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A virtual tourist counselor expressing intimacy behaviors : A new perspective to create emotion in visitors and offer them a better user experience?

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Abstract

Professional embodied conversational agents (ECAs) deployed in the market are dedicated to satisfying the digital customer relationship. However, ECAs still suffer from a lack of user adoption, in particular because most of them have few social skills. Inspired by social presence theories and based on the ergonomic components of user experience (CUE) model [1], the paper focuses on one social skill, *i.e.*, virtual intimacy, a 3-dimensional concept including honesty and genuineness, positivity and mutual comprehension. Virtual intimacy may be a way to reinforce the social dimension of human-agent interactions and to provide a better user experience. We therefore propose an interactive experiment that incorporates natural interactions between real tourists and an autonomously intimate virtual counselor who is an expert in tourism and able to express intimacy-related behaviors in verbal and nonverbal communication. The paper studies the impact of the agent's expression of intimacy-related behaviors on the perception of virtual intimacy, social presence and the user experience. The results show that users adopt a social attitude toward the intimate counselor, and although they do not significantly perceive virtual intimacy, they clearly perceive the dimension of honesty and genuineness. Moreover, the agent's expression of intimacy only enhances copresence, the first perceptive level of social presence. Except for user social status, which is enhanced, the user experience is also not significantly influenced by intimate expression.

The study results further demonstrate that perceiving virtual intimacy is a good predictor of social presence and user experience, especially user

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emotional reactions. Perceiving virtual intimacy influences user experience independently of social presence, which thereby indicates that independent intimacy-related mechanisms, such as emotional contagion, may be involved. Mediation analyses also underline that perceiving virtual intimacy has a direct effect on user emotional reactions, but this finding is not supported by the CUE model. The findings in this study provide new evidence that perceiving virtual intimacy in human-agent interaction elicits emotions in users and enhances user experience. In line with this, we propose an outline for an ECA-adapted, user experience model based on the CUE model.

Keywords: Virtual intimacy, human-agent interaction, multimodal behavior, social presence, user experience, emotions

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1. Introduction

Embodied Conversational Agents (ECAs) have been used for online customer relationships for almost two decades. These intelligent systems are able to communicate and behave "naturally", almost in the same way as do humans [2]. Professional ECAs have task-related competencies and provide customers with information and support in a wide range of domains, such as retailing, healthcare, banking, insurance, and education. However, ECAs still suffer from a lack of user adoption, and researchers underline the considerable gap between the users' expectations and their experiences of use [3]. Mimoun et al. [4] reported that between 2007 and 2009, a period of only two years, 60% of the embodied agents on online websites had disappeared. Systems adoption in the psychoergonomics field represents a massive literature that remains little known and invested by the research community on virtual agents. However, existing theories on user experience [5] may provide new insights into the mechanisms underlying the adoption of virtual systems and offer further perspectives to build better experiences with ECAs. Some existing user experience models, such as the components of user experience (CUE) model [1], particularly stand out from the literature, as these models consider emotions as an integral part of user experience.

Emotions are of particular interest in our questioning because similar to traditional ones, virtual customer relationships seem to involve a socioemotional dimension. One reason to explain this lack of adoption is that task competencies are not enough to fill human needs, and to be recognized as social partners in human-agent interactions, ECAs must also be provided with

social competencies. Indeed, Verhagen et al. [6] showed that both social (*i.e.*, friendliness) and professional (*i.e.*, expertise) aspects of a virtual agent influence service encounter satisfaction through social presence. Social presence is known to be "the sense of being with someone else" [7], and several studies have already shown that virtual agents displaying social behaviors are able to increase the feeling of social presence [8, 9]. According to the social response theory (*i.e.*, the human ability to extract mental properties, emotional states and intentions of the interlocutor based on social signs and to behave socially in response [10, 11]), feeling social presence can thus engage people in social interactions with virtual agents. Consequently, social presence appears to be an appropriate witness of the socioemotional dimension of human-agent interactions.

