Dimensional Learning in Kindergarten Children in the Absence of Hypothesis-Testing

Jeffrey T. Coldren
Department of Psychology
Youngstown State University

John Colombo
Schiefelbusch Institute for Life Span Studies
University of Kansas

Abstract

Four experiments test whether learning dimensions by kindergarten children differs under rule-learning or rule-given conditions. Results reveal that children may use one of two types of learning depending upon task demands. Lower-level nonsupervised processes are sufficient to learn perceptual dimensions, whereas hypothesis-testing, error-driven learning is required to solve conceptual problems.

Introduction

The dominant view of learning held by developmental psychology for decades is on the verge of transformation. Since the 1960's, the traditional view has maintained that children's learning occurs through a rational, hypothesis-driven process to generate responses and correct errors. Advancements in learning theory over the past ten years, however, cast substantial doubt on the exclusivity this interpretation. New approaches such as statistical, computational, Bayesian, and implicit forms of learning all share the assumption that children may learn by detecting regularly occurring structural information inherent in information without the need for supervised error-correction learning processes. Although both forms of learning are advantageous, the relationship between nonsupervised and hypothesis-driven learning processes has not been clearly delineated. In particular, it is unknown whether lower forms of nonsupervised learning may substitute for hypothesis-driven learning.

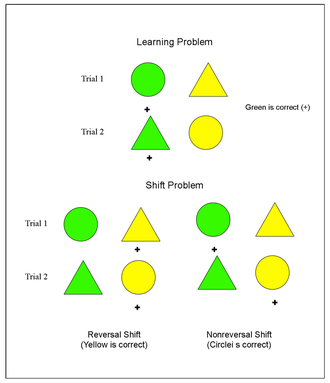
Purpose of the Experiment

The purpose of the present set of experiments is to determine if an explicit and active process of forming a rule-like conceptual structure is necessary to extract and transfer a dimension across problems or whether a lower-level unsupervised form of learning could suffice. In general, the experimental strategy is to pre-empt the verbal and hypothesis-driven system to determine if dimensional categorization still occurs. Four experiments examine the shift performance of kindergarten children by varying the learning demands. The general rationale for all of the studies is to determine whether dimensional learning during DLS problems can be demonstrated even when the hypothesis-testing process has been rendered unnecessary. Such a demonstration would cast serious doubt on classic explanations of how children learn, dimensionalize, and categorize stimuli that have stood for 50 years, and raise several interesting implications about the relation between implicit and explicit learning processes.

Contact Info
J. T. Coldren, Ph.D.
Department of Psychology
Youngstown State University
Youngstown, Ohio 44555
330-941-1617
jtcoldren@ysu.edu
www.as.ysu.edu/~jtcoldren

Experiment 1

In Experiment 1, which served as the baseline comparison, 32 children learned to select a particular feature among stimulus pairs that varied in color and form dimensions. Then, contingencies for responding were shifted to another feature within the same dimension (reversal - R shift) or to a feature on the opposite dimension (nonreversal – NR shift). As expected, kindergarten children required fewer trials to learn the reversal shift compared to a nonreversal shift, suggesting a hypothesis-driven process to learn the dimension (see Table 1).



Experiments 2 & 3

The next two experiments disrupted the presumed hypothesis-testing process to observe the effect on dimensional learning by either explicitly telling (Experiment 2 – 32 children) or pointing to (Experiment 3 – 32 children) the targets to select.

Again, children performed R shifts in fewer trials than NR's regardless of learning requirements. Because hypothesis-testing was eliminated as the basis for dimensional learning, an implicit process to detect the perceptual dimensions is likely responsible.

Table 1
Trials to Criterion for Pre-shift and Post-shift Problems

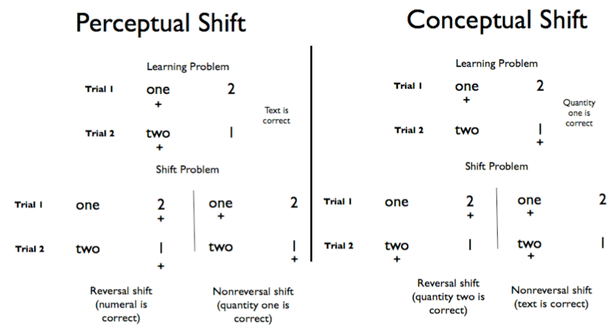
	Shift	Pre-shift	Post-shift
Experiment 1	Reversal	16.50 (13.57)	11.44 (4.30)
	Nonreversal	16.31 (14.91)	42.25 (20.05)
Experiment 2	Reversal	9.37 (2.36)	11.69 (4.03)
	Nonreversal	9.37 (2.82)	42.81 (18.17)
Experiment 3	Reversal	8.69 (1.96)	18.31 (18.29)
	Nonreversal	8.38 (1.50)	35.88 (24.16)

Note. Means are presented followed standard deviations in parentheses.

Experiment 4

The rationale for Experiment 4 was to isolate the contribution of lower-order perceptual-learning processes from higher-order hypothesis-testing. To do this, 64 children were tested in a version of the DLS task that could be solved by either a *perceptual* or *conceptual* basis. As before, learning requirements were manipulated to observe their effect on dimensional transfer.

Results (see Table 2) showed superior R shift performance in perceptual learning tasks when hypothesis-testing was either available or unavailable. Children were able to perform a R shift in the conceptual condition only when hypothesis-testing was available; no dimensional learning was observed without hypothesis-testing.



Note: The correct feature is indicated by a plus (+) under the stimulus.

Table 2

Trials to Criterion during the Post-Shift for Conceptual and Perceptual Shifts (Experiment 4)

Rule Condition	Type of Task	Shift	Pre-shift	Post-shift
Learn rule	Perceptual	Reversal	13.38 (8.16)	8.62 (.744)
		Nonreversal	15.50 (6.99)	38.75 (21.68)
	Conceptual	Reversal	11.62 (4.44)	12.12 (6.77)
		Nonreversal	10.00 (3.82)	33.62 (23.80)
Give rule	Perceptual	Reversal	9.62 (3.54)	15.25 (7.22)
		Nonreversal	9.50 (3.21)	49.00 (20.21)
	Conceptual	Reversal	8.25 (.71)	31.12 (27.27)
		Nonreversal	9.88 (5.30)	37.00 (20.34)

Note. Means are presented followed standard deviations in parentheses.

Conclusions

These results challenge traditional notions of categorical learning by suggesting children may use one of two types of learning depending upon task demands. In contrast to classic models, hypothesis-testing is not necessary for learning dimensions; instead, lower-order processes are sufficient to learn perceptual dimensions. When solving conceptual problems, in contrast, higher-order hypothesis-testing processes are required.