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#### **Authors**

Davies, Jim

Billman, Dorrit

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# Hierarchical Categorization and the Effects of Contrast Inconsistency in an Unsupervised Learning Task

Jim Davies and Dorrit Billman

School of Psychology, Georgia Institute of Technology  
Atlanta, GA

psg95jd@prism.gatech.edu and dorrit.billman@cc.gatech.edu

## Introduction

Two factors may guide concept learning: capturing predictive structure in input, and forming groupings which can be categorized by a simple criteria. Experiments from unsupervised learning suggest that there is a strong bias to sort things based on their similarity, similarity being property covariation. These sorts provide maximum predictive utility (Billman & Knutson, 1996; Anderson, 1991). Work on free sorting of examples has found that people frequently sort based on the values of a single dimension (Ahn & Medin, 1992). We find evidence that people will use both biases under different conditions.

## Method

The stimuli consisted of drawings of creatures laser printed on cards. There were nine attributes or dimensions (body-shape, mouth, tail, etc.), each of which had six possible values (long, lion-like, snake-like, etc.). Each participant viewed 18 cards. Each deck had two strongly marked *superordinate* categories based on covariation of attributes A, B, and C (since there are only two supers, there were only two values for these attributes). Each of the supers had three *subordinate* categories with three instances each. Subordinate structure was marked by covariation of the values of the remaining six attributes.

Table 1. Stimulus design (Columns are attributes, numbers specify a particular value, x's represent randomly assigned values)

Consistent Condition				Inconsistent Condition			
ABC	DE	FG	HI	ABC	DE	FG	HI
111	11	xx	xx	111	11	xx	xx
111	22	xx	xx	111	xx	11	xx
111	33	xx	xx	111	xx	xx	11
222	xx	11	xx	222	22	xx	xx
222	xx	22	xx	222	xx	22	xx
222	xx	33	xx	222	xx	xx	22

Each row in each condition represents a category with three members. There were two conditions (each with 12 participants): Consistent and inconsistent contrast. Consistent contrast means that within a given superordinate category, the same attributes are predictive of subordinate category membership. If people sort based on predictive utility alone, then

there should be no difference in the ability of the two groups to retrieve the intended sort. However, if people sort based on the values of a single dimension, then they will not be able to retrieve the intended sort, as there is no global consistency (consistency *across* supers) in either condition. Participants viewed all the cards and then sorted them freely into groups.

## Results

Sixty-six percent of participants sorted hierarchically, which is, in general, not predicted by categorization models. In the consistent condition, Forty-one percent of participants in the consistent condition produced the correct (correlation-based) sort, but no one in the inconsistent condition did. Thus people are sensitive to predictive structure when it is organized consistently. The inconsistent condition was very difficult; many pilot participants could not reproduce the correct sort even after seeing it and trying again. Sixty-six percent in the inconsistent condition sorted by a single attribute, compared to the consistent condition, in which only 25% did.

## Conclusion

We conclude that participants will sort by correlational structure if it is easy to notice. If stimulus structure or task make it difficult to learn about the structure, subjects will choose the very simple strategy of sorting by a single dimension. Models which are sensitive to pressures for coherent, compact descriptions and for informative groupings are needed to account for these data.

## References

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