From the perspective of enhancing the social dimension of human-agent interactions and promoting a better user experience, we focused on intimacy as one social competency for ECAs. Indeed, intimacy has been defined as a subdimension of social presence in computer-mediated communication [12] , and its expression in a virtual agent is related to better user satisfaction and intention of use or purchase of a product [13, 11]. Prior to being a concept considered in human-computer interactions (HCIs), intimacy was initially a core concept in human social exchanges [14]. It is regarded as an interpersonal process of emotional communication [15], whose expression involves both verbal and nonverbal behaviors [14]. Notably, intimacy plays an important role in service exchanges and is a determinant of customer relationship satisfaction [16]. Thus, we assume that an ECA expressing intimacy-related behaviors in its verbal and nonverbal communication during a professional exchange should engage users in an emotional process and should in turn promote a better user experience.

The aim of the present study is twofold. First, we explore the influence of the agent's expression of intimacy-related behaviors during the interaction, on the user's perception of virtual intimacy, social presence and on the user experience. Second, we explore to what extent the user experience framework is adapted to human-ECA interactions and transcribes the socioemotional processes involved in human-agent interactions. Based on the CUE model of user experience [1], we question the adaptability of the user experience framework, especially the importance of emotions in user experience, when the system of interest is a social ECA.

1.1. Components of user experience

Although several works have already studied the user perception of the quality of an interaction with a social agent, they have focused on one specific dimension of the interaction, such as satisfaction and behavioral intentions [13], engagement [17] or acceptance [18], without exploring the global user experience (for an exception, see [19]). However, the literature on ergonomics and psychoergonomics provides an extensive framework on user experience, its components, its determinations and its consequences on behaviors and intentions of use.

Norman et al. [20] introduced the term user experience to describe all aspects of a person's experience with a system. Later, ISO standard (2010) formalized user experience as the "person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" [21]. Thus, user experience includes "all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviors and accomplishments that occur before, during and after use".

Among the existing models of user experience, only a few clearly integrate emotions [22, 23, 1]. The CUE model, presented in Figure 1, describes user experience as the overall instrumental and noninstrumental perceptions of the system, as well as the resulting emotions [1]. In this model, the instrumental qualities of the system are related to a product's usefulness and usability aspects, and the noninstrumental qualities refer to the aesthetic and symbolic aspects of the product. The authors posited that user experience is influenced by the interaction characteristics (*i.e.*, system properties, user characteristics and context) and has consequences on user representation and usage behaviors. Along with the instrumental (utilitarian) and the noninstrumental (hedonic) qualities of the system, emotions are occupying a central position in this framework.

The CUE model is of particular interest in our questioning because its consideration of emotions relies on the appraisal theories of emotions. Appraisal theories consider emotions as a cognitive process and a function of meaning structures, which assess and appraise the personal significance of an event [24, 25, 26]. Jokinen [27] pointed out that appraisal theories mainly focus on the subjective interpretation of the event, a finding that is in line with the general perspective of user experience. Inspired by the component process model of emotions [24], the CUE model describes emotions as a multiple-layer process including subjective feelings, motor expression, phys-

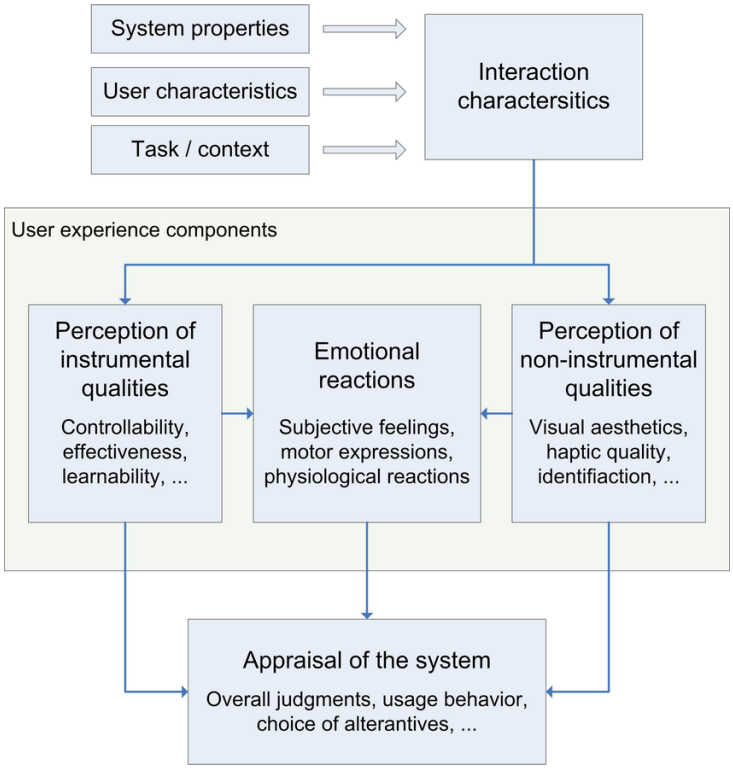


Figure 1: Components of the user experience (CUE-Model) theoretical research framework derived from Mahlke and Lindgaard [1]

