2003－IS－86 (5)
2003／11／19

2つのモードをもつ行動モデル
- 情報通信システムのデザインのために -

下川 信祐† 新上 和正‡ 大田原 一成†

人はどのようにしてシステムと深い関係を形成して行くのでしょうか？これを解き明かすには，従来のタスクレベルを越え，人レベルで利用行動を考察することが必要です．私たちは情報通信と人の幅広く深い関わりに注目します．マクロに眺めると現代の情報通信には，計算機と電話に由来する2元性（双対性）が現れています．これは，アンケート調査の分析で得られたミクロレベル（利用行為）での2種類の複雑さ（多様性と高次元性）に応じています．ミクロからマクロに一貫して2元性に応じている性差に注目し，その行動的起源を辿り，2つのモードをもつ行動モデルを抽出します．これは双対的なマクロ構造や性差研究報告を説明します．ユーザー経験を予想するための参照モデルとしてデザインに利用できます．また，人と深い関係を形成するためのシステム概念，技術と人間社会の発展に対する鳥瞰図，ライフスタイルの長期的シフト（日常化）が導けます．

A dual-mode behavioral model
- For designing information-telecommunication systems -

Shinsuke SHIMOGAWA† Kazumasa SHINJO‡ Kazushige OHTAWARA†

How do people generate deep relationship with a system? To reveal this mystery, we should study user's behaviors in individual level beyond ordinary task level. Attentions are paid for wide and deep relationships between people and telecommunications. A duality can be seen macroscopically in modern telecommunications. This duality corresponds to two types of microscopic complexity from the analysis of a questionnaire survey. Focusing on sexual difference laced through the scopes, we consider the behavioral origin of biological sexual difference and derive a dual-mode behavioral model. This model explains the duality and results from gender/sexual-difference studies. The model implicates a system concept for deep person-system relationships, entire perspective of human and technologies, and a long-term life-style-shift (usualization). The model may help designers to predict user's experiences.

1 Introduction

Recently, information and telecommunication fields have matured. PCs and cellular phones have prevailed very widely. High-profit products and services are going to be replaced by very low-profit ones. The impacts of new technologies intended for higher performances and higher functionalities have been smaller and smaller. The risk of market failures for new services and new products are increasing more and more.

It is said designers should carefully consider the opportunity of businesses from the customer's point of view when they introduce new technologies. However, it is still open problem to understand how people accept products and services even in information and telecommunication fields. A typical example is cellular phones. Cellular phone service as well as its short text messaging has been very widely spread in many countries. Cellular phones are, however, not easy to use, not good quality of voice, and not cheap. They may be interesting or enjoyable but different from entertainments such as games, movies, and music. An experimental study reports that users strongly complained about the stress or a bad condition when they were forbidden to use cellular phones for 15 days (Batista (2001)). Deep relationships have been established between users and cellular phones (Mikami et al. (2001), Macromill (2003)). If one can reveal the secret mechanism of how such a deep relationship between a person and a system is generated, it must strongly help us to design a new system for its prevalence.

This subject of understanding the generation of person-system relationships lead us to the issue of modeling behaviors in an individual or person level beyond the ordinary task level (Te'eni (2001)). In fact, person-system relationships are created in a person through her/his experiences of interactions with the system. These experiences strongly depend on how the person sees, looks at, touches, feels, and acts with the system and on how the person evolves the interactions between her/him and the system with affecting to her/himself. A person dominates these behaviors of these person-system interactions. For example, tasks and goals, even if they can be seen, are generated and selected through the experiences depending on their meanings to the person. The types of tasks and goals emerged in the interaction may be explained from a person level model but not from task level models.

We approach the issue of individual level modeling of behaviors from the viewpoint of telecommunications. There are three reasons. The first reason is to be pragmatic, i.e. the model based on telecommunications may be applied efficiently for designing new telecom-

