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Measuring the Socially Extended Perception in a Remote Experience of Interaction

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Abstract

The social and physical distancing and the rapid transition to remote learning during pandemics had an impact on children's life regarding educational activities and well being. In this context, the Human-Computer Interaction (HCI) field has faced challenges to design and evaluate computational systems, especially those for learning scenarios. In this paper, we propose an evaluation instrument considering socio-affective aspects of the experience, and present results from a pilot study to evaluate the Aquarela Virtual system. The Aquarela Virtual allows remotely situated children to interact with others by using physical objects related to a children's song, and emoticons to express their emotions. Based on findings of these evaluations, we provide insights on: a) improvements to be done in the system; b) aspects still to be covered by an evaluation instrument. Even considering the pandemic is now over, hybrid systems such as the Aquarela Virtual system came to stay, and so the need of evaluation instruments such as the proposed one remains.

Keywords: *Ubiquitous Computing; Socioenactive Systems; Remote Interaction*

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1 Introduction

During the pandemic time, children were confined at home so they were not exposed to the COVID-19 and could prevent the spread of the virus in schools and in their homes. With the schools closed, the children had to continue their school curricular activities on digital platforms. However, the rapid transition to digital platforms, the social and physical distancing from friends and teachers, and many other factors, ended up impacting the mental health and well-being of children by generating stress, inattention, irritability, among other behavioral and emotional disorders (Cianfarani & Pampanini, 2023; Hoffman & Miller, 2020; Jiao et al., 2020). Considering this scenario, the Human-Computer Interaction (HCI) field envisaged opportunities and challenges to face the design and evaluation of computational systems especially for educational scenarios.

In this paper, we evaluate the perception of others by exploring socio-affective aspects of a remote experience of interaction with the *Aquarela Virtual* system. The *Aquarela Virtual* system (Duarte et al., 2022) allows remotely situated kindergarten children to be able to interact with the system and with others according to elements of the *Aquarela* song (Moraes et al., 1983). Children can use physical objects to represent elements of the song and emoticons, to act in the system and express their emotions. Each object and emoticon contain a QR code to be detected by the system and to display feedback actions such as digital animations, visual expressions and sounds. The *Aquarela Virtual* system was developed during the pandemic time in the context of a thematic research project (Baranauskas, 2015) whose approach is related to the most recent discourse on the embodied mind (Varela et al., 2016) that represents an influential theoretical reference for understanding cognition, named *the enactive approach.*

Within the context of the Aquarela Virtual system, a research question we want to address is *"How to evaluate the Aquarela Virtual system affordances for the socio-affective aspects of the experience?"* Thus, we conducted a pilot study to evaluate the first version of the system. As we are interested in evaluating the potential of the system for raising social and affective aspects of the experience, we propose the *Socially Extended Perception of the Experience (SEPE)* as an evaluation tool. *SEPE* is based on two evaluation instruments: The *AttrakDiff questionnaire* (Hassenzahl et al., 2003) and the *Condensed Networked Minds Social Presence Inventory (NMSPI)* (Harms & Biocca, 2004). The first instrument was selected because it is one of the most recognized standardized questionnaires for UX evaluation (Díaz-Oreiro et al., 2019), as it evaluates important aspects of the experience such as its pragmatic and hedonic qualities. However, we perceive in it a need for more attributes to address social aspects of the experience (Mendoza & Baranauskas, 2020); hence, we were inspired by the *NMSPI* questionnaire to tell us how users feel socially, and how aware they are of the effects of their actions on the emotional and behavioral state of others, now interacting through the system.

The pilot study was developed remotely with 9 adult participants, and we used Google Meet as a tool to coordinate the communication during the study. The reasons of having adults as participants were two: not exposing children to test situations in a pilot study, and counting on the expertise of the group in HCI and Education fields. Results of the study are based on data gathered from *SEPE* that include AttrakDiff diagrams and participant responses for items related to the *NMSPI* questionnaire. This work contributes with (1) a preliminary evaluation of the Aquarela Virtual system, and (2) an evaluation instrument for considerations of socio-affective aspects of the experience.

This paper is an extended version of Mendoza et al. (2022), in which we included and deepened the theoretical background, and detailed the proposed method. In addition, we also enriched the discussion section with elements of the socioenactive perspective. It is organized as follows: Section 2 presents the theoretical and methodological background for the work. Section 3 describes the pilot study and results. Section 4 provides a discussion about the results obtained with our evaluation instrument and improvements in the system after the evaluation, and Section 5 concludes with insights on other aspects to be covered by our evaluation instrument.

2 Background and Methodological Reference

In this section, we present the theoretical background about the enactive approach to cognition, raise the socioenactive perspective to interaction, and introduce some potentially useful evaluation instruments applied in this work.

2.1 The Enactive Approach to Cognition

In the third interaction wave of HCI, the interaction has been treated as a form of meaning-making in which artifacts and their context are mutually defining and subject to multiple interpretations (Harrison et al., 2007). In this sense, several researchers in HCI have considered the phenomenological approach and cognitive science in the design of computational systems. Among them, Dourish (2004) proposed the concept of *Embodied Interaction* to refer to research ideas around tangible and social computing. According to the author, *Embodied interaction* refers to the understanding that users create and communicate meaning through their interaction with the system (and with each other, through the system). McCarthy and Wright (2004) proposed experience-centered approaches, including emotional and sensory conditions of interaction with technology.

