tone-scramble type

Of the 205 anticipations made by our participants, 129 were correct and 76 were incorrect. Thus, the proportion of correct anticipations was 0.63. This is significantly greater than chance ($p < 0.0001$). This *p*-value reflects the probability that a binomial random variable with $N = 205$ and $p = 0.5$ takes a value ≥ 129 (i.e., the probability that an unbiased coin comes up heads at least 129 times in 205 flips). Hence, on average, our participants show sensitivity to the difference between major versus minor tone-scrambles.

C. Evidence of a bimodal distribution in sensitivity

The results appear similar to those shown in Fig. 1. Out of our 30 participants, 20 had proportions of correct anticipations less than 0.7 (resembling the lower mode of the histogram in Fig. 1). All of the 10 other participants had proportions correct greater than 0.8: 1 had 13 correct out of 16 anticipations, another had 5 correct out of 6 anticipations, and the other 8 participants were correct on all trials in which they made anticipatory eye-movements. However, of the infants who performed perfectly, one made only a single anticipation, another made only two, and a third made only three anticipations. The other five perfect-performers made totals of 4, 5, 6, 6, and 6 anticipations. A Shapiro-Wilk test ($p < 0.01$) suggests that the distribution of the 30 proportions-correct represented in Fig. 3 deviates from normality. However, this test throws away information in the data about the numbers of anticipations contributing to the proportions-correct for different participants; moreover, it provides no insight into the specific manner in which the data deviate from normality. We are, therefore, left with the following question: Can we conclude that our infants actually comprise a heterogeneous mixture of high- and low-performers?

To investigate this question, we used a random permutation test of the null hypothesis that all of our participants are equally sensitive to the difference between major versus minor tone-scrambles. The MATLAB code for running the permutation test can be found online.[3] Our alternative hypothesis is that the distribution in Fig. 3 is identical to the distribution shown in Fig. 1. As our test statistic, we take the sum Σ_{pfct} of anticipations made by all infants who never made an error. For the data in Fig. 1, $\Sigma_{\text{pfct}} = 33$.

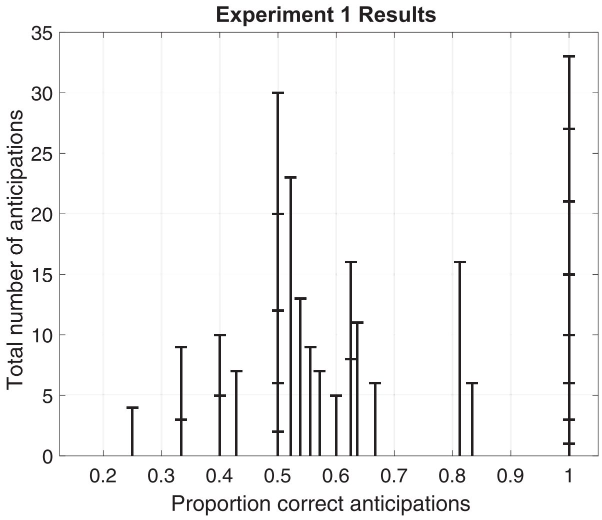

FIG. 3. Experiment 1 results. For a given proportion correct p, each tick-mark t on the line above p corresponds to one participant in the predictable-stimulus group whose proportion of correct anticipatory eye-movements was p. The length of the line-segment between t and the tick-mark directly below it (or the x axis if t is the lowest tick-mark) gives the total number of trials on which the infant performed an anticipatory eye-movement.

We proceed as follows: For $k = 1,2,...,30$, let $N(k)$ be the total number of anticipations (either correct or incorrect) performed by participant k. On each of 100 000 iterations, we generate a simulated distribution P of proportions-correct, which should be equivalent to the one shown in Fig. 3 under the null hypothesis, and compute Σ_{pfct}. In each iteration, we first form a random sequence S comprising 129 ones (for the correct anticipations) and 76 zeros and initialize Σ_{pfct} to 0; then, for $k = 1,2,\ldots,30$, we assign to each successive infant k the next $N(k)$ items in S to determine a simulated number of correct and incorrect anticipations for infant k. If all of these $N(k)$ anticipations are correct, then we increment Σ_{pfct} by $N(k)$. We take as our p-value the proportion of simulated Σ_{pfct} values that are greater than or equal to our observed value of 33.

