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# Effects of primatological training on anthropomorphic valuations of emotions

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ABSTRACT

Anthropomorphism implies the attribution of human like emotions and cognition to non-human animals. This tendency may be conditioned by similar morphologies between mammals and is particularly important in primatology. Some neurocognitive findings suggest that prefrontal brain activity associated to conceptual learning influences anthropomorphic judgments, nevertheless, individual differences are also presented indicating that training on primate behavior may influence anthropomorphism. We identified and interpreted brain activity registered by functional magnetic resonance imaging while seven trained primatologists (39.42 ± 10.86 yr.) inferred emotions in human primates, non-human primates and non-primate animals; comparisons were made with seven matched scholars with no primatological training (38.71 ± 9.34 yr.). Primatologists manifested cerebellar, occipital and frontal activity related to sensory and motor processes when valuating humans and non-human primates, but not for other animals. So, primatological training and experience may elicit brain plasticity processes allowing inner motor and sensory models through frontal and cerebellar interactions.

## 1. Introduction

Anthropomorphism implies the attribution of human like emotions and cognition to other animals. This tendency discussed since Darwin's animal's emotions proposal involves complex human cognitive properties permitting the inference of other's psychological states (Kiley-Worthington, 2017). Contemporary neurocognitive approaches to study anthropomorphism has been developed over the years; a more anthropomorphic thinking is correlated to a larger gray matter volume in the left temporo-parietal brain region involved in mentalizing (Cullen et al., 2014). Also, the recognition of humans, non-human primates, and dogs' emotions involves the activation of the prefrontal brain region cognitively associated to causal explanations, but the degree of this activation varies according to the individuals' beliefs about the non-human animals' mental abilities (Spunt et al., 2017).

Anthropomorphic attributions have been suggested as a consequence of similarities between human and non-human animals' morphologies, which may influence the accuracy to interpret complex behaviors and cognition in non-human primates and involves methodological discussions in ethology, anthropology, evolutionary psychology, conservation, or philosophy of mind (Chan, 2012; Kiley-Worthington, 2017; Spunt et al., 2017). Emotions are particularly important in the anthropomorphic discussion since they are used as social cues to be interpreted (Spunt et al., 2016) based on occipital, parietal, frontal and cerebellar brain functions allowing inner models throughout sensory and motor processes to interpret own and others' expressions (Fusar-Poli et al., 2009).

In this study we aimed to identify and interpret the neurofunctional correlates while trained primatologists infer emotions in human primates, non-human primates and non-primate animals, and to compare these functions with non-trained individuals. We expected frontal, occipital and cerebellar brain activity related to visual, motor and conceptual inferences when primatologists infer non-human primates' emotions.

## 2. Method

### 2.1. Participants and task

Seven academic specialists on primate behavior trained during at least eight years (3 women, *mean* age = 39.42 ± 10.86 yr.) and seven biomedical researchers with no primate behavior training (4 women,

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**Table 1**
Empathic dimensions evaluated in the Interpersonal Reactivity Index.

| | Primatologist | | Control | |
|---|---|---|---|---|
| Empathic dimensions | *M* ± S.D. | Median | *M* ± S.D. | Median |
| Perspective Taking | 16.85 ± 5.52 | 16 | 15.14 ± 4.09 | 16 |
| Fantasy | 16.14 ± 7.84 | 14 | 10.71 ± 3.63 | 10 |
| Empathic Concern | 21.14 ± 5.61 | 22 | 19.28 ± 4.53 | 20 |
| Personal Distress | 8.85 ± 2.03 | 8 | 13.14 ± 4.59 | 14 |

*Note:* No statistical differences between groups were observed when the Kruskal-Wallis test was applied.

**Table 2**
Non-human primate species represented in the pictures used for the experimental design.

| | Common name | Species |
|---|---|---|
| New world primates | Black-handed spider monkey | *Ateles geoffroyi* |
| | Black-headed spider monkey | *Ateles fusciceps* |
| | Mantled howler monkey | *Alouatta palliata* |
| | Black howler monkey | *Alouatta caraya* |
| | White-headed capuchin | *Cebus capucinus* |
| | Kaapori capuchin | *Cebus kaapori* |
| | Red uacari | *Cacajao calvus* |
| Old world primates | Rhesus macaque | *Macaca fascicularis* |
| | Arunachal macaque | *Macaca munzala* |
| | Tonkin snub-nosed monkey | *Rhinopithecus avunculus* |
| | Vervet monkey | *Chlorocebus pygerythrus* |
| | African green monkey | *Chlorocebus aethiops* |
| | Putty-nosed monkey | *Cercopithecus nictitans* |
| | Mandrill | *Mandrillus sphinx* |
| | Hamadryas baboon | *Papio hamadryas* |
| | Lar gibbon | *Hylobates lar* |
| | Chimpanzee | *Pan troglodytes* |
| | Bonobo | *Pan paniscus* |
| | Bornean orangutan | *Pongo pygmaeus* |
| | Sumatran orangutan | *Pongo abelii* |
| | Western lowland gorilla | *Gorilla gorilla gorilla* |

