

1 **Assessing the motivational value of infant video clips on chimpanzees through**
2 **discrimination learning task**

3 (Running title: *Conspecific video preference in chimpanzees*)
4

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19 **Statements**

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33

Abstract

34 The motivational value of visual infant stimuli in humans is consider to encourage parental
35 behaviour. To explore the evolutionary roots of this preference for infants, we examined the reward
36 value of conspecific infant videos compared to adult ones in nine chimpanzees. We employed a novel
37 approach, a simultaneous discrimination task with differential sensory reinforcement. In Experiments
38 1 and 2, we tested if watching conspecific infant videos is more rewarding than watching adult ones.
39 Participants were required to discriminate between two visual stimuli by a touch panel task. In video
40 reward trials, a video clip featuring a chimpanzee infant followed a correct choice, while one featuring
41 an adult followed an incorrect choice. However, the percentage of correct choices did not significantly
42 differ from chance except in one chimpanzee, indicating that chimpanzees did not exhibit a preference
43 for watching infant videos over adult videos. In Experiment 3, we tested if chimpanzees prefer
44 conspecific videos over a blank screen, however, we did not get evidence either at a group level. These
45 results suggest that the incentive salience of infant stimuli may not be universally compelling across
46 species. Additionally, we discuss the limitations of the task using sensory reinforcement.

47 **Keywords:** sensory reinforcement, chimpanzees, video, infant

48 1. Introduction

49 Not only primary reinforcers (e.g., food or water) but also sensory stimuli (e.g., light, photo,
50 video, or sound) can be rewarding for animals (*sensory reinforcement*)(Butler, 1954; Humphrey, 1974).
51 Sensory reinforcement is a useful way to investigate participants' motivation to look at certain types
52 of stimuli. By using the sensory reinforcement paradigm, for example, Fujita and Matsuzawa (1986)
53 reported that one chimpanzee (*Pan troglodytes*) learned to touch a key to see pictures on a screen, and
54 this operant behaviour was observed more frequently for human stimuli compared with simpler stimuli
55 (e.g., light). Sensory reinforcement in non-human primates showed their preference for certain species
56 (Andrews & Rosenblum, 1993; Fujita, 1987, 1993a, 1993b; Swartz & Rosenblum, 1980; Tomonaga,
57 1994), unfamiliar individuals (Haude & Detwiler, 1976), certain individuals (Humphrey & Keeble,
58 1976), or certain social behaviour (Haude & Detwiler, 1976). Animals differentially value the
59 opportunity to have visual access to different social stimuli. Deaner et al., (2005) found that male
60 rhesus macaques "pay" (i.e., sacrifice access to juice) to view female perinea and the faces of high-
61 rank monkeys, whereas they required juice overpayment to view the faces of low-rank monkeys. This
62 indicates that monkeys have higher motivation to view certain type of stimuli than the others. Sensory
63 reinforcement is used not only to test visual preference but also used as environmental enrichment for
64 captive animals (e.g., Ogura, 2012, for review see Wells, 2009). It should be noted, however, that
65 sensory reinforcement may be rather conditional, as sensory stimuli are effective as a reward only for
66 some individuals (Harris et al., 1999), or not as strong as a food reward (Washburn & Hopkins, 1994).

67 Among conspecific stimuli, infant stimuli are particularly preferred by humans. For example,
68 neurological studies revealed that infant faces, but not adult faces, activate the medial orbitofrontal
69 cortex, which is implicated in reward processing (Kringelbach et al., 2008). A study using an implicit
70 association test reported that human infant faces are associated with positive emotions across
71 participants regardless of the gender or parenthood status (Senese et al., 2013). It is considered that

72 the set of specific features of infant appearances, “baby schema (Lorenz, 1943)”, especially attracts
73 humans. Exaggeration of the baby schema induces cuteness perception and motivation of caretaking
74 as well as activates the nucleus accumbens, which mediates reward processing (Glocker, Langleben,
75 Ruparel, Loughead, Gur, et al., 2009; Glocker, Langleben, Ruparel, Loughead, Valdez, et al., 2009).
76 This motivational system triggered by infantile traits is believed to serve as a proximate mechanism
77 for parental care.

78 Parental care is important not only for human infants but also for non-human primate infants.
79 Therefore, one question arises: Do visual stimuli of infants serve as rewards for non-human primates
80 as well? A few studies have been conducted to test this question by using the sensory reinforcement
81 paradigm. Pryce et al. (1993) conducted research on common marmosets (*Callithrix jacchus*) and
82 demonstrated that visual stimuli of infants work as a reward. They examined the maternal motivation
83 in female marmosets by operant conditioning paradigm. In this paradigm, pressing a lever resulted in
84 (a) getting visual access to an infant replica and/or (b) turning off the playback of infant distress calls.
85 The marmosets learned this operant behavior even when only visual feedback was available, indicating
86 the rewarding nature of infant visual stimuli in marmosets. In another study, infant rhesus macaques
87 (*Macaca mulatta*) reared in isolation were examined for their visual preference for various social
88 stimuli (Sackett, 1966). By touching a lever, monkeys were provided control over the presentation of
89 various conspecific visual stimuli such as infants, threatening monkeys, monkeys in mating, and
90 monkeys doing nothing. As a result, “threat” and “infant” pictures induced more lever-touching
91 behavior. Since the monkeys were reared isolated, their preference for infants is likely innate instead
92 of acquired by experience.

