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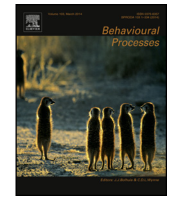

Observing real-time social interaction via telecommunication methods in budgerigars (*Melopsittacus undulatus*)

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ABSTRACT

Humans communicate with one another not only face-to-face but also via modern telecommunication methods such as television and video conferencing. We readily detect the difference between people actively communicating with us and people merely acting via a broadcasting system. We developed an animal model of this novel communication method seen in humans to determine whether animals also make this distinction.

We built a system for two animals to interact via audio-visual equipment in real-time, to compare behavioral differences between two conditions, an “interactive two-way condition” and a “non-interactive (one-way) condition.” We measured birds’ responses to stimuli which appeared in these two conditions. We used budgerigars, which are small, gregarious birds, and found that the frequency of vocal interaction with other individuals did not differ between the two conditions. However, body synchrony between the two birds was observed more often in the interactive condition, suggesting budgerigars recognized the difference between these interactive and non-interactive conditions on some level.

1. Introduction

Humans communicate with one another not only face-to-face but also via modern telecommunication methods. “Skype” and “FaceTime” are well-known tools and some people are starting to customize these novel applications for communication between pets and their owners, and even between animals. For example, owners can see and “talk” with their dogs even while they are not at home using iCPooch—Internet Pet Treat Dispenser (ICPOOCH01-US, iCPooch). Some studies have explored owner-pet video-chat systems (e.g. Golbeck and Neustaedter, 2012; Neustaedter and Golbeck, 2013; Murata et al., 2014). Most of these attempts were undertaken as part of engineering or animal welfare studies. Additionally, we found several video clips uploaded on YouTube demonstrating that pet owners tried to contact their pets via “Skype” and “FaceTime”. When contacting their pets via these telecommunication tools, pet owners seem to assume that their pets recognize that they are communicating with their owners in real-time, and are not merely watching a video image. However, no psychophysical studies have evaluated whether this assumption is correct or not. Therefore, the present study attempted to clarify this issue qualitatively and quantitatively.

Establishing an animal model for studying this modern communication style will help us understand the nature of communication in addition to creating a new paradigm of animal experiments. In addition, it may contribute to studies of the “Theory of Mind (ToM)” in animals. In humans, to establish telecommunication between “person A” and “person B”, it is necessary for “person A” to confirm that he can properly receive information from “person B”. In addition, “person A” must also confirm that “person B” can receive the information that “person A” is transmitting. Thus, telecommunication requires an understanding of the viewpoint of others, which is integral to ToM.

Previous studies have reported that animals can successfully discriminate others’ faces when presented visually on a monitor (e.g. budgerigars, *Melopsittacus undulatus*, Brown and Dooling, 1992; chimpanzees, *Pan troglodytes*, Parr et al., 2000; dogs, *Canis familiaris*, Racca et al., 2010). Patton et al. (2010) used artificial static images of female pigeons to investigate courtship behavior of males (*Columba livia*) and they showed that local features of the face were important to these courtship behaviors. Pigeons have been shown to discriminate real-time self-video images from delayed self-video images (Toda and Watanabe, 2008). Thus, animals are

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Table 1
Classification and definition of 10 behaviors.

Behavior	Definition
Drinking	Takes water into the beak and swallows
Feeding	Takes seeds
Jumping to the monitor	Holds onto the cage wall located between the perch and monitor
Walking to the monitor	Approaches the cage floor located between the perch and monitor
Yawning	Opens beak and deeply inhales
Preening	Nibbles own feathers
Leg-stretching	Extends limbs
Wing-stretching	Extends flight feathers
Scratching	Rubs own body using legs
Ruffling	Erects whole body feathers no longer than 1–2 s

