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Chimpanzees Prefer African and Indian Music Over Silence

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BRIEF REPORT

Chimpanzees Prefer African and Indian Music Over Silence

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All primates have an ability to distinguish between temporal and melodic features of music, but unlike humans, in previous studies, nonhuman primates have not demonstrated a preference for music. However, previous research has not tested the wide range of acoustic parameters present in many different types of world music. The purpose of the present study is to determine the spontaneous preference of common chimpanzees (*Pan troglodytes*) for 3 acoustically contrasting types of world music: West African akan, North Indian raga, and Japanese taiko. Sixteen chimpanzees housed in 2 groups were exposed to 40 min of music from a speaker placed 1.5 m outside the fence of their outdoor enclosure; the proximity of each subject to the acoustic stimulus was recorded every 2 min. When compared with controls, subjects spent significantly more time in areas where the acoustic stimulus was loudest in African and Indian music conditions. This preference for African and Indian music could indicate homologies in acoustic preferences between nonhuman and human primates.

Keywords: chimpanzees, *Pan troglodytes*, music, world music, acoustic preference

Every known human culture has some form of musical expression (Nettl, 1983), and although nonhuman primates do not produce music, they have similar auditory structures, perception, and behavioral responses (Arcadi, Robert, & Boesch, 1998; Boesch & Boesch-Acherman, 2000; Prestrude, 1970; Snowdon & Teie, 2010). Humans report that music has a significant effect on social arousal and mood (Balch & Lewis, 1996; Thompson, Schellenberg, & Husain, 2001), and, similarly, chimpanzees (*Pan troglodytes*) show an increase in social behavior and a decrease in agonism when music is played (Howell, Schwandt, Fritz, Roeder, & Nelson, 2003). Additionally, cotton-top tamarin (*Saguinus oedipus*) vocalizations, and music composed based on those vocalizations, elicited similar behavioral responses in conspecifics (Snowdon & Teie, 2010).

Evidence suggests that human and nonhuman primates have an innate ability to distinguish between music properties, such as types of rhythmic or melodic organization. For example, both human infants and New World primates (specifically, cotton-top tamarins) have been shown to discriminate between languages from different rhythmic classes, such as Dutch and Japanese (Nazzi, Jusczyk, & Johnson, 2000; Tincoff et al., 2005[1]). Human infants can also infer meter from basic rhythmic patterns, and can discriminate between duple and triple meters (common meters in Western music; Hannon & Johnson, 2005). Although primates have exhibited an ability to distinguish between rhythmic structures and a preference for slower tempos (McDermott & Hauser, 2007), it is unknown if they display a preference for particular rhythmic patterns.

[1] It was recently reported that several studies from Marc Hauser's laboratory at Harvard were found to contain fraudulent data. The investigation by Harvard University did not publicly report on the veracity of all of the studies from that laboratory. The studies from that laboratory cited here were not among those reported as fraudulent.

When given the option of listening to consonant or dissonant music, both humans and infant chimpanzees prefer consonant music (Sugimoto et al., 2010). Furthermore, according to Wright, Rivera, Hulse, Shyan, and Neiworth (2000), tufted capuchins (*Cebus apella*) are able to remember and generalize only diatonic melodies, or melodies that maintain a predictable scale or mode structure, rather than atonal melodies. This constraint on nonhuman primate perception parallels the human preference for music that is melodically structured.

Although human and nonhuman primates have displayed a preference between music choices, thus far, nonhuman primates have consistently preferred silence to the type music that has been tested (McDermott & Hauser, 2004, 2007; Sugimoto et al., 2010; Tincoff et al., 2005). Critically, past research has focused on rhythmic patterns and melodic intervals that occur in Western music (McDermott & Hauser, 2004, 2007; Sugimoto et al., 2010; Tincoff et al., 2005), and has not addressed the very different acoustic features that occur in non-Western music. Although Western music, such as pop, blues, and classical music, sound different to the casual listener, they all follow the same musical and acoustic patterns. Therefore, by testing only different Western music, previous research has essentially replicated itself.