This test yields a p-value of 0.0018. We, therefore, reject the null hypothesis in favor of the alternative hypothesis that the distribution of sensitivities in our infant population, as shown in Fig. 3, is given in Fig. 1. Finally, we note that a power analysis reveals that this test in conjunction with our 30-infant design has a vanishingly small probability of failing to reject the null hypothesis if the alternative hypothesis is true. In this power analysis, the experiment was simulated 1000 times. In each simulation, for $k = 1,2,\ldots,30$, the number of anticipations produced by infant k was drawn with replacement from the numbers observed in the actual experiment, and the simulated probability $P(k)$ of a correct anticipation for infant k was drawn randomly from the distribution in Fig. 1. These numbers were then used to derive a simulated data set upon which the test described above was performed. The largest p-value obtained in these 1000 iterations was 0.0036.

The results from experiment 1 clearly indicate that some 6-month-old infants are sensitive to the difference between major versus minor tone-scrambles. In addition, as in the case of adults, the distribution of sensitivity is bimodal. To ensure that these results were not due to some flaw in experimental design, we conducted a follow-up experiment in which the tone-scrambles did not predict the target's location but were instead randomly associated with target location. The second experiment, therefore, served as a baseline assessment for infants' chance eye-movement performance.

The results of experiment 2 are shown in Fig. 4. After removing trials on which an eye signal was not acquired by the eye-tracker, out of the $20 \times 60 = 1200$ trials presented to our participants in experiment 2, eye data were recorded on 703 trials. Out of these 703 trials, 521 (74.1%) were valid eye-movement trials. Of these trials, 142 (21.75%) were anticipations, 69 of which (48.6%) were on trials in which the tone-scramble was major and 73 of which (51.4%) were on trials in which the tone-scramble was minor. This difference is not significant; thus, as in experiment 1, we find no significant difference in the number of anticipations to major versus minor tone-scrambles.

Out of the 142 observed anticipations, 73 (51.4%) were "correct" (i.e., the saccade was in the direction of the target); as expected, this result is not significantly different from chance. We conclude that the elevated performance in experiment 1 is due to the predictability of the target location from the tone-scramble type. A Shapiro-Wilk test indicates that distribution of the 20 proportions-correct represented in Fig. 4 does not deviate significantly from normality. The kurtosis of the distribution shown in Fig. 4 is 4.41. The random permutation test applied to this data set yields a p-value of 0.86. Thus, we find no evidence for bimodality. We conclude that the bimodality of the

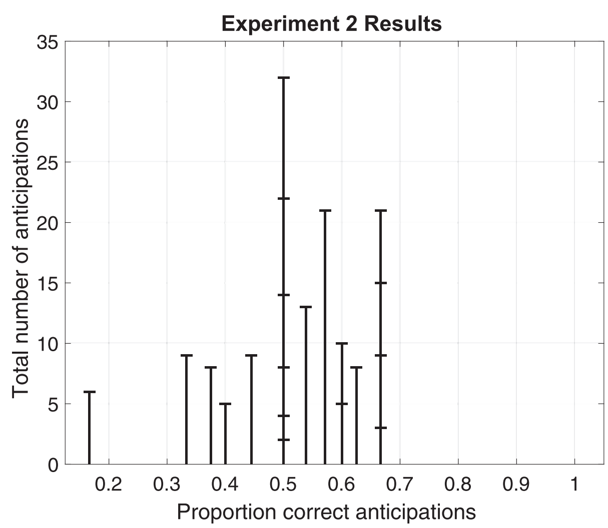

FIG. 4. Experiment 2 results. For a given proportion correct p, each tick-mark t on the line above p corresponds to one participant in experiment 2 whose proportion of correct anticipatory eye-movements (i.e., anticipatory eye-movements toward the subsequent target) was p. The length of the line-segment between t and the tick-mark directly below it (or the x axis if t is the lowest tick-mark) gives the total number of trials on which the infant performed an anticipatory eye-movement.

distribution obtained in experiment 1 is also due to the predictability of the target location from the tone-scramble type.