† ATR 適応コミュニケーション研究所 619-0288 京都府相楽郡精華町光台 2-2-2. E-mail: simogawa@atr.co.jp
ATR Adaptive Communications Research Laboratories, 2-2-2, Hikaridai, Seika-cho, Soraku-gun, Kyoto, 619-0288, Japan
‡ 株式会社ヴィジィ Viziv Co. Ltd. Japan

munication systems and services. The second reason is the deep relationship of telecommunications and human. Namely, telecommunications are based on huge infrastructures. From the economical viewpoint, the efficiency of telecommunication infrastructures decreases when the population of users decreases (network scale merits, e.g., Wenders (1986)). Decreases of user population make carriers very difficult to keep their infrastructures constructed with huge investments. Therefore, the evolution of telecommunication means that people keep using telecommunication systems, which means persistent relationships of people and telecommunications. Moreover, recent rapid evolution of modern telecommunications suggests that these persistent relationships may be emerged from the nature of human being. This is because persistent relationships should be compatible with the inside of human in some depth and the evolution of modern telecommunications is too rapid and too wide for people to change their deep inside for adapting modern telecommunications. The third reason is various scales of viewpoints. Namely, telecommunications can be seen as those by one person, between two persons, among intimate people, in a local area, in an organization, in a region, in a country, and in the world, where corresponding networks and/or infrastructures may show characteristics of each scales. Therefore, we may study telecommunications from appropriate macroscopic view to microscopic view, which may reduce the risk of missing basic and important properties in complex behaviors of a person.

First of all, we note that there is a duality in modern telecommunications from macroscopic viewpoints. That is, PC/Internet and mobile phone are two major domains of modern telecommunications, where these two domains show contrastively different (or anti-symmetric) characteristics for various macroscopic aspects. Next we go close to persons. For this, our main base is a questionnaire survey focusing on but not limited to high school girls on the use of communication tools including Print Club[1], Pocket Bell[2], PHS, cellular phones, E-mail, and WWW, which was made in 1998 just before the explosion of cellular phone prevalency. Through the analysis, two types of complexity can be seen in the interactions and the images of uses with those tools. One is the wide variety of interactions and the other is the higher dimensionality of interactions. These two types of complexity of interactions seem compatible with the macroscopic duality in modern telecommunications. Because these two types of complexity seem significant in the sexual difference, we consider behavioral origin of the sexual difference with the aid of the book by Margulis and Sagan (1997). This is due to the principle of interactions. That is, a person can interact with systems because the person has the very long history of biological organisms originated in the Archeozoic. Through an abstraction, we obtain two distinct and primitive types of actions of an individual with its environment. One is to act toward the environment whereas the other is to pull up preferable entities in distant area to its proximity. These two types of primitive actions can be seen in the famous two-hands experiments in phenomenology (Merleau-Ponty (1964)).

These two types of primitive actions can be considered as short-term behaviors. Long-term behaviors of them can be naturally derived where the two types of complexity seen in the questionnaire survey can be represented as the variety of closed interactions and an open continuum of higher dimensional interactions. Two types of behaviors should be considered as two mental modes of an individual, which are called, closed mode and open mode. This two mode model is compatible with the studies of sexual differences in cognition presented in Kimura (1999), and may compatible with the two dimensional measure due to Bem (1974) of gender including psychological androgyny. The dual mode model of a person can explain the duality in modern telecommunications. The model explains results from gender studies (Venkatesh and Morris (2000), Gefen and Straub (1997)) in the technology acceptance modeling research, where significant correlations in mental affects are analyzed from survey data. The closed mode behaviors explain the activity profile observed in a longitudinal study of PC/Internet use in households by Kraut et al. (1999).

Based on the dual mode model, we derive the entire perspective of the evolution of society and (information-telecommunication) technologies. In the perspective, new technologies are born in the boundary of the society with some wildness, and then they go to the boundary of open mode behaviors with themselves tamed. If the tamed technology is compatible with open mode behaviors, it may be pulled up into the area of open mode behaviors. For this case, a technological product is soon consumed or survives for long time by supporting the open neighborhood of an individual. This final step of supporting open neighborhoods may characterize strongly prevailed systems such as mobile phones beyond easy-to-use systems (Norman (1998)). The flow of technologies being pulled up into open mode area continuously expands the open neighborhoods. This expansion seems to shift life-style of people gradually by extending the situations where people behave with usual senses. Thus, the perspective suggests a long-term life-style-shift, which is said to be "usualization."

The model leads us to the concept of systems for open mode behaviors. Namely, in designing, a system is specified by its short-term behaviors but evaluated by user's experiences, which are long-term behaviors. The dual mode model provides both short-term and long-term behaviors. A system is said to be for open mode behaviors (abbr. OMB) if it mediates short-term open-mode behaviors with the long-term model, which seems necessary property of a system for establishing such relationships with users as mobile phones established. Characteristics of OMB systems are not only to support a user to quickly generate and access to a variety of preferable entities around the boundary but

1 Registered trade mark of ATLUS CO. LTD.
2 Registered trade mark of NTT DoCoMo, Inc.

also to support the user to quickly find meanings of the entities in open relations to her/his familiar things and senses.

