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1 **Animal agency can accelerate behavioural and neuroscience research**

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9

10 **Abstract**

11 Despite increasing numbers of publications showing that many animals possess the neural
12 substrates involved in emotions and consciousness, animals are still constrained and forced
13 to take part in applied or fundamental research. However, these constraints stress animals
14 and may result in false negatives or false positives. A change is needed in our work paradigm
15 with animals to progress in behavioural and neuroscience research and thus gain access to
16 hitherto inaccessible yet important scientific results. Animals interact in their own ways with
17 the world and we need to adopt these ways, i.e. their agency, to perform better research
18 and develop a better understanding of how the brain and behaviour evolve. This paper
19 discusses how animal agency can not only be the key to more wide-ranging and improved
20 research in existing domains, but can also lead to new research questions resulting from our
21 anthropocentric view.

22 **Keywords:** 3Rs, animal research, ethology, ethics, sentience

23 Introduction

24 By definition, animal research requires the involvement of animals. Although researchers
25 have made great progress and improved experimental conditions for animals through
26 application of the 3R rules (replace, reduce, refine), some behavioural experiments showed
27 that animals are still forced to enter experimental apparatus through different processes
28 such as throw nets, restraint chairs, cages or food privation. Thirty percent of researchers
29 still continue to use methods that entail negative reinforcement, whilst 70% of procedures
30 using restraint chairs could comprise positive reinforcement methods¹. Beyond the ethical
31 issues of such constraints for animals, these examples of experimental set-ups lead us to
32 consider which possibilities and results have yet to be investigated and more importantly,
33 whether such invasive protocols could lead to false negatives or false positives²⁻⁵. Indeed,
34 stress and contention can not only modify some animal behaviours but also entirely prevent
35 others from being displayed⁶⁻⁸. Some authors consider that the current 3R framework is not
36 sufficient to ensure that animals are meaningful participants, which is crucial to guarantee
37 that scientific results are not altered. These contexts offer few meaningful opportunities for
38 animals to exercise agency in their relationships, both between each other and with
39 humans⁹. Gillespie wrote that 'there is a long tradition of studying nonhuman animals in
40 spaces of animal use and exploitation, where researchers and teachers in effect become
41 complicit through passive participation in violence against nonhuman animals...' ¹⁰.
42 According to Blattner et al. (2020)⁹ who worked on animal agency in rehomed farm animals
43 and from which this paper is inspired, 'longstanding ideological blinders and anthropocentric
44 bias frame animals as limited beings whose lives unfold according to fixed genetic or species-
45 specific scripts, rather than as complex subjects who act with intention and purpose, both
46 individually and collectively'. We believe that constraint-based experiments are severely
47 limited in terms of what we can learn from animals, in individual and group contexts.

48 Indeed, increasing numbers of publications show that many animals (mammals, birds and
49 other creatures including octopuses) possess the neural substrates involved in emotions and
50 consciousness^{11,12}. Rats, primates and pigeons are capable of metacognition, i.e. knowing if
51 they are wrong or right in a test^{13,14}. Cetaceans and apes are conscious of their own
52 existence, and that of others¹⁵. Self-awareness was also found in cleaner fishes^{16,17}. Apes
53 know what their conspecifics know¹⁸ and believe¹⁹. Empathy has been observed in apes²⁰

54 and in rats ²¹. Finally, some apes have a sense of morality ²²⁻²⁴. Researchers obtained these
55 results by changing their way of thinking from an anthropocentric approach ²⁵ to an
56 acceptance of anthropomorphism ²⁶. For instance, self-awareness was not found in some
57 species when the mirror test was used, but it was found when researchers used the senses
58 of animals, such as the sense of smell for dogs ²⁷ or vocalisations in gibbons ²⁸. Merleau-
59 Ponty had already noted this problem in his *Causeries* back in 1948: researchers usually do
60 not try to understand animals in their singularity, *as they are*, but rather in comparison with
61 human beings, projecting essentially human characteristics on to animals ²⁹. However, this is
62 a means to measure the distance between human beings and other animals rather than a
63 tool allowing a real understanding of how animals live and express a subjective existence
64 ^{30,31}. Studied in the light of properly human normative references, animals always lack
65 something ²⁹. For as long as animals are studied from a human perspective and are tested in
66 terms of human problems (capacity to count, to draw, to speak a human language) instead
67 of their own questions and problems, they will always respond “as they can”³², without ever
68 being able to fully express their agency. Animals interact with the world in their own ways
69 and these ways, i.e. their agency, are precisely what we need to adopt to perform better
70 research and develop a better understanding of how the brain and behaviour evolve.

