Abstract. In the interactive processes between users and interfaces, new elements appear in the screens where signs are out of the users’ signification system. However, in each step to achieve completely a task, the users are inferring about the behavior of the system interface to execute all activities successfully. These inferences and expectations, possibly predictions, may be frustrated by technical failure or by communication failures. In this case, users must infer again. Truths future envisaged by the user can be destroyed if it has any disruption in the communication process between user and the interface (or with the interface’s designer). This preview of the future state that influences the user’s decision-making by is called Anticipation. Based on these assumptions the text describes the results of some theoretical studies about the Anticipation of possible actions that haven’t been learned by users in initial interaction. These studies have investigated possible interactions among Anticipation, Semiotics and Human-Computer Interaction - HCI. The results bring some predictions that address researches in Computational Semiotics and Quantum Semiotics.

Keywords: Anticipation, Human-Computer Interaction, Semiotics, Design

1 Anticipation

There are many concepts for Anticipation and anticipatory systems. Among them are [4]:

1. An anticipatory system is a system whose current state is defined by a future state.
2. An anticipatory system is a system containing a predictive model of itself and/or of its environment, which allows it to change state at an instant in accord with the model’s predictions pertaining to a later instant, in faster than real time.

The human being is anticipatory by nature. We are all the time anticipating possible future situations to make decisions, influencing the behavior or present choices, even if in an unconscious manner.

This happen, for example, when we are producing any artifact that uses creativity, we (the human beings) are making use of Anticipation, either by the proposed sensation to cause on the person who sees the artifact, or by advancing on new meanings of expressions or new ways of interaction.
For Nadin [5], the classical scientific theories are based on determinism models of cause-effect, where a subsequent state is determined strictly by the prior state, and Anticipation reveals to us that science can be done in an inverse way to that one, adopting pro-active models [2], as predicted by Charles S. Peirce.

Anticipatory models abandon Aristotelian vision of cause and effect, especially, the so-called *causa finalis*. In the real world there are ways which determinism sequences (cause-effect) cross each other with non-determinism, anticipatory and pro active sequences.

In this context, digital technology defined a new and rich world, but with a lot of stereotyped interactions, worried about HOW to do, instead of WHY do it [3].

Considering the manipulation of interactive systems, the future state would be a reaction of the system to a received stimulus, because of that; the user would make an interaction decision (present state), anticipating a possible reaction by the system (future state).

Designing computer systems as anticipatory systems is a new challenge for HCI research, such as intelligent interfaces.

Anticipation has strong relations with semiotics, as well as it involves an understanding about the complexity of integration of quantitative and qualitative aspects, besides the science model defended by C. S. Peirce, whose scientific process would follow three well defined stages: abduction, deduction and induction.

Anticipation has three very important aspects (expectation, prediction and forecast, which delineate the three stages of the scientific process defined by C. S. Peirce.

It has to be clear that the big difference to anticipation is that in it the actor positions himself in the present in function of what he anticipates to be in the future.

Nadin’s pragmatic perspective of anticipation may be expressed by “what we do”, “how we do” and “why we do”. It perceives the necessity of definition in which actions must be taken, according to its sequence and how to evaluate them. This way, to apply them in the most diverse sciences, including HCI.

And there are important initiatives which serve as groundwork for more recent studies about Anticipation, such as [6] and [2].

The theory of signs developed by Peirce was a consequence of his thoughts about knowledge of our thoughts (human) by means of inferences of something external, by the simple reason that there is no inference without signs.

### 4 Design, interaction and anticipation

Planning is a practical experience of Anticipation. In a plan, the expectations are the results of predictions through the measures to reach the established objectives and forecasts are considered.

Every design, including HCI is an expression of Anticipation through planning the potential actions by the user. In this case, the designer anticipates the needs, expectations and wishes of the users. Therefore, the design of interaction mechanisms of computer systems is by nature, pro-active [3].

In design plans, goals and signs are expressed. The messages sent by the designer are a result of the anticipatory process or processes created at the time of the design, at the moment the designer infers a set of behavior possibilities (actions) by the user.
On the other hand, in some applications, the “prediction” process of the future that will affect the present is coordinated in time of execution, as if in virtual reality environments or artificial intelligence.

Anticipation reflects, in time, the design, which is perceived by the designer with the “probability” of occurring during the process of interaction by the user.

According to Nadin [3], an explicit or implicit prediction, expresses the boundaries of our own understanding of what it wished to predict. In HCI, when the user finds himself with an interface, which may have incomprehensible signs, he may ask himself: “What would be the effect of a click here?”

The establishment of wrong anticipatory aspects by the designer can provoke some incomprehensible expressions by the user.

These expressions may be caught in a process of evaluation of communicability tagging which, on its turn, would identify possible ruptures in communication and possible prediction flaws from the designer or the user.

According Semiotic Engineering [1], every meta-messages is a sign of anticipation that the designer created about how the artifact will affect the lives of the users.

However, it is worth remembering that the expectation is one aspect of Anticipation, being strongly influenced by standard situations. In other words, an anticipatory process by the user of interactive systems will possibly have strong connections with situations already experienced by the user, as well as its own reality.

The user understanding about the task sequence is a determinant factor to its anticipatory process. The reality of a prior task will fatal influence the user much on the prediction of the subsequent step as well as in its own understanding of the task (meaning and interpretation process of the messages).

On a first contact with an interface, even before learning how to use it, the user creates directed expectations about learning. At this moment, the prediction tries to capture the interconnectivity of the elements involved in the set of signs presented.

It would be a thin line between cognition and semiotics in HCI.

In fact, according to Nadin [2] [3], it is important to make clear that prediction does not involve, necessarily, interpretation.

Every interface sign is an anticipation of its own interpretation that can be the result of an anticipation caused by a prior sign (on the designer), resulting on another sign – icon, index or symbol – which would be an anticipation of its own interpretation.

In this case, a sign would be the result of an unlimited semiosis process not considering only unlimited semiosis as an “endless” process of interpretation, but as an unlimited process of anticipations. In this process the semiosis would follow two time directions: from the past to the future and from the future to the present. The future, in special, would designate, for example, the wishes, the needs and ideals.

In a pragmatic level of Quantum Semiotics [5], the human being wants to fulfill his activities (read a text, access his bank account, edit a text, etc.) and the machine has its own mechanisms and limitations (servers, screens, language, etc.)

In an epistemological level, the human being assumes a non-determinism attitude, in opposition to the machine determinism; the human being is capable of learning, being creative, pro-active; on the other hand, the machine has no brain; therefore, it is not creative and not reactive. HCI functions as a mediator to these two “worlds” providing interaction.
In a Cartesian context, the decrease in complexity is the measurement for success to HCI, in other words, the focus is on facilitating the use and behavior patterns, approaching the machine to the user, making him feel sometimes as a machine, taking reactive and automatic attitudes.

However, in the anticipatory context and of Semiotic Engineering, the focus is on answering the user’s expectations.

5 Final Considerations

In HCI, we can observe Anticipation under different aspects, but mainly at moments of design and of interaction with the user. In both moments, the actors of the processes (designer and user) are anticipating, either with expectations or with predictions and forecasts.

Considering the communication aspects, consequently, semiotic, we can verify how Quantum Semiotics proposed by Nadin can be used on HCI studies on the project levels, interaction and evaluation of interfaces. Once the proposed quantum sign and anticipation integrate cognitive and semiotic approaches, in a certain way, “reconstructing” Peirce’s semiotics in HCI context.

We believe that the first contact by the user within an interactive system, even before learning it, creates expectations directed to learning what is being presented. At this moment, prediction tries to capture the interconnectivity of the involved elements in the sign set now presented.

This theoretical study was the first step of an empirical investigation project about this phenomenon in HCI. Besides this, the research project also regards verifying the connections between evaluation and communicability proposed by Semiotic Engineering and the anticipatory aspects: expectation, prediction and forecast.

References