The dual mode model helps the designers to predict user's experiences with a system. In fact, the closed mode describes the ordinary behaviors of designers when s/he develops functions whereas the open mode describes the user-behaviors that emerge such relationships as mobile phones established. With the references of the dual mode model, a designer may incorporate the way of user's behaviors into her/himself, predict user's experiences with a system, and then evaluate the extent of the open mode behaviors that the system supports.

2 A duality of modern telecommunications

Telecommunications have evolved extensively and now they are very complex. An approach for understanding them may be taking macroscopic viewpoints because characteristics seen in macroscopic viewpoints may reflect such basic factors as are common to most of the various microscopic telecommunications. Surprisingly, a duality can be seen in modern telecommunications from macroscopic viewpoints. In fact, it is not difficult to recognize that there are two major fields in modern telecommunications as shown in Fig.1. One field comprises mobile phone communications, which can be seen as evolved from the ordinary telephony. The other comprises communications mediated by Internet, intranets/LANs, and PCs, which can be seen as evolved as downsizing and globalizations of computer networks.

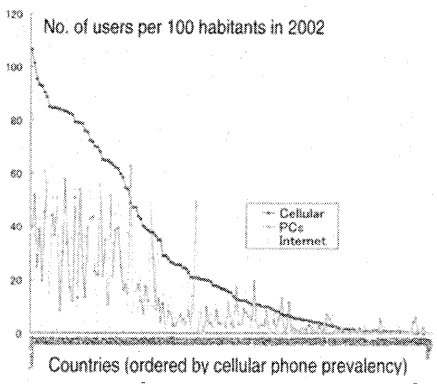

Figure 1. Worldwide prevalency of mobile phones, PC, and Internet (created from data of ITU (2003))

It should be emphasized that these two fields show contrastively different, or anti-symmetric, pairs of characteristics in various aspects as listed in Table 1. (Backups for this table will be shown in the presentation.)

Table 1 Dual characteristics of modern telecommunications

	Internet/PC	Mobile phone, telephone
Market evolution	Impactive introduction Limited prevalency Some bubbles	Silent introduction Higher prevalency Steady revenue
Social type	Organization	Person
Payment	Cheap	Expensive
Age	Shift to elders	Younger the stronger
Gender	Males	Females
Main contents	Information useful in business, hobby, study Playing games For outside the local community	Private communication with partner, family, and friends Within the local community
Contents volume	Rich	Light
System	Wide variety of complex functions "Parasite" to existing infra, Interconnections of open elements	Limited variety of simple functions Huge investment for infra Closed-ness of network, terminal, service, contracts with users, etc
Industry	Heterarchical, dynamic Users sometimes become suppliers.	Hierarchical, static Users are users forever.
Traffic	Long range dependence (Weak entropy generation)	Short range dependence (Strong entropy generation)

3 Two types of complexity in user-system interactions: analysis of a questionnaire survey

3.1 Interaction: A scheme of investigating user's experiences

Let us investigate microscopic behaviors, i.e., person's experiences through telecommunications. Experiences of using systems can be considered as the interactions as described in Fig. 2. Namely, the relationship between a person and a system is emerged from experiences of interactions among the person, the system, and environments. Because a person (human being) and a system (machines) are of mutually different natures, these interactions may be limited in the beginning. The interactions include mental affects, such as senses, feelings, emotions, moods, meanings, expectations, perspectives and so on. These mental affects are caused to the person by cooperative actions of the person and the system under the influences of environments. These affects change the person, which causes cooperation and interactions to evolve or to decay. The (extensively) evolved interaction means the relationship between the person and the system is adoptive. According to this outline, we should study the

evolutional behavior of the interaction emphasizing on the mental affects to persons.

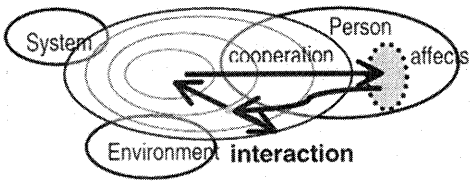

Figure 2. Interactions: basic scheme of investigating user experiences

3.2 The outline of the questionnaire survey

In the middle of 1990s, new telecommunication systems such as mobile phones, PHS, and Internet/PC began to prevail in Japan. We made a questionnaire survey Shimogawa et al. (1998), on the use of new communication tools from January to February of 1998 in Japan in order to explore the interaction that forms relationships between people and these new telecommunication systems. This survey aimed at observing the behaviors of people in continuing to use these tools and in non-continuing to use as well as people's images of the tools behind the behaviors. This survey was made for young people focusing on high school girls. Among a number of reasons, quite high prevalency of pager among them should be noted. Namely, in the autumn of 1996, the users of the pager (resp. mobile phone) were 43% (3.4%) of high school girls, 19% (8.6%) of high school boys, and 10% (10%) of general Japanese.