IV. DISCUSSION

In adults, sensitivity to the difference between major versus minor tone-scrambles is bimodally distributed (Fig. 1). The current findings suggest that 6-month-old infants show the same bimodal distribution of sensitivity. It might be proposed that all infants are equally sensitive to the difference between major versus minor tone-scrambles but that infants differ in the effort they exert to anticipate the target. Infants who exert greater effort achieve higher proportions of correct anticipations than infants who exert less effort. Under this hypothesis, the bimodal distribution of response accuracy seen in the current results should be seen generally in applications of the Visual Expectation Cueing Paradigm. This is not the case, however; previous infant studies using this paradigm with a range of different discriminatory cue stimuli, in which infants successfully learned the task and performed at rate significantly above chance, have not produced bimodal distributions (Baker *et al.*, 2008; Comishen and Adler, 2019; Comishen *et al.*, 2019). We conclude that (consistent with adults) the ability to discriminate major versus minor tone-scrambles is bimodally distributed across 6-month-old infants.

The striking similarity of the distributions shown in Figs. 1 and 3 suggests that both distributions may be produced by the same underlying process. Substantial evidence suggests that the bimodality of the distribution in Fig. 1 reflects the distribution of sensitivity to major versus minor modes in tone-scramble stimuli across adults (Dean and Chubb, 2017; Mednicoff *et al.*, 2018). In particular, high-performing adult listeners report that major and minor stimuli are marked by the "happiness" and "sadness" that characterize major versus minor music. It is, therefore, natural to conclude that it is sensitivity to the difference between major versus minor modes that produces the bimodal distribution shown in Fig. 3. If so, then the current results suggest that sensitivity to major versus minor modes (and to scale-defined musical qualities, more generally) is either innate or formed very early in life.

We note, however, that at least one previous study may seem to be at odds with this conclusion. Dalla Bella *et al.* (2001) found that 3- to 4-yr-olds could not determine whether a musical excerpt was happy or sad based on its mode, but 6- to 8-yr-olds could. An obvious and potentially important difference between the current study and that of Dalla Bella *et al.* (2001) is that the stimuli used in the two studies were dramatically different: The current study used major and minor tone-scrambles, whereas Dalla Bella *et al.* (2001) used 32 musical excerpts drawn from Western classical music (transcribed for piano). Different major (or minor) tone-scrambles sound very similar; by contrast, different musical excerpts may sound very different even if they have the same tempo and are in the same mode. It seems likely that the variations in musical structure across the stimuli used in Dalla Bella *et al.* (2001) might well influence the judgments of the 3- and 4-yr-olds in ways that could swamp systematic effects due to mode. More importantly, the current study required only that infants discriminate between major versus minor stimuli. By contrast, the task used by Dalla Bella *et al.* (2001) required children both to discriminate between major versus minor stimuli and also to classify them based on their happiness versus sadness. We have no reason to think that any of the infants used in the current study (including those who produced accurate anticipations) experienced major tone-scrambles as happy and minor ones as sad. It is entirely possible that the association between the major and minor modes and happiness and sadness does not form until substantially later in childhood.

Although the current findings seem to suggest that sensitivity to variations in musical mode is either innate or formed very early in life, there is an alternative possibility that should not be overlooked. All major stimuli in the current experiments contained eight B_5's and all minor stimuli contained eight Bb_5's. It is, thus, possible that those infant participants whose anticipatory responses were reliably guided by our major and minor stimuli were not sensing the majorness versus minorness of the stimuli (which are determined by the intervals formed by the target note with respect to the context); rather, they may have been sensing the presence of B_5's versus Bb_5's. Although such an account might seem unlikely, evidence suggests that infants behave differently from adults in using absolute (rather than relative) pitch to track patterns in tone sequences that do not conform to rules of music composition (Saffran and Griepentrog, 2001). Furthermore, the current findings reflect the processing of pure tones used in the current study, and it is not clear whether the findings would persist with more natural harmonic tones. Additional experiments are underway to investigate these possibilities.

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[1]See www.a-s-l.com (Last viewed January 20, 2015).
[2]See www.empirisoft.com/DirectRT.aspx (Last viewed June 8, 2016).
[3]See https://github.com/cfchubb/Major-minor-infant-study (Last viewed February 26, 2020).

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