A new form of cognitive science, named *enaction* or *the enactive approach*, studies the coupling between the human agent and the world and his/her experience as aspects of cognition. According to Varela et al. (2016), cognition "depends upon the kinds of experience that come from having a body with various sensorimotor capacities" and that "these individual sensorimotor capacities are themselves embedded in a more encompassing biological, psychological, and cultural context" (Varela et al., 2016, p. 173). These ideas of the new paradigm of cognitive science were also addressed in the design of computational systems. For instance, the work of Kaipainen et al. (2011) about *enactive systems* points out the bodily involvement and spatial presence of the human agent without the assumption of conscious control of the system in technological interaction, where the work of Mendoza et al. (2019) takes advantage of children's abilities to grasp and manipulate physical objects enhanced with technology to interact with a tangible tabletop and receive responses from the system on its display or on the physical object itself.

Additionally, the enactive approach emphasizes the extended, intersubjective, and socially situated nature of cognitive systems (Gallagher & Lindgren, 2015). Thus, social situations of interaction, emotions, embodiment, and experiences are keywords in the third interaction wave that should be considered (Harrison et al., 2007).

2.2 The Socioenactive Perspective to Interaction

The work of Baranauskas et al. (2021, 2023) propose a socioenactive perspective to interaction based on the enactive approach to cognition (Varela et al., 2016, p. 173) in which the mind, body, and environment are in a dynamic and mutually constituent interaction., They understand interaction not just in terms of individual actions with or intentions towards technology, but in terms of the domain of relations that limits and regulates individual and social group actions. Two main aspects characterizing the socioenactive interaction are: (1) the socioenactive tripartite coupling, and (2) the intersubjective relations (joint attention, joint action, coordination).

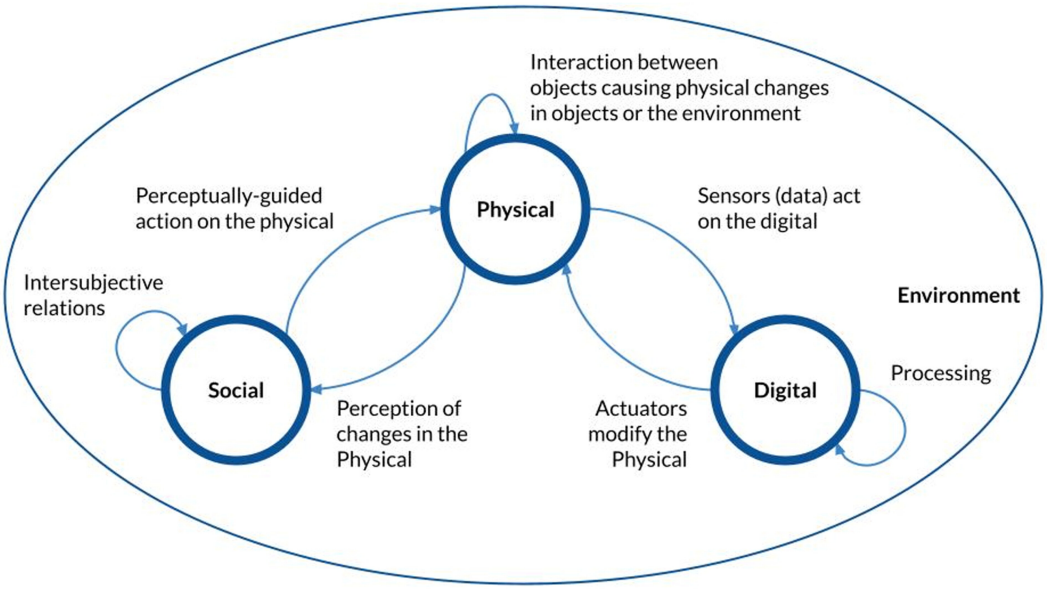

Figure 1: The social-physical-digital tripartite coupling (Baranauskas et al., 2023).

Figure 1 illustrates the socioenactive tripartite coupling to be considered into the design of computational scenarios constructed with ubiquitous technology, that address a socioenactive interaction. All three elements (social, physical and digital) are coupled by considering not only an individual organism interacting with a system, but also in the relation with other people and their environment. To regard intersubjectivity relations such as joint action, joint attention and coordination, these are embodied capacities of the human being for understanding and engaging with others. The work previously mentioned recognizes the relevance of intersubjectivity in the design of computational scenarios, and studies the phenomena of interaction in scenarios of ubiquitous technology. However, there is still a need for instruments to evaluate these interaction scenarios that include the social domain. We identified some potentially useful evaluation instruments and they are presented in the next section.

2.3 Evaluation instruments

The work of Mendoza et al. (2023) presented and discussed a systematic literature review on the evaluation of scenarios constituted by ubiquitous and pervasive technology. The authors identified that the main aspects evaluated were the people's experience and interaction, and that main methods of data collection were interviews, video recordings, and questionnaires. For example, we can find evaluation instruments to measure affect such as the Positive and Negative Affect Schedule (PANAS) (Watson et al., 1988), instruments to measure emotion such as the Self-Assessment Manikin (SAM) (Bradley & Lang, 1994) and the emoti-SAM (Hayashi et al., 2016), and questionnaires such as the AttrakDiff (Hassenzahl et al., 2003) to evaluate the user experience (UX).

