Male intelligence influences male mating success in the satin bowerbird (*Ptilonorhynchus violaceus*)

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Introduction:

The relationship between intelligence and sexual selection has not been directly examined, although several studies have examined the relationship between sexual selection and brain size[1,2,3]. Male satin bowerbirds, *Ptilonorhynchus violaceus*, have complex sexual displays that involve building a stick bower on the ground, decorating the bower with colored objects[4], and courting females at the bower with a complex dance during which they mimic other species of birds[5] and vary in their ability to react to female signals of discomfort[6]. Males destroy their rivals' bowers and steal decorations from them[7]. Males do not mature until seven years of age, and as juveniles they learn and practice display[8]. These behaviors suggest an important role for male intelligence in shaping male attractiveness to females. Intelligence in animal species can be quantified by performance on problem solving tests[9]. We tested the hypothesis that male mating success can be predicted by male intelligence as measured by two problem solving tests ("Red Coverage" and "Barrier" experiments, described below).

Rationale of Tests:

Satin bowerbirds prefer blue objects as decorations[10,11] and are adverse to red[4,12]. Males constrained from removing red objects placed on bowers must seek a novel solution.

Methods:

These field experiments were conducted at Wallaby Creek, NSW, Australia. Male mating success was assessed by automated cameras[4]. Our genetic studies show that paternity is accurately predicted by our video records of copulations[13].

Red Coverage Experiment: We glued 25 mm square tiles (red, blue, and green) to screw heads. We screwed the tiles into the platform 20 cm from each other at 33 bowers (Figure 1). We took digital photographs after 24 hours (Figure 2). We measured the area of the tile left uncovered using Image J (v. 1.34i, NIH). We then calculated the percentage of each tile covered.

Barrier Experiment: We placed a clear container over three red objects 25 cm from the bower entrance at 25 bowers (Figure 3). All behavior was videotaped and the time for each male to remove the container was calculated.

Figure 1. Layout of experiment. Dotted line segments are 20 cm long.

Figure 2. Digital picture of a red tile partially covered by a snail shell.

Figure 3. Male attempting to move clear barrier.

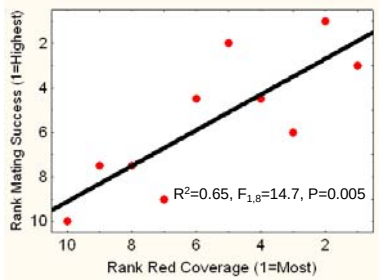

Figure 4. Male red coverage predicts male mating success. Males who covered the red tile more had more copulations.

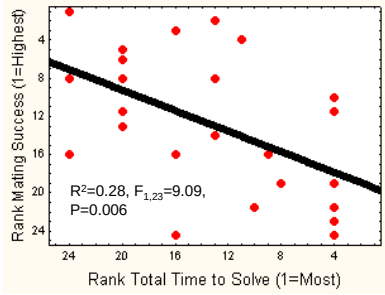

Figure 5. Male time to remove a barrier predicts male mating success. Males who removed the barrier sooner had more copulations.

Results:

Red Coverage Experiment: Red on average was covered significantly more than blue ($t=-2.37$, $P=0.047$), and green was intermediate in coverage. Tiles in the positions close to the bower (for example red and blue in Figure 1) were covered very little regardless of color. For males with red in one of these positions, red coverage did not predict mating success. However, for those males with the red tile in the outer position, male mating success was predicted by red coverage ($R^2=0.65$, $P=0.005$; Figure 4).

Barrier Experiment:
The amount of time it took for males to remove the clear barrier significantly predicted their mating success ($R^2=0.29$, $P=0.005$; Figure 5).

Differences in male motivation were extremely small and did not explain problem solving scores. Also differences in male age (which varied from 7-22 years) did not explain problem solving scores.

Significance:

This is the first study to show evidence that individuals who perform better on problem solving tasks are sexually preferred. The brain is very metabolically expensive and the seat of behavior, yet the hypothesis that male intelligence influences male mating success has not previously been considered. These experiments establish an important role for cognitive ability in sexual selection which has long been suspected but until now undemonstrated. Future studies will examine which cognitively-based display traits (e.g. bower building and mimicry) are related to male problem solving ability. This is necessary to understand how females are able to choose more intelligent males.

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