iological reactions, action tendencies and appraisal. By relying on a strong theoretical background in the psychology of emotions, the CUE model emphasizes emotions as a key concept in user experience and appears to be an appropriate and consistent framework for assessing user experience with social ECAs. Notably, Mahlke and Lindgaard [1]'s framework states that emotions result from the perception of instrumental (*e.g.*, "the system is crashing too often, I feel upset") and noninstrumental qualities (*e.g.*, "the product looks good and make me feel enthusiastic") of the system. However, we could therefore wonder if emotions may directly result from the interaction as well (*e.g.*, "the interaction is intimate and provides me a social support, I feel good") in human-agent interactions.

From a general perspective of enhancing the socioemotional dimension of human-agent interactions to promote a better user experience, we focus on intimacy as one ECA social competency that may elicit an emotional process

in users and enhance positive emotions.

1.2. Intimacy in human relationships

Intimacy has been extensively studied in natural and virtual human relationships and is related to very positive outcomes; it promotes general well-being by filling human needs to belong and by protecting people from mental disorders and psychological distress [14, 15]. Whether people have natural or virtual relationships with others, intimacy is at the core of the most fulfilling and gratifying human social exchanges [28].

Intimacy is a concept that has received broad interest in recent decades, and the literature on interpersonal communication provides many definitions and conceptualizations [29, 30, 15, 14]. Reis et al. [15] reported that intimacy can be considered as feelings, verbal and nonverbal communication processes, intimate behaviors, people's arrangements in space, personality traits, sexual activities, and types of long-term relationships. In a common sense, intimacy usually refers to close and personal relationships, in particular romantic relationships. However, intimacy is not restricted to romance and applies to professional relationships [16]. In a general way, interpersonal intimacy represents the overall physical, behavioral, cognitive, and emotional sharing experience. This process of emotional communication appeals to the expression of intimate behaviors and the perception of intimate experiences [14]. The expression of intimacy involves both verbal and nonverbal communication. Thus, in the literature, numerous nonverbal behaviors have been identified that foster intimacy; smiling, displaying head tilts and nods, and increasing physical proximity or gazing are typical intimacy behaviors [30, 31, 32, 14, 33]. In addition, verbal behaviors, such as self-disclosure, *i.e.*, revealing personal and private information about the self, and reciprocal behaviors have been massively studied in relation to intimacy [34, 14, 35].

Although intimacy is sometimes considered to be "limited" in the specific case of professional exchanges, it plays an important role in the customer relationship [16, 36]. By adopting a relational paradigm for services marketing, authors emphasize intimacy as an important affective component of customer relationships; intimacy can refer to the attributes of communication, caring, commitment, comfort, and conflict resolution [16].

By extension, we believe that intimacy also plays an important role in the customer relationship with an ECA. Thus, intimacy appears to be a meaningful social competency for the quality of social ECAs involved in

service relationships with users. Through the expression of intimacy-related behaviors, we claim that ECAs can increase intimacy in interaction and thus promote a better user experience.

1.3. Intimacy in human-agent interactions

To a lesser extent, intimacy has also been studied in relation to affective virtual agents [37, 32, 11], and these studies have mainly considered its expression through self-disclosure behaviors. To increase the social dimension of a virtual counselor during natural interactions with users, Bickmore and Schulman [38] developed a computational model for adapting the agent's self-disclosure strategy based on expected intimacy. Although the model was theoretically valid, the authors found no increased level of intimacy in human-agent interactions. This result emphasizes how difficult it is to foster the social dimension of virtual agents in field conditions. In children-robot interactions, it was demonstrated that self-disclosure behaviors increased the children's social perception of the robot, as well as the social nature of their relationship [39]. More recently, Lee et al. [40] demonstrated that an agent expressing low or high self-disclosures elicited higher reciprocal self-disclosures from users than an agent expressing no self-disclosure. Interestingly, the authors also underlined that over time, only high self-disclosures induced a significant increase in the users' perception of intimacy in an interaction.