Although some works in the literature review address social aspects in evaluation (i.e. (Harms & Biocca, 2004)), we hardly find instruments to capture social and affective aspects involved in the interaction and experience with others and technology. In this paper, we are interested in evaluating the perception of others as part of the social aspects involved in a remote experience of interaction with technology. For that, we propose *The Socially Extended Perception of the Experience (SEPE)* based on adaptations on the AttrakDiff questionnaire and the NMSPI questionnaire, both synthesized as follows:

2.3.1 AttrakDiff

The AttrakDiff is a questionnaire to capture the user experience to interact with interactive systems (Hassenzahl et al., 2003), and it is considered one of the most recognized standardized questionnaires for UX evaluation (Díaz-Oreiro et al., 2019). It consists of 28 word pairs that represent extreme opposites, with seven graduations between them. Each word pair refers to pragmatic or hedonic attributes to evaluate the pragmatic and hedonic quality of an interactive system, or it can refer to the attractiveness of the interactive system. Pragmatic Quality (PQ) emphasizes functional aspects of the system while Hedonic Quality (HQ) emphasizes the psychological well-being of individuals. Some examples of word pairs are: "complicated / simple", "isolating / connective", "undemanding / challenging", or "ugly / attractive". Results of the AttrakDiff illustrate the medium value of PQ and HQ, the average values of PQ, HQ and ATT, and the average value for each word pair. Table 1 shows the aspects and attributes covered by the Attrakdiff questionnaire.

2.3.2 Condensed Networked Minds Social Presence Inventory (NMSPI)

The NMSPI (Harms & Biocca, 2004) is a questionnaire to measure "Social Presence" in a mutual interaction with others according to the initial awareness, allocated attention, the capacity for both content and affective comprehension and the capacity for both affective and behavioral interdependence with others. It consists of 36 items grouped in six dimensions: Co-presence, Attentional allocation, Perceived message understanding, Perceived affective understanding, Perceived affective interdependence, and Perceived behavioral interdependence. For example, "Perceived affective understanding" refers to the user's ability to understand the emotional states of others, while "Perceived affective interdependence" refers to the extent to which the user's emotional state affects and is affected by the emotional states of others. Table 2 shows the dimensions and attributes covered by the NMSPI questionnaire.

Table 1: Attrakdiff attributes (Hassenzahl et al., 2003).

Dimension	Attributes
Pragmatic Quality (PQ)	"technical / human", “complicated / simple”, “impractical / practical”, “cumbersome / straightforward”, “unpredictable / predictable”, “confusing / clearly structured”, “unruly / manageable"
Hedonic Quality (HQ)	"isolating / connective”, “unprofessional / professional”, “tacky / stylish”, “cheap / premium”, “alienating / integrating”, “separates me from people / brings me closer to people”, “unpresentable / presentable”, “conventional / inventive”, “unimaginative / creative”, “cautious / bold”, “conservative / innovative”, “dull / captivating”, “undemanding / challenging”, “ordinary / novel"
Attractiveness	“unpleasant / pleasant”, “ugly / attractive”, “disagreeable / likeable”, “rejecting / inviting”, “bad/ good”, “repelling / appealing”, “discouraging / motivating”

Table 2: NMSPI dimensions (Harms & Biocca, 2004).

Dimension	Concept	Attributes
Co-presence	Degree to which the observer believes he/she is not alone and secluded, their level of peripheral or focal awareness of the other, and their sense of the degree to which the other is peripherally or focally aware of them.	i.e. I noticed (my partner) / (My partner) noticed me.
Attentional allocation	Attentional allocation addresses the amount of attention the user allocates to and receives from an interactant.	i.e. I remained focused on (my partner) throughout our interaction. / (My partner) remained focused on me throughout our interaction.
Perceived Message Understanding	User’s ability to understand the message being received from the interactant as well as their perception of the interactant’s level of message understanding.	i.e. It was easy to understand (my partner). / (My partner) found it easy to understand me.
Perceived Affective understanding	User’s ability to understand an interactant’s emotional and attitudinal states as well as their perception of the interactant’s ability to understand the user’s emotional and attitudinal states.	i.e. I could tell how (my partner) felt. / (My partner) could tell how I felt.
Perceived Affective interdependence	The extent to which the user’s emotional and attitudinal state affects and is affected by the emotional and attitudinal states of the interactant.	i.e. My attitudes influenced how (my partner) felt. / (My partner’s) attitudes influenced how I felt.
Perceived Behavioral interdependence	The extent to which a user’s behavior affects and is affected by the interactant’s behavior.	i.e. My behavior was often in direct response to (my partner’s) behavior. / The behavior of (my partner) was often in direct response to my behavior.

In this work, we combined the strengths of both questionnaires in their reach, while we balanced their complexity, resulting in the instrument used and described in this study: the *Socially Extended Perception of the Experience (SEPE)*. While the AttrakDiff allows us to measure pragmatic and hedonic qualities, and attractiveness of the system, the NMSPI allows us to know how users perceived the emotional state of others through the system and how aware they were of the effects of their actions on the emotional and behavioral state of others.