93 Later, several studies using a free viewing task demonstrated longer looking time for infants
94 than adults when conspecific visual stimuli were presented in non-human primates, including
95 Campbell’s monkeys (*Cercopithecus campbelli*) and Japanese macaques (*Macaca fuscata*) (Sato et al.,

96 2012), Barbary macaques (*Macaca sylvanus*) (Almeling et al., 2016). However, in these studies, visual
97 stimuli were presented passively without any control by animals. Since reward value and looking time
98 index different aspects of visual preference (Deaner et al., 2005), the evidence that animals looked at
99 one stimulus longer than another does not necessarily imply that they “like” the former more than the
100 latter. Consequently, these studies should be differently treated from sensory reinforcement studies.
101 As far as we know, therefore, the motivational value of seeing infant stimuli has been examined only
102 in limited species by a few early studies.

103 The present study aims to replicate previous findings concerning the reward value of infant
104 stimuli and extend it to different species, chimpanzees, a phylogenetically closest species to humans.
105 We aimed to assess the reward value of conspecific adult and infant videos in chimpanzees using a
106 novel approach, a simultaneous discrimination task with differential sensory reinforcement. In
107 Experiments 1 and 2, we aimed to determine whether watching conspecific infant videos is more
108 rewarding than watching adult ones. In Experiment 3, we investigated if sensory reinforcement using
109 conspecific stimuli is robust enough to form a visual discrimination. The chimpanzees were required
110 to discriminate between two visual stimuli using a touch panel task. In Experiments 1 and 2, a video
111 clip of a chimpanzee infant was presented after a correct choice, while an adult video followed an
112 incorrect choice. In Experiment 3, any conspecific video was played after a correct choice, contrasted
113 with a blank screen following an incorrect choice. We tested if the percentage of correct choices
114 significantly deviated from chance in each Experiment.

115 2. General Methods

116 **Participants**

117 Nine chimpanzees (*Pan troglodytes*) living at the Primate Research Institute, Kyoto
118 University participated in experiments. All of them were adults (seven females, 16-50 years old, Table
119 1). Among females, Chloe and Ai had prior experience rearing their offspring. All participants lived

120 socially with 12 individuals in an enriched environment with indoor and outdoor enclosures
121 (Matsuzawa et al., 2006). None of them were neither food- nor water-deprived. Their participation
122 was voluntary, and they could stop the task at any point. All the participants except Gon had prior
123 experience of participating in cognitive study although their expertise varies widely among individuals.
124 Among them, one female chimpanzee, Ai, had previous experience of participating in a study using
125 sensory reinforcement (Fujita & Matsuzawa, 1986). All procedures adhered to institutional guidelines
126 (the Primate Research Institute's 2010 version of "The Guidelines for the Care and Use of Laboratory
127 Primates"). The experimental design was approved by the Animal Welfare and Animal Care
128 Committee of the Primate Research Institute (2016-064, 2017-106) and the Animal Research
129 Committee of Kyoto University.

130 **Apparatus**

131 Experiments were conducted in an experimental booth (1.8 x 2.15 x 1.75 m) at the Primate
132 Research Institute, Kyoto University. Touch-sensitive monitors (1280 x 1024) and universal feeders
133 (Biomedica, BFU310-P100) were attached to the panel of the booth. Stimulus presentation, response
134 detection, and food delivery were controlled by a custom program written with Microsoft Visual Basic
135 2010 Express (Microsoft Corp.).

136 **Procedure**

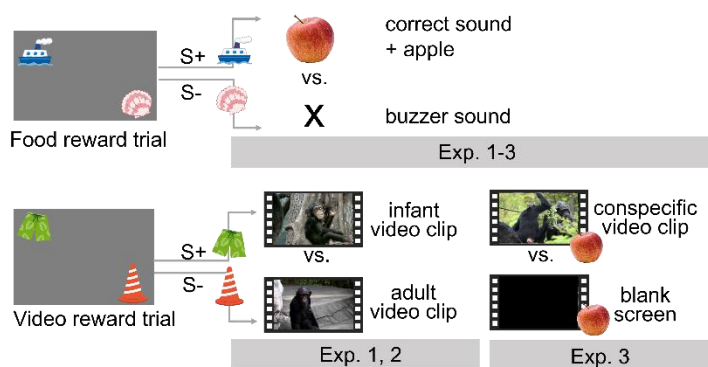
137 **Icon preference test**

138 To ensure equal original preference between two choice stimuli for each participant, we
139 conducted an "icon preference test". We prepared eight illustrations as possible choice stimuli (Fig.1,
140 "icons") for each experiment and conducted icon preference tests for each participant beforehand. In
141 icon preference tests, two of eight icons were presented on the screen after participants touched a self-
142 start key. The location of icons was randomised across six possible positions on the monitor. Each
143 session comprised of 56 trials, encompassing all possible combinations of the eight icons, appearing

