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Nest building, the forgotten behaviour

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In the last decade tool manufacture in birds has transformed the landscape of animal cognition. As tool manufacture, however, is rare and practised by species that are not commonplace it is not a particularly useful model for investigating the evolution of physical cognition. On the basis of recent evidence, we argue that nest building, which bears considerable phenotypic resemblance to tool making, is more useful for examining not only the role that cognition may play in construction behaviours, but also the neural underpinning of those behaviours and, ultimately their evolution. We substantiate our view with recent evidence that building by birds involves changes in dexterity, is experience-dependent and involves activity in, at least, motor, reward and social network brain regions as well as in the cerebellum.

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Introduction

Building by animals is a surprisingly neglected behaviour, surprising because it is key to reproductive success for many species and, of more recent relevance, because it bears a striking phenotypic similarity to tool making [1,2]. For a behaviour with such a broad taxonomic spread across orders of animals (e.g., birds [3], reptiles [4], rodents [5], primates [6], fish [7,8] and many social insects [9]), we still know remarkably little about how these animals know what structure to build. These structures include beaver dams, caddis larvae cases, antlion larvae pits, bowers, fish, chimpanzee and bird nests. In striking contrast, a considerable amount of research effort has been addressed to another form of construction behaviour, tool manufacture and use. Although much of this effort is on the basis of the apparent value of tool making for our understanding of the evolution of physical cognition (how animals acquire, process and use information about the physical world [10–13]), the rarity of tool making does not, in our view, make it a system of general applicability. Although tool making has been explicitly separated, by definition, from all other building behaviours [14,15] we contend that due to the significant phenotypic similarity that tool making shares with nest building, nest building, due to its greater amenability to experimental manipulation, to neural investigation and to phylogenetic analyses, may prove a more useful 'model' system.

Recent empirical evidence

In the 19th century several observers, including Alfred Russel Wallace, concluded that building by birds (of nests), like that of man, was dependent on their experience [16]. Despite supporting evidence from the Collias' and a few others in the 1960s [17–19], however, the common view, even in the 21st century, is that nest building by birds is innate [20–24]. Firm and widespread though this view may be, it has been held in the face of little to no evidence. That is, until relatively recently. Data are now steadily accumulating to show that birds modify where they build, what they build and how they build it, in response to experience.

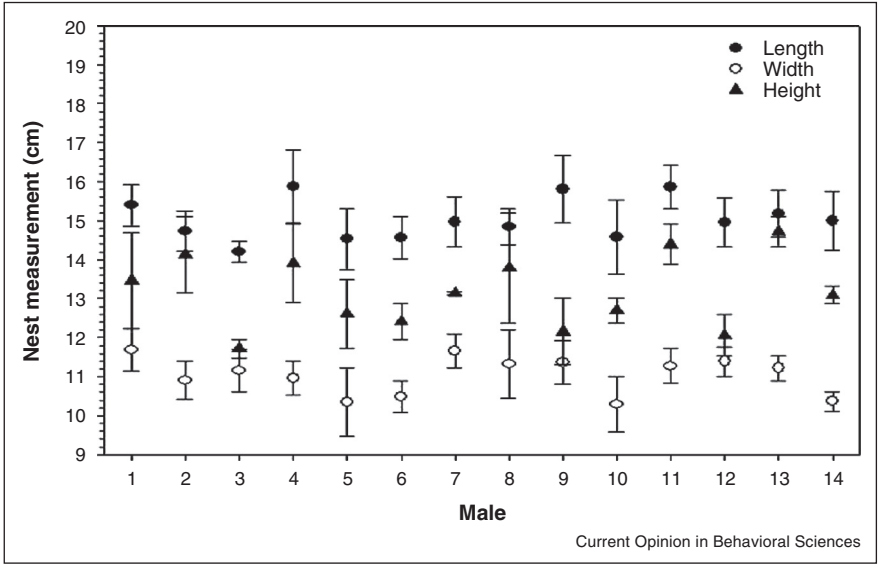
Field evidence for a significant component of experience-dependence in nest building comes largely from observations that, after suffering predation on their nest, birds will move to a different site to build their next nest [25]. The structure of the nests of some birds also varies depending on their geographical location [26,27], although it is not clear whether this variation in due to real-time responses by individuals to local conditions or to selection. That selection can act on nest morphology is shown by the evolution of the addition of domes to nests built by those babbler species that build their nests on the ground, thought to be a response to increased predation risk [28•].

The demonstration that there is low to no repeatability of the morphology of nests built by male Southern Masked weavers (*Ploceus velatus*, Botswana) and male Village weavers (*Ploceus cucullatus*, Nigeria [29,30]) strongly suggest that the building of these nests is not achieved by a fixed-action pattern or behaviour that is 'hard-wired' rather, that individual builders do modify their behaviour depending on their experience/their environment (see Figures 1 and 2). This interpretation is further supported by the observations that male Southern Masked weavers rarely complete a nest before they begin the construction of the next [31••] and that these males improve their material handling skills as they drop fewer pieces of grass the more nests they build.

Figure 1

A series of six nests from a single Southern Masked weaver males. Photos ordered by date of construction from top left to right.The picture originally appeared in [29] and appears here with permission.

Figure 2



Mean ± SEM nest measurements (*y*-axis) for length (filled circles), width (open circles) and height (filled triangles) of nests built by individual male Southern Masked weavers (*x*-axis), $n = 14$.
This figure originally appeared in [29] and appears here with permission.