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Evidence of tool use in a seabird?

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This article has been peer-reviewed and recommended by
Peer Community in Ecology

Fayet, Hansen & Biro provided a response to a slightly earlier version this comment, which is provided at the bottom of the article. beneath the references

ABSTRACT

Fayet, Hansen and Biro (1) provide two observations of Atlantic puffins, *Fratercula arctica* performing self-directed actions while holding a stick in their beaks. The authors interpret this as evidence of tool use as they suggest that the stick was manipulated towards the birds' plumage with the specific goal of scratching. While these are interesting observations, the authors do not address a simple and likely explanation of the self-directed actions that does not constitute tool use; that the observations occurred by chance. As such, their conclusions about tool use and cognition in seabirds are premature.

Keywords: puffins, tool-use, evidence

Fayet, Hansen and Biro (1) provide two observations of Atlantic puffins, *Fratercula arctica*, performing self-directed actions while holding a stick in their beaks. The authors interpret this as evidence of tool use as they suggest that the stick was manipulated towards the birds' plumage with the specific goal of scratching. While these are interesting observations, the authors do not address a simple and likely explanation of the self-directed actions that does not constitute tool use; that the observations occurred by chance. As such, their conclusions about tool use and cognition in seabirds are premature.

Instead of tool use, the puffins could have been engaging in common self-directed behaviour, such as preening, whilst incidentally holding a stick in their beaks. If the

stick did not impede the self-directed behaviour, or produced similar sensory results to it, then the birds would have no need to drop the stick while preening. Under this explanation, the authors conclusions about seabird cognition are premature. And this alternative explanation is both plausible and likely as birds often pick up sticks, even when not building nests (2, 3), and they often engage in self-directed preening. In fact, it would be surprising if the puffins did not occasionally engage in both behaviors simultaneously across the many years of observations in both locations. That Fayet, Hansen and Biro only reported two instances of the behavior across seven years by could even be taken as evidence *against* the hypothesis that puffins use stick tools for body care. The authors may have the data to probe this claim, specifically how frequently the puffins picked up sticks without then performing self-directed actions or nest building. If the only instances of stick pick-ups were followed by scratching then the data become more convincing evidence of tool use, but this analysis is necessary to support the authors' conclusions.

Furthermore, Fayet, Hansen and Biro (1) implicitly present a strong argument as to why we should be skeptical about the sticks being used as tools to scratch: Most birds can already reach most of their bodies with their beaks. This should lead us to have a very low prior expectation that a puffin would use a stick to scratch itself, when this action is likely both more difficult and less efficient for the puffin: If a hypothesis is unlikely, we should require strong evidence before we accept it. At the very least, before a conclusion of tool use for body care is reached, the authors would need to demonstrate that it is unlikely i) a chance combination of self-directed behaviour and stick holding, and ii) that the goal of the animal was to use the stick in order to scratch itself, which at present is a large and weakly-tested assumption. This assumption will be difficult to test, particularly as the intention to preen is common to Fayet, Hansen and Biro's tool use hypothesis and the alternative presented here. However, it is possible that with further observations more convincing footage of the sticks being deliberately manipulated to scratch could occur, an effort that could be facilitated by tracking the individuals who Fayet, Hansen and Biro suggest have learned to use the sticks as tools. These "tool-using" individuals should display much more frequent combinations of stick holding and self-directed preening actions than control individuals that display a similar amount of stick holding without preening. Further, converging evidence could be found by giving captive populations of puffins access to many suitable sticks and making similar video observations. And if some of these puffins did then learn to use the sticks to preen, the researchers could then explore the properties of these sticks. For example, do the puffins display any stick preference while preening, e.g. for sticks with sharp ends over blunt ends, that they do not display in other stick holding instances? Either way, many more observations are needed to test the hypothesis of tool-use some degree of confidence.

Finally, it is questionable whether searching for or reporting tool use in an all-or-nothing fashion as, an end in itself, is a promising direction for animal cognition research (see e.g. 4, 5). With enough observations, rare events that can be interpreted as tool use could likely be found for any species that interacts with free objects.

Data accessibility

There are no data associated with this article. A video of the stick-holding behaviour is available with the original publication (Fayet, Hansen and Biro, 2019), and is available at <http://movie-usa.glencoesoftware.com/video/10.1073/pnas.1918060117/video-1>

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Conflict of interest disclosure

The author of this preprint declares that they have no financial conflict of interest with the content of this article.

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Response to Farrar (2020) by AL Fayet, ES Hansen & D Biro.

Farrar's (2020) original pre-print is posted in black text below, with point-by-point replies by Fayet et al. in blue text throughout.