144 twice within one session. The participants were required to choose one of the two icons by touch, with
 145 responses randomly rewarded at a 50% probability. In 28 trials, a correct choice was rewarded with a
 146 piece of apple and a correct sound while a buzzer sound was played back in other trials. After twelve
 147 sessions, we calculated the percentage of choice for every icon pair. Two almost equally preferred
 148 icons were paired, and we made three icon pairs for each participant. These icons were used as choice
 149 stimuli in subsequent main tests. We employed different icon sets and conducted icon preference tests
 150 before each Experiment.

151 **Main test**

152 Before each session, participants underwent a forced choice session in which only one icon
 153 was presented on the monitor to expose chimpanzees to all the feedback (both positive and negative).
 154 Each forced-choice session consisted of 24 trials (i.e., 16 food reward trials and 8 video reward trials,
 155 half of them were positive (S+) and others were negative (S-)). Each icon appeared four times during
 156 these trials. Then, we conducted a free choice test session, where the participants were required to
 157 choose one of two icons. In a free choice test, one out of three pairs of icons randomly appeared after
 158 the participant touched the self-start key at the bottom of the monitor. Once the participant touched
 159 one of the icons, they disappeared, and feedback was provided depending on their choice (i.e., “correct”
 160 (S+) or “incorrect” (S-)). The free choice test consisted of 48 trials (i.e., 32 food reward trials and 16
 161 video reward trials). Each day only one session was conducted, totalling twelve sessions for each
 162 individual.



163

164 Fig.1 Procedure of the main test (free choice test).

165

166 **Data Analysis**

167 We fitted Generalized Linear Mixed Models (GLMMs) using R (R Core Team, 2023) and
168 the packages glmmTMB (Brooks et al., 2017). We fitted a model with a binomial error structure with
169 a logit link function. We included the choice (S^+ or S^-) as the response variable, and reward type
170 (coded as 0 for *video reward* or 1 for *food reward*), session number, and the interaction between them
171 as fixed effects. We included random slopes of reward types, session number, and their interaction
172 within participant ID. The random-effects structure was kept maximal to keep the type I error
173 minimum (Barr, 2013). The session number was z-transformed (yielding a mean of zero and a standard
174 deviation of one). Employing an intercept, we evaluated if the choice rate of S^+ significantly deviated
175 from an equal distribution when the reward type was video.

176 3. Exp. 1

177 3-1. Methods

178 Eight chimpanzees, including seven females, participated in Experiment 1 (Table 1).

179 We used 4-second video clips of chimpanzees as a video reward. Depicted chimpanzees
180 included both wild and captive individuals, all of which were unfamiliar to the participants. Each video
181 clip depicted a single individual without evident social behavior such as grooming or displays. Videos
182 were either obtained from the Internet, provided by other researchers, or taken by one of the authors.
183 We prepared 36 video clips, comprising 18 adult and 18 infant chimpanzees. The exact ages of most
184 chimpanzees and the sex of some chimpanzees in videos remain unknown. The videos were not
185 accompanied by any audio. We compared the impact of infant and adult chimpanzee videos as rewards.
186 Two icon pairs were presented as the food reward trials, where a correct choice led to the delivery of
187 a piece of apple along with the correct sound, while an incorrect choice resulted in a buzzer sound.

188 The other icon pair was for video reward trials. Here, selecting a “correct” icon (S+) led to the
189 presentation of a video clip featuring infant chimpanzees, whereas an “incorrect” icon (S-) resulted in
190 the display of a video clip featuring adult chimpanzees. Video clips were randomly chosen from
191 repertoires. No food reward was delivered for video reward trials regardless of chimpanzees’ choice.
192 In order to compare the results of video reward with positive control and to keep participants’
193 motivation to continue the task, two out of three trials in each session were food reward trials. In the
194 main test, we found later that one session of Ayumu had been conducted in the wrong way (the assigned
195 icon combination was incorrect), so we excluded the data from our analysis.

196 3-2. Results

197 Fig. 2 shows the choice rate of S+ (see Fig. S1 for individual results). Throughout sessions,
198 the average performance for food reward was 87.0 % (range: 61.7% - 99.5%) while that for video
199 reward was 46.2% (30.2% - 61.4%) among participants. In video reward trials, there appears to be no
200 distinct pattern in the group-level choice rate of S+ with substantial individual variations. Contrarily,
201 performance in food reward trials consistently exceeded chance by the 6th session for all participants
202 except Popo, who had less experience with touch panel tasks compared to the others.

