Using Cognitive Styles Typology to Explain Differences in Dynamic Decision Making in a Computer Simulation Game Environment

W. Scott Trees, James K. Doyle, and Michael J. Radzicki
Worcester Polytechnic Institute
100 Institute Road
Worcester, MA 01609-2280 USA

Introduction

Computer simulation games, or flight simulators, are often used as learning tools, particularly in corporate settings. The more complex the feedback structure, the more valuable computer simulation games are thought to be. Yet, performance on these games has historically exhibited wide variation across individuals. One question that naturally arises is whether this observed variation in ability is explainable.

This paper will describe the extent to which individual differences in cognitive style/learning style can help explain individual differences in dynamic decision makig in a computer simulation game environment. Specifically, the discussion will focus on three cognitive styles research instruments, the Myers-Briggs Type Indicator™, the Gregorc Style Delineator™, and a variation of Gordon's Cognitive Styles Indicator. These are coupled with the STRATEGEM-2 Microcomputer Simulation Game of the Kondratiev Cycle developed by Sterman and Meadows (1985) in an experimental setting (alpha testing) to determine if a cognitive styles approach might be valuable in the kind of non-laboratory settings (beta testing) where system dynamics and flight simulators are traditionally used.. Preliminary results indicate that people who have certain cognitive styles, in particular those who score higher on the Abstract component of the Gregorc test, do have a significantly higher propensity to score well on the Kondratiev flight simulator.

Cognitive Styles/Learning Styles

The most widely used and well known of the cognitive styles instruments used in our research is the **Myers-Briggs Type Indicator™**, or **MBTI™**. This personality test pairs four scales, each of which has two opposites. The scales are (DiTiberio and Hammer, 1993):

E (Extraversion)
People who prefer Extraversion focus on the outer world and pay attention to events in their external environment

I (Introversion)
People who prefer to focus on their own inner world. They pay attention to their own thoughts, feelings, and impressions.

S (Sensing)
People who are aware of what is real, what is actually happening. They focus on practical matters in the here and now.

N (Intuition)
People who are aware of meanings and relationships that go beyond the information that is given. They focus on the big picture and possibilities for the future.

T (Thinking)
People who prefer deciding things objectively, based on their analysis of the logical consequences of alternatives.

F (Feeling)
People who prefer to base their decisions on subjective, person-centered values.

J (Judging)
People who prefer to structure and organize the world. They like to make decisions and then move on. They like to have things settled.

P (Perceiving)
People who prefer to adapt to the outer world. They like to keep their options open to whatever new experiences or information comes along.

It is important to note that the MBTI does not purport to measure intelligence, aptitude, or achievement. Rather, it reflects what an individual prefers.

The second of the cognitive styles tests chosen for our research is the **Gregorc Style Delineator™**. Similar to the MBTI in that it requires the test taker to explicitly choose preferences among sets of alternatives, the Gregoric Styles Delineator nonetheless has its own unique lexicon, and the results of our research suggests that it tests significantly different preferences than the MBTI. Following Gregorc's terminology, there are four "Mediation Channels" which can apply to any individual. The Mediation Channels are (Schulz, 1993):

A (Abstracts)
People who prefer to learn deductively, with the big picture, concepts, and theory first, followed by examples.

C (Concretes)
People who prefer to learn inductively, starting with specific and practical examples, followed by an understanding of the pattern, followed by the theory.

S (Sequentials)
People who prefer to learn step-by-step in a very organized way.

R (Randoms)
People who prefer to learn creatively in different ways at different times and certainly not linearly.

These four components are then combined to form four learning style preferences: **CS**, **AS**, **AR**, and **CR**. Unlike the MBTI, where a person must fall into one or the other of the ordered pairs, the Gregoric can type a person as belonging to one, two, or even three learning styles simultaneously.

