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Lack of mirror use by pigs to locate food

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ABSTRACT

Many mammalian species, as well as birds, are able to use a mirror either in the context of self-recognition, or instrumentally for discovering and manipulating objects that cannot be perceived directly. A noteworthy study by Broom et al. (2009) investigated the ability of pigs (*Sus scrofa*) to use a mirror to locate a hidden food source. The mirror-experienced pigs appeared to be able to bypass a solid barrier that blocked direct view of a food bowl when the food bowl could be seen via a mirror. We tried to replicate these findings using 2 groups of 11 piglets each. The procedure used for testing the first group of 11 pigs followed Broom's description as closely as possible. Only two of the pigs of the first group were able to locate the hidden food bowl during the mirror test. Therefore, measures were taken to increase the number of pigs noticing the mirror in the second group of 11 pigs. Now, although pigs notice the mirror significantly earlier, only 1 of the mirror-experienced pigs and none of the mirror-naive pigs used the detour around the partition wall to reach the hidden food. We take this observation as evidence that the pigs did not understand what the mirror image represents, and did not use the mirror to locate food. This indicates that not all pigs are capable of using mirrors under all circumstances, and thus that mirror use may be at the upper limits of cognitive capacity of these animals at this age.

1. Introduction

Mirror use has been studied in a large range of species, either in the context of self-recognition, or of using a mirror instrumentally for discovering and manipulating objects that cannot be perceived directly. A number of species show signs of recognizing themselves in a mirror, generally using a test in which a mark which can only be viewed using a mirror, for instance on the forehead, is applied to the animal. The animal's response to its own reflection is then gauged, with an attempt to touch the mark on itself (and not in the reflection) taken as evidence for self-recognition. Examination of body parts not usually visible without a mirror, such as the inside of the mouth or ano-genital areas, can also be taken as evidence of self-recognition. Using tests of this genre, evidence of self-recognition has been seen in chimpanzees (*Pan troglodytes*) (Povinelli et al., 1993, 1997), dolphins (*Tursiops truncates*) (Reiss and Marino, 2001), elephants (*Elepahs maximus*) (Plotnik et al., 2006) and magpies (*Pica pica*) (Prior et al., 2008).

Instrumental mirror use is the use of a mirror to solve a problem. In primates, this often involves using a mirror to guide hand movements to a target object, usually food. Instrumental mirror use has been found in primates, such as chimpanzees (*P. troglodytes*) (Menzel et al., 1985),

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different species of macaques (*Macaca tonkeana*, *Macaca fascicularis*) (Anderson, 1986), and marmosets (*Callithrix jacchus*) (Heschl and Burkart, 2006). In non-primates, generally mirror use is tested by showing the animal a target (also usually food) that is not in direct line of sight, but visible in a mirror, and observing whether the animals move toward the mirror or the actual location of the target. Evidence of instrumental mirror use is also found in a broad range of non-primate species, including elephants (*Elepahs maximus*) (Povinelli, 1989); avians such as parrots (*Psittacus erithacus*) (Pepperberg et al., 1995) and crows (*Corvus macrorhynchos*) (Medina et al., 2011) also show evidence of using a mirror to detect and manipulate objects. Dogs (*Canis familiaris*) show very little (if any) evidence of mirror use (Howell and Bennett, 2011). Interestingly, in general primates which do not fall into the category of great apes generally fail self-recognition tests, but are capable of instrumental mirror use (Anderson and Gallup, 2011). Similar patterns are seen in some types of crows (Medina et al., 2011). Thus, the ability of self-recognition in the mirror is not a prerequisite for the ability to use a mirror image for finding and manipulating objects (Heschl and Burkart, 2006; Povinelli, 1989).