203 As a result of GLMM analysis, we found a significant interaction effect between reward
204 type and session (estimate: 1.86, $p < 0.001$, Table 2) and a significant effect of reward type
205 (estimate: 4.03, $p < 0.001$) on the choice rate of S+, indicating differential learning in visual
206 discrimination based on the reward types. The intercept did not significantly differ from 0 (estimate: -
207 0.16, $p = 0.30$), indicating that the overall choice rate of S+ did not deviate from chance in video
208 reward trials. The effect of the session was not significant (estimate: 0.07, $p = 0.57$). Consequently,
209 chimpanzees acquired visual discrimination associated with food rewards, while they did not learn
210 that with an infant video clip. These results imply that the perceived difference in reward value
211 between adult and infant videos was not big enough for the chimpanzees to acquire simultaneous

212 discrimination.

213 4. Exp. 2

214 The chimpanzees were seemingly habituated in the limited repertoires of video clips in
215 Experiment 1. This might explain why the chimpanzees did not exhibit a clear preference for certain
216 types of video rewards. Therefore, we tested again with an increased video clip repertoire in
217 Experiment 2.

218 4-1. Methods

219 The same eight chimpanzees participated in Experiment 2 (Table 1). We adopted the
220 identical procedure as Experiment 1, but we used 64 new video clips (comprising 32 adults and 32
221 infants) in Experiment 2.

222 4-2. Results

223 In Experiment 2, throughout sessions, the average performance for food reward was 91.9%
224 (range: 79.7% - 99.4%) across participants, whereas for video reward it was notably lower at 38.9%
225 (28.1% - 80.7%) (Fig. 2, see Fig. S2 for individual results). In video reward trials, there is no
226 discernible consistent group-level pattern with individual variations. Conversely, the performance of
227 food reward trials again surpassed chance levels by the 6th session for all participants.

228 The GLMM analysis revealed a significant interaction effect between reward type and
229 session (estimate: 1.85, $p < 0.001$, Table 2) and a significant effect of reward type (estimate: 4.66,
230 $p < 0.001$), indicating that the chimpanzees learned visual discrimination differently based on the
231 reward types. The intercept was not significantly different from 0 (estimate: -0.46, $p = 0.08$), indicating
232 that the overall choice rate of S+ did not differ from chance in video reward trials. The effect of the
233 session was not significant (estimate: 0.05, $p = 0.48$). These results indicate that chimpanzees did not
234 learn visual discrimination associated with infant video clips versus adult video clips in video reward
235 trials like in Experiment 1. Therefore, the difference in reward value between adult and infant videos

236 was insufficient for the chimpanzees to acquire simultaneous discrimination, even after expanding the
237 repertoires of video clips.

238 5. Exp. 3

239 In Experiments 1 and 2, the results did not show evidence that infant video clips more
240 effectively work as a reward compared to adult video clips. In Experiment 3, therefore, we aimed to
241 assess the reward value of conspecific videos themselves by comparing them to a blank screen within
242 the same experimental setting. Notably, during Experiments 1 and 2, some chimpanzees showed
243 frustrated behaviours, such as hitting the panel during the video reward trials. This behaviour might
244 suggest a potential loss of motivation for the video reward trial, where food rewards were not available.
245 Such frustration could have masked any potential effects of sensory rewards. To address this possibility,
246 in Experiment 3, food rewards were provided regardless of their choice (S+ or S-) during the video
247 reward trials.

248 5-1. Methods

249 Seven chimpanzees participated in Experiment 3 (Table 1). Two female chimpanzees from
250 Experiments 1 and 2, Cleo and Mari, did not participate in Experiment 3 due to scheduling conflicts
251 with other studies. However, Gon, a 50-year-old male chimpanzee who had not participated in
252 Experiment 1 or 2, joined Experiment 3. He had no prior experience with touch panel tasks. Since
253 sensory reinforcement is often used for social enrichment, however, data from naïve chimpanzees may
254 be beneficial. Therefore, we included him in Experiment 3 (but analyzed his data separately from other
255 individuals). Ayumu completed only 10 sessions due to his lack of sustained motivation to participate.

256 We prepared 32 video clips filming chimpanzees across various age groups, including
257 infants, juveniles, and adults. These clips showcased multiple individuals engaging in social
258 interactions, such as playing, greeting, grooming, or fighting. They were sometimes accompanied by
259 emotional displays (e.g., laughter or screaming). For control feedback, we used a black screen. In

260 video reward trials, participants were presented with a chimpanzee video clip randomly selected from
261 the repertoire and a piece of apple upon selecting a “correct” icon (S+). Conversely, choosing an
262 “incorrect” icon (S-) led to the display of a black screen and the provision of a piece of apple. In food
263 reward trials, a piece of apple was provided solely for selecting S+, similar to Experiments 1 and 2.

264 5-2. Results

265 In Experiment 3, throughout sessions, the average performance was 91.3 % (range: 80.5% -
266 99.7%) for food reward trials. However, for video reward trials, the average performance was 54.6%
267 (33.3% - 72.4%) across participants besides the naïve old male chimpanzee, Gon (Fig. 2, see Fig. S3
268 for individual results). Gon’s performance even in food trials was above chance only in two sessions
269 (a two-sided binomial test) and it was not stable presumably due to a lack of prior experience with
270 cognitive tasks (Fig. 3). Consequently, we exclude his data from the main analysis and analyzed it
271 separately. In video reward trials, there is no definitive group pattern but there were individual
272 variations. Contrarily, the performance in food reward trials consistently exceeded chance levels by
273 the 6th session for all participants.