In previous work, our research team investigated the multimodal expression of intimacy in the communication of a professional agent. The intimacy-related behaviors of the virtual counselor were designed based on a model of *virtual intimacy* related to human-ECA interactions. This theoretical model was developed based on the psychology literature [14, 15, 30, 31, 35]. Virtual intimacy is understood as a 3-dimensional concept including the following dimensions: (1) *honesty and genuineness*; (2) *positivity*; and (3) *mutual comprehension*. The expression of intimacy involves both verbal and nonverbal behaviors. Consequently, the dimensions of honesty and genuineness are related to self-disclosure behaviors, sharing emotions and opinions and revealing emotional vulnerability and shortcomings. Positivity refers to the expression of positive feelings, enjoyment and commitment. Finally, mutual comprehension is linked to considerate, reassuring and supportive behaviors. The expression of virtual intimacy also involves nonverbal behaviors, such as the following: facial expressions of emotions (*e.g.*, smiling); open arms or self-oriented gestures; head nods and tilts; and even eye contacts. The

theoretical model has been previously validated in video clips of human-agent interactions [41, 42]. Watching video clips of interactions was shown to be an adequate means for assessing the perception of social behaviors in human-agent dyads [43, 44]. By using the Virtual Intimacy Scale (VIS) consistent with our theoretical framework, we found that the observers' perception of virtual intimacy in human-agent interactions is strongly enhanced by the agent's expression of intimacy-related behaviors [41, 42]. Furthermore, we reported that the interaction with an intimate virtual agent can be perceived as intimate as an interaction with a human agent expressing very similar intimacy-related behaviors [45]. Our findings are in line with Ho et al. [46]'s research, which showed that a conversational agent and a human can elicit similar intimacy self-disclosure behaviors, leading to similar emotional perceptions and outcomes among users.

In a recent study, Lee and Choi [13] showed that interacting with a virtual counselor expressing certain intimate behaviors (*i.e.*, self-disclosure and reciprocity) increased user satisfaction and intention to use the interactive movie recommendation system in which the agent was deployed. This study sounds very promising for the development of satisfying professional ECAs and encourages us to study the influence of intimacy in human-agent interactions. In their laboratory study, the authors focused on verbal intimacy by providing the agent with self-disclosure and reciprocal behaviors. In addition, we propose to explore the agent's expression of verbal and nonverbal intimacy in real-world interactions. While Lee and Choi [13] focused on user satisfaction, in the present study, using the CUE model of user experience, we investigate the entire user experience.

For this purpose, we have built an autonomous virtual counselor that is an expert in tourism and whose mission is to help and accompany visitors in a tourist office by responding to their tourist requests. Equipped with functionality inspired by the theoretical model of virtual intimacy detailed in [41, 45], the virtual counselor has multimodal communication capability and is able to behave socially by expressing intimacy-related behaviors.

1.4. Research aims and hypotheses

In response to the lack of adoption of ECAs in the industrial marketplace, our goal is twofold. First, the aim of the study is to determine in interactive field conditions, the impact of intimacy on the users' perceptions and behaviors; we interrogate the users' behaviors, as well as their perception of virtual

intimacy, social presence and user experience after a real-world interaction with a virtual counselor expressing or not expressing intimacy-related behaviors. In addition, we question the impact of perceiving virtual intimacy on the user experience and the role of social presence in this equation. We offer the following hypotheses.

H0. From the perspective of building intimate human-agent relationships, we first hypothesize that participants are willing to talk longer to agents expressing intimate behaviors than to agents expressing nonintimate behaviors.

H1. Based on previous findings [41, 45], we also hypothesize that participants perceive higher virtual intimacy in the intimate condition than in the control condition.

H2. Intimacy has been identified as a subdimension of social presence in computer-mediated communication [12] and may also be closely related to social presence in human-agent communication. We thus hypothesize that participants perceive higher social presence with the intimate agent than with the nonintimate agent.

H3. By extending the findings of Lee and Choi [13], we hypothesize that participants perceive a better user experience with the intimate agent than with the nonintimate agent, especially regarding the emotions of the user experience (the emotions module) .

