Give me the right goals, I will be a good dynamic decision-maker

Jenshou Yang
Department of Business Administration, National Yunlin Institute of Technology, 123, University Road Section 3, Touliu, Yunlin, Taiwan, R.O.C.; E-mail: yangjs@ba.yuntech.edu.tw

Introduction

Previous studies on dynamic decision making found people fail to control dynamic complex tasks. A number of bounded rationality in dynamic decision making were found including (a) narrow time span of thinking where ignoring time delay (Sterman, 1989), (b) unable to dealing with interdependence among subsystems (Forrester, 1995), (c) linear decision rule which is not appropriate for nonlinear characteristic of dynamic complexity (Doerner, 1980). Given the bounded rationality of dynamic complexity, this study focuses on how to improve dynamic decision performance through goal setting.

A Systems Archetype View of Poor Dynamic Decision Performance

Subjects perform worse because they are bounded rational on dynamic complexity and thus trapped by some unrecognized systems archetype. For example, it is the Beer Game that belongs to Balancing with Delay structure, and the minimize stock/backlog goal thereby forcing participants to overshoot (see Figure 1). Goals dictate people's behavior and are the necessary factor to produce overshooting behavior. The Balancing with Delay structure is the other necessary condition which results in overshooting behavior.

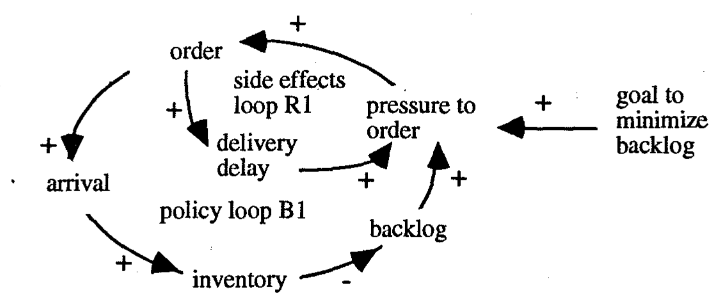

Figure 1. Beer Game is a Balancing with Delay systems archetype

The task adopted by Sterman (1989) is another case. As shown in Figure 2, the structure combine the "minimizing gap goal" to be a Fix That Fail systems archetype. Large amount of order fluctuation can not be produced by only subjects' unrecognition of unexpected reinforcing loop R1 unless they accepted the goal of minimizing the gap.

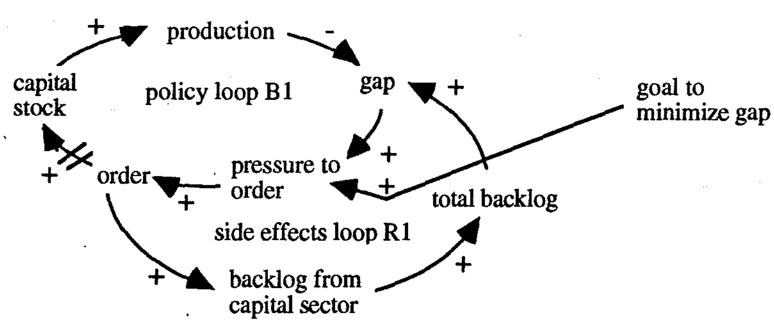

Figure 2. The task used by Sterman (1989) is a Fix That Fail systems archetype

Yang (1996) found when subjects accepted 30% order growth rate goal they suffered Growth and Underinvestment behavior as Growth and Underinvestment systems archetype predicted. As shown in Figure 3, the combined structure including "maximize order growth goal" became a Growth and Underinvestment systems archetype. Given subjects' bounded rationality of dynamic complexity, they hired too many salesmen and hesitated to invest resulting in underinvestment and delivery delay. Poor performance occurred. Underinvestment can not be produced by only subjects' unrecognition of unexpected balancing loop B1 unless they accepted the maximizing order growth goal.