274 The GLMM analysis revealed a significant interaction effect between reward type and
275 session (estimate: 2.58, $p < 0.001$, Table 2) and a significant effect of reward type (estimate: 4.89,
276 $p < 0.001$), indicating that the chimpanzees learned visual discrimination differently based on the
277 reward types. The intercept did not significantly differ from 0 (estimate: 0.19, $p = 0.38$), indicating
278 that the overall choice rate of S+ did not deviate from chance level in video reward trials. Furthermore,
279 the effect of the session was not significant (estimate: 0.05, $p = 0.63$). Thus, the chimpanzees acquired
280 visual discrimination of the icon pairs which were associated with food reward versus no food reward,
281 whereas they did not learn that with conspecific video clips (+ food reward) versus blank screens (+
282 food reward). These results show that the reward value of conspecific videos itself was insufficient for
283 the chimpanzees to establish visual discrimination.

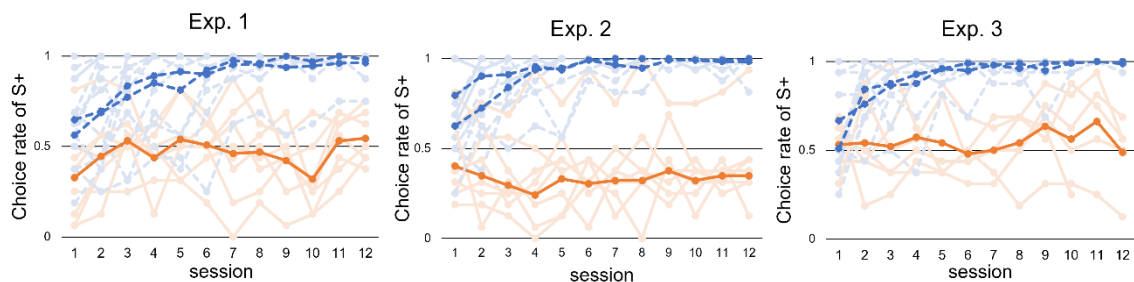
284 The data from Gon were separately analyzed (Fig. 3). We used a Generalized Linear Model
285 with binomial error structure and logit link function. We included the choice (S+ or S-) as the response
286 variable, reward type, session, and their interaction as explanatory variables. The session number was
287 z-transformed. We fitted the model in R using the function *glm*. As a result, we did not find a significant
288 interaction effect ($p = 0.38$). After the removal of the interaction, the analysis found a significant effect
289 of reward type (estimate: 0.82, $p < 0.001$, Table S1), but not session (estimate: -0.001, $p = 0.99$). The
290 intercept was significantly negative (estimate: -0.72, $p < 0.001$). These indicate that the choice rate of
291 S+ was higher in food reward trials compared to video reward trials. Specifically, he chose to watch
292 blank screens significantly more than conspecific videos in video reward trials. There was no
293 interaction effect between session and reward type or effect of session, indicating that the choice rate
294 did not change across sessions.

295 6. Individual results of Popo

296 When examining individual data (Fig. S1-3), one female chimpanzee Popo showed different
297 results compared to other individuals. Although the performances of video reward trials of other
298 chimpanzees did not clearly differ from chance, Popo's performance in video trials appeared notably
299 higher than that of the other individuals. Consequently, to ascertain whether her performance in video
300 reward trials significantly differs from chance level, we conducted a binomial GLM analysis with
301 Popo's data in the same way as Gon's data.

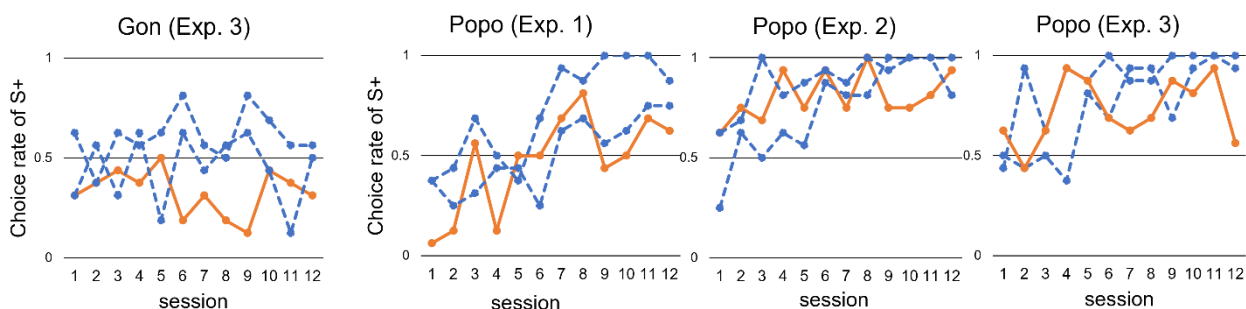
302 In Experiment 1, the interaction between reward type and session did not reach significance
303 ($p = 0.52$). Subsequently, after the removal of the interaction, the effects of reward type (estimate: 0.69,
304 $p < 0.001$, Table S1) and session (estimate: 0.78, $p < 0.001$) emerged as significant, while the intercept
305 did not (estimate: -0.14, $p = 0.35$). The result indicates that her performance in the video reward trials
306 was inferior to that in food reward trials and not significantly different from chance level. In
307 Experiment 2, the interaction was significant (estimate: 0.83, $p = 0.001$), but the effects of reward type

