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USER DISCOURSE ANALYSIS IN AN AVATAR-MEDIATED ENVIRONMENT

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Abstract

Analysis of self-report statements by users indicates what information is noticed, how it is evaluated, and what the person intends to do with it. User discourse is spontaneously produced during the process of engaging technological affordances. A model is described explaining the synergy between users' affective, cognitive, and sensorimotor biological systems in interaction with technology. Charting the flow of people's micro-information behaviors gives an empirical representation of how people actually receive information by noticing, appraising, and evaluating it, as well as how they make use of that information by intending, planning, and engaging the system. Survival and adaptation in this human-computer symbiosis relationship can thus be visibly marked in the virtual world where feelings, intentions, thoughts, noticings, and interactions are expressed through avatar mediated information and communication activities.

Keywords: self-reports, virtual world, biological information systems, technological affordances.

Introduction

The virtual world known as *Second Life* ("SL") can be viewed as a collaborative informational attempt by its millions of "residents" to recreate in virtuality many significant physical and social elements of real life ("RL") (Boellstorff, 2009). Participants build their own islands, buildings, shopping malls, clothes, etc. These virtual places are accessible by SLURL coordinates and teleport links in a search engine. Second Life is noted for the excellence of its 3-D reproductions of cities, rooms, gardens, and objects. Each item is built by residents using available affordances built into the Second Life browser. An object or texture is defined by digital information kept in each avatar's cumulative "inventory." The avatar owner can "rezz" any inventory item, an action that results in the objectification of the item inworld. Others can see it whose avatar is in that location. To avatars inworld objects are solid so that they must go around them to continue walking or flying. A virtual object is a collaboratively constructed realistic information object that permits real social interactions.

Second Life is therefore a real life real time telecommunications system within the venue of a virtual world that is constructed collaboratively to facilitate the social networking of participants in distributed locations. The realistic humanoid appearance of avatars and the iconic 3-D representations of the urban environment facilitate an intense emotional and sensorimotor experience of reality. An illustration of this is given in the following annotation produced in a self-report by a recently born "newbie" avatar owner:

> *This building has theater seating with comfy looking chairs. I can imagine myself listening to a lecture in this area. I notice there is a large cognitive difference for me when learning in areas which I like the environment versus when I don't. For example, I've seen some areas with stone seating and feel urgent for the lecture to end. Then there are some places where the seating is mostly pillows on the grass and I find myself way too relaxed in RL to focus on listening to a lecture. So at least in this area there's a nice middle ground. The chairs appear soft without the urgency to find a 'comfortable' chair or to leave… but also not too soft to the point where I'm falling asleep at my monitor. It's interesting to me that my RL body responds to a virtual environment the same way it would respond in the same RL environment. Too bad there isn't a way to incorporate scent into this virtual environment… JUST KIDDING, that would be weird.*

Self-reports such as this are spontaneously constructed by users when discussing some task they are doing with a computer like word processing or shopping on the Web. Nahl (2007a, b) showed that user discourse of this type is composed of people's references to their information practices in three domains, namely, the affective domain of emotions and intentions, the cognitive domain of meanings and plans, and the sensorimotor domain of operating with technological affordances. For instance consider the analysis of one text fragment from the self-report above:

And
[cognitive planning activity constructing a coherent justification]
I find myself
[sensorimotor noticing activity describing one's physical state at the computer station]
way too relaxed in RL
[affective evaluation activity using a comparative rating procedure]
to focus on listening to a lecture.
[affective motivational activity involving an intention for a specific goal]
So at least
[cognitive appraising activity attaching a particular meaning to the situation]
in this area there's
[sensorimotor noticing activity identifying a place on the display screen]

a nice middle ground.

[affective evaluation activity using a comparative rating procedure]

Micro-analysis of discourse and verbalizations spontaneously constructed by users gives an objective indication of what information is noticed, how it is evaluated, and what the person intends to do with it.

User Discourse

User discourse is spontaneously constructed during the process of engaging technological affordances. It is related to a general human ability noted by Vygotsky (1962) with the verbalizations of children who have not yet entered the phase of silent thinking or interior dialog with oneself. The overt verbalization that accompanies children's activity shows its function as an embodiment of their awareness of what is going on in the stream of micro-events that occupy their attention during play. Adults experience a replay of this developmental phase when they are engaged in adapting to a new situation or tool and (Luria, 1961). One can experience this process of awareness embodiment through the "think aloud" approach that has been used to raise people's conscious awareness of their own mental states (Ericsson & Simon, 1993, 1980). In technology interactions it is a common occurrence to construct user discourse (silent or audible) to assist us in managing the sequencing of our micro-behaviors while creating and searching for files or other computer task. Nahl (Nahl, 2007a, 2007b, 2010) has shown that the analysis of user discourse generated in a variety of technology environments, indicates that the discourse elements correspond to the three biological systems of the human body known as affective, cognitive, and sensorimotor (also noted by Norman 2003, 1981).