71 **Animal agency**

72 Agency is the capacity of an actor to act in a given environment. In the broadest sense,
73 agency is the ability to have an influence or an effect on something. In this sense, the agency
74 is owned by all humans and animals, but also by viruses, stones or tornadoes as explained by
75 Blattner et al. (2020) ⁹. However, its focus might be narrower when agency is considered as
76 the expression or manifestation of a subjective existence; agency implies affecting the world
77 in ways that reflect a subject’s desires or will ³³. It refers to an individual pursuing its own
78 good in its own way ³⁴. Blattner et al. ⁹ investigate animal agency in a sanctuary for formerly
79 farmed animals, considering how a careful exploration of dimensions of agency in this
80 setting might inform ideas of interspecies interactions (work, research, politics, etc.) and
81 ethics. Their study focused on multispecific animals living in a sanctuary. For the owners of
82 the sanctuary and for the study researchers, the sanctuary is an ‘integrated multispecies
83 community or society whose members shape spaces and practices together, take on
84 recognised social roles, and create and transmit social norms across species lines’. The

85 authors affirmed that we need to spend time in community with animals, to learn from
86 them, and to be prepared to respond and adjust our learning process through relationships
87 with them. This can be extended to scientific research, and means that animals should no
88 longer be considered as the subjects of our experiments, but rather as participants. For
89 example, when it comes to assessing animal intelligence, the researchers' focus should
90 encompass goals that are meaningful, useful and of interest to animals instead of focusing
91 on goals that are only relevant to the human scientist³⁵. Animals should no longer be seen
92 as objects of knowledge, or mere matter for the act of the human knower, but should rather
93 be granted a status as an *agent* in the production of knowledge³⁶. Interaction and
94 communication have to go in both directions. We need to make ourselves understandable to
95 animals. Of course, this communication would only be possible for some species, such as
96 apes and some monkeys, cetaceans, certain birds including parrots or corvids, social
97 carnivores and cephalopods. However, we need to extend this circle as some other species
98 are surely able to understand our intentions as behavioural or even neuroscientific
99 experiments. When researchers allow too little room for the animals' own forms of agency,
100 the true abilities of these individuals are obscured³⁷.

101 The study of agencies in animals can be divided into four schemes according to Blattner et al.
102 (2020)⁹ (Figure 1):