In the next section, we explain the instrument and the pilot study conducted to perform an initial evaluation of the Aquarela Virtual system by applying an initial version of our evaluation instrument to gather data for the analysis of the experience with the system. .

3 Pilot Study

In this section, we explain the context and participants of the study, method and materials, the proposed evaluation instrument, and the results of applying it.

3.1 Context and Participants

The pilot study was developed remotely and involved the participation of 9 researchers (Professors, PhD students, Master's students, and postdoctoral researchers) in HCI and Education fields, as an evaluation effort before involving children directly. The participants previously took part in the evaluation of other Socioenactive systems involved in a Socioenactive project (Baranauskas, 2015). This work is part of a project that was approved by a research ethics committee (CAAE 72413817.3.0000.5404). In addition to the Aquarela Virtual system, we used the Google Meet as a tool to coordinate the communication during the study.

3.2 Method and Materials

3.2.1 The Aquarela Virtual system

The *Aquarela Virtual* system is a web-based application that allows remotely situated children to interact with the system and with others according to elements of the Aquarela song (Moraes et al., 1983). This first version of the system provides an interaction experience enriched with tangible objects and QR-codes. Firstly, children can select avatars of animals (rabbit, panda bear, cat, dog, etc.) in the login interface (Figure 2) to represent them in the system. Subsequently, children can manipulate physical objects and emoticons attached with QR-codes in front of their webcams to experience the musical environment (Figure 3). Each QR-code represents elements of the song (castle, gull, sailboat, airplane, and a drop of paint), or emotional states differentiated by colors (happy, calm, angry, sleepy, sad, and afraid). According to the QR-code detected by the system, a song segment and animations related to the object are triggered by the system.

An instance of the interaction model is illustrated in Figure 4, one child selected a rabbit and the other child a panda bear to represent them. They interact with their sailboats and the *"happy"* emoticon. When the sailboat QR-code is detected by the system then the song segment related to it is played. Both avatars appear in the background and looked like they were blowing the digital

Figure 2: Login Interface of the Aquarela Virtual system taken from Duarte et al. (2022).

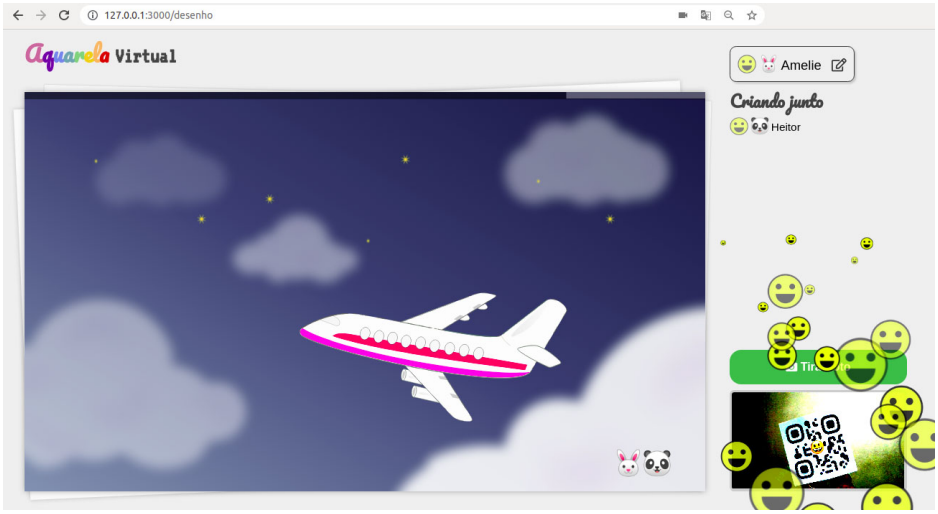

Figure 3: Interface of the Aquarela Virtual system taken from Duarte et al. (2022).

sailboat that moves over the waves. Moreover, when the *"happy"* emoticon is detected by the system then happy faces appear on the right side of the screen, whereas another child observes the emoticon close to the child's name who started the animation. More information about the interaction model of the system can be found in (Mendoza & Baranauskas, 2024) and (Duarte et al., 2022) .

3.2.2 The Socially Extended Perception of the Experience (SEPE)

The Socially Extended Perception of the Experience (SEPE) was proposed as an evaluation instrument to measure the perception of others by considering socio-affective aspects of an interaction experience with computational systems. Additionally, it allows the evaluation of Pragmatic Quality, Hedonic Qualities, and Attractiveness of the system. This first version of the *SEPE* was conceived as a Google form questionnaire with a seven-point scale composed of 41 items: 28