The communication tools concerned in this survey are wireless pager, PHS, cellular phone, and E-mail. This survey also concerns about some goods that are related to but different from communication tools, which enable us to study communication tools from their outside. These goods are Print Club, and Tamagotchi[3].

3.3 Grouping of tools and the variety of interactions

Fig. 3 shows grouping of communication tools. This grouping is based on respondents' written impressions and marked reasons to continue using and to have given-up using. It is found that the variety of impressions and reasons depends on groups and increases as G1 < G3 < G2 < G4, which implicate the increase of variety of interactions. It should be noted that this line alignment of the groups seems compatible with the two major domains of modern telecommunications. In fact, it is natural to add www and PC to the right-hand end of the line from the viewpoint of the complexity of functions provided by systems.

3.4 Gender shifts and dimensionality of interactions

This grouping shifts depending on the sexual difference. The variety complexity decreases [resp. increases] when the respondents are limited to females [resp. males]. In order to analyze this gender shift, we consider the dependency network of the marked reasons. That is a selection item *i* is said to be *dependent* of *j* for a collection *A* of the respondents if most of the respondents in *A* who selected *i* also selected *j*. An item *k* is said to be a *base* if a number of items depend on *k*. A base *k* is said to be *local* if the items depending on the base k are limited. It is found that the dependency network of female respondents has a number of local bases whereas that of male respondents has little local bases. This implicate that the interactions of a female may share lager number of factors than those of a male, which means the dimensionality of an interaction of a female is much higher than that of a male.

In summary, two types of complexity can be seen in person- system interactions. Higher dimensionality and small variety may characterize female-bias of interactions whereas lower dimensionality and wide variety may characterize male-bias of interactions.

4 Considering behavioral origin of sexual difference

Sexual difference seem quite important because from both macroscopic and microscopic viewpoints, dual characteristics seem to deeply related to sexual difference. Now we apply a basic principle of interactions. That is, a person can interact with a system because a person can interact with her/his environments. This capability of interactions has been acquired through the very long evolutional history of biological organisms. Therefore, it is rational to consider biological origin of sexual differences. Because the biological evolution transfers behavioral properties into organic structures through adaptations, we should consider behavioral

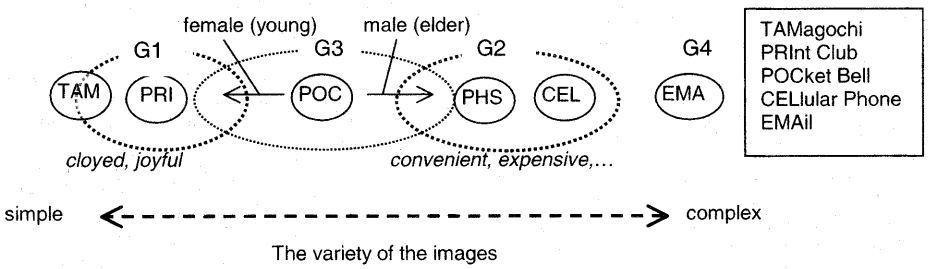

Figure 3. The grouping of communication tools based on users' images

[3] Registerd trademark of BANDAI CO. LTD.

origin of sexual difference.

According to a modern biology theory (Margulis and Sagan (1997)), the origin of sex is supposed to be usual transfers of genes among archean bacteria (prokaryotes). These transfers of genes are unidirectional and independent of reproductions of the bacteria. The impact of this genetic communications is symbiosis, i.e., the shares of safe mutational genetic codes, where mutations are usually dangerous for each bacterium but ultimately drive adaptations of the bacteria community to their environments (biological evolution). There is no gender among the bacteria. An origin of the fertilization with a sexual difference (female and male) is supposed that two similar unicellular eukaryotes try to eat each other. Fertilization succeeds if one eukaryote eats the other but the nucleus of the eaten eukaryote survives and two nucleuses fuse into one with two sets of chromosomes. Temporally, the eating eukaryote is female whereas the eaten one is male.

