Western scrub-jays conceal auditory information when competitors can hear but cannot see

Gert Stulp1,2, Nathan J. Emery2, Simon Verhulst2 and Nicola S. Clayton1,*

1 Department of Experimental Psychology, University of Cambridge, Cambridge CB2 3EB, UK
2 Department of Behavioural Biology, Rijksuniversiteit Groningen, Haren, The Netherlands
3 School of Biological and Chemical Sciences, Queen Mary University of London, London, UK
*Author for correspondence (nsc22@cam.ac.uk).

Western scrub-jays ( Aphelocoma californica ) engage in a variety of cache-protection strategies to reduce the chances of cache theft by conspecifics. Many of these strategies revolve around reducing visual information to potential thieves. This study aimed to determine whether the jays also reduce auditory information during caching. Each jay was given the opportunity to cache food in two trays, one of which was filled with small pebbles that made considerable noise when cached in ('noisy' tray), whereas the other one contained soil that made little detectable noise when cached in ('quiet' tray). When the jays could be heard, but not seen, by a competitor, they cached proportionally less food items in the 'noisy' substrate than when they cached alone in the room, or when they could be seen and heard by competitors. These results suggest that western scrub-jays know when to conceal auditory information, namely when a competitor cannot see but can hear the caching event.

Keywords: western scrub-jays; social cognition; cache protection; corvids

1. INTRODUCTION

Many animals hide food for future consumption (Vander Wall 1990). These caches are susceptible to pilfering by other individuals, both heterospecifics and conspecifics. To reduce this cache pilferage, several species engage in cache-protection strategies to reduce the likelihood that their caches are stolen. Many of these strategies are now established in a variety of species, such as covering up cache sites with leaves so they are inconspicuous, reducing the frequency of caching when competitors are around, and aggressively defending them (reviewed in Dally et al. 2006). In addition, there are several cache-protection strategies that may be restricted to corvids, such as ravens and jays, which are the only food-storers against theft using observational spatial memory, corvids engage in a variety of cache-protection strategies to reduce the chances of cache theft by conspecifics. Many of these strategies revolve around reducing visual information to potential thieves. This study aimed to determine whether the jays also reduce auditory information during caching. Each jay was given the opportunity to cache food in two trays, one of which was filled with small pebbles that made considerable noise when cached in ('noisy' tray), whereas the other one contained soil that made little detectable noise when cached in ('quiet' tray). When the jays could be heard, but not seen, by a competitor, they cached proportionally less food items in the 'noisy' substrate than when they cached alone in the room, or when they could be seen and heard by competitors. These results suggest that western scrub-jays know when to conceal auditory information, namely when a competitor cannot see but can hear the caching event.

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2. MATERIAL AND METHODS

The subjects of this experiment were eight (four males and four females) sexually mature hand-raised western scrub-jays that had prior experience with the cache-recovery paradigm. The birds were housed in pairs in cages measuring 2 m wide × 1 m deep × 1 m high, and were maintained inside on a 12 L : 12 D cycle on a maintenance diet supplemented with nuts, seeds, dog biscuits, various fruits, wax worms and meal worms. The maintenance diet was provided for caching in two trays, which were placed such that they were both equidistant from the competitor’s cage. One of the trays was filled with a soil substrate that made little detectable noise when cached in ('noisy' tray), whereas the other tray was filled with a substrate of small pebbles that made considerable noise when cached in ('noisy' tray), whereas the other tray was filled with soil that made little detectable noise ('quiet' tray).

To test this hypothesis, scrub-jays were allowed to cache in three different situations: (i) alone; (ii) seen and heard: a competitor could see and hear the caching event; and (iii) heard but not seen: a competitor could hear the caching event but its view was obscured by an opaque barrier. In each condition the caching event was observed by two caching trials, which were placed such that they were both equidistant from the competitor’s cage. One of the trays was filled with a substrate of small pebbles that made noise when cached in ('noisy' tray), whereas the other tray was filled with soil substrate that made little, if any, detectable noise ('quiet' tray).

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considered to be quiet, as most of these caches were placed under the

5.29, (proportion cached in the ‘noisy’ tray in the ‘alone

15.8

cant difference between the number of items cached in

3.5 items were cached, and there was no signifi-

p = 0.007). In total, a mean number of 15.8 ± 3.5 items were cached, and there was no signifi-

can and cannot see, but specifically only reduce sound in order to be able to listen to the activities of

4.1) conditions (repeated-measures ANOVA: F_{2,12} = 1.17; p = 0.34).

The proportion of items cached in the ‘noisy’ tray was 0.58 ± 0.11 in the ‘alone’ condition and 0.66 ± 0.15 in the ‘seen and heard’ condition, whereas it was only 0.15 ± 0.01 in the ‘heard but not seen’ condition (figure 1). Indeed, there was a significant effect of condition on these proportions (F_{2,12} = 5.29, p = 0.022), and the contrasts revealed that the proportion cached in the ‘noisy’ tray in the ‘alone’ (F_{1,6} = 7.69, p = 0.032), and ‘seen and heard’ conditions (F_{1,6} = 10.80, p = 0.017) were both significantly higher than in the ‘heard but not seen’ condition. Table 1 provides the individual data for each bird in each condition.

4. DISCUSSION

Western scrub-jays cached proportionally less in the ‘noisy’ tray when a competitor could hear but not see the caching event (‘heard but not seen’), compared with when no competitor could see or hear the caching (‘alone’) or when a competitor could both see and hear the caching event (‘seen and heard’). This finding suggests that these birds differentiate between these conditions not only on the basis of when a competitor can and cannot see, but specifically only reduce sound when the competitor relies on hearing alone.

