CCE: Cognitive Chrono-Ethnography
A Method for Studying Behavioral Selections in Daily Activities

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Abstract We, human beings, select next behaviors that should maximize our satisfaction by making use of meme that stores our past experiences and by processing input from environment and individual by appropriately allocating available cognitive resources. The underlying processes are simulated by Model Human Processor with Real Time Constraints, MHP/RT (see http://staff.aist.go.jp/kitajima.muneo/organic-self-consistent-field-theory/mhp-rt.html). On the basis of MHP/RT, this paper proposes a new study method for understanding human behavior selections in daily life, *Cognitive Chrono-Ethnography*, CCE. When a study field is specified, CCE defines critical parameters by conducting qualitative MHP/RT simulations, then designs ethnographical field observations and recordings of elite monitors' behaviors in the space defied by the critical parameters. Structured interviews follow in order to obtain the descriptions of the participants' history of behavioral development. By analyzing the results of interviews, models of present behavior selections and chronological changes will be built.

INTRODUCTION

Our 24-hour day is roughly divided into three categories. The first is the hours for work in order to earn money necessary for daily life, the second is the hours for biological activities, *e.g.*, eating and sleeping, that are necessary to live, and the third is the hours for leisure activities, *e.g.*, playing sports, watching TV, driving a car, playing PC games, traveling, going to the movies, and surfing the Web. Traditionally, human factor studies have dealt with the first two categories.

Recently, with the development of ICT, many leisure-time opportunities have been provided by a number of service industries. Whether to use the service repeatedly or quit using it is solely up to the receptor, and the decision is not critical. However, since our ultimate purpose of living is to spend hours of satisfaction, provision of appropriate services to an individual receptor is of vital importance.

This paper proposes *Cognitive Chrono-Ethnography* (CCE), a new method for studying service receptors' behavioral selections. The following sections describe CCE and elaborate on its distinctive features, such as conducting a field study with a limited number of elite monitors and retrospective interviews that consider human cognitive-behavioral processing during the interview sessions.
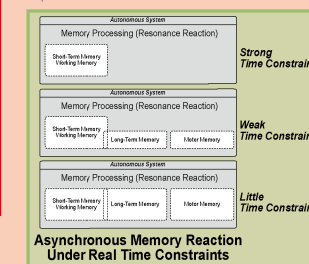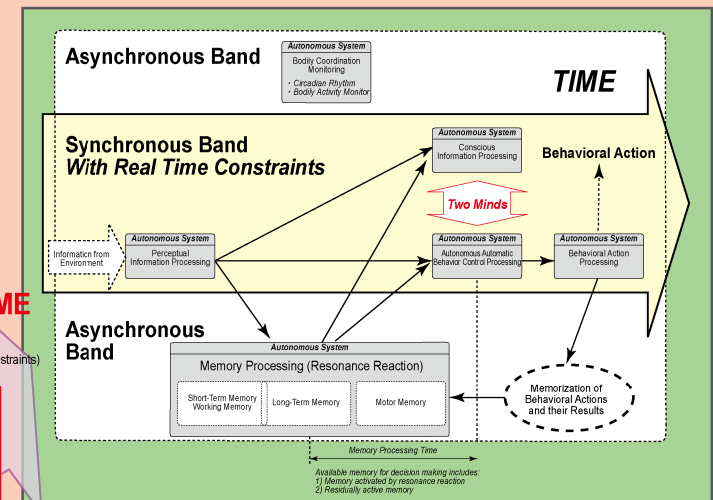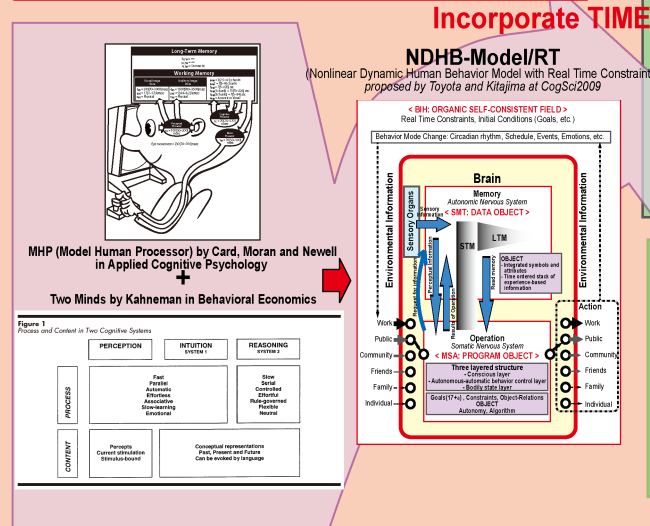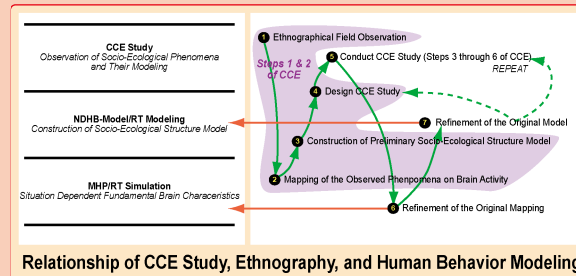
COGNITIVE CHRONO-ETHNOGRAPHY

Outline of CCE

CCE consists of ethnographical field study that is designed by considering cognitive constraints in order to understand service receptors' behavioral selections in terms of their chronological development. In this section, we describe each of the three concepts of CCE: ethnography, chrono(-logy), and cognitive constraints.

