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Object/picture recognition in hens

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ABSTRACT

Two experiments examined whether hens, *Gallus gallus domesticus*, would respond to photographs in the same way they do to the real objects depicted in the photographs. Experiment 1 assessed whether hens transferred a discrimination of differently coloured three-dimensional objects to two-dimensional photographs of those objects, and vice versa. All hens learned to discriminate between the stimuli and showed transfer to the alternative stimuli when the colour cues were present. In Experiment 2 transfer with stimuli that differed in shape only was examined. It was found that only three of the six hens learned to discriminate the stimuli to any degree, and that these three hens did not transfer this discrimination to the alternative stimuli. It was also found that previously learning an object discrimination did not aid the hens in learning to discriminate between photographs of the objects. These data suggest that the hens did not respond to the objects depicted in pictures in the same way they did to the real objects. The authors argue it cannot be assumed that all animals respond to two-dimensional pictures of stimuli in the same way as they do to the real three-dimensional stimuli and this should be established before researchers use two-dimensional stimuli as representatives of real world stimuli.

1. Introduction

In animal research, two-dimensional (2D) pictures (e.g., photographs or slides) have often been used as stimuli. Such images can vary from highly stylised cartoon-like representations to detailed photographs and moving images. While these images have been used to assess components of visual systems (such as spatial contrast, acuity, and motion perception to name a few), complex 2D stimuli have also been used as if their properties are close enough to those of the physical object that the animals will treat them as similar to those objects. For example, Candland (1969) used coloured slides of roosters to assess conspecific recognition in roosters and concluded that the combs were most easily discriminated by the birds. This use of images assumed that they were functioning as substitutes for the real animals; however, this was never assessed by Candland. If images are to be used as substitutes for real stimuli, it is first important to assess that they function as such. While pictorial stimuli are used in behavioural research, there is relatively little research on picture–object correspondence (Spetch et al., 1999) determining if animals respond to the images in a comparable manner to the way they would to the real objects.

Correspondence between pictures and real objects is generally measured using one of two methods. One method presents images of stimuli which would normally produce specific spontaneous responses (e.g., food, conspecifics or prey species) and assesses whether animals respond in a similar manner as they would to the real object. For example, Ikebuchi and Okanoya (1999) found that male Zebra and Bengalese finches emitted directed singing, and showed courtship behaviour, towards images of conspecific females presented on a TFT screen comparable to that found with live conspecific females.

The other method involves training a particular response to real stimuli and testing for transfer of that response to pictures of the stimuli, and vice versa. High accuracy in transfer tests is evidence of generalisation across the stimuli. However, if accuracy decreases during transfer tests, then the test stimuli are being treated as if they are different from the training stimuli. For example, Patterson-Kane et al. (1997) trained hens to discriminate between a red versus a green coloured card, a white hen versus no hen, and a brown hen versus no hen. The hens were then tested with videoed images of the stimuli. The hens showed transfer of performance to the videoed images of the red and green stimuli but showed no transfer for the white hens versus no hen stimuli. In addition, the hens learned to discriminate between a real brown hen and a real brown basketball quickly, but required several hundred trials to learn the same discrimination with videoed images, showing that the videoed images were not equivalent to the real images for the hens.

A number of studies have reported successful transfer for birds between 2D images and three-dimensional (3D) objects; however, in these studies it is possible that discrimination and transfer may have been based on a specific aspect of the stimuli such as the

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size, colour and/or texture differences. For example, Watanabe (1993) found that pigeons' discriminative performance transferred from objects to colour pictures (and vice versa) when the object was classified as a natural concept by the author (e.g., biologically relevant items such as corn and other food items). However, Fagot et al. (1999) noted there were size differences between the stimuli used by Watanabe that could have been a factor in those findings. In another study Watanabe (1997) trained one group of pigeons to discriminate between real objects (food grains and non-edible items) and their colour photos. Another group were trained to discriminate whether both food and non-food items were real or photographs. While both groups' accuracies transferred to novel stimuli, transfer broke down when both stimuli were painted matte black, suggesting that colour or texture cues were required for both the real and photograph discrimination. Thus, it could be argued that the birds were discriminating based on some aspects of the objects, and it is unclear if they could show similar levels of discrimination if those particular aspects were not available.

Spetch and Friedman (2006) controlled for colour and texture cues and trained pigeons to discriminate between two objects, or between two digitised images of these objects, shown on a TFT monitor. The authors varied the viewpoint from which the stimuli were presented ensuring the birds were required to attend to more than a single feature to learn the discrimination. Transfer and reestablishment of discriminative performance was then tested by replacing pictures with objects, or objects with pictures, for each group of pigeons. The discrimination was also reversed for half of the pigeons so that the stimulus associated with reinforcement was now the non-reinforced stimulus, and vice versa. There was some transfer and relatively fast reestablishment of discriminative performance for those pigeons presented with the same reinforced stimuli during training and transfer tests. Those pigeons tested with the opposite reinforced stimuli to that used in training showed more initial disruption and lower accuracy than the group presented with the same reinforced stimuli. The authors argued that these findings provided evidence that the birds "recognised the correspondence" (p. 969) between the objects and the images of them.

