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1 Wild skuas can follow human-given behavioural cues when objects resemble  
2 natural food

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21 **Abstract**

22 The capacity to follow human cues provides animals with information about the environment  
23 and can hence offer obvious adaptive benefits. Most studies carried out so far, however, have  
24 been on captive animals with previous experience with humans. Further comparative  
25 investigation is needed in order to properly assess the factors driving the emergence of this  
26 capacity under natural conditions, especially in species that do not have longstanding  
27 interactions with humans. Wild brown skuas (*Catharacta antarctica* ssp. *lonnbergi*) are non-  
28 neophobic seabirds that live in human-free habitats. In test 1, we assessed this species'  
29 capacity to use human behavioural cues (i.e., pecking at the same object previously picked up  
30 and lifted by a human experimenter) when the items presented were food objects:  
31 anthropogenic objects (wrapped muffins) and natural-food-resembling objects (plaster eggs).  
32 In test 2, we examined the response of another skua population towards non-food objects  
33 (sponges). Although all skuas in test 1 pecked at the object, they pecked significantly more at  
34 the same previously handled items when they resembled natural food (plaster eggs). Most  
35 skuas in test 2, however, did not approach or peck the non-food objects presented. Our results  
36 lead us to suggest that the use of human-behavioural cues may be influenced by skuas'  
37 foraging ecology, which paves the way to further field studies assessing whether this capacity  
38 is directed specifically towards food objects and/or develops after previous interaction with  
39 humans.

40

41 **Keywords:** choice task · human-animal communication · neophobia · skua · social  
42 cue · social learning

43

44

## 45 **Introduction**

46 The capacity to use human behavioural cues has been demonstrated in numerous non-human  
47 species and has remained the focus of extensive research over the last decade (e.g., gulls,  
48 *Larus argentatus*: Goumas et al. 2020; dogs, *Canis lupus familiaris*: Bhattacharjee et al. 2020;  
49 elephants, *Elephas maximus*: Ketchaisri et al. 2019; goats, *Capra hircus*: Nawroth et al. 2020;  
50 horses, *Equus caballus*: Lovrovich et al. 2015; kangaroos, *Macropus fuliginosus fuliginosus*,  
51 *Macropus giganteus*, *Macropus rufus*: McElligott et al. 2020; monkeys, *Cebus [Sapajus]*  
52 *apella*: Essler et al. 2017; pigs, *Sus scrofa domestica*: Nawroth et al. 2016; sealions, *Zalophus*  
53 *californianus*: Malassis and Delfour 2015). A widely-used method for investigating this  
54 capacity is the two-way object-choice paradigm, where subjects are presented with a choice  
55 between two containers, only one hiding a food reward, and the identity of the correct  
56 container is indicated through experimenter-given cues (such as gazing and pointing e.g.,  
57 Clark et al. 2019; Danel et al. 2022).

58 However, interpreting subjects' success on the task (i.e., through the selection of the  
59 correct container) can be difficult when the human experimenter makes contact directly with  
60 (e.g., provides the cue by touching) - or is in close proximity to - the rewarded container  
61 (Kaminski et al. 2005). The reason for the ambiguity is that cues given in proximity to a  
62 target can trigger responses through local enhancement: a form of social information use  
63 relying on attraction to a specific location merely due to the presence of other conspecifics  
64 there (Thorpe 1963). As such, responses may reflect an attraction to the location where the  
65 object is manipulated rather than an understanding of the cues presented.

66 So far, most studies have been restricted to captive populations, where rigorous controls  
67 can easily be administered. Field experiments, however, are crucial to elucidating whether  
68 and how human-given cue use operates under natural conditions. Moreover, recently, it has  
69 been suggested that the capacity to use human behavioural cues, including through local

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70 enhancement, may be facilitated in wild animals that often interact with humans and show  
71 low levels of neophobia ('fear of novelty'; Goumas et al. 2020). For instance, when two  
72 anthropogenic objects are directly visible (as opposed to hidden under containers), urban  
73 herring gulls (*Larus argentatus*) peck at the object previously handled by the human  
74 experimenter only when it is food-related (wrapped blueberry flapjack: Goumas et al. 2020).