Connecting these three domains of information Nahl (2007a) outlines a constructionist perspective described as a *social-biological technology*. The model describes the synergy between the sensorimotor system in interaction with technological affordances that are designed to display information and allow control through commands and selections. The model shows that every noticing on the display and every command entered are sensorimotor outcomes of cognitive and affective activities. When something is noticed on a screen (e.g., a name in a sentence) there is a spontaneous adaptive cognitive reaction that attaches some specific meaning to it, and this meaning evokes an emotion or value (e.g., "*That's interesting*." Or "*That's surprising, unbelievable*"). The meaning and value attachment activities of the individual are the result of adaptation to social practices. Whenever people function in an information environment, their actions, evaluations, engagement intentions and plans are organically developed as part of their adjustment to the social computing situation. Hence the expression "information behavior practices" more accurately reflects the situation than "information behavior." Technology, biology, and social practices are fused into an interacting synergy.

Applying this perspective to avatar mediated human behavior it is expected that user discourse in the virtual world known as *Second Life* would also be constructed out of the three biological components of human behavior. User discourse is evident on a continuous basis when consulting inworld chat text. Since Second Life is a complex virtual world replete with hundreds of affordances to engage, people experience a continuous stream of information needs, some of which are immediate and urgent, while others are postponed for later. As a result of this complexity people are constantly engaged in solving information needs that allow them to continue the activity inworld, or else they threaten to disrupt, embarrass, or worse. User discourse is therefore a prominent feature in Second Life. People ask how to do something or where something else is, and other people explain how to do it or where to find it. This user discourse is universally based on human biology in interaction with the information technology that is used by people in ways that support their social practices.

Nahl (2007b) has introduced a specific discourse analysis technique for analyzing text or dialog that is constructed by people when spontaneously discussing their information behavior practices. The user discourse is segmented into minimal units whose content is identified with reference to the three basic information systems of human behavior that have been investigated in psychology and education since 1950 (Bloom, 1956; Bloom & Broder, 1950; Jakobovits & Nahl-Jakobovits, 1987). The three biological systems give people the ability to feel and intend (affective system), to think and imagine (cognitive system), and to perceive or act upon the environment (sensorimotor system). These three domains of biological activity form significant components in people's information seeking behavior (Nahl & Tenopir, 1996; Nahl & Harada, 1996). User discourse analysis indicates that the three systems form an interacting synergy to produce information behavior at both the macro and micro levels (Nahl, 2006).

All three biological activities must be organically involved in a synergy in order for information reception and information engagement to occur. Successful adaptation and functioning in the information environment involves the repeated and continuous reception of information through these three biological phases. The specific content or properties of the activities in each phase is constructed by each individual *operating as a participant in a group* through the interface's "affordances" (Gibson & Pick, 2000). The quality and content of information behavior practices within each social group or setting can be observed through the analysis of user discourse in chat and the accompanying video stream of avatar interactions such as position, movement, distance, appearance, regularity of presence, participation rate in exchanges, etc. In addition, the discourse in self-reports about inworld activities provide data about ongoing and retrospective involvements within the three biological domains.

Figure 1 is a schematic representation of this social-biological technology (Nahl, 2007a). The model specifies two phases involved in the minimal unit of interaction with the affordances that are made available by the interface. One phase involves the reception of information from the information environment through *satisficing affordances* such as a command menu or a display window. The other phase involves engaging the environment by acting on it through the *optimizing affordances* such as mouse and keyboard or a button on the screen to click on. According to the model, the information reception phase involves the three biological systems in the organic sequence: sensorimotor, cognitive, affective. *First*, there is the noticing of information through a satisficing affordance such as an image or text on a screen. This is an activity of the sensorimotor system (S). *Second*, there is appraising of what has been noticed, which involves constructing meaning and implication to it, and is an activity of the cognitive system (C). *Third*, there is value-attaching to the appraised noticing (or "evaluation"), and this is an activity of the affective system (A), sometimes referred to as

"consummatory" (Nahl, 2007c). For example, a user notices the underlined words in blue on the screen (sensorimotor activity--S), figures that it is a hypertext link (cognitive activity--C), and feels curiosity about it (affective activity--A).