We try to construct a behavioral model of an individual through characterization of this distinction. For this purpose, let us describe the behaviors of the male and the female in this illustration in terms of the interaction of an individual (eukaryote) and its environment. For simplicity, we consider the set of genes as the center of an individual. The set of genes is transferred into the female eukaryote, (1) which can be seen that the male acts toward the environment. The female is just eating under the transfer, (2) which can be seen that the female interact with the environment by pulling up effective entities from the environment to her proximity (inside the cell near the genes).

These two types seem basic distinct classes of the interaction of an individual with its environment. This pair of behavioral types has been used by the transfers of genes (sex) including fertilizations and then it is more general than the sexual differences. Because transfers of genes play a basic role of biological evolution, the transfers, gender and sexual differences may have evolved as they have been much compatible with the pair of behavioral types. Thus both of these two types of interactions can be seen in an individual but there may be unbalance between the appearances of the two types of interactions depending on an individual. This dependence is, at least macroscopically, on the gender of the individual.

On the other hand, because these two types of interactions seem basic and general, they may play basic roles for the adaptation to the environment including biological evolution. Namely, biological organisms have been adapted to their environment. Functions of the adaptations have been acquired as complex structures of these organisms spending very long time. Because of the open nature of biological organisms, their environment often includes the new entities and factors that are seen to be dangerous for the complex structure but to be necessarily taken into account for the adaptation. For this conflict, it is natural to suppose that the actions toward the environment try to take the new entities into the interaction running the risk whereas the pulling-up takes a distance from the environment that may contain new factors and then selects preferable safer entities from the distant environment.

These two types of actions may be seen to collaborate to resolve the conflict. This is because the actions toward the environment may transform the new environmental entities into safer or familiar forms, from which the pulling-up selects. This collaboration can be seen in the bacteria society. Bacteria acquire new function in the code through the high-risk environment such as ultraviolet radiation. It is known that the bacteria collapse themselves and spread their genes if the bacteria are placed under some high-stress environment. These genes often survive and reach the other bacteria placed under better environments, and then the codes acquired in the self-collapsed bacteria are taken into the others. Here the creations of new codes under the high-stress can be seen as the actions toward the environment whereas the transfer of the new codes can be seen as the puling-up interactions of the bacteria society.

These basic roles in the adaptations imply that the organisms may have been evolved and acquired functions so that these two types of interactions can grow extensively. For example, these two types may be accelerated by pleasure and auto-controls of motions and sensing for the adaptation (Abram (1996)). On the other hand, in order to reduce the risk of the damages, it is reasonable to use a limited part of the individual but probably with stronger contact when the individual acts toward the environment. One may examine distinct types of the cooperation of our sensors and motions between the two types of interactions by touching one hand to the other and moving around the touching hand as shown in Fig. 4. This experimental situation is taken from phenomenology (Merleau-Ponty (1964)). The touching hand often uses a limited area, e.g., some parts of fingers, whereas an open wide area of the other hand is touched. Here both hands sense the surface of the touched hand.

These functions compatible with the two types of interactions may generate the mental mode (or psychological set) for each type through the pleasant experiences of the interactions. If the functions and the environments of an individual are unbalanced between the two types, the individual's behaviors may be extensively biased. Sexual type of an individual is probably an important factor of such bias.

5 A dual-mode behavioral model of a person

Based on the discussion above let us propose a behavioral model of an individual. (Figs. 4 and 5).

(1) There are two distinct types in the interactions of an individual with the environment: One type is to act toward the environment whereas the other type is to pull up preferable entities to her/his proximity selecting from those placed at distant areas of the environment. (Fig. 4)

(2) The action toward the environment generates a limited dimensional closed interaction with heavier activity. This closed interaction depends heavily on enti-

ties in the environment. The activity decays over time and then the individual exits from the interaction.

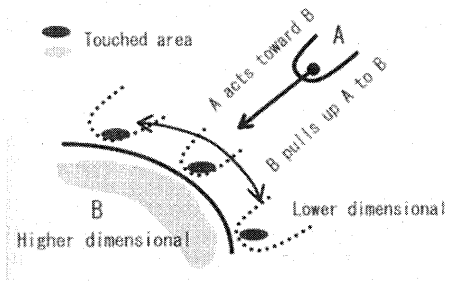

Figure 4. The short-term version of a dual-mode behavioral model (seen in the two hands experiment)

(3) The pulling-up action generates a higher dimensional open interaction with lighter activity. This open interaction lightly depends on the pulled-up entity from the environment but strongly depends on her/his mental and physical neighbor of proximities. This open interaction may not continue long time whereas new different interactions are easily generated by a little changes of the way of the interaction.