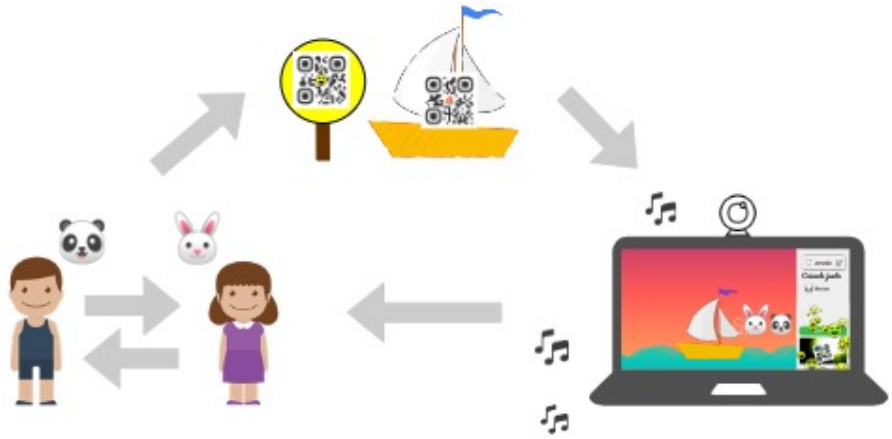

Figure 4: Interaction model of the Aquarela Virtual system.

items evaluate pragmatic and hedonic attributes, and the attractiveness of the system (*AttrakDiff* dimensions), while the remaining 13 items evaluate the perception of others according to the co-presence, attention, perceived affective understanding, perceived affective interdependence, and perceived behavioral interdependence (*NMPSI* dimensions). Each item is in its positive and negative form, and they are in Portuguese. Figure 5 shows the dimensions on which *SEPE* was based to evaluate socio-affective aspects of the experience, combining *AttrakDiff* and *NMPSI*.

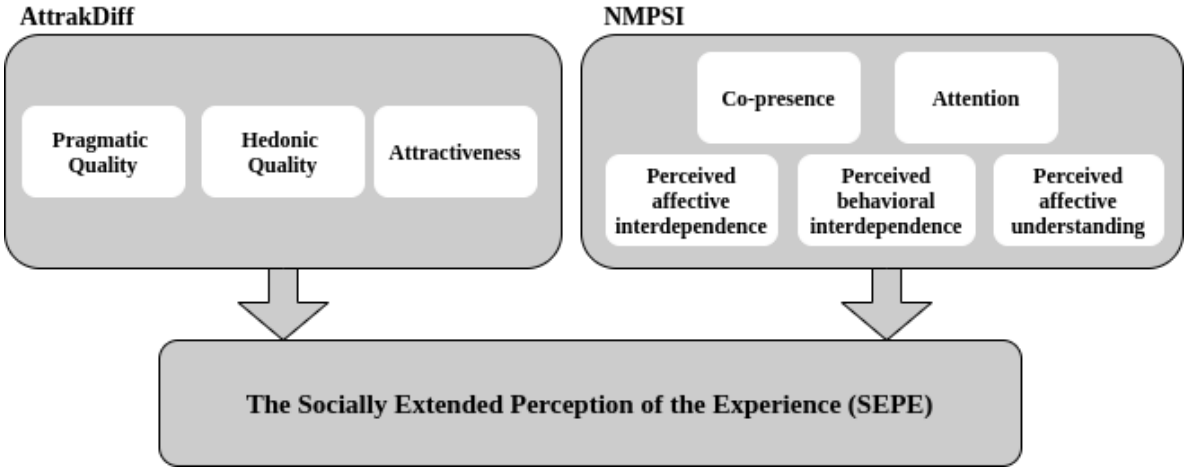

Figure 5: The Socially Extended Perception of the Experience (SEPE).

As described in Section 2.3, pragmatic quality tells us whether attributes of the system were perceived, for example, as *"simple – complicated"* or *"practical – impractical"*; hedonic attributes tell us whether the experience was perceived, for example, as *"creative - unimaginative"* or *"professional – unprofessional"*; while attractiveness attributes tell us whether the experience was perceived, for example, as *"likeable – disagreeable"* or *"good – bad"*. The 28 items of the AttrakDiff were translated to Portuguese and used in the SEPE. Only 13 items of SEPE grouped in 5 dimensions were chosen from the *NMPSI* questionnaire and adapted in their positive and negative form as shown in Table 3. Some examples are: *"My partner's actions influenced how I felt / My partner's actions did not influence how I felt"* and *"My partners could tell how I felt /*

My partners couldn't tell how I felt'.

Table 3: SEPE's opposite statement pairs inspired by the NMPSI.

Dimension	Positive form	Negative form
Co-presence	S1: I notice my partners S2: My partners noticed me	S1: I didn't notice my partners S2: My partners didn't notice me
Attention	S3: I remained focused on the activity	S3: I didn't remain focused on the activity
Perceived affective understanding	S4: I could tell how my partners felt S5: My partners could tell how I felt	S4: I couldn't tell how my partners felt S5: My partners couldn't tell how I felt
Perceived affective interdependence	S6: I was sometimes influenced by my partner's moods S7: My partners were influenced by my moods S8: My partner's feelings influenced the mood of our interaction S9: My feelings influenced the mood of our interaction S10: My partner's actions influenced how I felt S11: My actions influenced how my partners felt	S6: I wasn't sometimes influenced by my partner's moods S7: My partners weren't influenced by my moods S8: My partner's feelings didn't influence the mood of our interaction S9: My feelings didn't influence the mood of our interaction S10: My partner's actions didn't influence how I felt S11: My actions didn't influence how my partners felt
Perceived behavioral interdependence	S12: My behavior was often in direct response to my partner's behavior S13: The behavior of my partner was often in direct response to my behavior	S12: My behavior wasn't often in direct response to my partner's behavior S13: The behavior of my partner wasn't often in direct response to my behavior

3.3 Procedure

The pilot study was conducted as follows: First, the participants already had their objects related to the Aquarela song such as castles, sailboats, planes, etc. Previously to the study, the participants received printable QR-codes to be pasted on the objects. Also, they received printable emoticons with their respective QR-code to express their affective states. Then, the participants accessed the *Aquarela Virtual* system by typing a username and selecting an avatar to represent them in the system. By logging into the system, participants looked at all avatars and names of participants currently logged into the system as illustrated in Figure 6. During the interaction experience, all participants were free to manipulate their physical objects and emoticons in front of their webcams.