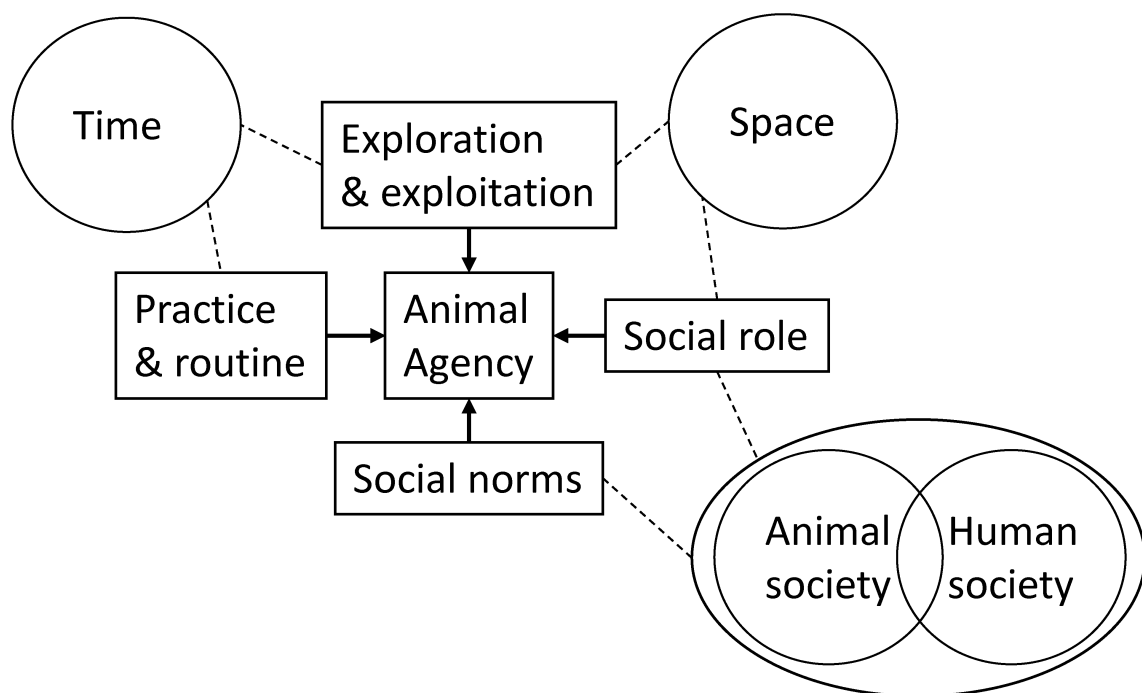
- 103 1. Agency through space and time: animals are mobile and explore/exploit their
104 environments. This exploration and exploitation can be used to better understand
105 the behaviours of animals but also their preferences in terms of habitats, sleeping
106 areas and social relationships. Whilst this agency seems obvious for many
107 researchers and is often applied for livestock and farmed animals³⁸⁻⁴⁰, it is rarely
108 applied in comparative psychology or neuroscience. Specifically, modifications of the
109 environment can be used to shape animal decisions and can remove some of the
110 negative reinforcement that is still applied to animals. Animals could experience less
111 stress in some parts of their environment than others, and carrying out experiments
112 in these places could increase their motivation to participate and decrease the risk of
113 false negatives^{41,42}.
- 114 2. Agency through practice and routine: Animals have habits, even in the wild. Social
115 animals collectively organise their day in order to meet their requirements and

116 maintain the advantages of living in groups⁴³. Rather than forcing animals to
117 participate in experiments, accepting that animals can accept or refuse to participate
118 according to their routine would increase the robustness and viability of results. Any
119 animals that want to be tested seek to use tablets or other interactive apparatus that
120 are based on technologies such as RFID^{44,45}; these tools respect their habits and
121 routines. Medical aspects such as health checks or medical procedures that require
122 constraints and restraints should also be based on these routines to decrease animal
123 stress and injuries, as already shown in their use by zoos.

124 3. Agency through social roles: A social role is the behaviour expected of an individual
125 who occupies a given social position or status. Individuals understand the place that
126 conspecifics hold in their society. The adoption of roles that are recognised and
127 acknowledged by others, and indeed mutually constructed with conspecifics, is an
128 important dimension of relational agency and a means by which we can effectively
129 affirm our subjective existence within a community. This role can be intraspecific or
130 interspecific. Roles of individuals inside their group 'have been amply described in
131 terms of dominance (policing behaviours, protecting groups), kinship and maternal
132 relationships⁴⁶. Individuals also develop strong relationships when they share similar
133 attributes as sex or age. Group members influence each other, and particularly share
134 knowledge⁴⁷. Dominant or old individuals can transmit important information to
135 others, and this social transmission can be used to make animals learn how to use
136 experimental apparatus or spaces. These individuals can consequently become
137 leaders. Multispecific and positive interactions or associations are also found
138 naturally in the wild in situations such as multispecies group protection, interspecies
139 grooming and predator alerts, even if negative interactions (cheating, predating,
140 competition) are also observed. Blattner et al.⁹ described multispecies interactions in
141 the sanctuary for formerly farmed animals. Individuals of specific species adopt
142 different roles with geese, cows or dogs acting as guardians and policers, cows
143 teaching sheep and multispecies friendship and parenting. Multispecific leadership is
144 also described in different reports with geese leading ducks and chickens, and goats
145 leading sheep⁴⁸⁻⁵⁰.