75 Here, we assessed whether a population (île Verte site) of wild brown skuas (*Catharacta*  
76 *antarctica* ssp. *lonnbergi*) follows human cues in two-way object-choice tasks involving the  
77 use of familiar and unfamiliar food objects ('Test 1: food objects' i.e., anthropogenic:  
78 wrapped muffins and natural-food-resembling objects: plaster eggs). To evaluate whether  
79 skuas are attracted towards non-food objects and to prevent familiarity with the experimental  
80 set-up from influencing results (Goumas et al. 2020), we tested a second skua population  
81 (Ratmanoff site) with non-food objects only ('Test 2: non-food objects' i.e., anthropogenic  
82 non-food objects: sponges). Skuas are closely related to gulls (Furness et al. 2018) and share  
83 behavioural traits believed to facilitate adaptation to changing environments (Wong et al.  
84 2015) and exploitation of anthropogenic resources, such as boldness, behavioural flexibility,  
85 fast learning, generalism, and opportunism (Carneiro et al. 2014, Carneiro et al. 2015).  
86 However, skuas inhabit human-free habitats, do not have longstanding interactions with  
87 humans, and are not familiar with anthropogenic resources. Investigation in closely related  
88 species that differ in terms of their previous exposure to humans is crucial to determine the  
89 predictors of the capacity to follow human cues, and understand its evolution. Moreover,  
90 skuas are non-neophobic and highly territorial (Furness et al. 2018; see also Danel et al. 2021;  
91 Danel et al. 2022), which facilitates greatly the study of their cognition in the wild. Based on  
92 this species' almost complete absence of neophobia and lack of longstanding interactions  
93 with humans, we first expected skuas from the first population (île Verte site) to approach all  
94 food objects ('test 1: food-objects' i.e., wrapped muffins, plaster eggs), but to peck

95 significantly more at salient, experience-based food objects (i.e., plaster eggs), without  
96 following human behavioural cues. For comparative purposes (Goumas et al. 2020), we also  
97 administered a test with non-food objects to skuas from the second population (Ratmanoff  
98 site). We predicted subjects to approach (without pecking at) non-food objects ('test 2: non-  
99 food objects' i.e., sponges).

### 100 **Methods**

#### 101 *Study population*

102 Two populations of adult wild brown skuas participated in this study, each located at a  
103 different geographical site within the Kerguelen archipelago, in the Southern Indian Ocean:  
104 18 birds at île Verte, Morbihan gulf (test 1: food objects) and 18 individuals at Cape  
105 Ratmanoff, Courbet peninsula (test 2: non-food objects). These sites are located  
106 approximately 67 km from each other, and thus represent independent populations.  
107 Experiments were conducted between November 2020 and February 2021. Tests were  
108 administered between 7 a.m. and 6 p.m. Only the subjects of test 1: food objects had  
109 previously interacted with humans: this consisted of cognitive experiments conducted over a  
110 very short period (i.e., 2.5 weeks) between December 2019 and January 2020.

#### 111 *Experimental setup and Materials*

112 In test 1: food objects, we used two food objects: (i) 'Cookie Creations' chocolate muffins  
113 in green liners wrapped in transparent packaging (8 cm in length x 7 cm in width; 40 g) as  
114 anthropogenic food objects, and (ii) two plaster blue petrel (*Halobaena caerulea*) eggs (6.5  
115 cm in length x 4 cm in width; 90 g) inserted into plastic zip lock bags as natural-food-  
116 resembling objects, given that eggs are part of skuas' diet (Furness et al. 2018) (Figure 1).  
117 Given the extent of resemblance, the insertion of the eggs into transparent bags was necessary  
118 in order to prevent skuas' swallowing attempts (SD, personal observation). In test 2: non-  
119 food objects, we used green sponges (10 g) of the same size and shape as the previous

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120 anthropogenic food objects (wrapped muffins). Although skuas are familiar with blue petrel  
121 eggs, our subjects had never encountered wrapped muffins and green sponges previously.

