

Object Shape in Basic Level Categorisation

Markus Graf (markus.graf@tuebingen.mpg.de)

Max Planck Institute for Biological Cybernetics
Spemannstr. 38, D-72076 Tübingen, Germany

Heinrich H. Bühlhoff (hhb@tuebingen.mpg.de)

Max Planck Institute for Biological Cybernetics
Spemannstr. 38, D-72076 Tübingen, Germany

Categorisation and Shape

One of the central questions in object categorisation is how the shape variability of different category members can be accounted for. It was proposed recently that the shape variability of objects from a basic level category usually can be described well with continuous deforming shape transformations (topological or morphing transformations). Previous experiments with line drawings showed that categorisation performance depends systematically on the amount of shape transformation, both in speeded categorisation tasks and rating tasks (Graf, 2002). We investigated whether this systematic dependency holds for grey-level images, and for rotated and shifted objects.

Methods

A database of basic level categories was created by constructing morphable 3D models of exemplars from 29 different categories (using 3ds max 4.2 modelling software), covering both biological and artefact categories. New members of each category can be produced by morphing between two category exemplars. The objects were rendered as grey-scale images (see Figure 1). The morphing technique allows a parametric variation of the shapes of common objects.

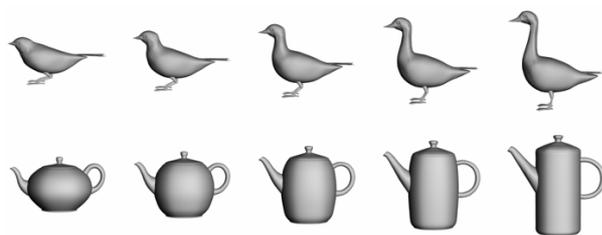


Figure 1: Shape variability within basic level categories can be described well with morph transformations, both for biological and for artefact categories, as exemplified by the categories *bird* and *pot*.

Two objects were presented sequentially and subjects were required to decide as fast as possible whether they belonged to the same category. The amount of shape

transformation between members of the same category was varied systematically. Objects were presented either upright (Experiment 1), in different orientations in the picture plane (Experiment 2) or at six different equidistant positions on the screen (Experiment 3).

Results and Discussion

In general, categorisation performance (reaction times and accuracy) deteriorated systematically with increased shape transformation. In Experiment 2, categorisation performance depended both on the amount of shape change and orientation change, while there was no significant interaction between orientation and shape. The effect of shape transformation was found despite position changes (Experiment 3).

The systematic dependency of categorisation performance on the amount of shape transformation is a very robust finding, having been demonstrated with line-drawings and grey-level images, with upright objects, image-plane rotated, and translated objects. Processes which compensate for shape and for orientation changes seem independent, which is in agreement with previous findings for other combinations of transformations (e.g., Lawson, Humphreys & Jolicoeur, 2000). Overall, the findings strongly indicate image-based instead of abstract or propositional category representations, but are compatible with a role of object parts in categorisation.

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References

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