146 4. Agency through social norms: Social norms are the customary rules that govern
147 behaviour in groups and societies⁵¹. The previous example of learners and teachers

148 brings us to the subject of social norms. Behavioural rules and social systems are
 149 partly genetic in animals but are also transmitted by cultures. In macaques, for
 150 instance, species are divided into grades ranging from despotic and aggressive to
 151 tolerant and democratic⁵². However, if an individual from one specific grade is
 152 transferred into a group of another grade, it will adopt their behaviours. Many
 153 traditions of tool use and social habits have been described in chimpanzees or
 154 macaques⁵³. Although collective decision processes are species-specific, variations
 155 are observed between groups of the same species. The roles played by individuals
 156 can lead to a strong leadership or the development of a more democratic process
 157 such as votes⁵⁴. Voting systems⁵⁵ are described in many species, with intentional
 158 behaviours and perceptions of the mental states of conspecifics indicating some
 159 theory of mind and reinforcing the idea of agency. A sense of community⁹ seems to
 160 exist in chimpanzees and in cetaceans, and indeed many other animals know exactly
 161 who belongs or does not belong to their group by recognising the faces or voices of
 162 group members.



163
 164 Figure 1: The four schemes of animal agency (squares) and the environmental factors
 165 affecting them (circles)

166

167 These different instances show that animals have agency over their spatial, temporal and
168 social environment. Animals can therefore be viewed as *agents*; their choice to act has direct
169 consequences on their environment, or they can also resist conditions that do not please
170 them, and act accordingly to change them⁵⁶. Researchers could use this agency to increase
171 animal welfare and obtain more viable and robust results, whilst extending the scope of
172 behavioural and neuroscience research. Indeed, the great difficulty today is to measure the
173 behaviours or the neuronal activities of aware animals whilst seeking to do so in natural
174 conditions: the results of many experiments have been criticised, as the associated captivity,
175 animal microbiota, genetic or behavioural variance of animals made it impossible to allow to
176 reproduce or generalise any results that were unaffected by false negatives or false positives
177⁵⁷⁻⁵⁹. Often, in the research process, many of the limitations shown by the animals to date
178 are actually the limitations of the scientific methods, rather than the animals themselves⁶⁰.
179 Similarly, Frans De Waal argues: 'All that most experiments have done thus far is testing the
180 ape's theory of the human mind. We would do better to focus on the ape's theory of the ape
181 mind'²². Following the concept of animal agency, we propose a future research framework
182 to work with animals and progress in research.

183 **Future research framework**

184 We remember some years ago, talking with colleagues in neuroscience or medical research
185 about applying the use of touchscreens in macaques, or suggesting to doctors that studying
186 mouse personality could help to avoid false negatives or false positives. Our interlocutors
187 laughed, saying that our suggestions were either unnecessary or impossible. Yet today, these
188 projects have become reality. Touchscreens or joysticks are used to understand cognition
189 and self-agency⁶¹ in a wide range of species (pigs, macaques, baboons, goats, horses,
190 etc.^{45,62-65}). However, this use is still limited to behavioural studies and should now be
191 extended to neuroscience¹. There is a huge amount of literature describing how animal
192 personality and microbiota can influence results. This success demonstrates the importance
193 of not limiting our imagination about how we could work with animals to obtain new results
194 in biological sciences.