122 < Figure 1 about here >

### 123 *Procedure*

124 Our general procedure was similar to the one used with gulls (Goumas et al. 2020). When  
125 a target individual was in view on the ground, the experimenter approached the skua holding  
126 in each hand a platform covered by a white plastic container. When the bird was  
127 approximately 8 m from the human experimenter, she crouched down on the ground, spaced  
128 the two platforms at a distance of 70 cm using a marked stick, and removed simultaneously  
129 both containers to reveal the objects. Then, the experimenter picked up one of the two objects,  
130 stood up straight and moved the object towards her face while mentally counting up to 20 s  
131 (continuously reorienting her body to keep facing the skua in case it did not stand still). The  
132 experimenter then put the object down in same place, stood up, took the white containers, and  
133 walked backwards up to a distance of about 6 m. Subjects received two trials (test 1: food  
134 objects: two types of objects, île Verte site) or one trial (test 2: non-food objects: one type of  
135 object, Ratmanoff site) in total (each trial lasting 120 s maximum, 2 trials per day maximum,  
136 minimum 1 h apart). Objects were always presented using the same side and orientation. The  
137 experimenter alternated the manipulation of the right and left object between trials (test 1:  
138 food objects). In test 1: food objects, the order of presentation of the objects was  
139 counterbalanced across subjects (bird 1 was first presented with wrapped muffins, then  
140 plaster eggs, bird 2 was first presented with plaster eggs, then wrapped muffins, etc.).

### 141 *Data analysis*

142 We used a Generalized Linear Mixed Model (GLMM) following a binomial distribution to  
143 test whether skuas' choice was influenced by the type of object manipulated by the human  
144 experimenter (matching/non-matching the experimenter's choice, measured by *pecking*, i.e.

145 behaviour that consists of touching with the beak the same (matching) or different (non-  
146 matching) object previously handled by the human experimenter) in test 1: food objects (i.e.,  
147 anthropogenic: wrapped muffins or natural-food-resembling objects: plaster eggs). Subjects'  
148 identity was included as a random variable, and the following fixed variables were  
149 considered as additional predictors: latency of contact and distance between the skua and the  
150 objects.

151 At the individual level, we also used two binomial tests ( $\alpha$  set at 0.05;  $\alpha$  at 0.025 with  
152 Bonferroni correction) to assess whether skuas pecked at previously handled food objects  
153 (i.e., plaster eggs or wrapped muffins) more than would be expected by chance.

154 Finally, we ran two Fisher's exact tests (two-tailed,  $\alpha$  set at 0.05;  $\alpha$  at 0.025 with  
155 Bonferroni correction) to evaluate whether the proportion of skuas that pecked at or  
156 approached the objects differed significantly between the two populations (île Verte site and  
157 Ratmanoff site). GLMM analysis, binomial tests, and Fisher's exact test focusing on pecking  
158 behaviours were conducted on 17 individuals at île Verte site, since one skua approached but  
159 did not peck at any object. All the analyses were conducted with R version 3.6, and the  
160 package lme4 (Bates et al. 2015) was used to perform the GLMM analysis.

### 161 **Results**

162 The variable type of object (wrapped muffins vs plaster eggs) had a significant effect on  
163 birds' choices. More precisely, skuas matched significantly more (pecked at the same object  
164 previously manipulated by the experimenter) when the objects were plaster eggs rather than  
165 wrapped muffins (binomial GLMM,  $Z = -3.36$ ,  $p \leq 0.001$ ; Table 1). Latency of contact and  
166 distance between the skua and the objects had no significant effect on skuas' choices.

167 At the individual level, skuas pecked at the same previously handled item more than  
168 would be expected by chance when the food objects presented were plaster eggs (14 out of 17  
169 subjects; binomial test:  $p = 0.01$ , adjusted  $p$  with Bonferroni correction = .02), but not when



170 they were wrapped muffins (7 out of 17 subjects; binomial test:  $p = .48$ , adjusted  $p$  with  
171 Bonferroni correction =  $.96$ ). We could not test whether skuas from the Ratmanoff site  
172 pecked indiscriminately at non-food objects as too few subjects pecked at non-food objects.

