((•)) **INNER WORKINGS**

Inner Workings: Face processing

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Meet the Greebles, a computer-generated clan of what psychologists descriptively call "novel objects." For more than 15 years, they have served as foot-soldiers in one of the most divisive debates in cognitive neuroscience: Does making sense of faces require specialized brain machinery, or is the hardware and software the same as for any other type of learned expertise?

Researchers have debated this question since at least the 1940s, when some soldiers returning from World War II with brain injuries found they couldn't recognize the faces of their own family members yet seemed perfectly able to recognize various everyday objects. This so-called face-blindness, or prosopagnosia, suggested that face processing was a distinct module of the mind and that the brain may have some special real estate dedicated to faces, perhaps because faces convey so much social information that being able to recognize them is somehow fundamental to human existence.

Of course, though, there's no way to test all possible objects and prove that faces are the only stimulus that prosopagnosiacs can't discriminate. An alternative explanation soon emerged. Perhaps, some psychologists reasoned, it's a question of developing expertise about a category of things that tend to look the same—like birds or dogs or cars—and faces are just the most obvious such category.

Greebles, the brain-children of Isabel Gauthier (now at Vanderbilt University) and Michael Tarr (now at Brown University), were created at Yale University in 1997—as part of Gauthier's doctoral dissertation—to help tease apart these two hypotheses. The three-dimensionally rendered computer-generated figures all have the same number of features in the same configurations; that is, their boges, quiffs, and dunths are much like our ears, eyes, and nose. Greebles exist in two genders and several families, delineated by shared features. On first sight they look pretty similar, but with training, most people become experts at telling apart individuals of the same sex and from the same family. Gauthier hoped to determine whether this kind of acquired expertise is mediated by the same brain mechanism as the mechanism through which people recognize faces.

However, some 25 subsequent publications using Greebles did not quench the debate. Among the strongest evidence for the "expertise" hypothesis are two papers describing prosopagnosiacs who could not learn to tell the made-up creatures apart (1, 2). However, on closer examination, it turned out that those individuals also had trouble learning to recognize other types of objects. "They couldn't actually start on equal footing with the typical participants," says Constantin Rezlescu of Harvard University. "So those cases are not actually direct evidence that faces and Greebles rely on the same mechanism."

In their recent paper (3), Rezlescu et al. describe two individuals who had no trouble learning to differentiate Greebles, yet have severe prosopagnosia. (One of the two did have difficulty with processing other objects.) Rezlescue believes his findings disprove the expertise hypothesis and put the Greebles clan permanently out of work. However, fans of the Greebles are already preparing their rejoinders and want to put them back on duty.
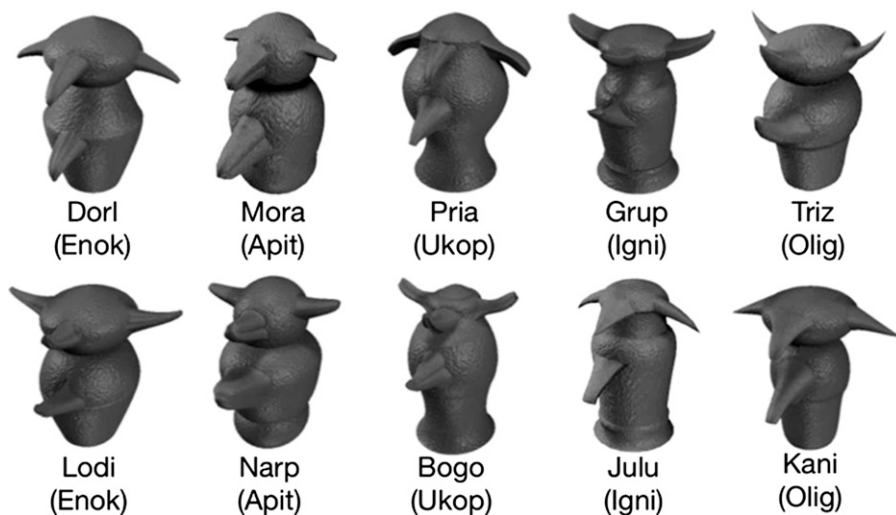
Ten of the 20 Greebles learned during the experiments. Individual Greebles belong to one of five families (in parentheses) and could be identified at the individual level and at the family level. Greebles had abstract four-letter names starting with a consonant (family names started with a vowel). Reprinted with permission from ref. 3.

1 Behrmann M, Marotta J, Gauthier I, Tarr MJ, McKeeff TJ (2005) Behavioral change and its neural correlates in visual agnosia after expertise training. *J Cogn Neurosci* 17(4):554–568.
2 Bukach CM, et al. (2012) Does acquisition of Greeble expertise in prosopagnosia rule out a domain-general deficit? *Neuropsychologia* 50(2):289–304.
3 Rezlescu C, Barton JJ, Pitcher D, Duchaine B (2014) Normal acquisition of expertise with Greebles in two cases of acquired prosopagnosia. *Proc Natl Acad Sci USA* 111(14):5123–5128.