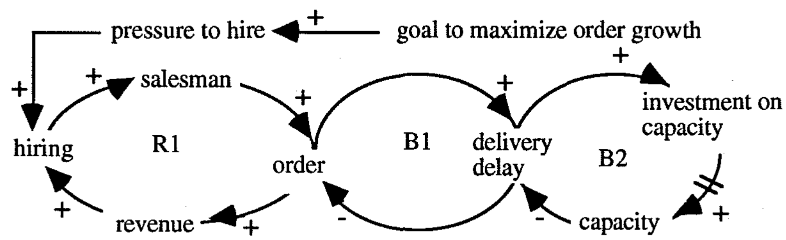

Figure 3. The task used by Yang (1996) is a Growth and Underinvestment systems archetype

Improving Performance via Setting Right Goals

Given the proposition that bounded rationality of dynamic complexity, counterintuitive structure, and the goals combine to determine some dysfunctional systems archetype behavior and poor performance. The hypothesis of this study was dynamic decision performance could be improved via right goal settings.

Method

Task

The dynamic decision task, a management flight simulator, as shown in Figure 4, was a simulated ecosystem. The decisions in the task were the number of prey hunting and predator killing. Subjects managed the system via the two decisions to reach the assigned goals.

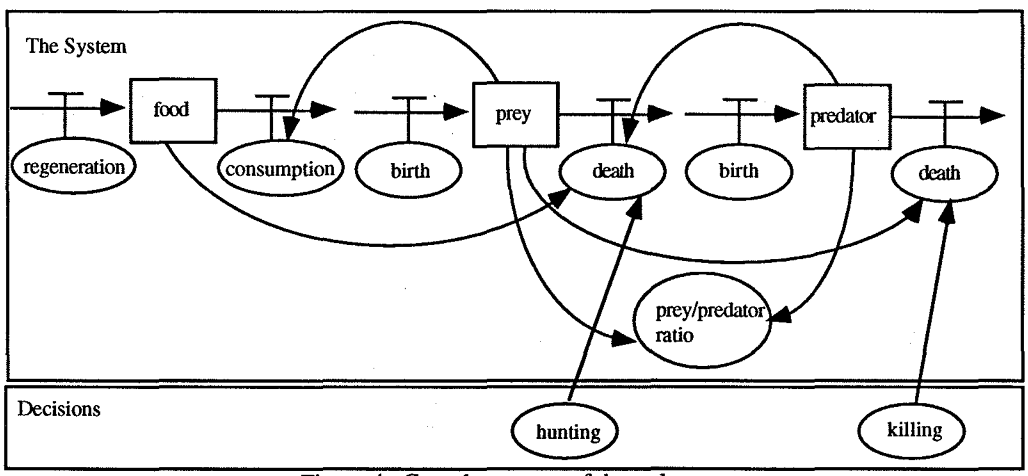

Figure 4 Causal structure of the task

Design

Three kinds of goal setting were manipulated as following under the consideration that the number of prey and predator and the prey/predator ratio was 1400, 492, and 2.85 respectively at steady state. Ten percent of variation was allowed. The first was prey/predator ratio goal, a wholesystem ratio goal, in which subjects were instructed to maintain the ratio between 2.57 and 3.14. The second was prey/predator number goal, a wholesystem number goal, in which subjects were instructed to maintain the number of prey within 1260-1540 and the number of predator within 443-541 at the same time. The third was prey number goal, a subsystem goal, in which subjects were instructed to maintain the number of prey within 1260-1540. The more times subjects reached the goals, the better their performance.

Dependent Variables

Fix that fail decisions Fix That Fail dysfunctional behavior occured when subjects were bound rationally ignoring the side effects of hunting or killing too many prey or predator to reach the goals. The hypothesis was that subsystem goals induced more Fix That Fail decisions.

Goal achievement. The times that subjects achieved assigned goals was used as performance measurement. The hypothesis was that wholesystem goals were beneficial for keeping the systems under steady state that is reaching the goals.

Results

The analysis results supported the hypothesis that goal setting made difference on behavior and performance. Subjects in prey/predator ratio goal condition made more dysfunctional decisions and thus performed worse than prey/predator number goal condition.