How can we explain the reduction in the proportion of items cached in the ‘noisy’ tray in the ‘heard but not seen’ condition? A preference for either substrate due to simple associative learning can be ruled out because the jays had no prior experience with the two particular substrates used, and as the jays had no opportunity to recover the caches they had made, they were neither rewarded nor punished for caching in the trays in either the ‘seen and heard’ or the ‘heard but not seen’ conditions. Furthermore, we cannot explain the jays’ behaviour in terms of an exclusive preference to cache in the ‘quiet’ tray since there was a significant preference for the ‘noisy’ tray in the ‘alone’ condition. Additionally, the preference to cache in the ‘quiet’ substrate was only manifest in the ‘heard but not seen’ condition.

The jays’ decision of where to cache was also not based on the absence or presence of a competitor by itself because the jays showed a preference to cache in the ‘noisy’ tray in both the ‘alone’ and ‘seen and heard’ condition (in which, respectively, no competitor and a seeing and hearing competitor was present). The jays only cached differently in the condition in which the competitor could hear the caching event but not see it (‘heard but not seen’ condition).

Similar reasoning leads us to reject the hypothesis that the bird reacts solely to a competitor, independent of its state. As there is a difference between the conditions with a competitor (seeing and hearing versus hearing alone), the mere presence of a competitor is not pivotal to the expression of the cache-protection strategy of reducing auditory information. We conclude, therefore, that jays are sensitive to both visual and auditory information that a competitor may use to detect the location of their caches, and consequently the catchers only reduce sound when the competitor relies on hearing alone.

Another explanation for our results, not mutually exclusive, is that the caching jays reduced making sound in order to be able to listen to the activities of the competitors behind the partition. We cannot exclude this interpretation, but consider it more likely that the jays were primarily concerned with the protection of their food rather than the behaviour (which has to be inferred by listening) of the observer.
Our findings are comparable to those found in the studies of Melis et al. (2006) and Santos et al. (2006), in which chimpanzees (Pan troglodytes) and rhesus monkeys (Macaca mulatta) concealed auditory information in a competitive situation. In comparison with these studies, we did find an effect after only one trial (in contrast to Melis et al. 2006) and we included an additional control condition (the ‘alone’ condition, in contrast to Santos et al. 2006) to exclude the possibility of a baseline preference for always being silent, except when observed. Consequently, we argue that food-caching western scrub-jays conceal auditory information if—and only if—the competitors can hear, but cannot see the cachers. In short, western scrub-jays know when to be as quiet as a mouse.

These experiments comply with the UK Home Office regulations concerning animal research and welfare, as well as the University of Cambridge regulations on the use of animals. We thank Chris Bird for advice and discussion.

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Melis, A. P., Call, J. & Tomasello, M. 2006 Chimpanzees conceal visual and auditory information from others (Pan troglodytes). J. Comp. Psychol. 120, 154–162. (doi:10.1037/0735-7036.120.2.154)


Vander Wall, S. B. 1990 Food hoarding in animals. Chicago, IL: The University of Chicago Press.


### Table 1. The number of items cached in the ‘noisy’ tray (N), ‘quiet’ tray (Q) and ‘out of tray’ (O) and the proportion of items cached in the ‘noisy’ tray in the three different conditions per jay. For the ‘alone’ condition, averages are reported.

<table>
<thead>
<tr>
<th>bird</th>
<th>proportion in ‘noisy’</th>
<th>no. of items (N; Q; O)</th>
<th>proportion in ‘noisy’</th>
<th>no. of items (N; Q; O)</th>
<th>proportion in ‘noisy’</th>
<th>no. of items (N; Q; O)</th>
</tr>
</thead>
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<tr>
<td>1</td>
<td>0.75</td>
<td>(3.0; 1.0; 0)</td>
<td>0.68</td>
<td>(17; 0; 8)</td>
<td>0.29</td>
<td>(7; 0; 17)</td>
</tr>
<tr>
<td>2</td>
<td>0.30</td>
<td>(5.7; 1.4; 12)</td>
<td>0.92</td>
<td>(11; 1; 0)</td>
<td>0.45</td>
<td>(10; 4; 8)</td>
</tr>
<tr>
<td>3</td>
<td>0.33</td>
<td>(11.0; 3.8; 18.5)</td>
<td>0.20</td>
<td>(6; 2; 22)</td>
<td>0.16</td>
<td>(4; 2; 19)</td>
</tr>
<tr>
<td>4</td>
<td>0.33</td>
<td>(6.5; 43; 9)</td>
<td>0.83</td>
<td>(10; 1; 1)</td>
<td>0.17</td>
<td>(6; 9; 20)</td>
</tr>
<tr>
<td>5</td>
<td>0.50</td>
<td>(2.0; 2.0; 0)</td>
<td>1</td>
<td>(21; 0; 0)</td>
<td>0</td>
<td>(0; 7; 14)</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>(4.0; 0; 0)</td>
<td>1</td>
<td>(2; 0; 0)</td>
<td>0</td>
<td>(0; 0; 6)</td>
</tr>
<tr>
<td>7</td>
<td>0.83</td>
<td>(6.3; 1.3; 0)</td>
<td>0</td>
<td>(0; 2; 0)</td>
<td>0</td>
<td>(0; 2; 0)</td>
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