In Figure 6, we show the situation in which one participant showed the "sun" object and started the song and animation segment of the "castle and sun" environment. His/her avatar ("bear") appears jumping in front of the castle and the animation of the sun increasing in size

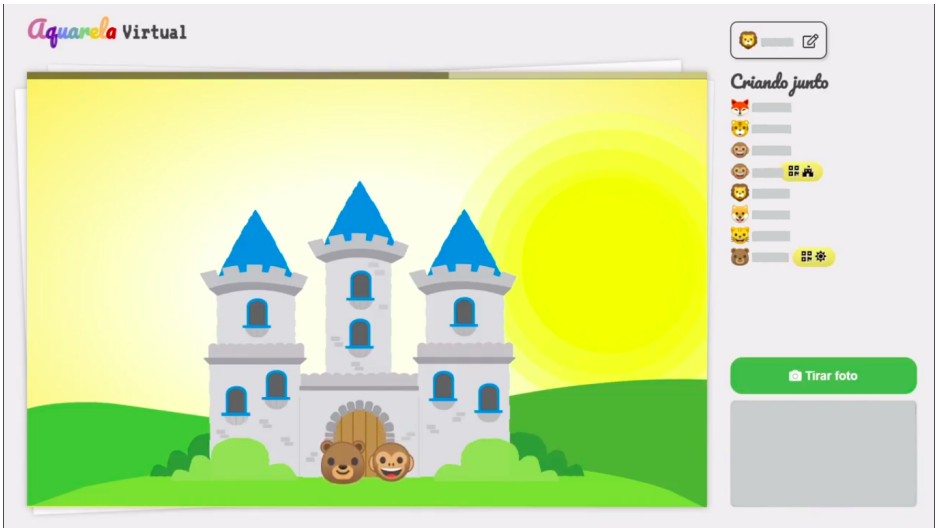

Figure 6: A screenshot of the Aquarela Virtual during the workshop..

and intensity is activated. Next, another participant showed the “castle" object and his/her avatar (“monkey") also appears jumping in front of the castle. Participants can perceive which object each person is interacting with by observing a referential image of the object (social feedback) that appears next to each participant’s name. After the experience, participants filled out the *SEPE* form, anonymously, to evaluate their experience.

Interaction data was collected, including expressions of emotional states through emojis and the number of actions performed by the participants using their physical objects; those data will be subject to analysis in future research endeavors. The QR codes and the source code can be found in (Mendoza, Duarte, Queiroz, et al., 2023).

3.4 Results

The analysis of the participant’s responses to the instrument was split into two parts: Results based on the AttrakDiff questionnaire, and results based on the socio-affective aspects of the experience.

3.4.1 AttrakDiff Results

As described in Section 2, the AttrakDiff questionnaire measures the perceived Pragmatic Quality (PQ), Hedonic Quality (HQ), and the attractiveness (ATT) of interactive systems. HQ can be subdivided into providing stimulation (HQ-S) and communicating identity (HQ-I). To analyze the participant’s responses related to the 28 word-pairs of the AttrakDiff, we transferred these collected data to an online tool. The online tool provides us with three diagrams: (1) The Portfolio of Results diagram (Figure 7-left) illustrates relation between PQ and HQ, with the medium value of PQ relative to HQ; (2) The Diagram of Average values (Figure 7-right) illustrates the average values for PQ, HQ-S, HQ-I, and ATT; and (3) The Distribution of Response Patterns diagram (Figure 8) illustrates the distribution of the responses for each word-pair of the AttrakDiff represented by blue squares.