BGF: Fayet, Hansen and Biro (1) provide two observations of Atlantic puffins, *Fratercula arctica*, performing self-directed actions while holding a stick in their beaks. The authors interpret this as evidence of tool use as they suggest that the stick was manipulated towards the birds' plumage with the specific goal of scratching. While these are interesting observations, the authors do not address a simple and likely explanation of the self-directed actions that does not constitute tool use; that the observations occurred by chance. As such, their conclusions about tool use and cognition in seabirds are premature.

Instead of tool use, the puffins could have been engaging in common self-directed behaviour, such as preening, whilst incidentally holding a stick in their beaks. If the stick did not impede the self-directed behaviour, or produced similar sensory results to it, then the birds would have no need to drop the stick while preening. Under this explanation, the authors conclusions about seabird cognition are premature. And this alternative explanation is both plausible and likely as birds often pick up sticks, even when not building nests (2, 3), and they often engage in selfdirected preening. In fact, it would be surprising if the puffins did not occasionally engage in both behaviors simultaneously across the many years of observations in both locations. That Fayet, Hansen and Biro only reported two instances of the behavior across seven years by could even be taken as evidence *against* the hypothesis that puffins use stick tools for body care. The authors may have the data to probe this claim, specifically how frequently the puffins picked up sticks without then performing self-directed actions or nest building. If the only instances of stick pick-ups were followed by scratching then the data become more convincing evidence of tool use, but this analysis is necessary to support the authors' conclusions.

Fayet et al: We agree it is possible that a bird might pick up a stick and then engage in preening behaviour while still holding the stick “by mistake” – indeed we think that it is a likely way for behavioural innovation to occur and to lead to tool use behaviours (see below for more discussion on how object manipulation is regarded as a precursor to tool use). However, we think it is unlikely that the two cases we observed in puffins occurred by chance. First, if they had been accidental, puffins would have moved their heads further (closer towards their body) than needed and this would have made the stick “bump” into their body and potentially be shifted or dislodged from the beak, which was not the case in either of our observations. Instead, the birds’ movements were precise and delicate. Second, it is possible to see in the video that the bird moves its head slightly from side to side once the stick has reached its plumage, in a scratching motion, which we also interpret to mean that the stick itself was part of the “intended” behavioural sequence. In future, kinematic analysis (e.g. measuring head trajectory and speed) could help better quantify these observations and to distinguish between accidental vs intended application of the stick.

We also rather strongly disagree with the statement that the behaviour we observe would only be convincing evidence of tool use if the instances of sticks being picked up were always followed by tool use. It is difficult to imagine behavioural innovations like tool use arising from the very first instance an animal holds a specific object, and we argue it is much more likely that the animals regularly handle the relevant objects first before using them as tools. This is necessary for them to learn about the mechanical properties, affordances and manoeuvrability of the objects. In fact, object manipulation is often discussed as a precursor – both developmentally and evolutionarily – of tool use (e.g. Hayashi & Matsuzawa, 2003; Koops, Furuichi, Hashimoto, & van Schaik, 2015), and many important papers in the literature report how tool using animals, including chimpanzees, New-Caledonian crows, bearded capuchins, woodpecker finches and long-tailed macaques, pick up and handle objects well before they

begin to use them as tools (Eshchar, Izar, Visalberghi, Resende, & Fragaszy, 2016; Inoue-Nakamura & Matsuzawa, 1997; Kenward, Rutz, Weir, & Kacelnik, 2006; Tan, 2017; Tebbich, Taborsky, Fessler, & Blomqvist, 2001).

In addition, the rarity of our observations (two in the space of four years) does not preclude their classification as tool use behaviour, and we make it clear in our paper that we consider it a rare behaviour among puffins. Novel discoveries in the field of animal tool-use research often report similarly small numbers of observations (e.g. Breuer, Ndoundou-Hockemba, & Fishlock, 2005; Gallot & Gruber, 2019; Hirata, Myowa, & Matsuzawa, 1998; Rutz & Deans, 2018) so our paper is not an exception. Second, puffins mostly live on remote uninhabited islands, with only a handful of populations under frequent study by scientists, and even at these sites researchers usually only observe a very small proportion of the population (<1% in our case). As such, most puffins get on with their lives away from the scrutiny of scientists, and so we believe that it is reasonable to assume that this behaviour, although rare, may have occurred more than the two times we were lucky enough to observe it. This applies to many other species for which reports of tool use behaviour exist but are scarce.