173 All skuas at île Verte (test 1: food objects:  $n = 18$ ) approached the food objects (wrapped  
174 muffins and plaster eggs), while at the Ratmanoff site (test 2: non-food objects:  $n = 18$ ), only  
175 5 individuals did so when exposed to non-food objects (sponges). This difference was  
176 significant (Fisher's exact test:  $p \leq 0.001$ ). Seventeen out of 18 skuas at île Verte and 4 out of  
177 18 skuas at Ratmanoff pecked at the objects presented. This difference was also significant  
178 (Fisher's exact test:  $p \leq 0.001$ ).

179 < Figure 2 and Table 1 about here >

### 180 **Discussion**

181 Although most free-ranging skuas pecked at both food objects (wrapped muffins and  
182 plaster eggs: île Verte site), they used human behavioural cues only when the objects  
183 resembled natural food (plaster eggs). Furthermore, few skuas approached and pecked at  
184 objects in test 2: non-food objects (Ratmanoff site).

185 Thus, at the île Verte site (test 1: food objects), handled food seemed more attractive when  
186 objects resembled natural (plaster eggs) rather than unfamiliar, anthropogenic food (wrapped  
187 muffins). This suggests that local enhancement (attraction to the handled object; Thorpe 1963)  
188 is driven by ecologically relevant, context-specific stimuli in wild skuas. Due to their  
189 identification as familiar food items, plaster eggs may have represented highly salient stimuli  
190 when manipulated by the human experimenter (Furness et al. 2018). This behaviour may  
191 originate from skuas' tendency for piracy (Kanaujia et al. 2014), also known as  
192 kleptoparasitism, which consists of stealing food already procured by others (Morand-Ferron  
193 et al. 2007). Skuas seem particularly attracted by food held by conspecifics and other species

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194 - and they may have been able to generalize this behaviour towards humans, as is the case for  
195 some other kleptoparasites (e.g., gulls: Rock 2005).

196 At the Ratmanoff site (test 2: non-food objects), few skuas approached and/or pecked at  
197 anthropogenic non-food objects. Despite an almost total lack of neophobia, this result shows  
198 that skuas from this population do not necessarily approach - or are attracted towards - novel  
199 objects. In this context, one can relate exploration and the salience of - or attraction towards -  
200 ecologically-relevant stimuli (plaster eggs) discussed above to the results obtained with free-  
201 ranging herring gulls (Goumas et al. 2020). More specifically, when skuas and urban gulls  
202 are confronted with *repeated* food-human learning associations in their environment (i.e.,  
203 skuas at île Verte and urban gulls), they may be more inclined to peck at all objects presented  
204 by humans, but also to follow their cues particularly when food objects are ecologically  
205 relevant (i.e., skuas: plaster eggs, gulls: wrapped blueberry flapjacks). The rapidity with  
206 which skuas may have acquired this food-human association is intriguing and may relate to  
207 this species' ecology (e.g., the necessity to form quickly new associations regarding prey  
208 availability and foraging behaviour in fluctuating environments: Carneiro et al. 2015).

209 However, at this stage, further studies are necessary to control for and draw firm  
210 conclusions about whether the types of objects presented (food vs. non-food objects) affected  
211 subjects' interest, for example by eliciting more peck and approach behaviours when they  
212 resembled food items, or whether short food-mediated contact with humans played a  
213 significant role in the development of interspecific local enhancement (i.e., by testing the  
214 same individuals at the Ratmanoff site with food objects, and those at the île Verte site with  
215 non-food objects).

216 Beyond showing that the use of human handling as a cue is food-specific (Goumas et al.  
217 2020), our findings suggest that this capacity is influenced by a species' foraging ecology.  
218 This experiment contributes to to-date small number of cognitive studies investigating the use

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219 of human behavioural cues in the wild, especially in populations that live in human-free  
220 habitats. By testing animals that vary in their fear of novelty, history of past interactions with  
221 humans, and ecology (e.g., urban vs. non-urban vs. outside of anthropogenic habitats), we  
222 will be able to obtain a fuller picture of the selective forces acting on the development of this  
223 skill in the wild.