Fix That Fail decisions

As shown in Table 1, subjects made more dysfunctional Fix That Fail decisions in prey/predator ratio goal condition than in prey/predator number one ($X^2(2)=4.04$, $p<0.05$). Subjects accepting prey/predator ratio goal made Fix That Fail decisions because they intended to decrease prey/predator ratio. While hunting too many prey resulted in the decrease of predator and thus increased prey/predator ratio consequently as shown in Figure 6. The side effects loop R1 was overlooked although the goal consisted of the number of prey and predator.

Table 1. Fix That Fail decision and goal achievement

	prey/predator ratio goal setting	prey/predator number goal setting	prey number goal setting	Test
Fix That Fail decision [a]	28	19	25	$X^2(2)=4.22$, $p=0.12$
destruction [a]	18	0	5	$X^2(2)=27.88$, $p<0.005$
prey/predator ratio goal achievement [b]	1.1	2.3	0.5	$F(2,72)=10.46$, $p<0.0001$
prey/predator number goal achievement [b]	1.2	2.5	1.0	$F(2,72)=7.38$, $p<0.005$
prey number goal achievement [b]	2.1	3.3	3.2	$F(2,72)=4.141$, $p<0.05$

a: N=41 for each cell; b: Number presented was goal achievement for the final 5 decisions.

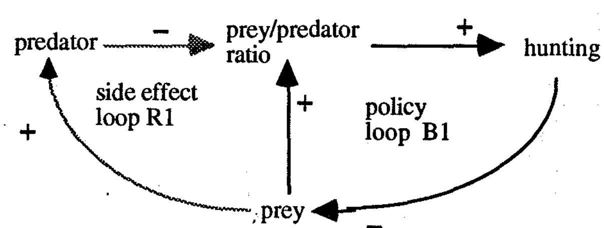

Figure 5. Fix That Fail induced by the prey/predator ratio goal

Given subjects' bounded rationality of dynamic complexity, a wholesystem goals such as prey/predator number goal can not stop Fix That Fail decisions thoroughly as shown in Figure 6. In order to decrease the number of prey, subjects hunted too many prey to decrease predator unexpectedly and increase prey consequently. More subjects made this kind of dysfunctional decisions in prey number goal condition than in prey/predator number one.

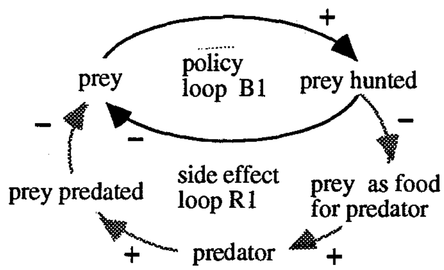

Figure 6. Fix That Fail induced by the prey/predator number and prey number goals

Goal achievement

As shown in Table 1, subjects accepting prey/predator number goals outperformed the other two groups no matter what goal achievement measurements. The other performance measure that can be used is to look at the times of system destruction where subjects made too inferior decisions to destroy the ecosystem. There were eighteen subjects (45%) destroyed the system in prey/predator condition that was significantly more than the other two conditions.

Discussion and Conclusion

The hypothesis that the choice of goals affects subjects' decision behavior and performance was supported in the study. Prey/predator number goal, a wholesystem goal, induced less Fix That Fail decisions and performed better than the other two types of goals. Although two main stock variables were included, prey/predator ratio goal setting led subjects to pay attention to prey or predator subsystems only and make Fix That Fail decisions to destroy the simulated system frequently. When goals were set with the number of stocks, prey/predator number goal led subjects to pay attention to both the two main subsystems of prey and predator and decrease Fix That Fail decisions. Further, the choice of goal just from the subsystem point of view is insufficient as well. Prey number goals led subjects to make Fix That Fail decisions and perform worse.

In conclusion, the choice of goals affects decision-makers' focus of attention. Given people are bounded rationally on dynamic complexity and goals oriented , an inferior choice of goal causes decision-maker to fail to manage the systems successfully; some dysfunctional systems archetype behavior resulted. Choosing the right goals, people could be good dynamic decision-makers.

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