We also wish to emphasize that in our paper we do not in any way affirm that our observations demonstrate that seabirds have high cognitive abilities. Rather, we suggest that it would be worth investigating whether seabird cognition is more sophisticated than we had previously thought, not only based on our observations but also based on the accumulation of recent findings demonstrating a range of other complex tasks that seabirds solve in their daily lives. For example, seabirds feed in patchy, unpredictable environments, where they must integrate multiple sources of physical and social information to make complex decisions in space and time – solving such problems requires behavioural flexibility and skills in multiple domains including learning, memory, and planning. For instance, a breeding seabird must balance the

need of its nest-bound offspring for frequent feeding with its own need to maintain body condition (which may require different prey from separate feeding grounds at sea) while also coordinating its schedule to its partner's to minimise chick fasting. To achieve this, many seabirds follow dual-foraging strategies alternating several short chick-feeding trips with a longer self-sustenance trip (Shoji et al., 2015), switching duties with their mate when they meet at the nest (Tyson et al., 2017). The high fidelity in migration and foraging routes found in many seabirds also suggests a key role of learning and memory (Fayet et al., 2016; Votier et al., 2017), recently supported by evidence of exploration and the progressive refinement of their migration route over time (Campioni, Dias, Granadeiro, & Catry, 2020). As such, seabirds may well possess an extensive set of sophisticated cognitive abilities, including those needed for behavioural innovation.

BGF: Furthermore, Fayet, Hansen and Biro (1) implicitly present a strong argument as to why we should be skeptical about the sticks being used as tools to scratch: Most birds can already reach most of their bodies with their beaks. This should lead us to have very low priors that a puffin would use a stick to scratch itself, when this action is likely both more difficult and less efficient for the puffin. At the very least, before a conclusion of tool use for body care is reached, the authors would need to demonstrate that it is unlikely i) a chance combination of self-directed behaviour and stick holding, and ii) that the goal of the animal was to use the stick in order to scratch itself, which at present is a large and weakly-tested assumption.

Fayet et al: The fact that an animal can scratch its body with its own beak, hands or foot does not invalidate observations of stick-scratching being interpreted as tool use. Several species are known to scratch with sticks (chimpanzees, elephants, numerous captive parrots) and they do not necessarily only scratch parts of their bodies they cannot reach otherwise – yet these

observations are widely accepted as tool use. Besides, we explain in detail in our paper why we think our puffins might have used sticks to scratch, discussing the possible advantage of their mechanical properties to dislodge ticks, or to apply chemical substances (as an analogue of anting). Another explanation, suggested by Prof. Alex Kacelnik in a newspaper interview, concerned preventing the beak coming into contact with noxious substances on the birds' plumage (e.g. oil from the sea). In sum, while we agree with the argument made by Hansell & Ruxton (2008) that tool use is overall rare in the animal kingdom because anatomical adaptations already allow animals to achieve many goals, tools *can* sometimes increase the efficiency or convenience of a behaviour, and this is the case we make for our puffins.

Furthermore, as far as we could see the puffin in the video did not use the stick for any other purpose, as it dropped it after scratching, and did not take it to its nest even hours later. The most common reason puffins pick up objects from the ground (usually grass) is to line their nest, and this stick was not taken to the nest and remained visible on camera for ~24h after the tool use behaviour.

As such we think the evidence for tool use from our observations is strong. We agree that showing repeated behaviour would have been ever better, but our observations were fortuitous (we were not looking for tool use behaviour, the cameras were deployed to study chick-provisioning) and we do not have additional data.

BGF: Finally, it is questionable whether searching for or reporting tool use in an all-or-nothing fashion as, an end in itself, is a promising direction for animal cognition research (see e.g. 4, 5). With enough observations, rare events that can be interpreted as tool use could likely be found for any species that interacts with free objects.

Fayet et al: In line with the approach of catalogues like Shumaker, Walkup, & Beck (2011) or Bentley-Condit & Smith (2010) which account for the prevalence of the behaviour at the species level, we ourselves repeatedly point out in our paper that our observations are few, and, as such, we do not extrapolate to the species level – hence the comment about the all-or-nothing nature of reporting is unwarranted. Our species-level comments concern puffin (and more broadly, seabird) cognition being deserving of further study, but that is a more general point that goes beyond tool use and is based on a much wider range of evidence (see above).

On a related note, we would disagree with suggestions that reporting small numbers of novel observations of behaviour are not advancing animal behaviour research. On the contrary, these rare observations have fantastic potential to drive future research. They are an important first step in encouraging others to look out for more, and, even more importantly, to begin to explore their cognitive implications through further observation and experimentation.

As a positive outcome, in response to the publication of our paper we have received numerous reports from members of the public describing candidate cases of tool use they had observed in various species. Evaluating, compiling and publishing these in future compendia on animal tool use will give us a yet more complete picture of the behaviour's distribution in the animal kingdom. As we allude to in the paper, such “stamp-collecting” is not an end in itself, yet scientific treatment of the evolutionary and developmental drivers of tool use must begin with a detailed account of its taxonomic spread – including its within-species prevalence for which the rare/habitual distinction is also key.

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