The purpose of the present study was to determine the spontaneous preference of common chimpanzees for three contrasting types of instrumental world music (West African akan, North Indian raga, and Japanese taiko). The musical traditions chosen define both pitches and rhythms very differently (Table 1). West African music is characterized by multiple layers of ostinatos—or short, repeating rhythms—that imply different beats and meters played simultaneously; melodic accompaniment is generally pentatonic (five defined pitches per octave; DjeDje, 1997). Indian raga is structured in large rhythmic cycles, usually 16 to 80 beats, with few strong beats relative to weak beats; its microtonal melodic lines (24 defined pitches per octave) are highly structured and predictable (Arnold, 1997). Japanese taiko is characterized by atonal melodic figures and highly predictable, steady rhythmic figures. If the chimpanzees prefer one of these types of music rather than silence, they would be expected to spend more time in areas where they can hear the acoustic stimuli compared with silent controls. Furthermore, if a preference were not caused by stimulus novelty, the effect would be expected to be stable over time.

Method

Subjects

Subjects were 16 adult chimpanzees (*Pan troglodytes*) housed in two groups (Group 1 and Group 2) at the Yerkes National Primate Research Center Field Station in Lawrenceville, Georgia. Group 1 consisted of one male and 10 female chimpanzees, and Group 2 consisted of three male and nine female chimpanzees. Subjects were frequent participants in other behavioral and cognitive research, and although they had previous exposure to Western music, they did not have any experience with non-Western music. Both groups live in spacious outdoor enclosures (Group 1 = 711 m^2 and Group 2 = 528 m^2) with grass, wooden climbing structures, and enrichment toys. Each enclosure was also connected to five interconnected indoor bedrooms with sleeping platforms, swings, and nesting materials; however, subjects did not have access indoors during testing periods but were given full access after the trial period each day.

Stimulus

Acoustic stimuli consisted of 40 min of continuous West African akan, North Indian raga, or Japanese taiko instrumental music. These were chosen because they employ contrasting acoustic characteristics and are representative of their region of origin (see Table 1). Because human infants, common marmosets (*Callithrix jacchus*), and cotton-top tamarins have demonstrated a preference for slower tempos (McDermott & Hauser, 2007), all music stimuli maintained an identical base tempo of 90 beats, or impulses, per minute regardless of rhythmic structure. Additionally, the volume of the music was standardized at 50 dB so that the all music maintained the same average amplitude. Tempo and volume (amplitude) were manipulated using GarageBand (Apple Inc.).

Prior to testing, each enclosure was divided into four concentric zones radiating from the audio stimulus (with Zone 1 closest to the audio stimulus and Zone 4 furthest from the stimulus; see Figure 1). All testing and controls began at 8:30 a.m. and lasted 40 min. Before each trial, a music player was placed 1.5 m outside the mesh enclosure wall. Audio volume remained constant across trials, in which audio stimuli could be heard clearly throughout Zone 1, to a lesser extent in Zones 2 and 3, and hardly at all in Zone 4, as rated by a human listener.

Procedure

To begin each trial, a researcher pressed "play" to begin the music stimulus (or, in controls, simply touched the player, which remained silent) and immediately left the testing area. Meanwhile, another researcher observed and recorded the location of each subject using written notes and a video camera (Sony DCR-HC52 Handycam) oriented toward the stimulus at a wide angle. The location of each chimpanzee with respect to each zone was recorded every 2 min, totaling 21 scan samples per subject per trial (cf. Altmann, 1974). Each trial ended when the stimulus music concluded (after 40 min).