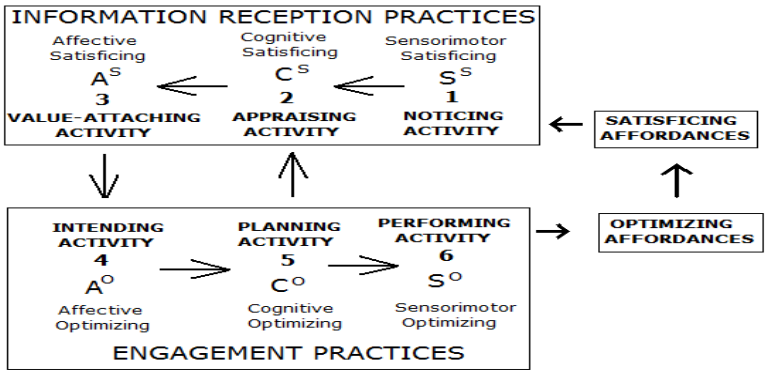

Figure 1: Schematic Representation of Social-Biological Technology

Once the information is satisficed through affective value-attachment activities ("*I am curious about what's on that linked page. It sounds interesting. It will be fun going there. Etc.*"), there follow the three biological phases in the reverse order. *Fourth*, forming a motivated intention, and this is an "optimizing" affective activity that produces an intention to engage the system for the sake of a goal (also called "conative") (Nahl, 2007c). *Fifth*, constructing a plan of execution, and this is a cognitive activity that is constricted or delimited by the affective intention or goal already activated in the earlier phase. Sixth, executing the plan by performing an action on an available optimizing affordance, as for example, using the mouse and click routine or typing a word. This is an activity of the sensorimotor system. The minimal interaction unit in social-biological technology is to step through these six activity phases sequentially involving noticing (S), appraising (C), value-attaching (A), intending (A), planning (C), and performing (S). The simple act of noticing a link and clicking on it involves these six biological activity phases. When user discourse is analyzed there is clear evidence of these six phases forming the context of activities in an information environment. This may be seen from the following example cited in Nahl (2007b) in which a Web user was thinking out loud and spontaneously describing to another user what he was doing.

> *When you google search* [C^o planning] *you just* [A^s value attaching] *have to* [A^o intending] *type in a topic* [S^o performing] *and the search engine will find a list of things* [S^s noticing] *that correspond to the topic* [C^s appraising] *you are looking for* [A^o intending]. *I am now looking at the list* [S^o performing] *they provided* [C^s Appraising] *so* [C^o planning] *I have to* [A^o intending] *choose one* [C^o planning] *and just* [A^s value attaching] *click on it* [S^o performing]. *Right now* [C^o planning] *I am clicking on the Los Angeles Lakers home page* [S^o performing]. *Now* [C^o planning] *the home page has opened up* [S^s noticing].

The discourse segments (*in italics*) are shown to correspond with the A (affective), C (cognitive), and S (sensorimotor) systems, and whether they are satisficing (superscript ^{s}) during reception phases, or optimizing (superscript ^{o}) during engaging phases. For instance, S^s denotes sensorimotor satisficing or noticing, while A^o refers to affective optimizing or intending.

It is apparent that by using the three biological information systems as a model for user discourse analysis, it is possible to produce meaningful segments of user verbalizations that indicate the micro-behavioral information practices of people engaged in information activities with technology. This approach is also likely to be methodologically useful in the analysis of avatar-mediated user discourse produced in the virtual world. For instance, the following sample text appears in the self-report of an individual who took on the task of finding various activities to do in Second Life and to describe each *while the activity was going on*, thus alternating between the Second Life viewer and the word processor in order to make the self-report sufficiently concurrent (rather than retrospective) (Ericsson & Simon, 1980). In this fragment the person is describing a visit to a shopping area:

> *Starting to feel a little overwhelmed.* [A^s value attaching] *I'm deciding to just run through the entire store* [C^o planning] *looking for certain areas* [A^o intending]. *Too much shopping is making my brain numb.* [A^s value attaching] *Also,* [C^s appraising] *I've begun to notice how people advertise.* [S^s noticing] *Some pictures I look at* [S^s noticing] *I get an annoying feeling* [A^s value attaching]. *For example this yellow picture* [S^s noticing] *bugs me* [A^s value attaching]. *I can't quite identify* [C^o planning] *what about the picture bugs me* [C^s appraising]. *It has to do with* [C^s appraising] *the yellow background* [S^s noticing] *and how it relates to* [C^s appraising] *the outfit the girl is wearing* [S^s noticing]. *It gives me a different generational vibe.* [C^s value-attaching]

It is possible to create statistical descriptions of discourse segments by inspecting the frequency and type of references that the user is practicing. In the above concurrent self-report there are mentioned 14 satisficing activities of which 7 are cognitive, 5 sensorimotor, and 4 affective. There are only three optimizing activities mentioned. In the retrospective self-report below there are 11 satisficing activities mentioned (10 cognitive; 5 affective; and 4 sensorimotor), and 8 optimizing activities. Future research may explore the task and interaction conditions that significantly influence the distribution of biological involvement by those present.