308 (estimate: 0.42, $p = 0.10$) and session (estimate: 0.32, $p = 0.09$) were not. In Experiment 3, both the
 309 interaction (estimate: 0.87, $p < 0.001$) and the effect of reward type (estimate: 0.77, $p = 0.001$) were
 310 significant, yet the effects of the session was not (estimate: 0.25, $p = 0.12$). The intercepts were
 311 significant in both Experiment 2 (estimate: 1.46, $p < 0.001$) and Experiment 3 (estimate: 0.97, p
 312 < 0.001), indicating that her performance in video trials was significantly above chance level. These
 313 results indicate that Popo chose to watch infant video clips more frequently compared to adult video
 314 clips in Experiment 2 and chose to watch conspecific video clips over blank screens in Experiment 3.
 315



316 Fig. 2 The choice rate of S+ in each Experiment. Blue dotted lines indicate food reward trials and
 317 orange solid lines indicate video reward trials (infant videos in Experiment 1, 2, and conspecific videos
 318 in Experiment 3). Individual performance is indicated by pale colours while average performance is
 319 indicated by dark colours.

320
 321



322 Fig. 3 The choice rate of S+ for Gon (Exp. 3) and Popo (Exp. 1-3). Blue dotted lines indicate
 323 food reward trials and orange solid lines indicate video reward trials.

324 7. General Discussion

325 The present study tested the reward value of infant video stimuli compared to adult stimuli
326 in chimpanzees. As a result, performance in video reward trials was generally much worse than in food
327 reward trials across all Experiments except in one chimpanzee. In both Experiments 1 and 2, there was
328 no indication that chimpanzees, as a group, exhibited a higher motivation to watch infant videos over
329 adult ones. In fact, in Experiment 2, the trend seemed to lean towards the opposite, with chimpanzees
330 demonstrating a slight preference for watching adult conspecifics over infants. In Experiment 3, we
331 tested the reward value of watching any conspecific video itself, yet failed to provide evidence that
332 such videos were rewarding enough for chimpanzees to establish and sustain a simultaneous
333 discrimination at the group level. Throughout all three Experiments, all chimpanzees except Gon, not
334 surprisingly, successfully learned discrimination in food reward trials. This indicates that the lack of
335 the ability to simultaneous discrimination learning is not the reason why chimpanzees did not
336 consistently differentiate between two icons in video reward sessions.

337 Overall, the results indicate a general lack of preference among chimpanzees for watching
338 video clips of conspecific infants over adults. The present results are different from the previous
339 studies showing the reward value of infant visual stimuli in humans (e.g., Glocker, Langleben, Ruparel,
340 Loughead, Gur, et al., 2009; Glocker, Langleben, Ruparel, Loughead, Valdez, et al., 2009; see
341 Kringelbach et al., 2016 for review). While two studies with other non-human primate species like
342 common marmosets (Pryce et al., 1993) and infant rhesus macaques (Sackett, 1966) have shown the
343 reward value of infant stimuli, our findings question why chimpanzees did not exhibit a preference for
344 infant videos in the present study.

345 Interpreting negative results can be challenging due to various potential contributing factors.
346 After the current study, we also conducted a free-viewing eye-tracking study involving the same
347 chimpanzee participants. Our findings revealed that they looked at conspecific infant faces for longer

348 duration compared to adult faces in naturalistic images (Kawaguchi et al., 2019). The difference in
349 results simply could reflect different aspects of visual preference measured by passive gaze behaviour
350 and active choice to watch stimuli, suggesting the ambiguousness in the interpretation of visual
351 “preference”. It is considered that visual preference is modulated by two mutually not exclusive factors,
352 *interest* (determined by the information about the stimulus) and *pleasure* (determined by the
353 attractiveness of the stimulus) (Damon et al., 2019; Humphrey, 1972). In the case of chimpanzees, it
354 is possible that while infant stimuli capture their visual attention more effectively (as measured by the
355 looking time), they may not necessarily perceive these stimuli as more rewarding (as measured by the
356 spontaneous motivation to watch) as compared to adult stimuli. Despite the general tolerance to infants
357 within their group (van Lawick-Goodall, 1968), infanticide is also common in this species (Wilson et
358 al., 2014). Consequently, seeing unfamiliar infants, therefore, may not be always particularly
359 rewarding in chimpanzees. The evidence of clear differences in their looking behaviour toward infants
360 and adults by Kawaguchi et al. (2019) suggests that it is unlikely that the reason why chimpanzees did
361 not exhibit a preference for infant videos over adult videos was because they were unable to discern
362 them. Instead, the chimpanzees did not exhibit a difference in their motivation to view infant videos
363 versus adult videos, although they were probably capable of differentiating between the two.