(4) Both open and closed interactions often generate positive affects such as pleasure, interesting feeling, hedonic sensation, excitement, vitality, and so on.

(5) There are two types of mental modes, which we call *closed* and *open*, corresponding to the two types of interactions. In the closed mode, an individual moves around at least mentally and acts toward the environment. A new closed interaction can be seen as a creation of a closed site mentally separated from other behaviors. After exiting from the closed site, the individual restarts moving around and then acts toward the environment repeatedly. To enter a closed site, the individual often needs to prepare appropriate formation of her/him-self in order to adapt entities in the environment. The timing to start the interaction can be delayed but an interruption after the start may collapse the closed interaction. Because closed interactions strongly depend on the entities in the environment, similar entities cause similar interactions. However, the interaction on a revisited site is no more heavily active than the time when the site was created. Thus, generated closed sites survive but age over time. An individual may go far away leaving behind the area of aged closed sites and rarely return there.

(6) In the open mode, an individual at least mentally sits down a place where unfamiliar entities in the environment are in distant areas. The individual selects an entity in the environment and pulls it up to her/his proximity, and then starts an open higher dimensional interaction with the entity. The interaction may finish soon but the pulled-up entity and the generated mental effects are kept at the proximity as far as new interactions affect them. The individual restarts to select another entity and pulls it to her/his proximity, and then generates next open interaction. Repeats of these pulling-up interactions create and expand her/his neighborhood of proximities. Because an open interaction strongly depends on the neighbor hood of proximities evolved by preceding open interactions, open interactions are often mutually correlated. Thus, interactions in this mode can be seen as a large open continuum of higher dimensional interactions generated on the expanding neighborhood of proximities. The dynamics of this open continuum is much complex and deep. Interactions are continuously generated and consumed. Associated with this, preferable entities placed at the boundary of the neighborhood and their generated mental effects float on the continuum to the center gradually. These entities and effects sometime invade the individual deeply.

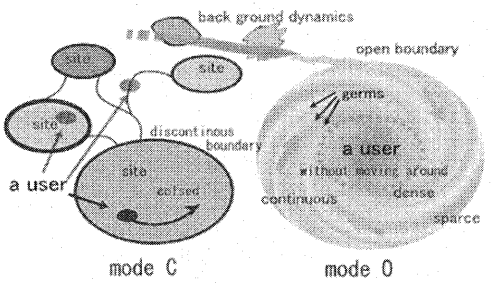

Figure 5. The long-term version of a dual-mode model behavioral model

The essence of this model is (1) describing short-term behaviors whereas (2)-(6) are derived naturally from (1) to long-term behaviors. We do not assert that all behaviors of an individual can be classified into these two types described in (1). There may be complex combinations of these two types of behaviors in general. Our hypothesis is that these two types can be basic aspects for most activities and outline them.

This model explains or is compatible with the macroscopic duality of modern telecommunications, the two types of complexity in person-tool interactions from the analysis of the questionnaire survey, studies of sexual differences in cognitive behaviors (Kimura 1999), two-dimensional gender measures allowing androgyny (Bem (1974)), studies with technological acceptance modeling (Venkatesh and Morris (2000), Gefen and Straub (1997)), and the gendered use of the ordinary telephony (Moyal (1992)). Because of the limited space, the details of them are omitted.

6 Implications and applications

6.1 An entire perspective of the relations between human and information-telecommunication technologies

The collaborative adaptation to the environment by the two type of behaviors discussed in Section 4 leads to illustrate an entire perspective of the relations between

human and (information-telecommunication) technologies.

(1) Open mode behaviors emerge in the central/core area of entire activities surrounded by closed mode behaviors.

(2) New environmental entities including technologies are found around the boundary of entire activities through highly active closed mode behaviors.

(3) Closed mode behaviors can communicate each other by exchanging closed sites. Low dimensional nature of a closed site reduces historical and cultural barriers for this communication.

(4) Because of the low dimensionality, activity with a closed site decays over time, which reduce wildness of new technology and requires ease-of-use to them. Tamed closed sites surround open mode behaviors. Open mode behaviors pull up preferable (technological) entities arrived at the boundary of the open neighborhood from tamed closed sites as well as other familiar entities. These entities may be consumed soon or mediate open mode behaviors. Ease of use or taming of technology may be necessary but not enough to mediate open mode behaviors. This is the uni-directional communications from closed mode behaviors to open mode behaviors whereas complex organisms (persons) are emerged from open mode behaviors.