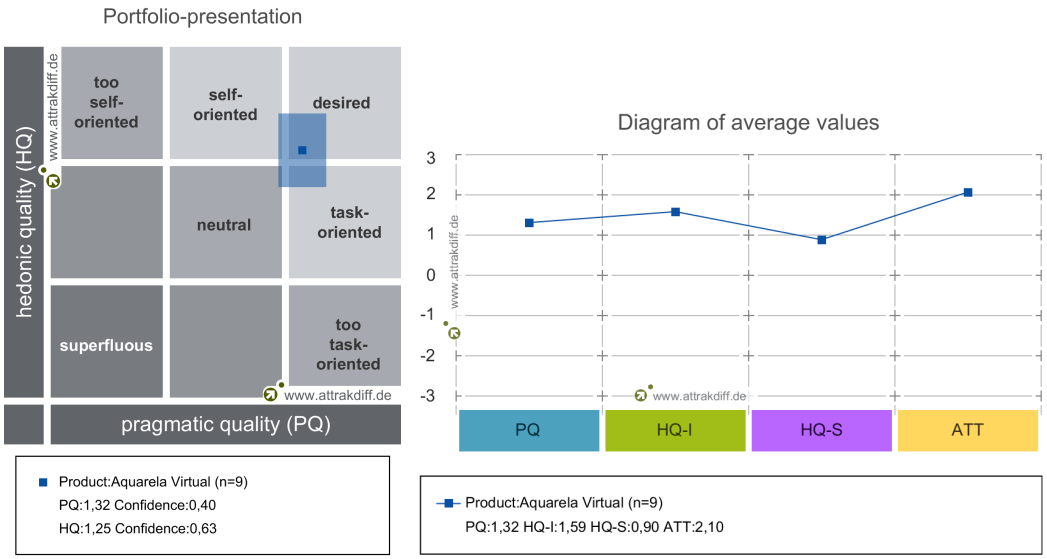

Figure 7: Left: The Portfolio of Results - Right: The Diagram of Average values .

Results in Figure 7-left show a strong PQ (value: 1.32, confidence interval: 0.40) and a strong HQ (value: 1.25, confidence interval: 0.63) suggesting that the system satisfies both the pragmatic and hedonic needs of the participants. In Figure 7-right, ATT obtained the highest value (value: 2.1) suggesting that the system was perceived as highly attractive. According to Figure 8, pragmatic attributes of the Aquarela Virtual system were mainly perceived as practical and simple to use; hedonic attributes were mainly perceived as professional, presentable, and stylish; whereas for the attractiveness of the system, word-pairs like “good”, “likeable” and “attractive” were highlighted.

3.4.2 Socio-affective Results

To analyze socio-affective aspects of the experience, we counted the participant’s responses relating to the 13 statement pairs inspired by the NMPSI questionnaire. According to Figure 9, S3 (*I remained focused on the activity*) obtained the highest value followed by S10 (*My partner’s actions influenced how I felt*) and S1 (*I noticed my partners*). The lowest values were obtained by S7 (*My partners weren’t influenced by my moods*), S9 (*My feelings didn’t influence the mood of our interaction*), and S12 (*My behavior wasn’t often in direct response to my partner’s behavior*). The results suggest that most participants perceived the system as great at keeping attention (S3 = 2.22) because they remained focused on the activity attracted by music, images and animations. Also, participants perceived that the action of the other participants influenced how they felt (S10 = 1.33), noticing the social presence of others (S1 = 1.22) and the influence of their actions on their affective states. Our evaluation instrument also captured positive values related to the perception of how others felt and if they perceived how I felt during the activity (S4 = 0.44, S5 = 0.44). On the other hand, it was less perceptible for the participants to know if their partners were influenced by their affective states, or if the mood of the social interaction was influenced by their affective states.

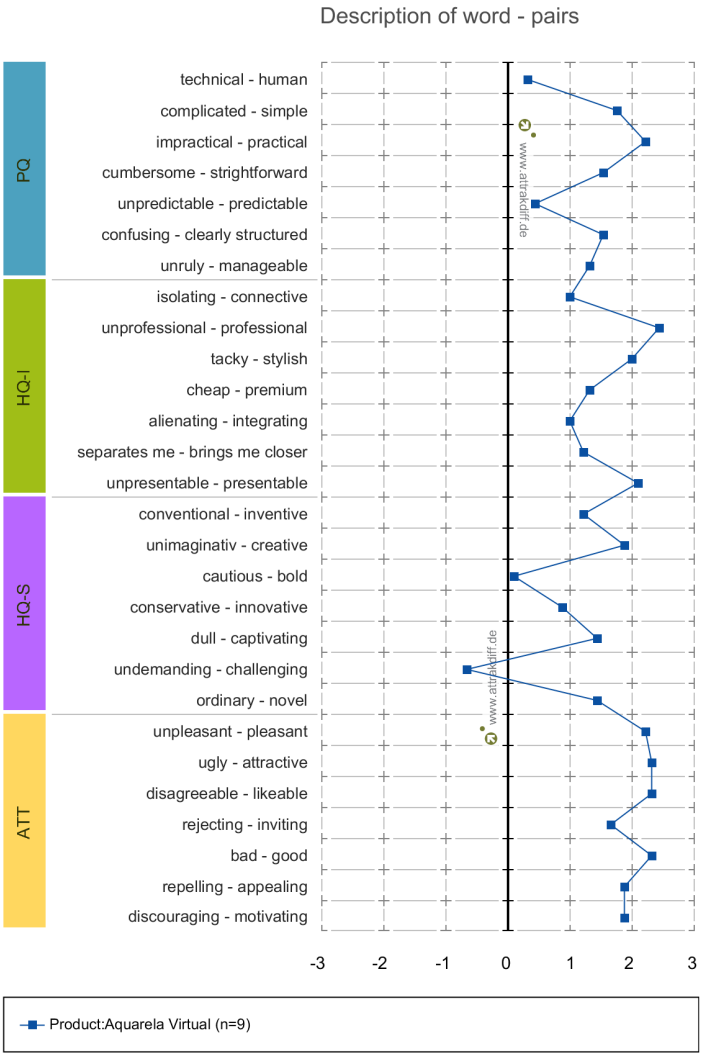

Figure 8: The Distribution of Response Patterns.

4 Discussion

In this section, we first answer our research question and discuss the quantitative results of applying our proposed questionnaire. Then, we discuss improvements to be made to the evaluation instrument from a socioenactive perspective.