364 In humans, Kringelbach et al. (2008) observed specific brain activity linked to reward
365 processing triggered by infant faces but not adult faces by using magnetoencephalography (MEG).
366 However, in a study by Hahn et al. (2013), where participants controlled looking duration by key-
367 press, infant faces were viewed for durations similar to adult faces among women, while men did not
368 exhibit extended viewing of infant faces. A similar gender difference in motivation to view infants is
369 also reported by Charles et al. (2013). This implies a conditional incentive salience associated with
370 infant stimuli, varying between genders. Similar results were also reported for visual attraction to
371 infant stimuli in free-viewing tasks, such as the research conducted by Cárdenas et al., (2013). In the

372 study, female participants looked at infant faces for a longer duration regardless of whether the infant
373 was presented with a woman or man, while males did so only when the infant was presented with a
374 man but not with a woman. Therefore, gender differences seemingly exist in both visual attention and
375 motivational value of infant stimuli in humans. Although in the present study, it is difficult to discuss
376 potential sex differences due to limited male participants, but it is possible that individual factors could
377 influence the results. Indeed, one female chimpanzee Popo exhibited a significant preference for
378 watching infant video clips over adult ones in Experiment 2. Therefore, at least for her higher reward
379 value is associated with viewing infant video stimuli compared to adult ones. It remains unclear why
380 only Popo but not others showed a preference for infant videos, but it should be also noted that she is
381 the only chimpanzee who preferred to watch conspecific videos over a blank screen in Experiment 3.

382 The absence of evidence regarding the reward value of infant video stimuli in the current
383 study might be attributed to the limitations within the paradigm of differential sensory reinforcement.
384 Even a consistent preference for conspecific videos over blank screens was not observed among
385 chimpanzees in Experiment 3. In previous studies with non-human primates, the rewarding nature of
386 seeing conspecifics has been reported (Fujita, 1987, 1993b, 1993a; Mulholland et al., 2021; Swartz &
387 Rosenblum, 1980). For instance, Mulholland et al., (2021) tested chimpanzees using a sensory
388 reinforcement paradigm and found that chimpanzees played back videos significantly more often
389 during sessions when conspecific stimuli were presented compared to control stimuli (vehicles,
390 humans, other animals). Differences in methodology might account for the disparities between
391 previous studies and our findings. In the previous studies, animals needed to acquire and maintain a
392 single operant behaviour (e.g., pressing a lever) corresponding to video reward, meanwhile, in our
393 paradigm in the present study, the chimpanzees were required to establish a visual discrimination
394 corresponding to two different types of rewards. Furthermore, apart from Popo, Mari, and Gon, our
395 chimpanzees were well-trained for cognitive studies, which use social stimuli such as conspecific

396 videos (e.g., Morimura & Matsuzawa, 2001) or face image (e.g., Kano & Tomonaga, 2009, 2010) as
397 experimental stimuli (but not rewards). Thus, conspecific stimuli, especially images, were not
398 unfamiliar to them although the video clips we used were all novel. The sequencing of Experiments 1,
399 2, and 3 might have also led to habituation to conspecific stimuli, potentially reducing the rewarding
400 value of watching conspecific videos in Experiment 3. Conversely, our result is in the same line as a
401 previous study by Washburn & Hopkins (1994), which demonstrated no difference in choice rate
402 between pellet and pellet accompanied by video in rhesus monkeys. It suggests the need for optimizing
403 several variables, as we discussed later, to attain the maximal effect of sensory reinforcement.

404 Although video playback is often used as environmental enrichment for captive animals, our
405 results from Experiment 3 show that the preference for a conspecific video versus a blank screen was
406 not consistent and varied significantly among individuals. Interestingly, Gon's results were contrary
407 to the expected preference for conspecifics; he opted to watch a blank screen over a conspecific video.
408 In other words, Gon did not acquire visual discrimination in food reward trials, but he did so in video
409 reward trials, associating "S+" with blank screens and "S-" with conspecific videos. Apart from Gon,
410 we also tested two chimpanzees (Mari and Popo), who had limited previous exposure to touch panel
411 tasks, and they learned at least for food reward trials. While Mari consistently performed better in food
412 reward trials than in video reward trials, Popo displayed a smaller performance gap and indeed chose
413 to watch conspecific video clips over a blank screen in Experiment 3. Consequently, there exist notable
414 individual differences in the effect of sensory reinforcement. Previous studies have shown similar
415 variability in task performance using a sensory reinforcement (Andrews & Rosenblum, 1993; Harris
416 et al., 1999). Several factors such as sex, age, rearing history, housing environment, parity, and training
417 history may affect the efficacy of the sensory reinforcement.