(5) Open mode behaviors communicate each other by exchanging the entities including experiences that can easily correlate to open neighborhood consisting of familiar ones. Therefore, among matured open mode behaviors, communications may require that open neighborhoods of individuals have similarity, which depend on the histories and the cultures of them.

(6) The boundary of entire activity continuously expands by the creations of new closed sites whereas the uni-directional communications expand the open neighborhoods invading the ordinary closed mode areas.

6.2 Long-term activities of systems supporting open mode behaviors and closed mode behaviors

Long-term behaviors of the closed [resp. open] mode described as (5) [resp. (6)] in Section 5 implicate that the long-term activity profile of using systems supporting closed [resp. open] mode behaviors can be illustrated as in Fig. 6. This activity profile of closed-mode uses can be found in Kraut et al. (1999) where the activity of using PC/Internet in households was measured for one year. The long-term activity profile of open-mode uses such as using cellular phone seems not to have been reported yet, which is a conjecture derived from the model. On the other hand, this activity profile for the open mode is consistent with the prevalence profile of mobile phone where the number of subscriptions linearly increases up to 65% of the total population of Japan (Japanese Ministry of Public Management 2002) and with the preserved strong needs for it (Dentsu 2003).

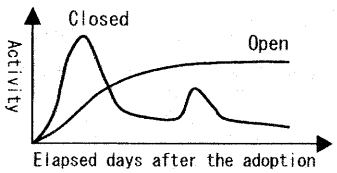

Figure 6. Activity profiles drawn from the dual mode model

6.3 Usalization: a long-term life-style-shift

The continuous expansion of the open neighborhood described in 6.1 (6) implicates a long-term life-style-shift. Namely, at the boundary of the open neighborhood, technologies are taken so that the open neighborhood expands. Because the open neighborhood consists of entities familiar to the person, s/he is in usual senses in the open neighborhood. Continuous expansions of this neighborhood implicate the expansion of the situations and the areas where s/he behaves with usual senses, which we call usualization. Namely, ceremonies become simpler year by year; we go to bed or go outside without changing cloths much often rather than before; mobile phones let us go to cities to meet friends without detailed planning; young females make up in commuter trains, and so on. It should be noted that usualization indicates the opportunity where technologies meet new needs for open mode behaviors.

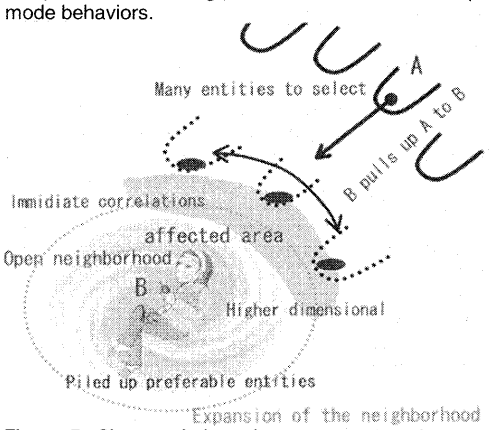

Figure 7. Characteristics of systems supporting open mode behaviors

6.4 Characteristics of systems supporting open mode behaviors

Let us discuss characteristics of the systems that support well open mode behaviors. Designing of a system must determine its short-term actions/behaviors. In order to figure out short-term interactions with a system, we should combine long-term behaviors and short-term behaviors as shown in Fig. 7. Systems supporting open mode behaviors should expand the open

neighborhood by mediating open mode behaviors. For this, ease of correlations to piled up entities inside of the open neighborhood seem much important as well as ease of pulling-up of many preferable entities around the boundary of the open neighborhood.

6.5 Application to predicting users' experiences

There is a basic question of why designers often fail to develop systems to be accepted by normal people although a designer is also a normal person. The dual-mode behavioral model well describes this situation. Namely, most designers in information and telecommunication field develop systems by implementing the functions. This process consists of typical closed mode behaviors. Because of the distinction between the behaviors in the closed mode and in the open mode, designers fail to predict users' experiences in their ordinary lives, which are in the open mode. The dual-mode behavioral model help designers to incorporate users' way of sensing, feeling, and thinking by checking her/his mental mode with the model. It should be noted that, as shown in Fig. 4, the dual mode model describes not only actions but also affects (sensations). Topological descriptions of long-term behaviors also include outlines of affects. Therefore, designers can check her/his mode with her/his affects even in her/his mental simulations of user's behaviors. It also should be noted that the model can not be replaced by interviews to the users because users can describe only a number of open mode interactions, which is far from the entire of the open mode interactions for the systems under the consideration. Designers should examine the remaining large part instead of users.