> *Today* [C^o planning sequence] *I continued to figure out how to change my appearance* [C^o planning and C^s appraising]. *However with a slower computer* [C^s appraising], *the changes and the program itself are responding very slowly* [C^s appraising]. *I was playing with the Search button* [S^o performing] *and I was teleported to another place in the program* [S^s noticing]. *I am now in the Adam n Eve channel* [S^s noticing]. *I am trying to get back on Help Island* [A^o intending and C^o planning] *but nobody is able to help me here* [C^s

appraising and A^s value attaching]. *I tried getting a job* [A^o intending] *but it is confusing* [A^s value attaching]. *I have to register* [S^o performing] *with programs in second life through my internet browser* [C^o planning]. *I am not too sure if it is exactly safe to sign up for these sites* [C^s appraising and A^s value attaching], *as it seems like a third party application* [C^s appraising].

The above user discourse segment is retrospective and was constructed for a journal-type written report. Given this context, the units of reported behavior tend to be more general and refer to macro-units of the sequence of biological activities, unlike the concurrent report (presented earlier), which yields micro-behavioral details of the activity level in the three biological information systems. Nahl (2007b) noted that user discourse varies with context in terms of the omission of details for those activities that the intended audience is assumed to already know or be able to notice without it being mentioned. The user practice of omitting unnecessary detail in verbalizations or chat discourse is a marked feature of verbal interaction in virtual world. It is aversive to be told in detail what one already knows, as is illustrated by the following discourse segment from a novice user in Second Life (SL):

The more I learn about SL [C^s appraising] *the more easily bored I become.* [A^s value-attaching] *Not with SL* [C^s appraising] *but bored when people try to tell me* [A^o appraising] *how to do things that I already know* [C^s appraising]. *The closest example I can think of* [A^s value-attaching] *is when someone is in sixth grade and they're stuck in a kindergarten class.* [C^s appraising] *I tried to be very polite* [A^o intending and C^s appraising] *but the librarian kept trying to explain to me how to inspect the object* [A^o intending] *when I told her kindly* [C^o planning] *that I already know* [C^s appraising] *how to do that.* [C^o planning] *That made me* [C^s appraising] *a little frustrated.* [A^s value-attaching]

Here there are 14 biological activities mentioned, two-thirds satisficing and one third optimizing. The modal activity mentioned is cognitive satisficing [C^s appraising].

This discourse analysis technique is possible because people spontaneously use the three biological information systems when thinking about or describing their own information behavior practices. These three systems are biologically based human functions that are important in survival, adaptation, and learning in physical as well as virtual information environments. According to this constructionist model, all user discourse will contain mention of evaluations or intentions (A–affective channel), of thoughts and images (C–cognitive channel), and of noticing or doing something (S–sensorimotor channel). For example, someone might be looking at a list and say "*I don't like any of these items listed here.*" This user discourse fragment contains an affective reference ("I *don't like*"), a cognitive reference ("*any of these items*"), and a sensorimotor reference ("*listed here*"). The analysis of user discourse data shows that people construct verbal accounts and explanations of their information behavior practices using sentences that exhibit this threefold biological categorization.

By charting the flow of people's micro-information behaviors in context, one obtains an empirical representation of many details of how people actually receive information from a satisficing affordance (noticing, appraising, value attaching), and how they make use of that information in moment-by-moment interaction with an optimizing affordance (intending, planning, engaging). Survival and adaptation in this human-computer symbiosis relationship are visibly marked in the virtual world where feelings, intentions, thoughts, noticings, and interactions are expressed through visible avatar mediated information and communication activities. These involve group practices, norms and expectations, such as what to notice on a screen and what to ignore, or how to react to some happening inworld or to a remark by someone in chat.

Meaning or consciousness of inworld social reality is embodied in the information behavior practices that are carried out by the interacting individuals in social context. Newbies to a particular inworld information ground or setting are less conscious of the social details embodied in the interaction practices since the interaction of newbies is restricted to what they can notice and perform. As their repertoire of noticings and engagement with affordances gradually increases and becomes adaptive, newbies are progressively inducted more completely into the group interaction practices and the resulting intersubjective consciousness. In Second Life all the chat is recorded on one's computer making it easy for user discourse analysis to reveal the social dynamics of these interaction practices and the organic induction process through which new participants are incorporated as members.

The six phases of adaptation and engagement can be used as structured self-report prompts to help people become more conscious of their avatar-mediated spontaneous activities. The following sample records by two different individuals illustrates this procedure:

1. Noticing:
   I noticed that I had fallen from flight when I clicked on the stop flying button
2. Appraising
   I noticed because I have seen other people fly and land gracefully so I knew I was doing something wrong.
3. Value Attaching:
   To be honest it just was more embarrassing than anything else because it singles you out as a newbie. When you aren't graceful in the way you walk and fly it's a sign that you are inexperienced.
4. Intending:
   I want to change this behavior so that people don't single me out right away. The goal is to look like you know what you are doing even when you don't.
5. Planning:
   I planned to ask someone or look up how to fix this problem. I just need to have someone to talk to first.
6. Executing:
   By watching the Orientation videos, I found a sign that instructed users on how to land so I utilized this resource and will never have to fall out of the sky again. I found out that I just have to click on the "c" key and that is how

Second sample:

1. Noticing:
After re-spawning to my last location, I noticed a creature thing called "Digital God.'
2. Appraising
I saw a chair on top of the head of the "Digital God" and thought that it would be appropriate to ride it, not realizing or knowing that it was another avatar.
3. Value attaching:
Everyone who witnessed this action was name-calling me and stating how much of a newbie I was.
4. Intending:
I want to never make the mistake to ride another avatar. It makes you look like a newbie and makes you look like an ass. It shows the rest of the SL community that you don't know or don't care about their rules.
5. Planning:
I will read the note cards and be aware of my surroundings when I enter an area, whether foreign or visited.
6. Executing:
I will attempt a conversation in order to see if they are indeed another avatar or a part of the area to which I travelled.

Urgent, Persistent, and Long Term Information Needs

Affective load (Nahl, 2010) refers to the intensity and quality of the consummatory value-attaching activities during information reception while interacting with satisficing affordances. Sub-components of affective load in Web based activities include emotional uncertainty, anxiety, frustration, rage, low optimism, low self-efficacy, and locus of control away from self (Nahl, 1996). Biologically, these affective activities are symptoms of the struggle to engage the optimizing affordances provided by the interface. The following sample segment from a retrospective self-report in Second Life illustrates some affective and cognitive content of this struggle to adapt to the virtual world information environment:

> *I then tried* [C^o planning and A^o intending] *to change my appearance with some new gear* [C^o planning and S^o performing] *but my avatar bugged out.* [S^s noticing and A^s value-attaching] *My hair and clothing* [S^s noticing] *were messed up* [C^s appraising, and A^s value-attaching] *and my avatar kept switching outfits automatically* [S^s noticing and A^s value-attaching]. *I tried to change them back* [A^o intending and S^o performing] *and had only partial success* [C^s appraising]. *My clothes were back to normal* [S^s noticing and A^s value-attaching] *but my head was bald and I could not edit it* [A^o intending and S^o performing].

The person is carrying out these affective, cognitive, and sensorimotor activities in repeated sequences, looping through them over and over again, each time experiencing the reception and engagement phases. Affective load is a theoretical concept that attempts to identify, measure, and chart the cumulative emotional cost factor involved in adaptation and engagement with technological affordances. Preliminary analysis of chat verbalizations in Second Life reveals three types of information needs that people experience inworld. Each has its affective properties when an information need is met (reward) and when it is not met (load).

Urgent Information Needs

Daily life is replete with urgent information needs that must be solved immediately to avert a crisis. For example, the cell phone is heard ringing somewhere in the house. People normally feel an intense emotion of urgency when trying to avert an imminent crisis. Frantic searching is a common outcome when feeling this urgent information need. Often it is accompanied by frantic verbalizations like "*Where on earth is it? I've got to find it before they hang up. I'm expecting a call from…How come it's not here? Oh my God it's in my purse in the closet! How stupid is this? Etc.*" In avatar-mediated information behavior one learns to practice basic survival skills such as avoiding collisions with other avatars when walking or flying. When the basic skills fail, there is a crisis that precipitates urgent information needs. For example, the avatar acts like there is an invisible barrier that it cannot cross, moving sideways along it, or reversing direction. This occurs sometimes when teleporting to a new area that is experiencing rezzing lag due to telecommunications overload. Some parts of the building or its partitions take longer to rezz than other parts, leaving the impression that the avatar is free to start walking in that direction. It can be puzzling, frustrating, and even alarming to see one's avatar suddenly unable to move normally. During the 5 to 10 seconds of this crisis, urgent information needs are activated involving a heavy affective load.

Instances of urgent information needs are regularly experienced in the complex virtual world of Second Life. The following sample record is from a structured concurrent self-report:

> To what extent are you feeling frustrated doing this particular task?
> Not Frustrated 1 2 3 4 5 6 7 8 9 10 Extremely Frustrated
> Type your number here and briefly explain your rating: **8**
> *Knowing the fact that the Reference Desk will be filled with information makes me feel overwhelmed and frustrated. I do not like how information is everywhere in SL. Sometimes notecards and reading instructions give me a headache.*

The feeling of being overwhelmed with information is particularly stressful in Second Life because it is a world made up entirely of information so that the survival and basic activities of one's avatar depend on one's information management practices moment by moment. The simplest activities in the virtual world are information intense. There is an affective cost or "load" to information seeking and management. People have to be willing to put up with the affective load as a collateral effect of avatar mediated social interactions. The social-biological technology has greatly increased the interdependence between technological affordances and the human sensorimotor system. The following record

segment from a retrospective self-report illustrates the intensity of the affective load associated with urgent information needs:

> *Adra sent us IM beforehand saying that we will need pictures. I had plenty of pictures on my desktop so I was not worried at all. But I misunderstood and found out that I needed the pictures to be in my inventory. When one thing goes wrong and cannot move on to the next step, I begin to feel frustrated. My classmate was following her without any problems. Why can't I do it?? Plus, when I do not get it, it slows down the class. I really hate that feeling. When my frustration hit the maximum point, I just wanted to give up. I usually never feel that way even if I faced difficulties. I craved for some immediate help. I wanted someone to show me how to do it from my point of view, but that was impossible.*

The specific emotional character of urgent information needs is embodied in the statement, "*When one thing goes wrong and cannot move on to the next step, I begin to feel frustrated*" Information becomes urgent when it is needed immediately to prevent a crisis ("*when I do not get it, it slows down the class. I really hate that feeling*"). When affective load gets to be high the motivation to quit builds rapidly ("*When my frustration hit the maximum point, I just wanted to give up.*").

The source of affective load can be interactional and communicative as in the following retrospective self-report following a visit to an inworld library:

> *I asked a librarian where I can find a free suggestion box like the one they had on their desk. She said that she had to buy it so she didn't know. She tried to tell me how to identify who made the item because it's a great way to find more things. However, I found myself easily bored.*

The next user discourse segment from a retrospective self-report identifies a common source of affective load: "*irritating building layouts.*" Walking through a series of shopping areas and stores looking for a specific information object builds affective load as the search proceeds without positive value-attachments.

> *I was expecting this area to be boring. However it is funny how many areas beforehand I think will be boring but while I explore them they are not. So I'm deciding to give this area the benefit of the doubt. As I arrived here I noticed the way they separated different areas is interesting. Obviously there are multiple topics so the creators of this place decided to use low walls which give the visitor the ability to see what's inside an area without having to walk all the way around. This is useful to me because this saves me time in finding out which areas look interesting or not. With so many things to explore in SL it's nice not to have to deal with irritating building layouts.*

Here the user is conscious of positive affect when expected boredom turns to appreciative interest. Expected boredom is contributes to affective load, which is negative, while appreciative interest builds positive affect or reward. The consciousness of reward and positive affectivity is the consequence of success in resolving an information need. Ultimately the achievement of balance between affective load and affective reward will determine whether the person becomes an occasional visitor or a regular participant (called "resident" in Second Life).

Persistent Information Needs

Not all information needs require immediate resolution. They can be postponed. The activity can proceed with sufficient satisficing without causing a crisis. The specific information need doesn't go away. It returns over and over again with different activities and locations. Information needs that are persistent also increase affective load, though less steeply as with urgent information needs (Nahl, 2010). In the following user discourse segment from a retrospective self-report the individual expresses awareness of a persistent information need that interferes with her participation in the communicative practices of the group she is with:

> *I saw people clapping at the end of the lecture. I needed to participate myself more to make the communication become more real. Some people write how they felt and their opinions constantly during the lecture and I was too busy following the directions. I realize that I need to attend more public conferences; events that offer guest speakers to get more used to and witness ways of communication in SL.*

Multi-tasking is practiced commonly in an information intense collaborative exchange. While a talk is being presented in Second Life the local chat window delivers short segments of text pasted or typed by the presenter. In between the presenter's text segments, there come at a rapid pace, the typed user discourse constructions of the audience of attending avatars ("*people write how they felt and their opinions constantly during the lecture*"). It takes repeated practice before one is able to follow the lecture presentation while also disentangling several topical threads going on simultaneously.

In the virtual world everything one can do and be is encapsulated in the avatars "inventory" folders. After a few months of inworld exploration it is common to accumulate thousands of inventory items in dozens of folders and sub-folders containing items of clothing, avatar pets, personal animation HUDs, pictures or textures, interaction scripts, notecards, or landmarks. Locating things in one's inventory often becomes an activity marked by intense affective load. Inventory management raises a series of persistent information needs. The following is sample record from a prompted concurrent self-report by a person attending an inventory management class in Second Life:

How likely is it that you will become good at this particular task? (1 to 10)

> *I give myself 9 because I realized that organizing my inventory is important and by doing it, I improved and became good at it.*

How likely is it that the skills you are learning in this task will be useful in your career?