195 First we need to change our way of thinking to a perspective of working *with* animals rather
196 than *on* animals. Animals are agents endowed with intentions which transcend traditional
197 subject-object relations. We need to trust their capabilities in order to increase our research

198 possibilities. Experimental set-ups that restrain animals, such as restraint chairs or food
199 privation, stress animals and prevent them both physically and mentally from fully
200 expressing their agency. This challenge may certainly take time, but would be hugely
201 beneficial. Patter and Blattner⁶⁶ suggest core principles to follow with animals: non-
202 maleficence, beneficence and voluntary participation⁶⁷. Economic or convenience
203 euthanasia of animals should not be an option^{68,69}. Euthanasia also has a strong impact on
204 the emotions of caretakers⁷⁰. Positive methods exist and have proved to be efficient^{6,71-75}.
205 The readiness of chimpanzees to voluntarily participate in interactions or allow humans to
206 observe them can facilitate the measurement of embryo development and brain activities in
207 unanesthetized and unrestrained individuals (Figure 2⁴⁴). Unrestrained and voluntary
208 animals can be trained to put their head in a mask⁷⁶ and be tested whilst receiving fruit
209 juice. This allows the measurement of different metrics with eye tracking^{19,77,78} and non-
210 invasive neuroimaging⁷⁹ (Figure 3.A).

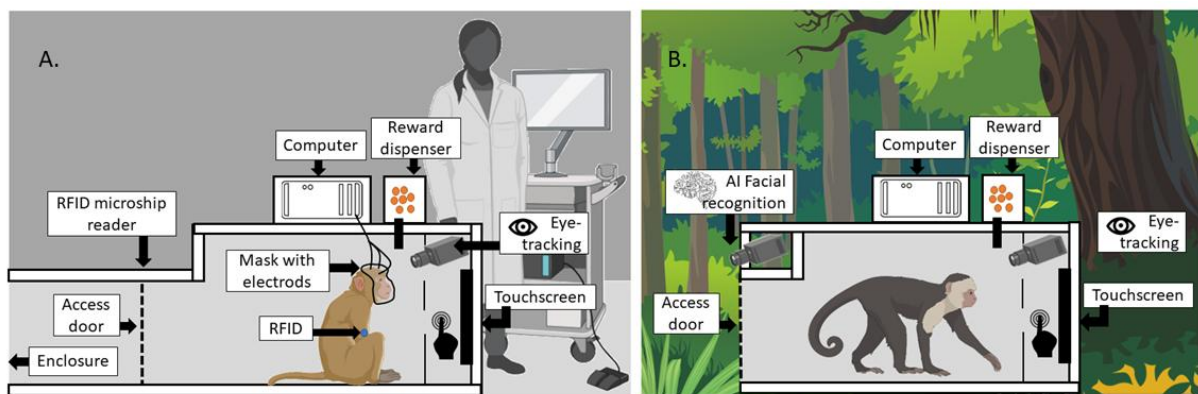
211



212
213 e 2: (A) Developmental neuroscience. Fetal brain development in chimpanzees was
214 measured by a non-invasive ultrasound technique. (B) EEG recordings in a chimpanzee. The
215 chimpanzee quietly sat on the chair and allowed the experimenter to put electrode patches
216 on the skin of her forehead and the top of her head. Photos provided with the courtesy of
217 Satoshi Hirata.

218

219 Traditional approaches involve bringing animals into a lab and restraining them while they
220 perform tasks in order to ensure stable gaze-tracking and neural recordings (in the case of
221 neuroscience). However, this unnatural setting does not permit the study of brain activity
222 during natural, social and complex behaviours. Specific ethical guidelines exist now for
223 research in the wild^{80,81}. The likely benefits and possible negative effects of our presence
224 and field methods on study subjects, their environment and the local human community
225 should, of course, be considered⁸². New technologies allow us to bring science into the wild
226 and test animals in a free condition in their natural environment, thus removing any
227 experimental source of stress and measuring their entire behavioural repertoire. The
228 animals studied can be identified using RFID techniques⁸³ but also via artificial intelligence
229 with the recognition of individuals by videotracking⁸⁴⁻⁸⁶. The latter removes the need to
230 catch animals. A location can then be defined where different touchscreens deliver food,
231 with activation only for certain species and individuals. We can imagine going beyond the
232 use of touchscreens with the implementation of eye-tracking and neuroimaging apparatus in
233 the wild (Figure 3.B). This could open up new research avenues in species that are in danger
234 of extinction or cannot be easily maintained in captivity.