418 In the end, the present study has some limitations. The efficacy of sensory stimuli as rewards
419 can depend on various parameters such as intensity, duration, or interval of the stimuli. In our study,

420 we used a relatively larger number of video clips with shorter duration as stimuli (36-64 four-second
421 video clips in our study while ten 15-second video clips in Mulholland et al., 2021). Nonetheless, it is
422 possible that these parameters may not represent the optimal conditions for eliciting responses.
423 Another limitation pertains to the experimental setting. Many of our chimpanzees were highly
424 motivated to perform tasks and get food rewards efficiently in the experimental booth, owing to their
425 long history of cognitive research. Consequently, feedback unrelated to food rewards might have elicit
426 less interest, particularly within this experimental environment. In certain trials, some participants
427 displayed signs of frustration (e.g., hitting the panel) during video reward trials. Thus, the experimental
428 booth might not be the most suitable environment for examining spontaneous preferences for sensory
429 stimuli.

430 8. Conclusion

431 The existing body of research on sensory reinforcement in non-human primates has
432 primarily reported positive outcomes, although the conditional nature of this reinforcement has been
433 frequently suggested. Only two studies among them, to our knowledge, have investigated the effect of
434 infant stimuli as sensory rewards in non-human primates, both highlighting the rewarding nature of
435 viewing infant stimuli. Contrary to these prior findings, our study, focusing on chimpanzees, did not
436 demonstrate incentive value of infant videos over adult videos, nor conspecific videos over blank
437 screens at a group level. Instead, considerable individual differences were observed among participants.
438 Despite potential limitations necessitating future improvements, our study consistently yielded
439 negative results across all Experiments with the exception of one participant. These results suggest
440 that the motivational value of watching infant or conspecific visual stimuli may not be consistently
441 robust in chimpanzees. Furthermore, our study sheds light on limitations associated with employing
442 sensory reinforcement.

443

444 Figure legends

445 Fig.1 Procedure of the main test (free choice test).

446 Fig. 2 The choice rate of S+ in each Experiment. Blue dotted lines indicate food reward trials
447 and orange solid lines indicate video reward trials (infant videos in Experiment 1, 2, and conspecific
448 videos in Experiment 3). Individual performance is indicated by pale colours while average
449 performance is indicated by dark colours.

450 Fig. 3 The choice rate of S+ for Gon (Exp. 3) and Popo (Exp. 1-3). Blue dotted lines indicate
451 food reward trials and orange solid lines indicate video reward trials.

452

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459

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582

584 Table 1. Participant information

Name (GAIN id ^a)	Sex	Age (years)	Rearing environment	Birth experience	Previous experience with cognitive tests ^b	Participation
Ai (0434)	F	40	Wild-born	Parous	Frequent	Exp. 1-3
Ayumu (0608)	M	16	Mother	-	Frequent	Exp. 1-3
Chloe (0441)	F	35	Nursery-peer	Parous	Frequent	Exp. 1-3
Cleo (0609)	F	16	Mother	Nulliparous	Frequent	Exp. 1, 2
Gon (0437)	M	50	Wild-born	-	None	Exp. 3
Mari (0274)	F	40	Wild-born	Parous	Limited	Exp. 1, 2
Pal (0611)	F	16	Mother	Nulliparous	Frequent	Exp. 1-3
Pendesa (0095)	F	39	Nursery-peer	Nulliparous	Frequent	Exp. 1-3
Popo (0438)	F	34	Nursery-peer	Nulliparous	Limited	Exp. 1-3

585 a) GAIN (Great Ape Information Network) is the information network for Hominoidea living in Japan.

586 b) *Frequent*: well-trained for various touch panel tasks, *Limited*: had some experience of cognitive

587 tasks but not necessarily of touch panel tasks, *None*: never participated in any kind of cognitive tests.

588

Table 2. The results of GLMM.

Fixed effect	Estimate	SE	z	95% CI	<i>p</i>
Exp 1					
(Intercept)	-0.16	0.15	-1.04	[-0.46, 0.14]	0.30
Reward type	4.03	0.85	4.74	[2.36, 5.70]	<0.001
Session	0.07	0.13	0.58	[-0.18, 0.33]	0.57
Reward type: Session	1.86	0.53	3.52	[0.82, 2.89]	<0.001
Exp 2					
(Intercept)	-0.46	0.27	-1.74	[-0.98, 0.06]	0.08
Reward type	4.66	0.73	6.40	[3.23, 6.08]	<0.001
Session	0.05	0.07	0.71	[-0.08, 0.18]	0.48
Reward type: Session	1.85	0.32	5.84	[1.23, 2.47]	<0.001
Exp 3					
(Intercept)	0.19	0.22	0.88	[-0.24, 0.63]	0.38
Reward type	4.89	1.06	4.61	[2.81, 6.98]	<0.001
Session	0.05	0.11	0.48	[-0.16, 0.26]	0.63
Reward type: Session	2.58	0.59	4.39	[1.43, 3.73]	<0.001

589

*Reference category of Reward type: *video*

590

The session was z-transformed to a mean of zero and a standard deviation of one.

591

592