7 Conclusion

This paper tries to construct a model of a person for designing information-telecommunication systems to be accepted by general people for their personal use.

We employed three viewpoints. Among them are the macroscopic viewpoint for modern telecommunications, the microscopic viewpoint of person-communication tool interactions, and considering biological behavioral origin of characteristic human factors. From these, we derived a dual-mode behavioral model of a person. This model explains and/or is compatible with observed characteristics and results of related behavioral studies. The model implicates a system concept for deep person-system relationships, entire perspective of human and technologies, and a long-term life-style-shift (usualization). The model may help designers to predict user's experiences. Can we transform PC/Internet technologies so that they extend the open neighborhood? This is the main issue to be studied in the near future.

Acknowledgements

This research was supported in part by the Telecommunications Advancement Organization of Japan.

References

Abram D. (1996) *The Spell of the Sensuous: Perception and Language in a More-Than-Human World*, Pantheon Books, New York.

Batista E. (2001) "Sex and the Cell Phone-Deprived," *Wired News*, Oct. 31, http://www.wired.com/news/wireless/0,1382,48008,00.html.

Bem S. L. (1974) "The Measurement of Psychological Androgyny," *J. Consulting and Clinical Psychology*, 42 (2), 155-162.

Dentsu Communication Institute (2003), *i-Life 2003*, (in Japanese), http://www.dci.dentsu.co.jp/news/data/I-LIFE2003.pdf.

Gefen D. and Straub D. W. (1997) "Gender Differences in the Perception and Use of E-mail: An Extension to the Technology Acceptance Model," *MIS Quarterly*, 21 (4), pp 389-400.

ITU (International Telecommunication Union) (2003) *ICT Free Statistics Home Page*, http://www.itu.int/ITU-D/ict/statistics/

Kimura D. (1999) *Sex and Cognition*, The MIT Press, Massachusetts.

Kraut R., Mukhopadhyay T., Szczypula J., Kiesler S., and Scherlis B. (1999). *Information and Communication: Alternative Uses of the Internet in Households*, Infor. Sys. Res. 10 (4), 287-303.

Macromill (2003) "Questionnaire Survey on the Loss and Breakdown of Mobile Phones," *Publicly Open Research Results*, http://www.macromill.com/client/r_data/20030924keitai/index.html.

Margulis L. and Sagan D. (1997) *What Is Sex ?*, Nevraumont Book, New York.

Merleau-Ponty M. (1964) Le Visible et L'invisible: Suivi de Notes de Travail, Editions Gallimard.

Mikami S., Korenaga R., Nakamura I. Kenjo T., Mori Y., Yanagisawa K., Mori Y., and Sekiya N. (2001) "Survey Research on Uses of Cellular Phone and PHS in 2000," *The Research Bulletin of the Institute of Socio-Information and Communication Studies, The University of Tokyo*, 15, pp.145-235.

Ministry of Public Management, Home Affairs, Posts and Telecommunications, Japan (2002) *Information and Communication in Japan, white paper 2002*, http://www.johotsusintokei.soumu.go.jp/whitepaper/eng/WP2002/2002-whitepaper.pdf

Moyal A. (1992) "The Gendered Use of the Telephone: an Australian Case Study," *Media, Culture and Society*, 14 pp. 51-72.

Norman D. A. (1998) *The Invisible Computer*, The MIT Press.

Shimogawa S. Shinjo K. Igeta K, (1998), "High school students (mainly girl students) and communication tools" (in Japanese), paper presented at 2-E-2, *The 1998 Fall National Conference of Operations Research Society of Japan.*

Te'eni D. (2001) "A Cognitive-Affective Model of Organizational Communication for Designing IT," *MIS Quarterly 25* (2) pp. 251-312.

Venkatesh V. and Morris G.M., (2000), "Why Don't Men Ever Ever Stop to Ask for Directions? Gender, Social Influence and Their Role in Technology Acceptance and Usage behavior", *MIS Quarterly* 24 (1) 115-139.

Wenders J. T. (1986) *The Economics of Telecommunications*, Ballinger Publishing Company.