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Investigating social discrimination of group members by laying hens

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ABSTRACT

Social relationships in domestic fowl are commonly assumed to rely on social recognition and its pre-requisite, discrimination of group-mates. If this is true, then the unnatural physical and social environments in which commercial laying hens are typically housed, when compared with those in which their progenitor species evolved, may compromise social function with consequent implications for welfare. Our aims were to determine whether adult hens can discriminate between unique pairs of familiar conspecifics, and to establish the most appropriate method for assessing this social discrimination. We investigated group-mate discrimination using two learning tasks in which there was bi-directional exchange of visual, auditory and olfactory information. Learning occurred in a Y-maze task ($p < 0.003$; $n = 7/8$) but not in an operant key-pecking task ($p = 0.001$; $n = 1/10$). A further experiment with the operant-trained hens examined whether failure was specific to the group-mate social discrimination or to the response task. Learning also failed to occur in this familiar/unfamiliar social discrimination task ($p = 0.001$; $n = 1/10$). Our findings demonstrate unequivocally that adult laying hens kept in small groups, under environmental conditions more consistent with those in which sensory capacities evolved, can discriminate group members: however, appropriate methods to demonstrate discrimination are crucial.

1. Introduction

The progenitor of the domestic fowl (*Gallus gallus*) naturally forms small polygynous harems or bachelor groups of up to 30 birds, adapted to communication in a forest habitat (Collias and Collias, 1996; Mench and Keeling, 2001). The artificial social and physical environments in which poultry are housed commercially comprise dim light intensities, restricted space, elevated noise and poor atmospheres. These may interfere with the effectiveness of social signalling (e.g. Hughes et al., 1974; Algers and Jensen, 1985; D'Eath and Stone, 1999; Jones et al., 2001) and alter the ability of hens to recognise conspecific identity and/or intent (D'Eath and Keeling, 2003), thereby disrupting social function, with potential implications for welfare (Craig et al., 1969; Grigor et al., 1995; Freire et al., 1997; D'Eath and Stone, 1999). To understand the importance of the social environment to hens, it is necessary to gauge their cognitive capacity for establishing stable social relationships under environmental conditions which do not compromise the transmission and perception of social signals, thereby providing a baseline against which commercial environmental conditions can be compared. This requires a robust and repeatable method and the use of live stimuli.

Social relationships in fowl are commonly assumed to rely upon individual recognition (Guhl and Ortman, 1953; Bradshaw, 1991; Hauser and Huber-Eicher, 2004), although this has never been demonstrated explicitly and hens rely primarily upon visual displays, postures and vocalisations for communication (Wood-Gush, 1971). Use of status cues, such as body size and comb size and colour, to maintain social order without memory for individuals is also plausible (Wood-Gush, 1971; Maynard-Smith and Harper, 1988; Pagel and Dawkins, 1997; Estevez et al., 1997), although correlations between such features and rank do not always appear to be reliable (Guhl and Ortman, 1953; Bradshaw, 1992c; Cloutier and Newberry, 2000). For example, flocks of dubbed hens still form peck orders, though this alternate social strategy may be constrained by group size, when individual recognition becomes impracticable due to memory limitation and hens therefore appear to be more socially tolerant than those in small flocks (D'Eath and Keeling, 2003; Estevez et al., 2003).

Many studies have investigated discrimination of familiars from strangers (e.g. Hughes, 1977; Bradshaw, 1992a; Grigor et al., 1995; Jones et al., 1996; D'Eath and Dawkins, 1996; D'Eath and Stone, 1999; Marin et al., 2001; Deng and Rogers, 2002; D'Eath and Keeling, 2003; Hauser and Huber-Eicher, 2004; Porter et al., 2006; Guzman and Marin, 2008), and hens appear to attend to the task behaviour of high ranking birds over subordinates, regardless of skill (Nicol and Pope, 1999), but the pre-requisite to true individual recognition based on idiosyncratic cues, as defined by Zayan (1994), is

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the discrimination between familiar conspecifics irrespective of relative rank and un-weighted by other social information. Concerns have been raised over the fidelity of artificial cues (Bradshaw and Dawkins, 1993; Dawkins, 1996; D'Eath and Dawkins, 1996; Patterson-Kane et al., 1997) and only one study has reported such a discrimination of live stimuli. Bradshaw (1991) used a Y-maze learning task to demonstrate social discrimination in an extremely small number of laying hens viewing stimuli at 75 cm. However, Dawkins' subsequent assertion (Dawkins, 1995, 1996) that social recognition in hens may only occur at distances less than 30 cm, a constraint imposed by the binocular visual field thought to be used for social discrimination, raises the possibility that Bradshaw's (1991) birds, although discriminating more than one pair, may have been forced to do so on the basis of cues which are not used socially but still are apparent at a distance, such as gross differences in size or plumage colouration. Thus his subjects may not have demonstrated true group-mate discrimination.

In this study, the ability of two small groups of hens, kept under environmental conditions considered optimal for perception of social signals, to discriminate between individual group members in a Y-maze choice task (Experiment Y-FF; FF—familiar/familiar) and an operant pecking task (Experiment Op-FF), respectively, was investigated. The aims were to determine whether group-mate discrimination could occur at short distances, and to determine which task was most appropriate for studies of social cognitive capacity in laying hens. The Y-maze task was similar to that used previously with pigs (McLeman et al., 2005), but the operant pecking task offered the opportunity to minimise subject handling and labour and to increase the number of trials per training session in which subjects could learn. Experiments Y-FF and Op-FF were run simultaneously. A third discrimination of familiar vs. unfamiliar hens (Experiment Op-FU: FU—familiar/unfamiliar) was subsequently conducted with the operant-trained birds using the operant pecking task to examine further the appropriateness of that method using a different social category for discrimination.