Table 1
Acoustic Parameters of Typical Western Music and the African, Indian, and Japanese Stimulus Music

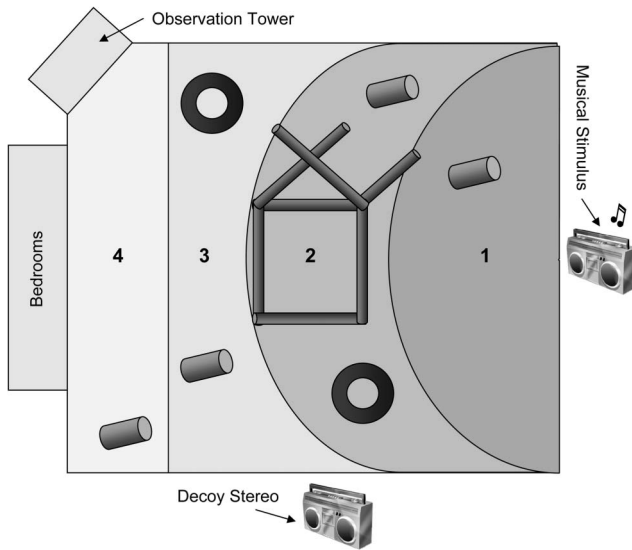| Music type	Melodic type	Pitches per octave	Rhythms
Typical Western music	Semitonal	12	1 strong beat per 1 to 3 weak beats
West African akan stimulus	Pentatonic	5	Most strong beats with few nonregular weak beats
North Indian raga stimulus	Microtonal	24	1 strong beat per 31 weak beats
Japanese taiko stimulus	Atonal	Undefined	1 strong beat per 1 weak beat

Figure 1. Schematic representation of Group 1's enclosure divided into four zones, with Zone 1 closest to the stimuli and Zone 4 furthest from the stimuli. The zones and playback volume were chosen so that the music would be clearly audible in Zone 1 and barely audible in Zone 4, with gradations in Zones 2 and 3.

For each group, initial control trials were conducted over three consecutive days, followed by nine consecutive experimental trials. The order of the stimulus music in experimental trials was randomized so that the types of trials were presented in a random order (i.e., BBBAAACCC). Chimpanzees did not have access to indoor areas during trials; however, some failed to leave the indoor area prior to testing. Because of this, trials were only conducted when at least 60% of the chimpanzees were outside (eight chimpanzees for Group 1, and seven chimpanzees for Group 2). Chimpanzees were omitted from the study if they were not present for two or more control trials.

A proximity index was calculated for each subject and condition using the following formula: (% samples in zone, experimental) – (% samples in zone, control). For example, if for Subject X, 20% of samples were in Zone 1 for the Indian music stimulus, and 5% of samples were in Zone 1 for the control stimulus, Subject X's Indian music proximity index would be 15.

Results

A one-way analysis of variance (ANOVA) showed that the two chimpanzee groups did not differ statistically ($p = .71$), so the data

were combined for both groups for all analyses. A repeated measures ANOVA was conducted to compare the mean proximity index of all the music conditions for Zone 1, the area nearest to the music stimulus. There was a significant overall effect of music, $F(2, 34) = 3.89$, $p = .03$, $\omega^2 = .040$, 95% CI [.024, .070]. Furthermore, post hoc protected Fisher's least significant difference tests were conducted to compare specific music types. When compared with the control condition, chimpanzees exhibited a significant preference for Zone 1 for the African akan ($M = 13.75$, $p = .045$, $d = .34$, 95% CI [−.33, .99]) and Indian raga ($M = 21.64$, $p = .01$, $d = .57$, 95% CI [−.09, 1.24]) conditions; they did not display a preference for the Japanese music (see Table 2). Table 2 also depicts the distribution of the proximity index across each zone for all conditions.

In order to determine whether there was an effect of novelty, an ANOVA was conducted to compare the proximity index for each day (Days 1, 2, and 3) of all conditions for Zone 1. There was no significant change in location preference across trial days ($p = .29$). An additional repeated measure ANOVA was conducted to determine if there were variations in location preference within each trial period. The 40-min trial was divided into four 10-min periods for analysis. There was no significant change in location preference within the trial period ($p = 0.51$).