224 **Declarations**

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228 **Conflicts of interest/Competing interests**

229 The authors declare that they have no conflict of interest.

230 **Ethics approval**

231 This article does not contain any studies with human participants performed by any of the  
232 authors. The protocols were carried out in accordance with published guidelines of the  
233 Association for the Study of Animal Behaviour (ASAB) and the Animal Behavior Society  
234 (ABS). The experiment was approved by the French Ethical Committee (n°  
235 201707131540776 of 22/07/2017).

236 **References**

237 Bates D, Mächler M, Bolker B, Walker S (2015) Fitting Linear Mixed-Effects Models Using  
238 lme4. J Stat Softw 67: 1-48.

239 Bhattacharjee D, Mandal S, Shit P, Varghese MG, Vishnoi A, Bhadra A (2020) Free-ranging  
240 dogs are capable of utilizing complex human pointing cues. Front Psychol 10: 2818.

241 Carneiro APB, Manica A, Phillips RA (2014) Foraging behaviour and habitat use by brown  
242 skuas *Stercorarius lonnbergi* breeding at South Georgia. Mar Biol 161: 1755-1764.

243 Carneiro AP, Manica A, Trivelpiece WZ, Phillips RA (2015) Flexibility in foraging strategies  
244 of Brown Skuas in response to local and seasonal dietary constraints. J Ornithol 156:  
245 625-633.

246 Clark H, Elsherif MM, Leavens DA (2019) Ontogeny vs. phylogeny in primate/canid  
247 comparisons: A meta-analysis of the object choice task. Neurosci Biobehav Rev 105:  
248 178-189.

## HUMAN BEHAVIOURAL CUES IN SKUAS

- 249 Danel S, Chiffard-Carricaburu J, Bonadonna F, Nesterova AP (2021) Exclusion in the field:  
250 wild brown skuas find hidden food in the absence of visual information. *Anim Cogn* 24:  
251 867-876.
- 252 Danel S, Rebout N, Bonadonna F, Biro D (2022) Wild skuas can use acoustic cues to locate  
253 hidden food. *Anim Cogn* 1-7.
- 254 Danel S, Rebout N, Kemp LV (2022) Assessing the spontaneous use of human-given cues in  
255 ground-hornbills. *Behav Process* 199: 104659.
- 256 Essler JL, Schwartz LP, Rossettie MS, Judge PG (2017) Capuchin monkeys' use of human  
257 and conspecific cues to solve a hidden object-choice task. *Anim Cogn* 20: 985-998.
- 258 Furness RW, Boesman P, Garcia EFJ (2018) The brown skua (*Catharacta antarctica*). In: del  
259 Hoyo J, Elliott A, Sargatal J, Christie DA, de Juana E (eds) *Handbook of the birds of*  
260 *the world alive*. Cornell Lab of Ornithology.
- 261 Goumas M, Boogert NJ, Kelley LA (2020) Urban herring gulls use human behavioural cues  
262 to locate food. *R Soc Open Sci* 7: 191959.
- 263 Goumas M, Burns I, Kelley LA, Boogert NJ (2019) Herring gulls respond to human gaze  
264 direction. *Biol Lett* 15: 20190405.
- 265 Kaminski J, Riedel J, Call J, Tomasello M (2005) Domestic goats, *Capra hircus*, follow gaze  
266 direction and use social cues in an object choice task. *Anim Behav* 69: 11-18.
- 267 Kanaujia A, Kumar A, Kushwaha S, Kumar A, Kumar A (2014) A Review on the  
268 Kleptoparasitic Skuas of the Islands. *G-j Environ Sci Technol* 2: 39-43.
- 269 Ketchaisri O, Siripunkaw C, Plotnik JM (2019) The use of a human's location and social cues  
270 by Asian elephants in an object-choice task. *Anim Cogn* 22: 907-915.
- 271 Lovrovich P, Sighieri C, Baragli P (2015) Following human-given cues or not? Horses  
272 (*Equus caballus*) get smarter and change strategy in a delayed three choice task. *Appl*  
273 *Anim Behav Sci* 166: 80-88.