4.1 Synthesizing

To answer our research question *"how to evaluate the Aquarela Virtual system affordances for socio-affective aspects of the experience?"*, we conducted a pilot study by using the proposed evaluation instrument, SEPE, followed by a debriefing with the participants after the experience. Results point out that the evaluation of the experience with the system by considering social and

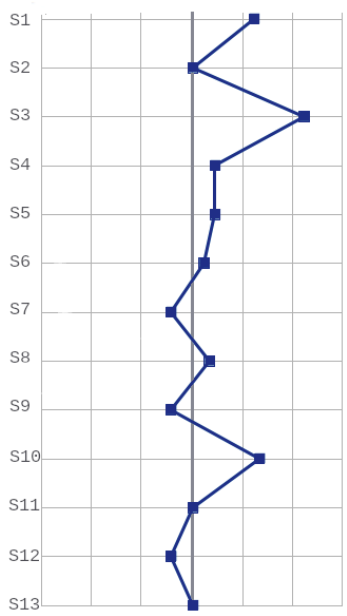

Figure 9: Socio-affective results .

affective aspects was mostly positive. For example, most participants perceived the practical way to interact with the system provided by the freedom to manipulate and choose different objects (more practical than impractical, PQ = 2.22), the system encouragement for creativity and creative freedom (more creative than unimaginative, HQ-S = 1.89), the good balance between simplicity and complexity for actions (simpler than complicated, PQ = 1.78), and the attractive, likeable an good aesthetic aspects of the system aligned with a children's environment (ATT = 2.33). Moreover, our evaluation instrument captures the perception of the system as more undemanding than challenging (HS-Q = -0.44). This could be due to the profile of the pilot study participants; studies with children should help to clarify this point. Additionally, improvements can be made in the system to make the social feedback of affective states more noticeable, improving the perception of the "other" and perception of "myself" for the "other" during the interaction experience.

After the study, a debriefing session was carried out with the participants. Some participants expressed that on some occasions they felt that only the other participants started a segment song despite the fact that they had shown an object and it had been detected. It was observed that when a segment song was started, the participants interacted with their different objects (not necessarily related to the current segment song) hoping to receive some response from the system or to be able to start the next segment song. However, the next segment song was initiated only when the previous segment song ends and an object is detected. Thus, in that version of the system, all other displayed objects in a stanza in progress were ignored to start a new segment song. In this case, the high value obtained by S10 (My partner's actions influenced how I felt) suggests that the affective states of these participants were affected because they couldn't start a segment song with their objects because someone else had already started it, and the system did not consider their interactions with the objects to start the next segment song. Based on this result, a new version of the system implemented a "voting strategy" in which the most detected object during the interaction with a segment song would start the next segment song.

4.2 Socioenactive Perspective

Fuchs (2018, p.175) in his ecological theory of the brain, indicates that "the development of the embodied human mind does not only require interaction between brain, body, and environment, but essentially interaction with other humans". The socioenactive perspective to interaction proposes coupling the social and intersubjective relations that arise in the interaction with other people, in the design and development of computational systems. By considering a socioenactive perspective, our evaluation instrument was designed to evaluate the perception of others in an experience of interaction with ubiquitous computing systems. For example, the instrument allows us to capture the person's affective perception in relation to others and the affective perception of others in relation to him/her. In this sense, the instrument is taking into account that the person is not alone interacting with the system, but that there are other people who can influence their action and perception.

The preliminary evaluation of the Aquarela Virtual system allowed us to identify points to improve in the system such as the social feedback of affective states, the digital animations, the voting strategy, and aesthetic aspects of the interface. We suggest that items related to the "perceived behavioral interdependence" dimension should focus on actions more than on behavior. In this sense, the item: "My behavior was often in direct response to my partner's behavior" should be replaced by "My actions were often in direct response to my partner's actions". Other points to improve in our evaluation instrument could include aspects related to ubiquitous technology, or concepts related to the enactive approach such as the embodiment. For example, we could include items related to how the ubiquity of a system is perceived, how the system stimulates the involvement of the body, or how people perceive whether a system reacts to their physical presence or physiological information and triggers some feedback in the environment.

5 Conclusions

In this work we addressed the need for considerations of the other actions and affective expression of peers during remote interaction. We proposed an evaluation instrument and conducted a pilot study to evaluate the potential of the Aquarela Virtual System for raising socio-affective aspects of the experience in a remote experience of interaction. An evaluation of the instrument itself is also a focus of this study. This preliminary evaluation of the Aquarela Virtual system was relevant to detect and correct bugs, make aesthetic improvements to the graphical interface, improve the digital animations, and improve the interaction experience considering social and affective aspects of participants.

The perception of others through their actions and affective states promoted by the system were captured by our proposed evaluation instrument, which has shown effectiveness to evaluate the socio-affective aspects involved in the remote experience of interaction. Further work involves studies with children's participation and the consideration of other concepts related to the enactive approach such as the *embodiment*. In this sense, new research questions arise to deepen the subject: *"How computational systems can incorporate design considerations that allow physical body involvement in the interaction?"* and *"How to evaluate these design considerations in a socioenactive scenario?"*

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Award-winning Paper Extended

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