Title
An Unsupervised Connectionist Modelling of Young Infants' Categorisation Processes

Journal
Proceedings of the Annual Meeting of the Cognitive Science Society, 27(27)

ISSN
1069-7977

Authors
HU, Jon-Fan
Plunkett, Kim

Publication Date
2005

Peer reviewed

An Unsupervised Connectionist Modelling of Young Infants' Categorisation Processes

Jon-Fan Hu (jon-fan.hu@psy.ox.ac.uk) & Kim Plunkett (kim.plunkett@psy.ox.ac.uk)
Department of Experimental Psychology, University of Oxford
South Parks Road, OX1 3UD, Oxford, UK

Introduction

The problem of how young infants form categorical representation is one of main interests to the students in the area of human development. Following Rosch's (1975) analytical approach of concept formation, Younger (1985) showed that 10-month-olds could form one or two visual categories due to the experimental manipulation where the infants experienced the restricted or full range of feature covariance.

Mareschal & French (2000) proposed a three-layer feed-forward Autoencoder connectionist network which has the same number of input nodes and output nodes applied with a supervised error-correction algorithm to simulate Younger's (1985) study results. They assume that how infants process the familiarisation and testing tasks could be analogous to a specific training and testing regime of networks and suggest that infant's looking time are equivalent to the output errors of networks with positive correlation fashion. However, there are two crucial difficulties found when we tried to replicate Mareschal & French's (2000) simulations: 1) only the 'batch' updating training more could lead to a successful simulation outcome instead of the 'pattern' updating mode, which is a more realistic scenario for implementing humane cognitive processes, and 2) the output patterns of error could not completely fit Younger's (1985) experimental findings while considering all comparisons of experimental results.

Objective

In contrast to Autoencoder model, we constructed a two-layer unsupervised connectionist model to simulate the same experimental tasks of categorisation processes in order to conquer those drawbacks. This model, based on the processing principles of 'Self-Organising Map' (SOM) (Kohonen, 1998) was considered to compute the property of similarity of features. Therefore, it was expected the convergence of output nodes would result in clusters topologically through the dynamic competition between network nodes without any explicit desired target value for the output nodes set required in Autoencoder networks. Besides, a substantial difference of SOM to Autoencoder regarding the investigation of the category formation, we reason, is the assumption that the amount of summed distances calculated between output nodes are parallel to the length of looking time observed from experiments.

Method

The training and testing schemes in this simulation study were designed to mimic the same procedure of Younger's (1985) two experimental conditions. A fully connected two layer SOM network was constructed embedded with Kohonen competitve learning algorithm containing 4 and 143 nodes in the input layer and output layer respectively. Initially all connection weightings were randomly assigned decimal values (from 0 to 1). The quantity values of features of traing and testing pictures were converted into normalized vectors and consisted input and output patterns. For the training session, each network received 8 training input patterns with random sequential order and updated connection weightings afterwards. During the following testing session, 3 novel testing patterns were randomly fed to networks for validating the performance of networks.

Results

Compared with the experimental results (Younger, 1985), the outcome of SOM simulations indicates that, with 'pattern' updating training mode, networks can successfully simulate the processes of category formation based on the overall adjusted distances between the most activated output nodes and its neighbour nodes. The appealing properties of being more biologically plausible could provide an alternaltive to verify the underlying mechanisms about how young infants coin their primitive concepts and what kinds of information they require.

References

Kohonen, T. (1998). The self-organizing map. *Neurocomputing: An International Journal, 21*(1-3), 1-6.

Mareschal, D., & French, R. (2000). Mechanisms of categorization in infancy. *Infancy, 1*, 59-76.

Rosch, E., & Mervis, C. (1975). Family resemblances: Studies in the internal structure of categories. *Cognitive Psychology, 7*(4), 573-605.

Younger, B. A. (1985). The segregation of items into categories by ten-month-old infants. *Child Development, 56*(6), 1574-1583.