

Testing the Equality of Learning Rates Using a Linear Hypothesis

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The Problem of Testing Learning Rates

For over a hundred years, psychologists have tried to describe and understand human learning. While many models disagree on the nature of the process, most agrees that the performance is well described by a power function (Newell and Rosenbloom, 1981). This equation has a curvature parameter as well as two scaling parameters.

Recent models are making quantitative predictions on the learning rate, which is represented by the curvature parameter of the function. For example, Logan's race model (Logan, 1988) predicts that standard deviations and means of response times will decrease at the same rate. The most intuitive way to test this hypothesis is to estimate the best-fitting parameters and to apply a statistical test on those estimations. The problem with this approach is that those estimations are highly biased (Cousineau, Hélie and Lefebvre, in press).

In the late fifties, Rao (1959) proposed a test of linear hypothesis. By assuming that the learning rates are equal, the power functions (or any other learning model postulated) become a linear combination of each other, irrespective of the scaling parameters. However, since learning data tends to be noisy, the power of Rao's test was limited. In order to reduce the effects of noise, Cousineau, Hélie and Lefebvre (in press) proposed to apply Rao's test on block-average data.

An Example of Application

In recent works (Hélie, Cousineau, Lefebvre and Charbonneau, 2002), we postulated the existence of two types of stimuli (integral and separable) and two kinds of tasks (conjunctives and disjunctives). When there is a match between task demands and stimulus type, the learning rate would be faster then when there is a mismatch. In order to test this hypothesis, four experimental conditions where created: two match conditions (integral / conjunctive and separable / disjunctive) and two mismatch conditions (integral / disjunctive and separable / conjunctive). The learning curves obtained on 4 sessions of 512 trials are shown on Figure 1. Our predictions are: 1) the curvature parameter will be higher for match conditions then for mismatch (faster learning), 2) the curvature (learning rate) of the two match conditions will not differ and, 3) the same pattern of results will be present in the mismatch conditions.

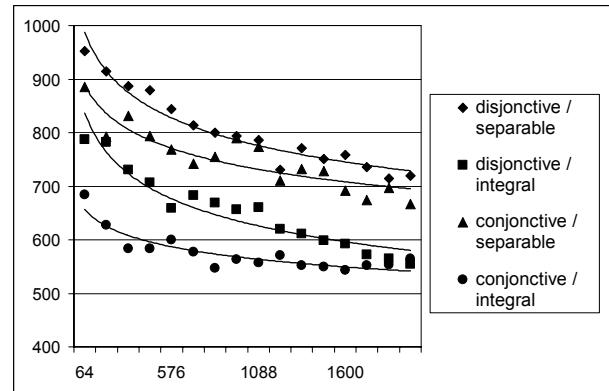


Figure 1: Results of the experiment presented by Hélie, Cousineau, Lefebvre and Charbonneau (2002)

The test of linear hypothesis, as augmented by Cousineau et al. (in press) confirmed these predictions.

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