Despite the findings of Spetch and Friedman (2006) there are a number of studies that failed to find generalisation across 2D and 3D stimuli. For example, Weavers (2000) found hens' responses to slide images of conspecifics did not generalise to the live conspecifics. Watanabe et al. (1993) found that pigeons could not discriminate between slides of novel foods/items but could discriminate between the real objects. Trillmich (1976) found that while budgerigars were able to discriminate live conspecifics and slides of conspecifics in a T-maze discrimination, only one of the birds showed transfer from slides to live conspecifics, and this bird did not show transfer in the opposite direction.

Bovet and Vauclair (2000) and Weisman and Spetch (2010) reviewed picture–object recognition and correspondence in birds and noted that there are many inconsistencies in the findings that have been reported. It would appear that some bird species (e.g., pigeons) may show some transfer between photographs and objects, but that this ability is limited, and may be affected by a number of variables (e.g., method of stimulus presentations, type of stimuli used, procedural methodology).

Despite inconclusive findings in the literature, research has been done with hens that have used images as a substitute for the real animal (e.g., Abeyesinghe et al., 2009; D'Eath and Keeling, 2003; Evans and Marler, 1991; Hauser and Huber-Eicher, 2004; Keeling and Hurnik, 1993; Lundberg and Keeling, 2003). However, it is still not clear whether hens recognise the relation between objects and their images. Furthermore, while there is extensive research into correspondence with pigeons, there are relatively few studies with hens (e.g., Patterson-Kane et al., 1997; Weavers, 2000). Hence, a further study assessing whether hens can transfer a discrimination learned with real objects to photographs of those objects (and vice versa) might help to clarify whether pictorial stimuli can be substituted for the real stimulus in behavioural research with these animals. There is research assessing hens' visual abilities (e.g., visual acuity: DeMello et al., 1992; accommodation: Schaeffel et al., 1986; flicker fusion: Nuboer et al., 1992; Railton et al., 2009; viewing distance: Dawkins and Woodington, 1997; colour vision: Foster et al., 1995), which shows that hens are able to learn visual discriminations and are suitable to serve as experimental subjects in research involving visual stimuli.

While there have been studies that have looked for transfer by birds from 3D objects or conspecifics to 2D photographs or moving images (e.g., Cabe, 1976; Dittrich et al., 2010; Lumsden, 1977; Watanabe et al., 1993) relatively few studies have assessed whether transfer occurs in the opposite direction (see Spetch and Friedman, 2006; Trillmich, 1976; Watanabe, 1993). Thus, one aim of the present research was to study transfer in both directions with hens.

Many studies using a conditional discrimination procedure include an observing response before the presentation of a stimulus. An observing response is a response that must be completed before the stimulus is turned on, but that has no effect on the probability of reinforcement (Wyckoff, 1952; Zeigler and Wyckoff, 1961). For example, in a study by Zeigler and Wyckoff (1961) pigeons were shown the discriminative stimuli only after depressing a pedal that was located in front of the response keys. The advantage of using an observing response is that it orients the animal towards the discriminative stimuli and, as Zeigler and Wyckoff (1961) state, it increases the probability that the animal is attending to the stimuli when it responds. Thus, in these present experiments the hens were trained to break an infra-red beam for a fixed period of time which oriented their heads towards the stimulus being presented before the response keys were activated.

This first experiment aimed to assess a novel procedure that could be used to examine whether hens would transfer their discrimination of 3D objects to 2D photographs, and vice versa. To ensure the hens could learn this discrimination, the stimuli (both objects and images) differed in colour as well as shape. Hens are able to discriminate easily between colour, and many studies have used colour as a discriminative stimulus (e.g., Foster et al., 1995). Once the hens had learned this discrimination they were tested for transfer of their performance from the objects to the photographs (and vice versa).

2. Experiment 1

2.1. Method

2.1.1. Subjects

Six one-year old Brown Shaver-Starcross hens, *Gallus gallus domesticus* (numbered 51–56) served as subjects. The hens were individually housed in adjacent wire cages (500-mm long × 510-mm wide × 420-mm high) in a ventilated room lit on a 12:12-h light:dark cycle with two 100-W incandescent lights. Grit and vitamins were supplied weekly and water was available ad lib. Each hen was weighed daily before each experimental session (approximately six days per week) and was provided with supplementary feed (commercial laying pellets) if required to maintain them at approximately 80% (±5%) of their free-feeding body weights. The principles of laboratory animal care were followed and all procedures were approved by the University of Waikato Animal Ethics Committee.