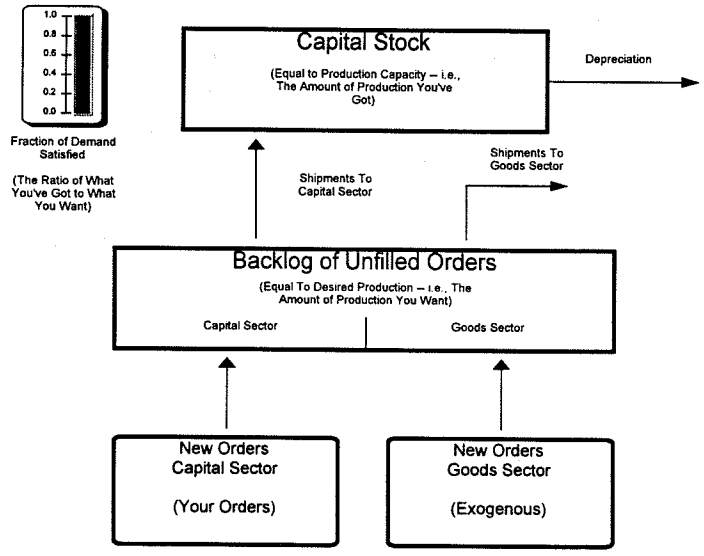
The third cognitive styles test we administered was a variation of Gordon's Cognitive Styles Indicator. This test is very different from the others in that it does not explicitly ask participants to reveal preferences. At no time during the completion of the test instrument does a subject know how the information is to be used. The Cognitive Styles Indicator only has two components:

> **Diff (Differentiation)**: People who score "high" on this cognitive style demonstrate an ability to pick up on nuances and subtle distinctions which can be useful in diagnosing problems and setting a direction for tackling them.

RA (Remote Association): People who score "high" on this cognitive style have an ability to solve problems which are fairly well defined, for which the solution is not known or even implied by the problem statement, but is easily and quickly recognizable once it appears. They do not need logical linkages between the elements of a solution, and they can see connections that cannot be explained by extrapolation.

People score either "high" or "low" on each of these cognitive styles, and the resulting information is used to form a matrix of four types: **Integrator** (high Diff and high RA), **Problem Finder** (high Diff and low RA), **Problem Solver** (low Diff and high RA), and **Implementor** (low Diff and low RA).

STRATEGEM-2: A Microcomputer Simulation Game of the Kondratiev Cycle



A sector diagram of the Kondratiev flight simulator reveals the deceptive simplicity of the underlying model. The only decision that participants are asked to make is to order capital for the capital goods sector, and they are supplied with all relevant information except the order stream for new capital which eminates from the goods producing sector of the model. Even when these exogenous orders follow a straightforward pattern such as a step function, as is the case in this experiment, returning the system to equilibrium is problematic for most participants. As Sterman suggests, "the optimal path is at once too difficult to compute and too different from intuitive notions of reasonable strategy" (1989: 323).

Experimental Cohort

The subjects of this experiment are 56 students enrolled in a psychology class at Worcester Polytechnic Institute. They were not paid for their participation, nor were their grades affected by either participation or performance. Although this calls into question the motivation that some subjects might have had (many students admitted on a post test that they did not try

very hard to score well on the flight simiulator), the cognitive styles tests could well be expected to explain who was motivated and who was not given the nature of the tasks involved.

Preliminary Results

- Neither Gordon's Cognitive Styles Indicator nor the Myers-Briggs Type Indicator™ are successful in explaining the variation in the flight simulator scores at any reasonable level of significance.
- The two Abstract components of the Gregorc Style Delineator™, AS and AR, do seem to explain flight simulator scores. Using simple linear regression techniques, coefficient estimates for AS and AR are -246 and -230 with p-values of .06 and .07 respectively. Given that both AS and AR range in value from a low of 10 to a high of 40 with means of 28.75 and 27.50 respectively, the coefficient estimates are sufficiently large to warrant further investigation. A regression using an explanatory variable which is the sum of AS and AR yields similar results. The coefficient estimate for this variable is -122 and the p-value is .009. Simply put, as the Abstract score on the Gregorc Style Delineator™ rises, the score on the Kondratiev flight simulator becomes smaller (better).
- Scores on the flight simulator do not explain scores on a post test administered shortly after subjects played the game. This post test was designed to see if subjects learned about Kondratiev cycles. Although a tentative finding, it suggests that the process of learning may have little to do with performance on flight simulators. Similarly, none of the cognitive styles tests explained scores on the post test either.
- The various cognitive styles tests are in general not correlated with each other. Although the Gregorc components are correlated with Gordon's notion of Differentiation, they do not explain Remote Association nor any of the MBTI.
- Subjects who identified themselves as possessing weaker computing skills (3 or 4 on a 7 point scale) scored significantly better on the Kondratiev flight simulator.

Conclusion

Many of those who use system dynamics and flight simulators as teaching tools, particularly those who do consulting, assume that what works for one works for all. Our research results begin to suggest that this is not true.

References

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