235
236 Figure 3: (A) Non-invasive neuroimaging and eye-tracking system with voluntary experience
237 in the lab. (B) Non-invasive touchscreen system with voluntary engagement and individual
238 identification in the wild. This figure was realized using FAVPNG.com and Biorender.

239
240 Some research, and especially the biomedical or physiological/cellular domains, cannot be
241 performed outside the research structure. It is important for these experiments to respect
242 the 3Rs but also to think about the Bateson cube⁸⁷, meaning that scientists need to evaluate

243 the ethical acceptability of their research for society as a whole, including animals. The 3Rs
244 can be extended by testing animals in viable conditions. Indeed, lab conditions were
245 standardised for many years in terms of animal genetics, husbandry, food for study
246 comparison and repeatability. However, this way of doing research is criticised today as
247 animals are agents interacting with their world, and the lab conditions in which they live
248 have a strong effect on them and thus on scientific results. Moreover, it is difficult to
249 replicate similar conditions in the laboratory, as even animals that are genetically similar and
250 live in similar environments develop different personalities⁸⁸. Moreover, even if animals are
251 living in similar conditions, similar food and litter sources affect their microbiota⁸⁹⁻⁹¹ and
252 their behaviours differently⁹². Animal sociality was long forgotten in neuroscience or
253 biomedical research, but it is an important part of animal agency⁹. Indeed, sociality has an
254 important impact on the health of animals, and a great number of publications highlight the
255 link between sociality and health ageing⁹³⁻⁹⁵. Making use of the sociality of animals, i.e. their
256 agency, can even reverse cognitive decline and extend longevity⁹⁶⁻⁹⁸.

257 **Conclusion**

258 There is still much progress to be made to attain a more compassionate, less stressful and
259 more robust animal research model. This requires training and teaching researchers to adopt
260 new methods including animal agency and change their view of the role animals play in
261 research. As Jacques Derrida wrote in *The Animal That Therefore I Am*, the traditional
262 scientific and philosophical discourse on animals observes and speaks of non-human animals
263 but never really engages with, experiments *with* or gains experience with the latter⁹⁹: this
264 type of discourse can therefore only position animals as mere passive objects of the
265 theoretical knowledge these disciplines build. Such methods are completely blind to the
266 animals' own processes of interacting with their world⁹⁹, and are completely blind to their
267 agency. This view of animals as objects is not limited to research but is also found in
268 different aspects of everyday life (food, work, clothing, etc.). Researchers worldwide must
269 have the conviction that ethical animal research must consider individuals as subjects of
270 their own life and of their own world, and as co-creators of knowledge. Accepting this co-
271 creation of knowledge can create new research questions from our anthropocentric view, as
272 animal cognition dimensions are different from ours²⁵. Animals are agents in our research.
273 They are active in the research process and some researchers have even gone so far as to

274 add them in the acknowledgments or even list them as co-authors^{66,100}. This recognition of
275 animals as agents rather than objects is not approved of by some researchers, who consider
276 that this is tantamount to removing animal agency, committing over-anthropomorphism and
277 overstepping the will of animals to cooperate. Acknowledging animal agency could facilitate
278 social acceptance of animal research⁶⁷ and be of benefit to the animals concerned (well-
279 being through learning, creating and participating¹⁰¹). The consideration of animals as agents
280 could be extended from research to other domains: a new ontology considering non-human
281 animals as agents can have political, ethical and legal consequences. The concept of capital
282 applied to animals needs to be extended to social capital, ecological capital and cultural
283 capital¹⁰²: we can learn from animals and they can be part of our societies¹⁰³. This new way
284 of viewing animal agency can therefore raise critical ethical questions in regard to the
285 treatment of animals in research and to the place we grant them politically in our social
286 world.

287

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