Broom and colleagues (Broom et al., 2009) published the results of a noteworthy study about the use of a mirror to locate a food source by pigs (*Sus scrofa*). Mirror experienced pigs of 4–8 weeks of age appeared to be able to bypass a solid barrier that blocked direct view of a bowl that was visible via a mirror and which they had been trained to associate with food. This behaviour was present with short latency times, with 7 out of 8 of the mirror-experienced pigs tested reaching the mirror-visible food in 46 s or less. Pigs that had no previous experience with a mirror, i.e. "mirror naïve", were reported to search behind the mirror rather than using the reflection to locate the food. Furthermore, mirror experienced pigs responded differently to a mirror than hole covered in wire mesh through which the food bowl was visible in the same place that it was apparently located in the mirror reflection. Together, this points toward the ability of pigs to use a mirror instrumentally. This accomplishment requires complex cognitive processing of the visual information as well as good visual abilities.

Pigs are able to learn complex cognitive tasks (Gieling et al., 2011a; for reviews see: Gieling et al., 2011b; Kornum and Knudsen, 2011). Moreover, accounting for the cognitive ability of animals in human managed husbandry systems may be a way to improve animal welfare (Gonyou, 1994; Broom, 2010). It is also known that a 'proven' level of a species' awareness and abilities can influence the human attitude toward the species (Mendl et al., 2001; Broom, 2003). Besides ethical considerations as put forward by Broom (2010), another reason for being aware of a species' capabilities is to be able to meet its behavioural needs. If pigs are demonstrated to have a high level of awareness, it may be important to keep pigs in a more challenging environment. From a neurobehavioural research point of view, measuring pigs' intellectual capabilities provides us with additional information about the translational value of research with pigs as model species for humans; this is important as pigs are increasingly being used as model animals in biomedical research (Gieling et al., 2011a; de Groot et al., 2005). Moreover, this information is useful when deciding which species to use to answer a specific neurobehavioural question.

The study conducted by Broom and colleagues produced potentially important results, which should be tested for robustness in a close replication, using different experimenters and laboratories. Because of the large potential implications of complex intellectual abilities in pigs for both pigs as model animals in neurobehavioural research, and for pig welfare in commercial pig management systems, we attempted a replication of Broom's (2009) mirror experiment.

2. Material and methods

2.1. Ethical note

The study was reviewed and approved by the local ethics committee (DEC, *d*ier*e*xperimenten*c*ommissie), and was conducted in accordance with the recommendations of the EU directive 86/609/EEC. All efforts were made to minimize the number of animals used and to avoid suffering.

2.2. Subjects and apparatus

Where details about subjects or apparatus differed from the Broom study (Broom et al., 2009), this will be mentioned explicitly. This also accounts for experimental details that were not explicitly described in Broom et al. (2009).

2.2.1. Animals

11 male and 11 female piglets [Duroc × (Fin × York)] born at the pig-breeding farm of Utrecht University were used in the experiment. The piglets were tested in two successive batches of 11 animals (group 1 and group 2, see Table 1) Piglets were selected after weaning and mixing. At the age of 4–6 weeks they were moved to our experimental facility. The piglets in the Broom study (Broom et al., 2009) were 4–8 weeks old between moving to the facilities and testing.

Each piglet was randomly assigned to one of the two groups. Within the first group, 6 piglets were assigned to the "Mirror exposed" (*ME*) condition; the other 5 animals were assigned to the "Mirror naïve control" (*MNC*) condition. Within the second group, 5 piglets were assigned to the ME condition; the other 6 animals were assigned to the MNC condition (see Table 1).

2.2.2. Housing

The piglets were group-housed in a former horsebox (5.0 m × 4.0 m), adapted for housing piglets, in a large, naturally ventilated and lighted stable. The concrete floor was covered with straw bedding. Minimal and maximal temperatures in the stable were registered daily (range: −6 °C (nighttime) to 12 °C). The enriched pen contained a covered piglet nest (breadth 2.50 m × depth 1.24 m, height at front 0.66 m, height at back 1.23 m). The floor of the nest box was covered with a rubber mat and a thick layer or sawdust and