**Table 3**
Non-primate animal species represented in the pictures used for the experimental design.

| | Common name | Species |
|---|---|---|
| Mammals | Porcupine | *Coendou prehensilis* |
| | Polar bear | *Ursus maritimus* |
| | Grizzly bear | *Ursus arctos horribilis* |
| | Giant panda | *Ailuropoda melanoleuca* |
| | Red panda | *Ailurus fulgens* |
| | Koala | *Phascolarctos cinereus* |
| | Wild pig | *Sus scrofa* |
| | White rhinoceros | *Ceratotherium simum* |
| | African elephant | *Loxodonta africana* |
| | Indian elephant | *Elephas maximus indicus* |
| | Camel | *Camelus dromedarius* |
| | Cow | *Bos primigenius taurus* |
| | Donkey | *Equus africanus asinus* |
| | Horse | *Equus ferus caballus* |
| | Sheep | *Ovis aries* |
| | Elk | *Alces alces* |
| | Chipmunk | *Sciurus vulgaris* |
| | Rabbit | *Oryctolagus cuniculus cuniculus* |
| | Weasel | *Mustela nivalis nivalis* |
| | Cat | *Felis silvestris catus* |
| | Leopard | *Panthera pardus pardus* |
| | Bengal tiger | *Panthera tigris tigris* |
| | Wolf | *Canis lupus lupus* |
| | Dog | *Canis lupus familiaris* |
| | Dolphin | *Delphinus delphis* |
| | Seal | *Hydrurga leptonyx* |
| | Sea cow | *Trichechus manatus* |
| Birds | Royal owl | *Bubo bubo* |
| | Red-lored parrot | *Amazona autumnalis* |
| | Red macaw | *Ara macao* |
| | Rooster | *Gallus gallus domesticus* |
| | Domestic duck | *Anas platyrhynchos domesticus* |
| | Upland goose | *Chloephaga picta* |
| | Mallard | *Anas platyrhynchos* |
| Reptiles | Iguana | *Iguana delicatissima* |
| | Galapagos tortoise | *Chelonoidis donfaustoi* |
| | Crocodile | *Cocodylus moreletii* |

*mean* age = 38.71 ± 9.34 yr.) were recruited. Participants were right-handed and had a good mental health as verified by a neuropsychiatric interview. Since empathy may influence the brain function related to inferring others' emotions (Banissy et al., 2012), the Interpersonal Reactivity Index (Pérez-Albéniz et al., 2003) was applied to verify similar empathic attitudes in both groups (see Table 1). All the participants were pet owners (dogs and/or cats) and all of them signed an informed consent. The protocol was conducted in accordance with the Declaration of Helsinki and was approved by the Bioethics Committee of the Neurobiology Institute, Universidad Nacional Autónoma de México.

The functional MRI session consisted of three series alternating pictures in a block designed task implemented in the E-prime 2.0 software (e-Prime Psychology software tools, inc. Pittsburgh, Pa). *Series 1* alternated four blocks of human faces and four blocks of non-human primate faces; *Series 2* alternated four blocks of non-human primate faces and four blocks of non-primate animal faces; *Series 3* alternated four blocks of non-primate animals faces and four blocks of human faces. Also, each series alternated four blocks of scattered faces to avoid the influence of non-face elements.

Only to control attention and induce others' emotions inferences, participants were instructed to watch each picture and to press a button using a ResponseGrip (Nordic Neurolab Bergen, Norway) when they considered the picture represented happiness.

Each block comprised 10 pictures representing the same kind of stimuli (humans, non-human primates, non-primate animals, or scattered faces) and each picture was projected during 2 s allowing a total of 40 same-kind stimuli per block. A fixation cross with 1 s duration was projected after each picture to permit the motor response indicating the inference about the projected face's emotion made by the participant. This experimental design permitted series with a 360 s of total duration comprising four blocks with 30 s duration each one which is regularly used to detect BOLD signals and to perform reliably statistical contrasts between cognitive conditions. Also, we consider 2 s as enough time to watch each picture considering previous designs to evaluate emotions reported by our group (p.e. Mercadillo et al., 2011) as well as by reports focused on anthropomorphic valuations (e.g. Chaminade et al., 2007; Spunt et al., 2016).

To neutralize the effect of the finger movements over motor brain functions, we counterbalanced the experimental design so, four participants in each group (primatologist and control group) used their right index finger while the rest used the left one to indicate their emotional inferences. As well, to avoid the effect of mere visual stimulation over the primary occipital cortex, the scrambled pictures were edited with the same intensity and gray color than the pictures representing faces.

Human pictures represented 20 female and 20 male faces; non-human primate pictures represented seven new world primates and 14 old world primates species (see Table 2); non-primate animals represented 27 terrestrial or marine mammals, seven birds, and three reptiles species (see Table 3).

### *2.2. Brain images acquisition and analysis*

Brain images were acquired in a 3 T Discovery MR750 GE MRI scanner (General Electric Company USA), with a 32-channel head coil, at the Resonance Magnetic Unit, Institute of Neurobiology, Universidad Nacional Autónoma de México. Anatomical high-resolution images were acquired using a 3D SPGR (spoiled gradient sequence) protocol: