



An Experience with Deep Time Interactive Installations within a Museum Scenario

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Abstract

This technical report presents preliminary results of the museum research scenario that were achieved during the third year of the Socioenactive Systems project. In this report, we first briefly introduce the context of the Socioenactive Systems project, then, we present an overview of the second workshop situated within the museum scenario, which was conducted at the Exploratory Science Museum of Unicamp. In this workshop, named “Uma Experiência no Tempo Profundo” (“An Experience on Deep Time”, in English) three interactive artifacts on the theme of deep time were exhibited at the museum and explored by $N = 15$ participating children and adolescents between ages of 7 and 14. The workshop involved the following activities: reception, exploration, reflection and evaluation, all described within this technical report. Finally, we close the report with our concluding remarks and the next steps intended for the following year.

1 Introduction

Aligned with Weiser’s [15] concept of ubiquitous computing, current digital technologies are present in many aspects of our lives and are used for a variety of purposes all the time, everywhere, and by many people. These technologies, however, are not entirely “invisible” in the sense proposed by Weiser, as they still largely rely on goal-oriented interaction models and the traditional Graphical User Interfaces (GUI) input and output methods through mouse, keyboard and (touch)screen. As an alternative to more transparent interaction, the work of Kaipainen *et al.* [11], with their so-called “enactive systems”, hints towards the idea of human and computer not as separate systems, but as a “coupling” between the human being and the computational technology. Their premise, inspired by the seminal work of Varela, Thompson and Rosch [14], is that interactions are *embodied*, *i.e.*, interactions are guided by the body’s involvement and the human agent’s spatial presence. An enactive system, as proposed, can detect both deliberate and non-deliberate information from body (*e.g.*, body movement or physiological readings) and respond accordingly. This, in turn, generates a response on the person, and the enactive cycle goes on.

Although valuable in many aspects, there is one important limitation in Kaipainen *et al.*’s [11] exemplified concept of an enactive system: it is ultimately a one-person experience, presenting the opportunity of expanding the concept of enactive systems to something that also takes the social dimension into account. In this regard, this work is part of a five-year project, called “Socio-Enactive systems: Investigating New Dimensions in the Design of Interaction Mediated by Information and Communication Technologies” funded by the São Paulo Research Foundation (FAPESP) grant #2015/16528-0, which we will refer to in this technical report as Socioenactive Systems project. The Socioenactive Systems project foresees three scenarios of experimentation: educational (school), healthcare (hospital) and artistic and scientific (museum). All the three scenarios

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share the same goal of expanding the concept of enactive systems, by adding the social element to it. The adopted methodology for the construction of the Socioenactive Systems project is the set of semio-participatory techniques [1] built upon methods and artifacts from Organizational Semiotics (OS) [12, 2].

This technical report describes the activities conducted in the museum scenario during the year of 2019, which was the third year of the Socioenactive Systems project (for 2018, see [7], and 2017 see [6]). In this report we will focus on the second workshop conducted within the museum scenario at the Exploratory Science Museum of Unicamp, with artifacts constructed on the deep time subject. This technical report is organized in the following manner: in Section 2 we present an overview of the second workshop conducted in the museum scenario, and in Section 3 we present our main conclusions and directions for next steps.

2 Workshop: “An Experience on Deep Time”

On January 12, 2019, the second workshop under the museum scenario of the FAPESP Thematic Project of Socioenative Systems was held at the Exploratory Science Museum of Unicamp, located inside the campus of the University of Campinas (UNICAMP). The museum has an audience quite involved in activities and workshops that are systematically carried out there. Thus, the museum staff was responsible for announcing and receiving the public to participate in our second workshop. Several researchers from the Socioenactive Systems project helped in the planning and conduction of this workshop, titled “Uma Experiência no Tempo Profundo” (“An Experience on Deep Time”, in English). It was aimed at children and adolescents between 7 and 14 years old, however, parents were also invited to participate alongside their children. We had a total of $N = 15$ participating children and adolescents. The workshop had an approximate duration of three hours, and was composed of four different phases: 1) reception, 2) exploration, 3) reflection, and 4) evaluation. We describe each of these different phases in the following subsections.

2.1 Reception

During the first 30 minutes of the workshop, we welcomed the participants and their parents as they arrived. The principal researcher was responsible for conducting the workshop and explaining to the participants and their parents about the activities that would be carried out. As the workshop is part of a project approved by a research ethics committee (CAAE 72413817.3.0000.5404), we explained and handed to the participants and their parents the appropriate assent and consent terms that they signed. The children and adolescents signed a term of free and clarified assent, written in a language according to their age range. The parents, in turn, signed a term of free and clarified consent. Furthermore, we introduced the theme of “deep time” by raising motivational questions such as “Do you know how old the planet earth is?”, or “Do you know how long ago life on planet earth came about?”, listening the participants’ answers and guesses, and showing examples related to the subject (*e.g.*, the geological processes of transformations on the earth surface, or the evolution of species).

2.2 Exploration

For the exploration phase, we used the space provided by the museum to create an exhibition with three interactive digital artifacts. The participants were organized into three groups, and each group was assigned to start at a different artifact. For approximately 30 minutes, each group was able to freely explore one of the three artifacts in any way they wanted to, and with minimum intervention

from the researchers. After 30 minutes, the groups rotated to the next artifact until the three groups had explored all the three artifacts. These interactions were video recorded for further analysis. The three artifacts exhibited are illustrated in Figure 1 and described as follows:



Figure 1: The three interactive digital artifacts, TangiTime, CronoBit and Temporário, exhibited in the “Uma Experiência no Tempo Profundo” workshop.

- **TangiTime:** This artifact explores the passage of time in the planet, through its main eras, by handling a volcano, a meteorite, two dinosaurs and a dragonfly on different geological eras projected on a tangible tabletop. Participants act on the interactive surface, manipulating the objects, to perceive characteristics of the random projection and choosing corresponding object(s). The tangible objects have unique markers attached to their base, to be detected by the interactive surface, and embedded devices to provide several types of communication. For instance, the volcano produces a volcanic eruption animation on the surface, and the meteorite creates a meteorite fall animation. The dragonfly shapes a digital dragonfly moving its wings along with it. The wings on the physical artifact are also provided with movement by actuators embedded in it. The two dinosaurs also have corresponding digital images and, as the dragonfly, they use embedded LEDs to light their eyes and change color when they are facing one another. They also emit sounds in some situations. TangiTime was created by Yusseli Lizeth Méndez Mendoza [13].
- **CronoBit:** This artifact explores the concept of deep time in a playful way showing the difference on the effects caused by the human and by nature impacting on natural processes. A display, drumsticks and two drums embedded with sound sensors compose this artifact. The display invites the audience to pick up the drumsticks and play the drums to start the interaction. First, participants can choose between two natural processes: the erosion of the coastline or the evolution of species. Each option contains a temporal sequence of images, and the current image is replaced by the next one every time a drum is played, generating an interactive animation. The “nature” drum plays the animation at average speed, while the “humanity” drum drastically increases its speed by skipping several images. Thus, playing the “humanity” drum can dramatically accelerate the process of erosion on the coastline that otherwise would take much longer if the “nature” drum is played. CronoBit was created by Arthur Biscaino Fruch, Giovanna Lucas Dias Pereira Mariano, Luciano Gigantelli Zago, Luis Fernando Dos Santos Lacalle and Yago De Lima Barbosa in a project named InsTime [8].

- **Temporário:** This artifact explores a social way of watching an educational video that presents information on the concept of deep time in a timeline. The main idea is that the number of people watching the displayed video at the same time will impact its playback speed, which can also be related to the passage of time itself. The artifact uses a proximity sensor to detect if someone is nearby, and a webcam to identify how many people are watching the displayed video at the same time. Initially, the video is paused at the beginning before anyone approaches. After someone starts looking at the screen, the video starts playing at normal speed, and as more people start watching together, the playback speed is increased. When nobody else is looking at the video anymore, the picture receives a grayscale filter, and the video starts to rewind. The rewind continues until someone approaches the video again, or the beginning of the video is reached, returning the artifact to its initial state. Temporário was created by Carlos Avelar Martins De Sousa, Rogério Guimarães Meirelles, Tiago Loureiro Chaves, Victor Ferreira Ferrari and Vinicius Couto Espindola in a project named InsTime [8].

2.3 Reflection

For reflection about the theme of deep time and the interactive artifacts we asked the following questions to the participants after they interacted with each artifact:

- How “deep time” appeared in the artifact?
- What do you like in the artifact?
- What you do not like in the artifact?

Each installation had a blank flip-chart sheet affixed near it to hold the feedback responses. The participants wrote their answers and comments on post-its, and placed them on the blank flip-chart sheet on the wall. Also, after the experience in a particular installation, children answered, in a blank sheet, some challenge questions regarding the concepts of deep time, described as follows (these activities lasted approximately 20 minutes):

- TangiTime:
 - Which geological era had the highest temperature in the planet?
 - In which geological era did the first plants appear?
 - In which geological era did a layer of primitive ozone appeared?
- CronoBit:
 - What happens faster: changes caused by nature or by human direct action?
 - Without human intervention, what would erosion on a coast look like?
- Temporário:
 - What happens if more or fewer people are watching the video?
 - How is “time” shown in the artifact?
 - How is “deep time” shown in the artifact?

2.4 Evaluation

At the end of the workshop, we invited the participants to evaluate their experience regarding the workshop as a whole. We used two different evaluation instruments. The first evaluation instrument is an adaptation of the AttrakDiff questionnaire [9], that seeks to measure hedonic, pragmatic and attractive qualities in an interaction. While pragmatic qualities refer to functional aspects of interaction, hedonic qualities refer to the product attributes to evoke pleasure. The adapted questionnaire, illustrated in Figure 2, is composed of 20 items distributed in seven pairs whose poles are opposing adjectives (*e.g.*, “complicated - simple”, “boring - captivating”, or “bad - good”). The original English terms of the questionnaire were translated to Brazilian Portuguese and we used terms more suitable for children. Some word pairs in the original questionnaire that we considered not relevant to the workshop in the original questionnaire were removed, and the instrument was presented in printed form [4].

Adaptado de  AttrakDiff

Com a ajuda dos pares palavras, aponte o que você considera a descrição mais apropriada da Experiência.

Humana	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Técnica
Agradável	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Desagradável
Simples	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Complicada
Profissional	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Antiprofissional
Feia	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Atraente
Prática	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Impraticável
Estilosa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Brega
Previsível	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Imprevisível
Alienante	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Integradora
Me aproxima das Pessoas	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Me Separa das Pessoas
Apresentável	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Inapresentável
Desinteressante	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Convidativa
Sem Imaginação	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Criativa
Boa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Ruim
Confusa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Claramente Estruturada
Inovadora	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Conservadora
Tediosa	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Cativante
Pouco Exigente	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Desafiadora
Motivadora	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Desencorajadora
Nova	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Comum

Figure 2: Adapted AttrakDiff questionnaire.

The second evaluation instrument, aimed at surfacing self-assessed emotions, is based on Hayashi *et al.*'s Emoti-SAM [10], which in turn is an adaptation of Bradley and Lang's Self-Assessment

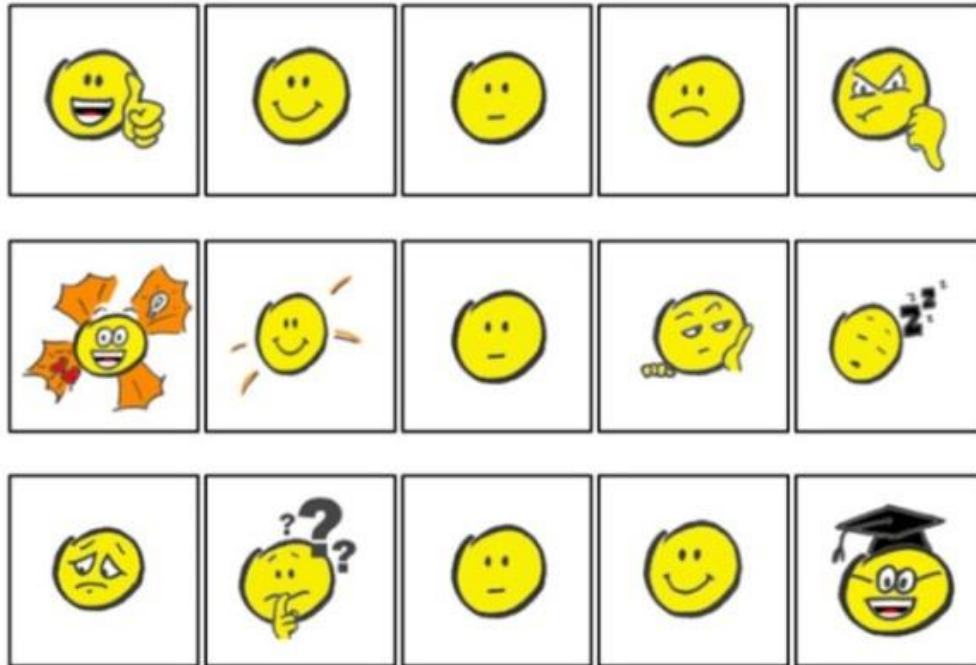


Figure 3: Original Emoti-SAM.

Manikin (SAM) [3]. The Emoti-SAM consists of 15 emoticon icons representing the three dimensions of pleasure, arousal, and dominance, as illustrated in Figure 3. We adapted the Emoti-SAM instrument in the following manner: we printed multiple copies of every symbol from Emoti-SAM (at least one copy of each emoticon for each workshop participant) and presented them to participants inside a wooden box. We then asked each participant to pick the symbol that best represented his emotional state towards the workshop and then to deposit it in an urn. After the evaluation was complete, which lasted for approximately 10 minutes, completing the three hours of the workshop, the workshop was officially concluded.

2.4.1 Evaluation Results

For the adapted AttrakDiff questionnaire [4] we used AttrakDiff’s official online tool¹ to analyze the participant’s responses. The results of the analysis are briefly described through the main visualizations of AttrakDiff: the portfolio of results, the diagram of word pairs, and the diagram of average values. The portfolio of results illustrates the medium value of pragmatic and hedonic qualities and the confidence interval of the results. The medium value is represented by a small and dark blue rectangle and the confidence interval is represented by a larger and light blue rectangle. In the portfolio of results from the workshop, illustrated Figure 4, the medium value is located into the self-oriented quadrant suggesting that, although the pragmatic quality of the experience is positive, hedonic attributes of the experience stood out.

The description of word pairs diagram illustrates the distribution of response patterns for each word pair of the four AttrakDiff dimensions. The extreme values are of particular interest. In Figure 5, most of the blue squares are located significantly to the positive side of the diagram. Exception to this is the result to Pragmatic Quality (PQ) in the word pair “unpredictable – pre-

¹<http://www.attrakdiff.de/index-en.html>

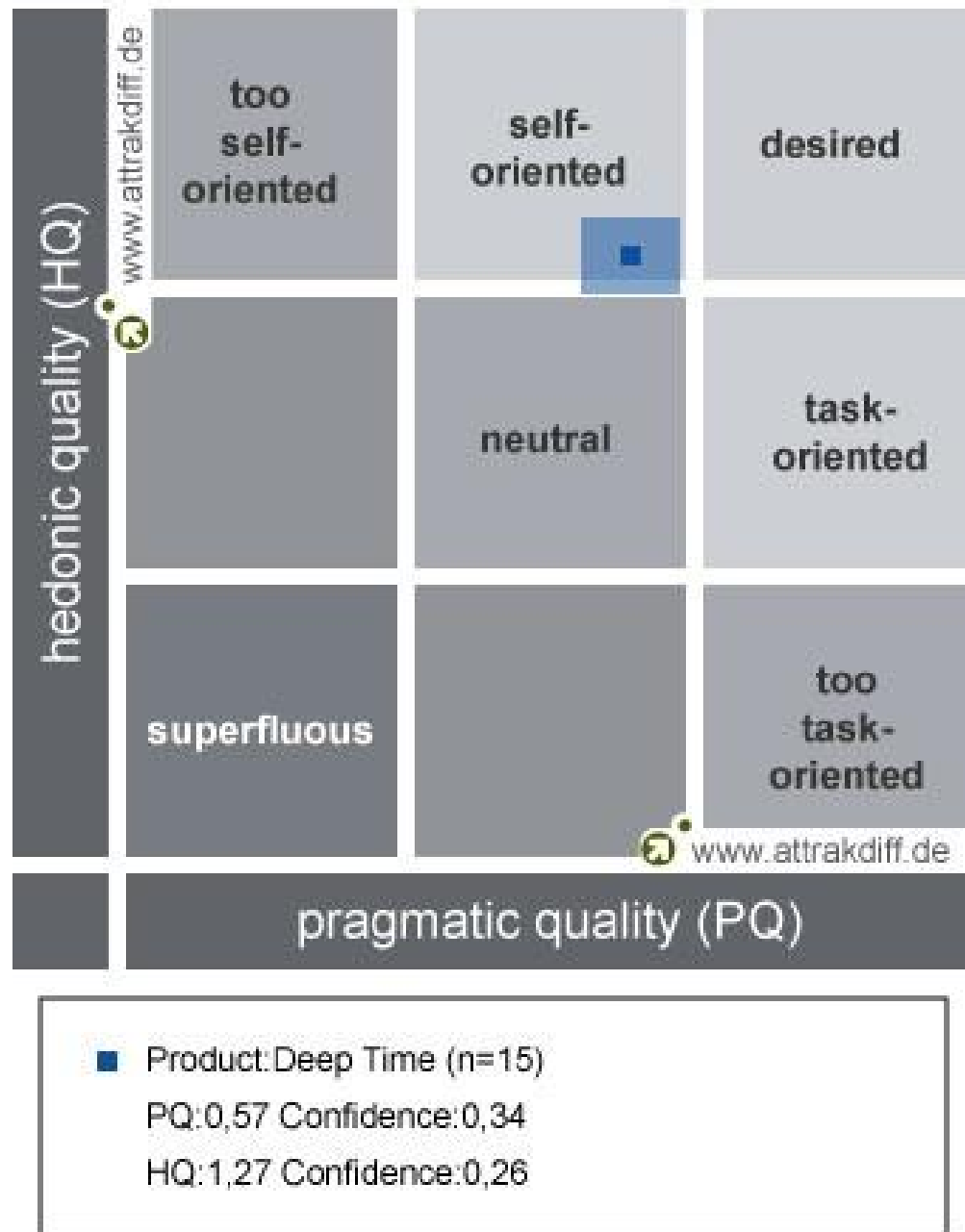


Figure 4: AttrakDiff's portfolio of results.

dictable”, positioned to the negative side with a value of -1 . This value suggests that the behavior of the artifacts was experienced more as not predictable than predictable by the participants. Furthermore, participants’ perception about the Attractiveness (ATT) highlight the word pair “rejecting – inviting” with a value between $+2$ and $+3$. This result suggests that participants considered the experience with the workshop as inviting. Also highlighted are the qualities “brings me closer”, “captivating”, “pleasant”, “attractive”, and “good”.

In the results from the diagram of average values, illustrated in Figure 6, the Pragmatic Quality

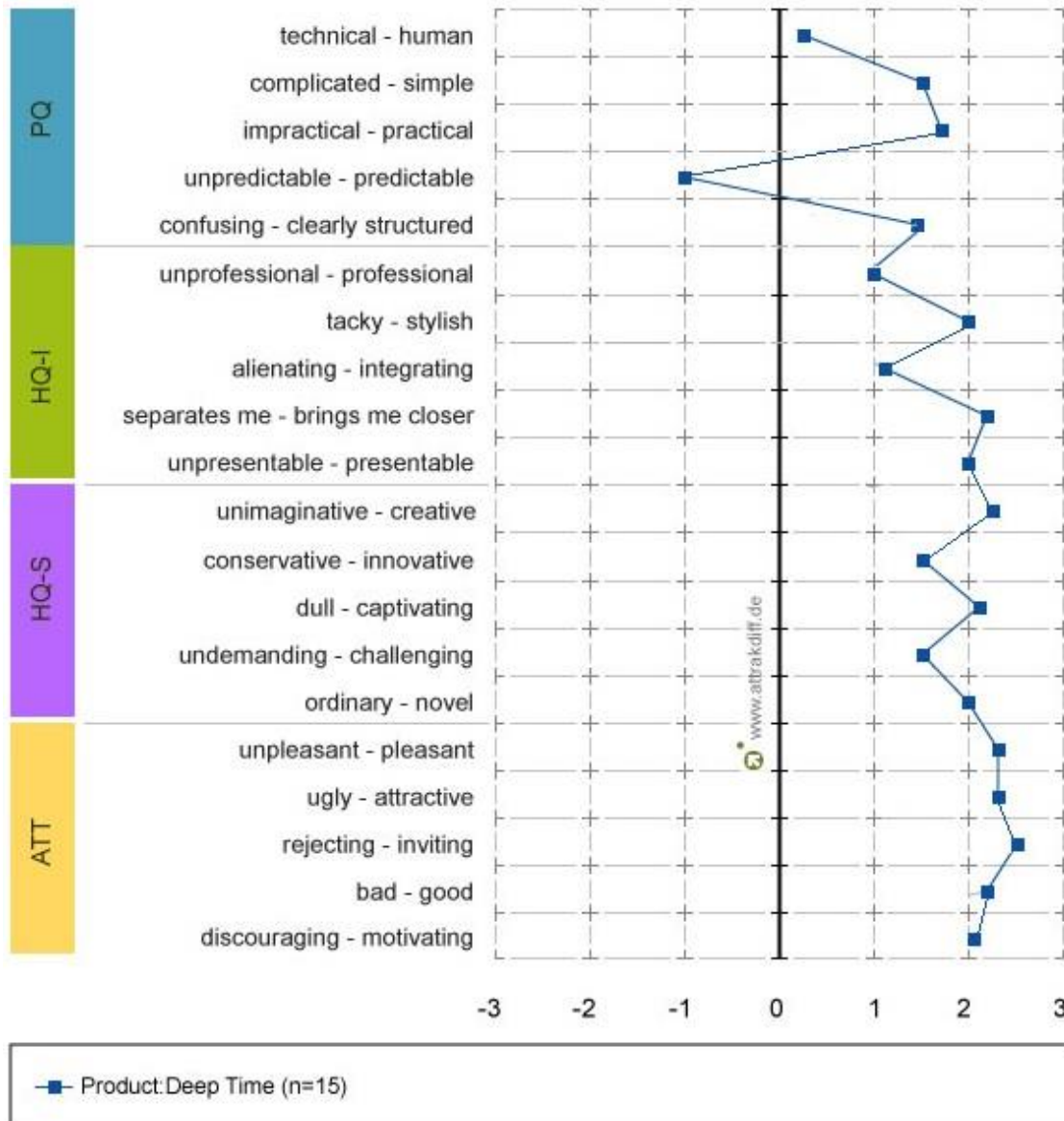


Figure 5: AttrakDiff's diagram of word pairs.

(PQ) value indicates the degree of success in achieving specified objectives and obtained a score of 0.57. The Hedonic Quality – Identity (HQ-I) value indicates the level of identification of the participants with the experience and obtained a score of 1.19. The Hedonic Quality – Stimulation (HQ-S) value, which indicates whether the experience is original, interesting and stimulating, obtained a score of 1.35. Finally, the Attractiveness (ATT) value indicates how attractive the experience was to the participants and obtained a score of 1.64, the highest among the categories.

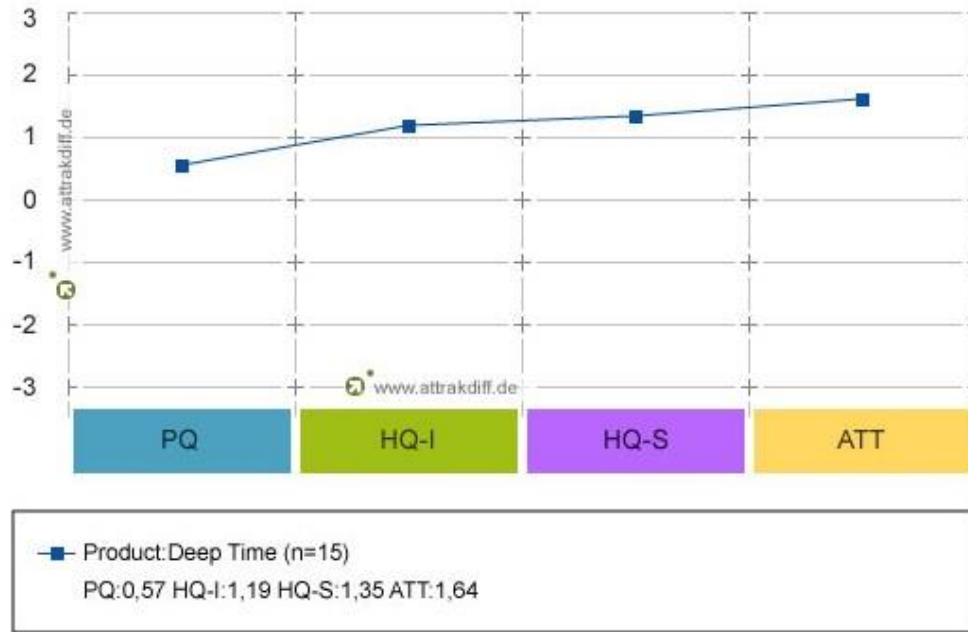


Figure 6: AttrakDiff's diagram of average values.

3 Conclusions

To expand on the concept of enaction, towards the original concept of socioenaction, there is a need to bring theory and practice as close together as possible, and this is our goal for conducting workshops at the Exploratory Science Museum of Unicamp. The results of this workshop, including data of video recordings, should contribute towards this objective. For next steps, we intend to further analyze the results of this second workshop, including a qualitative analysis of the video recordings of interactions with the three new artifacts, and publish our main findings. It is our understanding that these results (both the artifacts themselves and their analysis) and publications will support the Socioenactive Systems project, advancing the original concept of socioenaction and providing working prototypes to exemplify and evaluate this concept. Another ongoing effort in the museum research scenario that should be mentioned is the construction of a full-scale version of the interactive installation created in the InstInt project [5], to be experimented with in future workshops.

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