Discussion

When exposed to three different types of world music, chimpanzees spent more time in areas closest to the source of Indian and African music, suggesting a preference for both music types over silence. Furthermore, these preferences were stable throughout the experimental period, suggesting that they were not simply caused by stimulus novelty. This observed preference for any type of music is in direct contrast to previous literature in which primates preferred silence to Western music (McDermott & Hauser, 2004, 2007; Tincoff et al., 2005). By considering only Western music, previous research has limited itself to a small set of acoustic features. The key difference is that the current study focused the investigation on world music with different, non-Western acoustic parameters.

The preferred types of music in the current study, Indian and African, had extreme ratios of strong to weak beats: The Indian music had one strong beat for every 31 weak beats, and the African music, as it is built on ostinatos, had almost all strong beats, with very few weak beats interspersed. Because of these extreme ratios of strong to weak beats, the listener does not hear an obvious pulse to the music. In contrast, the Japanese music, which was not preferred, had regular strong beats every other beat, producing a

Table 2

The Distribution of the Mean Proximity Index Where Each Chimpanzee Was Located in Each Zone for Each Music Condition

	African		Indian		Japanese	
	M	95% CI	*M*	95% CI	*M*	95% CI
Zone 1	13.75[*]	[2.82, 24.68]	21.64[*]	[8.18, 35.11]	5.13	[−9.21, 19.48]
Zone 2	−6.45	[−15.02, 2.12]	−3.79	[−14.71, 7.11]	−1.30	[−12.99, 10.40]
Zone 3	−0.43	[−7.92, 7.07]	0.45	[−8.67, 9.56]	2.88	[−2.59, 8.37]
Zone 4	−2.38	[−14.10, 9.43]	−11.82[*]	[−24.14, 0.41]	−1.54	[−14.89, 11.80]

Note. Proximity Index = (Percentage of Music Samples in Zone 1) − (Percentage of Control Samples in Zone 1).
[*] $p < .05$.

clear, percussive pulse. It is also interesting that Western music, which primates have not shown a preference for historically, generally employs a rhythmic style similar to the Japanese music. Chimpanzees may have perceived the strong, predictable rhythmic patterns as threatening, as chimpanzee dominance displays (including those of the Yerkes chimpanzees) commonly incorporate repeated rhythmic sounds such as stomping, clapping, and banging objects (Goodall, 1986). This may also help to explain why previous studies have failed to find a preference for Western music over silence in nonhuman primates (McDermott & Hauser, 2004, 2007; Tincoff et al., 2005).

Additionally, both the Indian and African music had considerable melodic development. Although they were melodically different (the African music is pentatonic, whereas the Indian music is microtonal), they were similar in that the melody is highly structured and tonal, rather than atonal like the Japanese music. It may be that chimpanzees prefer more tonal music, which would agree with an observed preference for consonant music in primates (Sugimoto et al., 2010) and birds (Watanabe & Nemoto, 1998).

In the current study, chimpanzees showed differential responses to three styles of music using a small sample of world music. It is important to note that we did not test Western music in this initial study because of concerns that the chimpanzees' previous exposure to it could bias results; the chimpanzees have a long history of exposure to Western music, but the world music chosen was entirely novel. Because of this exclusion of Western music, we are cautious to compare the results of the current study with those of previous studies that concluded a nonpreference for Western music. Because we used a different method of playback than previous studies of Western music, it is theoretically possible that chimpanzees could display a preference for Western music using our study design. The objective is not to necessarily isolate specific cultures, but to use cultural music as a vehicle to pinpoint specific acoustic properties. These results reinforce the potential to investigate the origin of music in humans by looking at homologies in acoustic preference between nonhuman and human primates.

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