2. Methods

2.1. Subjects and housing

Two groups, of 15 and 16 experimentally naïve Hy-line Brown pullets, respectively, were obtained from a commercial producer at point-of-lay and housed in separate, naturally ventilated 3 m × 3 m pens bedded with wood-shavings. A bell-drinker, a tube feeder, perches, nest-boxes containing a small amount of straw and a dish of layer-grit were provided in each pen. Birds were fed *ad libitum* on commercial layer pellets and were exposed to natural daylight, with a mean (±S.D.) illuminance of 153 ± 49 lx. In addition, their photoperiod was gradually extended from that experienced during rearing (11 h) to 16 h over 11 weeks using a supplementary fluorescent strip light. All guidelines and requirements set out in the Principles of Laboratory Animal Care (National Institutes of Health, U.S.A., Publication No. 86-23, revised 1985) and the UK Animals (Scientific Procedures) Act 1986 were followed.

2.2. Apparatus

2.2.1. Y-maze

For the Y-maze choice task (experiment Y-FF), a Y-maze was constructed from three stainless steel rectangular chambers joined by a non-slip, ridged, stainless steel triangular, floor piece. Each chamber comprised an opaque PVC hinged door, a transparent acrylic roof to admit light and a non-slip ridged stainless steel floor, and

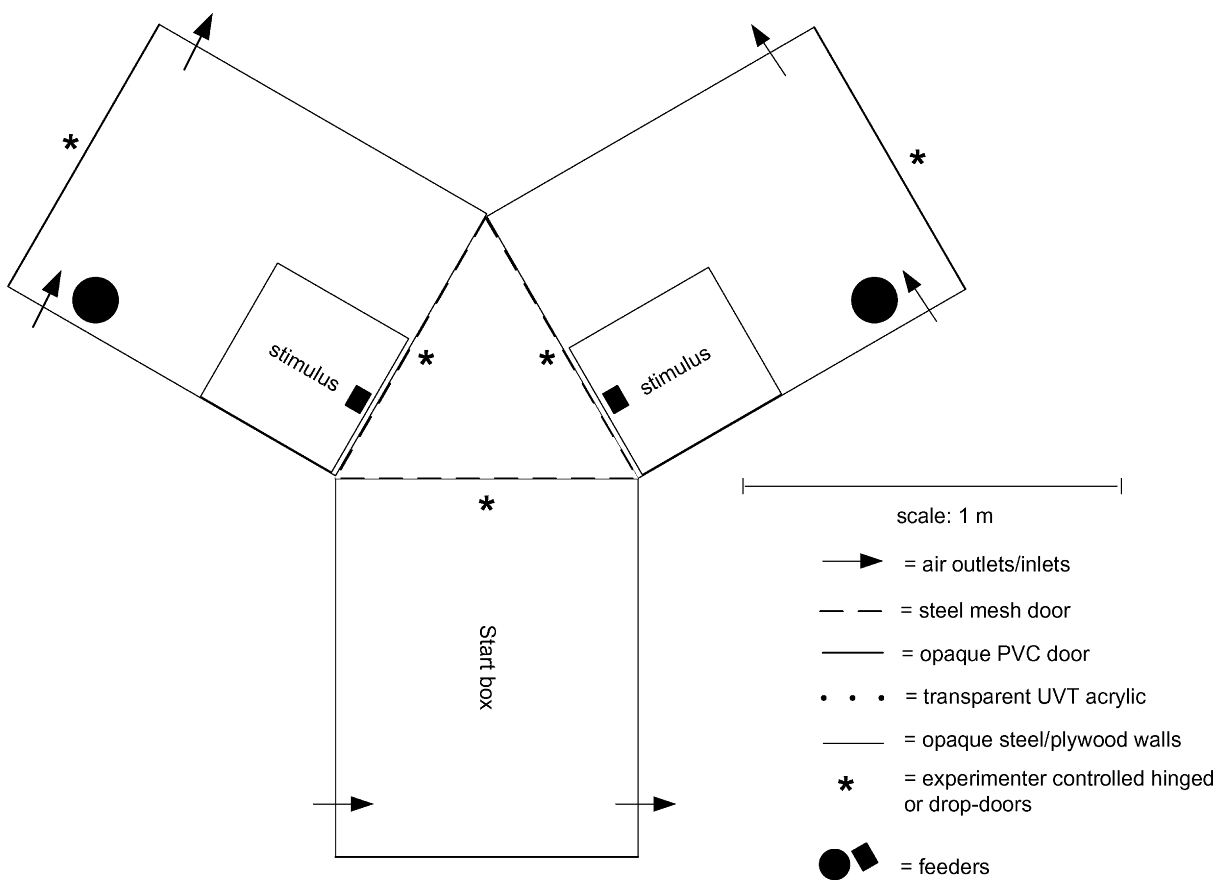

Fig. 1. Experiment Y-FF: plan view of the Y-maze apparatus.