> *I give it 10 because organizing skill is a skill that most careers would expect you to have.*

To what extent are you feeling frustrated doing this particular task?

> *I give it 9 because when I first looked through my inventory, it was a huge mess.*

To what extent are you feeling irritated doing this particular task?

> *I give it 8 because looking at each item and deciding whether I should keep it or not took some time.*

Long Term Information Needs

Information intense environments as in Second Life, provide a progressive form of adaptation or acculturation. "Newbie" avatars are easily recognized by "residents" from their stilted appearance and gate, as well their primitive interaction style and less informed content that is apparent in their user discourse constructions in local chat. Both residents and newbies constantly face information needs that may not be urgent or persistent in the sense that they can continue postponing these needs indefinitely. Having long term information needs is embodied in the awareness that in the information environment created by the social-biological technology one is always a newbie in some sense. When people install the latest operating system and move to the new versions of familiar applications they are precipitated for awhile into a continuous state of crisis involving urgent and persistent information needs. In the long run certain needs are postponed indefinitely for the sake of less convenient and efficient workarounds that are constructed for them, or else they are given up altogether. Few people enjoy studying the highly elaborate and knowledge filled Second Life Wiki on the Web, but merely being conscious of its existence helps people postpone their long term information needs ("*I will look this up some day")*.

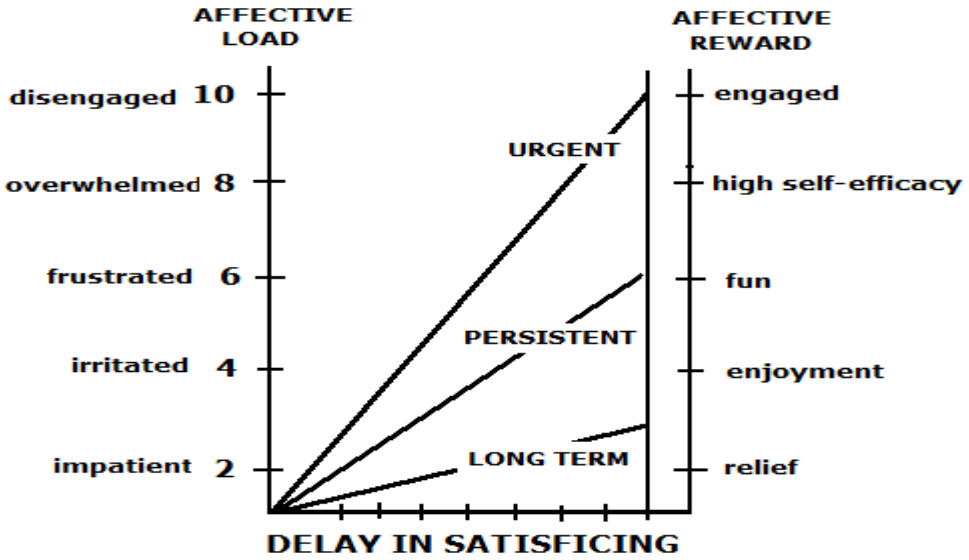

Figure 2: Affective Load as a Function of Delay of Satisficing

Figure 2 is a theoretical prediction based on the experience of a small sample of observers in Second Life (based on Nahl, 2010). It may be a useful way of categorizing the biological activities during real time avatar-mediated synchronous social and collaborative interactions. Activity in the virtual environment proceeds moment by moment through information management. This involves controlling the avatar's appearance and movements, getting to a specific gathering place, reading and typing in local chat, and finding a particular menu command from among hundreds available on the interface. Each micro-detail composing any of these activities consists of a distinct information need. Every information need has a solution that controls the consummation and attainment of the goal that satisfices the need. This is the reward. One can act, proceed, participate, relate. Everything in the virtual world depends on that bit of information.

Some information needs in the virtual world can be postponed while others cannot. For instance, when trying on new apparel in a store that does not have a change room, avatars can be seen without clothes for a brief period. It is common for users to report that they feel "embarrassed," even "humiliated" when unexpected other avatars suddenly appear. This is a "persistent" information need because it recurs over and over again. One solution reported by some participants is to rezz a portable change room they keep in their inventory. Persistent information needs can be postponed since one can still try on and buy the desired clothes. But it has an affective cost, namely, repeated embarrassment sessions accompanied by uneasy expectations, even "alarm," that gets associated with the practice of shopping for clothes inworld.

