The Role of Action Knowledge in Visual Object Recognition

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Introduction

Brain areas involved in action representation (premotor cortex, posterior parietal cortex) are activated when subjects name pictures of artifactual manipulable objects, like tools [1],[2].

Moreover, psychophysical evidence indicates that manipulable objects automatically potentiate possible actions [3],[4].

These observations lead to the view that action knowledge is intrinsic to the representation of manipulable objects and, thus, is likely to contribute to object recognition.

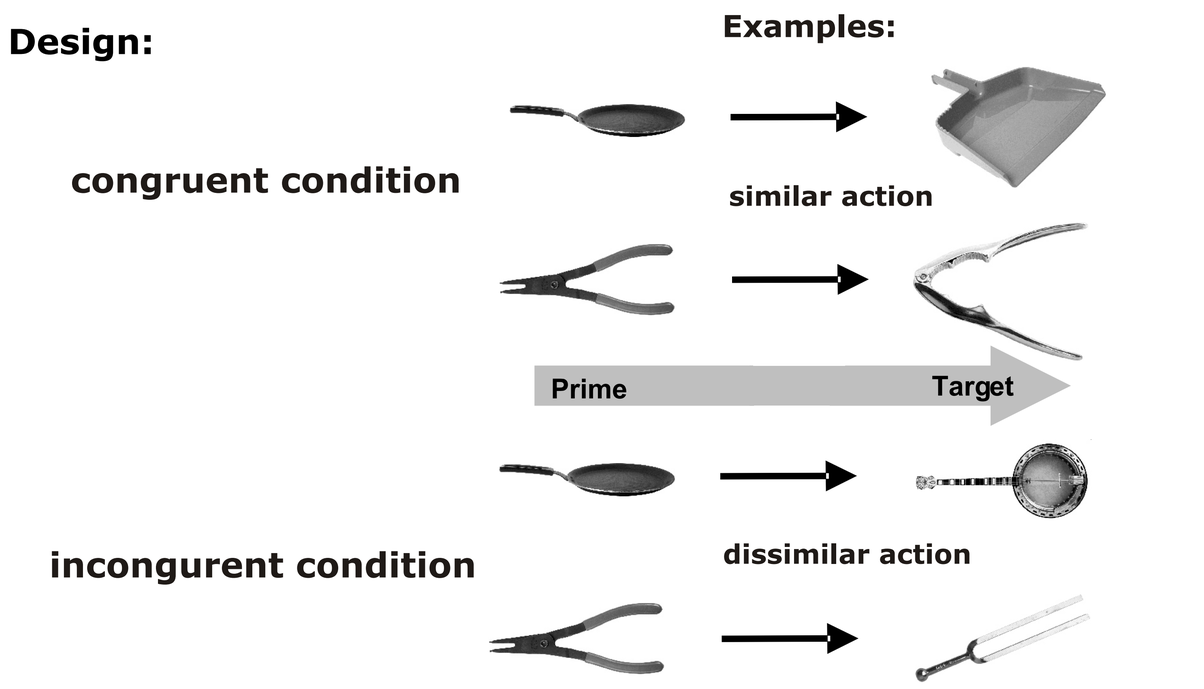
We apply an action priming paradigm to explore the hypothesis that the action typically associated with an object facilitates its recognition.

General Methods & Stimuli

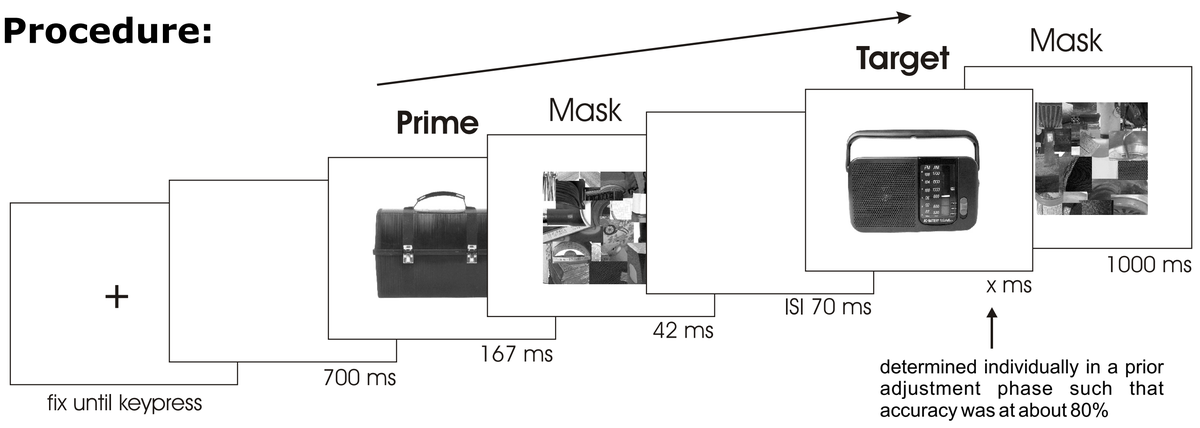
Stimuli:

- Gray-scale photographs of man-made objects (HEMERA Photo Objects Vol. 1-2).
- Prime and target object are typically associated with either similar (congruent) or dissimilar (incongruent) actions.
- 72 stimulus pairs
- Stimulus pairs in both conditions (incong./cong.) were equated for:
  - baseline accuracy (pretest, prime obj. replaced by animals)
  - visual similarity (ratings)
  - semantic similarity (ratings)
  - word frequency [5]
  - word length

Design:



Procedure:



task: name both objects (Prime&Target) in order of presentation

REFERENCES:

[1] Chao, L.L. & Martin, A. (2000): Representation of Manipulable Man-Made Objects in the Dorsal Stream. *NeuroImage* 12, 478-484.
[2] Martin, A., Wiggs, C.L., Ungerleider, L.G. & Haxby, J.V. (1996): Neural correlates of category-specific knowledge. *Nature*, 379, 649-652.
[3] Tucker, M. & Ellis, R. (1998): On the Relations Between Seen Objects and Components of Potential Actions. *Journal of Experimental Psychology: Human Perception and Performance* 24, 830-846.
[4] Tucker, M. & Ellis, R. (2001): The potentiation of grasp types during visual object categorization. *Visual Cognition*, 8, 769-800.
[5] Ruoff, A. (1990): Häufigkeitswörterbuch gesprochener Sprache (2nd ed.). Tübingen: Niemeyer.

Experiment 1

Purpose:

* Does action knowledge contribute to object recognition? We applied an action priming paradigm to address this question.

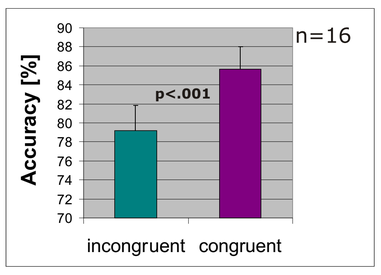
Method:

Exp1a: **without fam.:** prime stimulus not familiarized

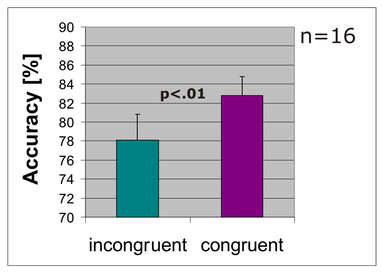
Exp1b: **with fam.:** prime familiarized (to reduce number of errors in prime recognition)

Results:

Exp1a:



Exp1b:



Conclusion:

- Action priming effect on naming accuracy indicates an involvement of action knowledge in object recognition.

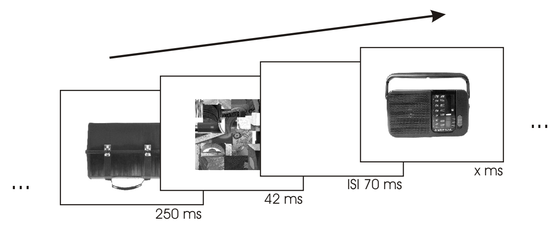
Experiment 2 & 3

Purpose:

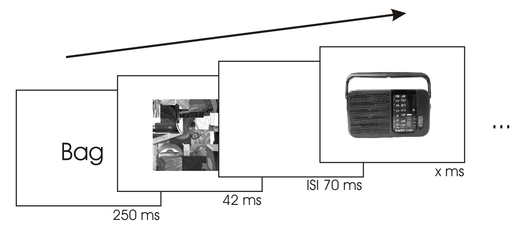
* Which processes are involved in generating action priming effects?
* Must the action be precisely parametrized by visual properties of the object to elicit action congruency effects?

Method:

Exp2: **inverted** objects as prime.

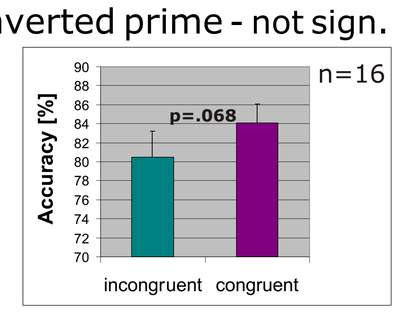


Exp3: **word** labels denoting the prime object.

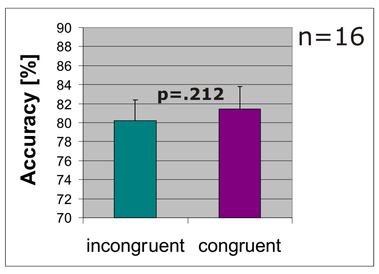


Results:

Exp2: inverted prime - not sign.



Exp3: word as prime - not sign.



Conclusion:

Exp.2:

★ prime inverted — motor interactions for prime and target less similar. action priming effect is not significant.

- The congruency effect relies on actions that need to be determined (parametrized) relatively closely by visual features.

Exp.3:

★ Action priming effect is absent if the prime is presented as a word.

- Semantic representations are not sufficient to generate action priming effects.

Summary

- Action knowledge contributes to object recognition (Exp1a&b).
- Relatively precisely parametrization of an action by visual features is necessary to generate action priming effects (Exp2).
- Semantic knowledge alone is not sufficient to generate action priming effects (Exp3).