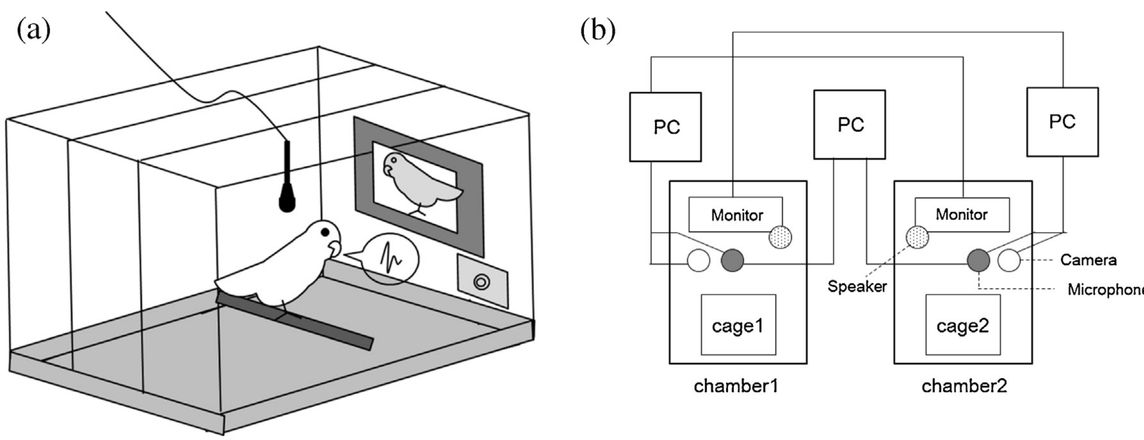

Fig. 1. Schematic of the experimental setup. A bird was put in a metal-mesh wire cage placed inside the chamber. A monitor with a built-in-loudspeaker, a microphone and a micro CCD camera (a) were located in front of the cage for the bird to be able to interact with another bird. Audio-visual equipment was controlled by 3 PCs (b).

likely sensitive to both static and video images of other individuals (review in D'Eath, 1998; Fleishman and Endler, 2000). Moreover, such video images could modify animal behavior. Non-human primates were shown to yawn more often after viewing video playback of yawning in other conspecifics (chimpanzees, Anderson et al., 2004; stumptail macaques, *Macaca arctoides*, Paukner and Anderson, 2006). Courtship behaviors in birds have been examined using video images (pigeons, Shimizu, 1998; bengalese finches, *Lonchura striata* var. *domestica*, Takahashi et al., 2005, Takahashi and Okanoya, 2013; zebra-finches, *Taeniopygia guttata castanotis*, Ikebuchi and Okanoya, 1999). In addition, courtship in spiders have been studied in this way (jumping spiders, *Maevia inclemens*, Clark and Uetz, 1992; wolf spiders, *Schizocosa ocreata*, Uetz and Smith 1999), as well as fish (three-spined sticklebacks, *Gasterosteus aculeatus*, Rowland et al., 1995; guppies, *Poecil reticulate*, Kodric-Brown and Nicoletto, 1997). Video images also induce foraging (manakins, *L. punctulata*, Rieucau and Giraldeau, 2009) and imitative behaviors (budgerigars, Mottley and Heyes, 2003; Mui et al., 2008). Additionally, Watanabe and Troje (2006) demonstrated that computer-generated (CG) pigeons could serve as experimental visual stimuli. Pigeons discriminated between CG pigeons displaying normal movements from those displaying movements that were physically impossible. However, there are few studies examining whether animals can recognize another animal presented in both a video and in person as being the same individual. For example, female Japanese quail (*Coturnix japonica*) showed a preference for males that had been presented through a monitor previously (Ophir and Galef, 2003). Rooks (*Corvus frugilegus*) were able to recognize affiliated conspecifics from unaffiliated conspecifics even though they were shown as video images (Bird and Emery, 2008). These studies indicate that birds can make a connection between an individual presented as a video image and an individual viewed in person. The responses to video-images can be different depending on the type of the video playback (review in King, 2015). For example, jacky dragons (*Amphibolurus muricatus*) showed more aggressive displays with playback of video-images of a submissive individual, whereas video-images of an aggressive dragon inhibited such aggressive displays (Ord and Evans, 2002).

Video images of conspecific animals can elicit spontaneous operant responses in primates (bonnet macaques, *Macaca radiate*, Swartz and Rosenblum, 1980; Andrews and Rosenblum, 1993; chimpanzees, Fujita and Matsuzawa, 1986; Japanese macaques, *Macaca fuscata*, Tsuchida and Izumi, 2009). Such "sensory reinforcement" has been also reported in birds. Gilbertson (1975) showed that a direct visual contact with a real bird functioned as a reinforcement in pigeons (although Linton (1981) failed to replicate these results). Static images of conspecifics (European starlings, *Sturnus vulgaris*, Perret et al., 2015) and conspecific song (zebra finches, Adret, 1997) also could function as a primary reinforcer.

Therefore, we posed the question: how do birds behave when we provide them with a real-time interactive environment via telecommunication tools? Previous studies showed that audio-visual presentation of stimuli could elicit some behavioral responses in budgerigars, a small parrot species that establish flocks (Wyndham, 1980). Such studies have demonstrated stronger vocal production in response to playback of their mates' calls compared with the calls of others (Ali et al., 1993), behavioral contagion with viewing video playback of others (Mui et al., 2008), and contagious yawning with playback of yawning of others (Gallup et al., 2015). These studies suggest that this species is fairly suitable for the present study rather than rodents, which require olfactory and somatosensory inputs for recognition of other individuals.

Thus, we built a system for two budgerigars to interact via audio-visual equipment between two separate cages. We observed birds' behavior across three experimental conditions: (1) real-time, two-way communication (Paired condition), (2) "one-way"