COMPUTER SIMULATION OF CONCEPT LEARNING BY
INDIVIDUALS IN A MINIMUM SOCIAL SITUATION*

Robert G. Joyner
York University
Faculty of Administrative Studies
Toronto 12
Ontario, Canada

SUMMARY

Following five laboratory studies a
computer model was constructed that simulated
the behavior of the individual player in the
three-person common target game. The model, 
COMTARG, contained three model-relevant indi-
vidual difference parameters as well as general
deterministic mechanisms. Computer subjects
were constructed according to a specified method
of sampling the values of the three parameters.
Program runs for the computer subjects were then
made previous to making experimental observations
on humans playing the game under two previously
unobserved treatment conditions. ANOVAs failed
to distinguish human from computer subjects.

i) widely different rates of acquisition
   of various strategies,

ii) unequal probabilities of using various
    strategies on the first and early trials,

iii) non-stationarity of errors prior to last
    error, and

iv) individual differences in acquisition.
No known stochastic or response conditioning
model is sufficient to account for these
results.

* Preparation of this report and the research on
  which it is based was supported in part by: the
  Public Health Service, Department of Health,
  Education and Welfare (U.S.A.) under Grant
  MH-07722, the Ford Foundation, the Carnegie
  Corporation, the National Research Council
  (Canada) under Grant APA54, and the Institute
  of Computer Science of the University of
  Toronto. The research was completed while the
  writer was visiting Carnegie Institute of
  Technology on a Ford Foundation Faculty
  Research Fellowship while on leave from the
  Department of Psychology, University of Toronto.

INTRODUCTION

Five pilot studies were carried out
using Leavitt's three-person common target
game as the experimental task. The game was
played over an intercom system in which the
players could not communicate with one another
and receive game information on performance
feedback from the experimenter on each trial. The
studies were designed to produce the rapid
and reliable acquisition of various strategies
by individuals in the groups. Subjects in
these studies demonstrated:

1) It postulates a conceptual structure of simple
   game-relevant numeric concepts that are
   stored in a memory structure.

2) It postulates an ordered search and evaluation
   through successively less accessible parts of
   memory structure for a set of concepts for
   three players that match those uniquely re-
   quired under any experimental condition.
3) The search is directed by the goals of change other versus change self and concepts are tested and evaluated by criteria that differ as goals change. Goals change as a function of outcomes and of the value of an Independence parameter. The first concept(s) evaluated that satisfies the current criteria on any trial is (are) accepted and search stops. The search and evaluation mechanisms are completely deterministic.

4) The model postulates a specific probabilistic distribution of individual differences among subjects on three parameters; vis., Independence, and in the initial loading of concepts in two memory lists, FALM (Fast Access Memory List) and SAM (Slow Access Memory).

5) The model postulates the selection of concepts from a store of known concepts in memory and the association of specific concepts with specific players. It does not take the further step of learning to associate player-concept pairs with differing equivalence classes of target numbers.

6) CONTARG was constructed with strong postulates about the control that cognitive processes exercise on behavior in that environmental information is used as a source of concept evaluation but not of concept induction.

CONTARG's structure and inclusion of individual difference parameters made it susceptible to standard methods of experimental verification. A number of such tests are reported.

RESULTS

CONTARG was tested predictively through making the computer run previous to observing data from a sixth study under two previously unobserved treatment conditions. These data are shown in Table 1, Table 2 and Figure 1.

ANOVAs failed to distinguish human from computer subjects under these conditions. Additional postdictive tests were made by comparing CONTARG with behavior observed in the fourth and fifth pilot studies. Again the fit is good across most of these conditions.

The report concludes through briefly describing some related and concurrent research that bears on the development of computer-assisted group problem solving.

REFERENCES

Joyner, R.C. A process model of individual concept learning in groups. Monograph, Carnegie Institute of Technology, 1966, Graduate School of Industrial Administration.

SIN - Simulation of interaction in communication networks I; experiments with the common target game. Working paper, OSIA, Carnegie Institute of Technology, 1965.

### TABLE 1

Descriptive Statistics for Two Treatment Conditions Showing Number (N) of Human (H) and Simulated (S) Subjects, Number of Trials, Number of Subjects who Acquired The Strategy, Mean Trials to Last Error and Mean Number of Correct Responses

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Subjects</th>
<th>N</th>
<th>Trials</th>
<th>Subjects who Acquired Strategy</th>
<th>Trials to Last Error</th>
<th>Correct Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>TENS First Digit</td>
<td>H</td>
<td>39</td>
<td>24</td>
<td>36</td>
<td>7.14</td>
<td>18.49</td>
</tr>
<tr>
<td>TENS First Digit</td>
<td>S</td>
<td>39</td>
<td>24</td>
<td>35</td>
<td>6.23</td>
<td>18.74</td>
</tr>
<tr>
<td>TWOs Divide</td>
<td>H</td>
<td>15</td>
<td>24</td>
<td>10</td>
<td>12.20</td>
<td>12.13</td>
</tr>
<tr>
<td>TWOs Divide</td>
<td>S</td>
<td>15</td>
<td>24</td>
<td>12</td>
<td>10.25</td>
<td>12.47</td>
</tr>
</tbody>
</table>

### TABLE 2

Summary of F Ratios From Analyses of Variance of Correct Sets of Numeric Responses of Human (H) and Simulated (S) Subjects in Two-Trial Blocks for All Blocks of Trials and for The First Six Blocks of Trials under Two Experimental Conditions.

<table>
<thead>
<tr>
<th>Condition</th>
<th>All Blocks of Trials</th>
<th>First Six Blocks of Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Source</td>
<td>df</td>
</tr>
<tr>
<td>TENS First Digit</td>
<td>H vs S</td>
<td>1.76</td>
</tr>
<tr>
<td></td>
<td>Trials</td>
<td>11,836</td>
</tr>
<tr>
<td></td>
<td>HS x Tr</td>
<td>11,836</td>
</tr>
<tr>
<td>TWOs Divide</td>
<td>H vs S</td>
<td>1.28</td>
</tr>
<tr>
<td></td>
<td>Trials</td>
<td>11,308</td>
</tr>
<tr>
<td></td>
<td>HS x Tr</td>
<td>11,308</td>
</tr>
</tbody>
</table>