Affective load of an unfilled information need is more serious and emotionally stressful when its solution cannot be postponed. One participant reported that she had logged in several times in six months and found her avatar in the same position stuck in the corner of a bridge. Each time she would give up after a few minutes of trying to get her avatar moving. Figure 2 shows that if an urgent information need is not satisficed it rises to its maximum affective load for that person, which is disengagement or quitting. In contrast, long-term information needs have a low affective load associated with their indefinite postponement. The right hand portion of Fig. 2 indicates what happens when an information need is met or solved. Urgent information needs do not tolerate postponement so that the affective load reaches the point of disengaging unless it solved immediately. When solved, the affective reward is proportional to the affective load that is consummated by the solution. Remaining engaged is the highest reward. Solving an urgent information need that is "overwhelming" brings high self-efficacy, which is the feeling that one can survive in this environment. If a persistent information is eventually solved, it brings back enjoyment and fun to the activity. If a long-term need is eventually solved, it brings relief from irritation.

Further research needs to explore how such information management issues create affective load and the rewards that come with its consummation. Specific instruction and collaboration activities in Second Life can be targeted for investigation using the methods described.

Conclusion

Behavior in the virtual world consists of information management activities that participants practice in their interactions. Each participant succeeds by successfully interacting with the interface affordances through information reception and engagement with them. User discourse constructed by users during interaction with affordances indicates that successful avatar-mediated interactions and collaboration involves their information management practices through the three human biological information systems known as the affective, cognitive, and sensorimotor domains of activity. In order to keep their avatars acting appropriately and their chat comments socially relevant, each participant practices individual procedures within these three systems in such a way as to be seen by others as a group member. Visitors, strangers, newbies who may come around are recognized by their varying information behavior practices. The biological activities of non-members are recognized by members as different from their own. User discourse can be a source of data for identifying and charting the micro-information behavior practices that all participants are engaged in on a continuous basis in the virtual world.

References

Bloom, B. S., (Ed.). (1956). *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive domain*. New York: David McKay.

Bloom, B. S. & Broder, L. J. (1950). *Problem-Solving Processes of College Students*. Chicago: University of Chicago Press.

Boellstorff, T. (2009). *Coming of Age in Second Life: An Anthropologist Explores the Virtually Human*. Princeton: Princeton University Press.

Ericsson, K. A. & Simon, H. A. (1993). *Protocol Analysis: Verbal Reports as Data*. Revised edition. Cambridge, MA: The MIT Press.

Ericsson, K. A. & Simon, H. A. (1980). Verbal reports as data. *Psychological Review* 87, 215-251.

Gibson, E. J. & Pick, A.D. (2000). *An Ecological Approach to Perceptual Learning and Development*. Oxford: Oxford University Press.

Jakobovits, L. & Nahl-Jakobovits, D. (1987). Learning the library: Taxonomy of skills and errors. *College and Research Libraries* 48(3): 203-14.

Luria, A. (1961). The Role of Speech in the Regulation of Normal and Abnormal Behavior. New York: Liveright .

Nahl, D. (2010). Affective load and engagement in Second Life: Experiencing urgent, persistent, and long term information needs, *International Journal of Virtual and Personal Learning Environments* 1(3), (July-September): 1-16.

Nahl, D. (2007a). Social-biological information technology: An integrated conceptual framework. *Journal of the American Society for Information Science and Technology* 58(13): 2021–2046.

Nahl, Diane. (2007b). Domain interaction discourse analysis: A technique for charting the flow of micro-information behavior. *Journal of Documentation* 63(3) (May): 323-339.

Nahl, D. (2007c). The centrality of the affect in information behavior. In *Information and Emotion: The Emergent Affective Paradigm in Information Behavior Research and Theory*. (Medford, NJ: Information Today), pp. 3-37.

Nahl, D. (2006). A symbiotic human-machine model for tracking user micro-attributes. *Skilled Human-Intelligent Agent Performance: Measurement, Application, and Symbiosis Symposium, HICSS-39* (Hawaii International Conference on System Sciences), January 4, Kauai, (Los Alamitos, CA: IEEE Computer Society Press).

Nahl, D. (1996). Affective monitoring of internet learners: Perceived self-efficacy and success. *Proceedings of the 59th ASIS Annual Meeting*, 33 Baltimore, MD, October 20-25: 100-109.

Nahl, D & Harada, V. (1996). Composing boolean search statements: Self-confidence, concept analysis, search logic, and errors. *School Library Media Quarterly* 24(4): 201-207.

Nahl, D. & Tenopir, C. (1996). Affective and cognitive searching behavior of novice end-users of a full text database. *Journal of the American Society for Information Science* 47(4): 276-286.

Norman, D.A. (2003). Emotional design: why we love (or hate) everyday things. New York: Basic Books.

Norman, D. A. (1981). Twelve issues for cognitive science. In D. A. Norman (Ed.), Perspectives on cognitive science (pp. 265-295). Hillsdale, NJ: Erlbaum, Basic Books.

Vygotsky, L. S. (1962). *Thought and Language*. Cambridge: MIT Press.