## HUMAN BEHAVIOURAL CUES IN SKUAS

- 274 Malassis R, Delfour F (2015) Sea lions' (*Zalophus californianus*) use of human pointing  
275 gestures as referential cues. *Learn Behav* 43: 101-112.
- 276 McElligott AG, O'Keefe KH, Green AC (2020) Kangaroos display gazing and gaze  
277 alternations during an unsolvable problem task. *Biol Lett* 16, 20200607.
- 278 Morand-Ferron J, Sol D, Lefebvre L (2007) Food stealing in birds: brain or brawn? *Anim*  
279 *Behav* 74: 1725-1734.
- 280 Nawroth C, Ebersbach M, von Borell E (2016) Are domestic pigs (*Sus scrofa domestica*) able  
281 to use complex human-given cues to find a hidden reward? *Anim Welf* 25: 185-190.
- 282 Nawroth C, Martin ZM, McElligott AG (2020) Goats follow human pointing gestures in an  
283 object choice task. *Front Psychol* 11: 915.
- 284 R Core Team (2019) R: A language and environment for statistical computing. R Foundation  
285 for Statistical Computing, Vienna, Austria. URL <https://www.R-project.org/>.
- 286 Rock P (2005) Urban gulls. *Br Birds* 98: 338-355.
- 287 Thorpe WH (1963) *Learning and Instinct in Animals*. 2nd edn. Methuen, London.
- 288 Wong B, Candolin U (2015) Behavioral responses to changing environments. *Behav Ecol* 26:  
289 665-673.

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### 290 **Tables**

291 **Table 1** – Results of the GLMM analysis for test 1: food objects.

	Estimate	SE	Z	p
Test 1: food objects				
Intercept	10.56	3.82	2.76	≤ 0.001
Type of object (wrapped muffins and plaster eggs)	-20.01	5.94	-3.36	≤ 0.001

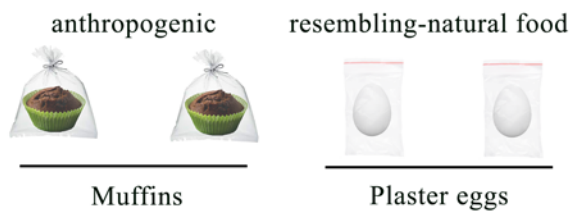
292

293 **Figure legends**

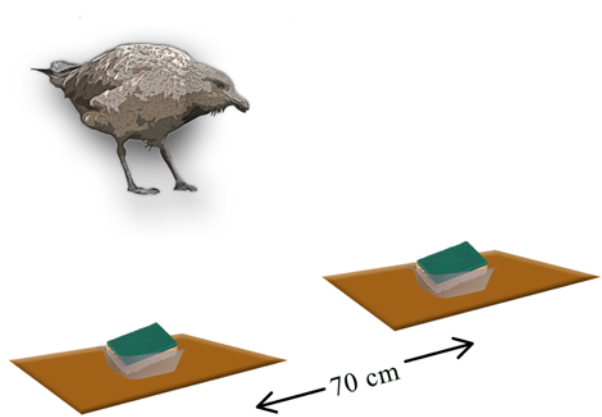
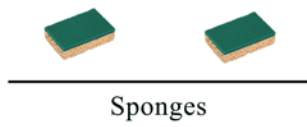
294 **Figure 1** Objects and experimental set-up presented to wild brown skuas. **(a)** Test 1: food  
295 objects i.e., wrapped muffins and plaster eggs. **(b)** Test 2: non-food objects i.e., sponges. **(c)**  
296 An example of the experimental set-up with sponges (test 2: non-food objects).

297

a. Test 1: food objects - *île Verte*



b. Test 2: non-food objects - *Ratmanoff*



298