Ethnographical field study. By definition, service is intangible, heterogeneous, simultaneous in production and consumption, and perishable. Therefore, the study must be conducted at the site where a service is implemented, not in a laboratory. In other words, the study method must be ethnographical.

Chronological understanding. What a person does at a specific time is determined by contents loaded in working memory, which originate from the environment and long-term memory. Sensory input from the environment is controlled by cognitive processes. Long-term memory cumulatively stores information as a person's living history and works as an autonomous system. Therefore, understanding the service receptors' behavior in the study field involves understanding active memories when they receive the service at the time of the observation and the developmental process of the active memories in their service-receiving histories. Retrospective interviews are conducted to analyze the meme structure.

Cognitive constraints. Service receptors engage in cognitive-behavioral processing; therefore, ethnographical observables are constrained by service receptors' cognitive capabilities. This feature is described by the *Model Human Processor with Real-Time Constraints*, MHP/RT, that extends the seminal "Model Human Processor" (Card, Moran, and Newell, 1983) for simulating people's information processing tasks in the domain of daily activities by incorporating such ideas as Two Minds, which is the basis of Kahneman's behavioral economics, long-term memory as an autonomous system, sophisticated goal management for pursuing satisfactory living, and real-time constraints to organize behavior synchronously with the environment. Cognitive constraints include the following: the capacity of working memory is limited; the contents stored in working memory decays, *e.g.*, at the rate of two or three items in 10 seconds; memory is bound to the context in which it was formed, *i.e.*, encoding specificity principle; contents in long-term memory are re-

trieved by placing cues in working memory; and behavioral selection is not rational, *i.e.*, bounded rationality and satisficing principle.

Ethnographical field observations must be designed by considering the cognitive constraints that affect the service receptors' behavior. In addition, retrospective interviews for chronological understanding of the service receptors themselves are also regarded as cognitive-behavioral activities; thus, it is necessary to design the interview sessions by considering cognitive constraints.

CCE's Procedure

CCE is carried out in the following six steps.

Step 1: Define the study field. It is important to specify the study field sufficiently to undertake successful CCE studies. Manifestations of cognitive constraints under the characteristic atmosphere of the study field, which must be understood in terms of the effects of cognitive constraints, will be observed in the study field.

Step 2: Define critical parameters. Critical parameters are initial hypotheses about the cognitive constraints that should work when service receptors' activities are organized in the study field. To do this, it is necessary to examine the structure and dynamics of the study field in order to ensure the existence of chronological changes of the service receptors, to construct hypotheses about the critical parameters, and to carry out a preliminary test. Steps 1 and 2 are conducted interchangeably to define the parameter space to be explored.

Step 3: Select elite monitors. In order to conduct CCE, we select study participants (elite monitors), using the parameter space. Each point in the parameter space has values, continuous or discrete. We want to

know what such-and-such service receptors would do in such-and-such way in such-and-such circumstance (not an average behavior). Therefore, we select service receptors in which we are interested (such-and-such persons) by consulting the parameter space. In this process, it is necessary for the points in the parameter space that correspond to the elite monitors to be appropriate for analyzing the structure and dynamics of the study field. Monitor selection is conducted by purposive sampling rather than by random sampling. This step is unique to CCE.

Step 4: Record the monitors' behavior. The elite monitors should behave as they normally do at the study field. We record their behavior in such a way that the collected data is rich enough for us to consider the results in the parameter space, as unintrusively as circumstances allow.

Step 5: Conduct retrospective interviews. We then use the collected data to clarify the structure of the meme of the elite monitors by conducting a series of structured interviews. The results of the interviews are analyzed for the purpose of defining the basis of the representations of the collected data. The analysis involves finding common terms used in the interviews and common activities that are defined by combinations of the common terms, as well as statistical analysis of the activities, *e.g.*, factor analysis and cluster analysis.

Step 6: Construct models of service receptors. The last step of CCE is to construct models of service receptors that address what such-and-such service receptors do in such-and-such a way in such-and-such circumstances.

Relationship of CCE Study, Ethnography, and Human Behavior Modeling

MHP (Model Human Processor) by Card, Moran and Newell in Applied Cognitive Psychology
+
Two Minds by Kahneman in Behavioral Economics

NDHB-Model/RT
(Nonlinear Dynamic Human Behavior Model with Real Time Constraints)
proposed by Toyota and Kitajima at CogSci2009

Incorporate TIME

Asynchronous Memory Reaction Under Real Time Constraints