UC Merced
Proceedings of the Annual Meeting of the Cognitive Science Society

Title
Conditions for the Inverse Base-Rate Effect. in Categorization

Permalink
https://escholarship.org/uc/item/6pj0z9wf

Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 26(26)

ISSN
1069-7977

Authors
Johansen, Mark K.
Fouquet, Nathalie
Shanks, David R.

Publication Date
2004

Peer reviewed

Conditions for the "Inverse Base-Rate Effect" in Categorization

Mark K. Johansen (johansenm@cardiff.ac.uk)
School of Psychology, Cardiff University
PO Box 901, Cardiff, CF10 3YG, UK

Nathalie Fouquet (n.fouquet@ucl.ac.uk)
David R. Shanks (d.shanks@ucl.ac.uk)
Department of Psychology, University College London
Gower Street, London WC1E 6BT, UK

Background

The inverse base-rate effect (Medin & Edelson, 1988) is a paradoxical result in human category learning. It occurs, see Figure 1 left, after participants have been trained over a series of trials with corrective feedback to categorize pairs of features into high-frequency (C) and low-frequency (R) categories, where each category has a perfectly predictive feature (PC or PR) and a shared, imperfectly predictive feature (I). The term "inverse base-rate effect" reflects the fact that when tested with the conflicting cues together (PC+PR, Figure 1 left), participants non-normatively tend to respond with R despite its low frequency relative to C even though both cues are otherwise equally predictive of their categories.
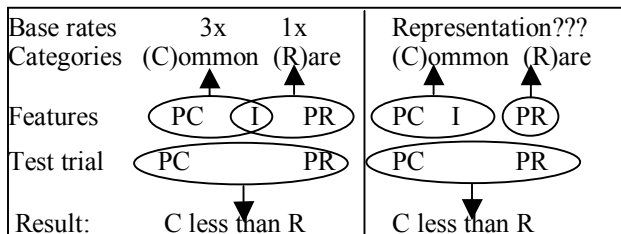

Figure 1: Left: Abstract category structure plus test trial (terminology from Kruschke, 1996). Right: Hypothesized asymmetric representation in relationship to the test trial.

Experiments

One of the most persistent theoretical explanations (e.g. Kruschke, 1996; Medin & Edelson, 1988) of the inverse base-rate effect is that the learned category representations are asymmetric, Figure 1 right, (for any of several reasons which we don't have space to describe) but that, based on similarity to this representation, the decision-making at test is normative. The purpose of our research was to evaluate whether asymmetric representation is a necessary and sufficient condition for the inverse base-rate effect in either a trial-by-trial category-learning task with corrective feedback or a purely decision-making task based on a single presentation of summary information: base-rate information together with feature-category relationships as specified in either the left or right hand sides of Figure 1, symmetric or asymmetric respectively. The four experimental conditions are in Table 1. Note that the results for the trial-by-trial learning of the symmetric structure are from Kruschke (1996).

Results

The results, see Table 1, for the pure decision-making task (N=33) on the summary information for the Symmetric structure indicate strong use of the explicitly presented base-rate information (C=0.94 > R=0.06) compared to the results from trial-by-trial learning of the Symmetric structure (C=0.35 < R=0.61). The results of trial-by-trial learning on the Asymmetric structure (N=16) show a significant inverse base-rate effect (C=0.27 < R=0.63) indicating that asymmetric representation in the context of the learning task is sufficient to produce an inverse-base rate effect. However, the results of the pure decision-making task on the Asymmetric summary information (N=33) show the absence of an inverse base-rate effect (C=0.58 > R=0.42). This indicates that asymmetric representation is not by itself sufficient to produce an inverse base-rate effect, possibly because the base-rate information is presented explicitly. Nevertheless, the fact that the results for the pure decision-making task on the Asymmetric structure are qualitatively closer to an inverse base-rate effect than the results for the Symmetric structure is consistent with Asymmetric representation being a necessary condition whose impact is overcome by the influence of the explicitly summarized frequency information.

In summary, asymmetric representation of the categories may be a necessary condition for the inverse base-rate effect, but it is not by itself a sufficient condition.

Table 1: (**C**)ommon and (**R**)are response proportions for perfectly conflicting cues (trials PC+PR) by task

	Task category structure			
Learning procedure	Symmetric		Asymmetric	
	C	**R**	**C**	**R**
Pure Decision Making	0.94	0.06	0.58	0.42
Trial-by-Trial Learning	0.35	0.61*	0.27	0.63

*Kruschke (1996) sum < 1 because of other possible responses.

References

Kruschke, J.K. (1996). Base rates in category learning. *Journal of Experimental Psychology: Learning, Memory and Cognition,* 22:3-26.

Medin, D.L. & Edelson, S.M. (1988). Problem structure and the use of base-rate information from experience. *Journal of Experimental Psychology: General*, 117(1):68-85.