H4-H5. Based on our previous hypotheses, we hypothesize that perceived virtual intimacy predicts both social presence (H4) and the user experience (H5).

H6. Inspired by the work of Verhagen et al. [6], we hypothesize that social presence mediates the effect of perceived virtual intimacy on the user experience.

Second, the purpose of the study is to provide new insights into the extension of user experience theory to human-ECA interactions. By relying on the CUE model [1], we question the place of emotions in user experiences with virtual agents. In the CUE model, emotions result from product perceptions (*i.e.*, the users' perception of the instrumental and noninstrumental qualities of the system). The theories of social presence [47] and of social response [10], however, suggest that social exchanges induce emotional reactions in humans. Based on this assumption, we assume that interacting with

a social ECA expressing intimacy-related behaviors (*i.e.*, system properties) may increase the level of virtual intimacy in the interaction (*i.e.*, interaction characteristics). In addition to the emotional reactions resulting from their perception of the product, users may also experience emotional reactions directly due to the perception of virtual intimacy during the interaction.

H7. Based on the CUE model framework, we hypothesize that in addition to the indirect effect mediated by product perceptions, on user experience, perceived virtual intimacy has a direct effect on the emotions of the user experience (the emotions module).

2. Experimental study

To study how the expression of intimate behaviors by the ECA would impact the users' perception of virtual intimacy, social presence and user experience in a real-world situation, we created an interactive study conducted in field conditions and that involved interactions between our virtual tourism counselor and real tourists. Through this study, we aim to transcribe the real conditions of interactions with a professional virtual agent in order to capture as accurately as possible the perceptions and usage behaviors of real users.

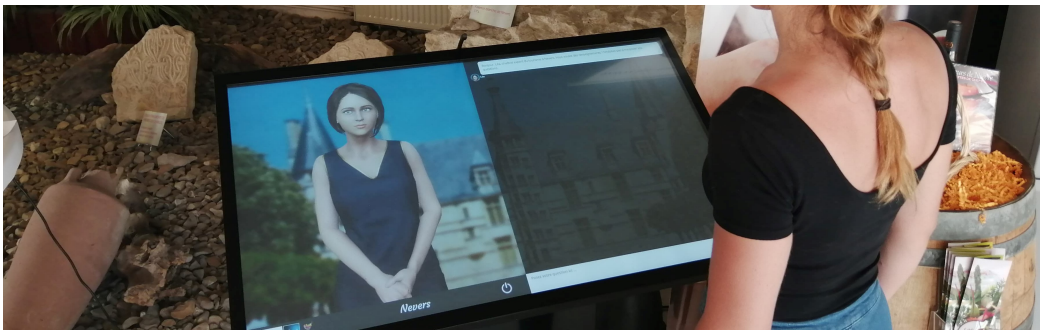


Figure 2: The interactive device deployed in a tourism office in the summer of 2019 is shown (France) ; Léa, the virtual counselor, provides tourists with information on cultural heritage, activities, gastronomy and any other tourism-related information.

2.1. Support of the human-ECA interaction

An interactive kiosk presented in Figure 2 was chosen to support the experiment and enabled visitors to interact with the virtual counselor in the tourism office. The device has a tactile screen, a microphone and load

speakers; these features facilitate natural communication between the users and the counselor. In addition, a tactile keyboard on the screen can appear and allows participants to chat with the agent as well. The conversational interface shows the virtual counselor in the left window of the screen, and a chatbox displaying the exchange between the agent and the user is positioned in the right window. Two buttons positioned in the lower part of the chatbox allow visitors to engage voice or text-based conversation with the agent.

The virtual counselor used in the study was developed by DAVI and was provided with RETORIK technology. The dialogue system of the agent is based on ontology (*i.e.*, formal model of relations between knowledge of a main domain); by following semantic rules, the system is able to detect the intention of the question raised in natural language by the user. Each intention of an ontology (*e.g.*, "finding a restaurant" in the ontology "tourism") matches with a verbal response previously written by a human expert in a corpus of responses (*e.g.*, "The restaurant Chez Annie offers very affordable lunch formulas and a nice view on the Loire River."). The agent's knowledge and responses have been created on the basis of real professional exchanges and called upon the expertise of tourism experts.

The counselor's nonverbal behavior is generated by an animation engine developed by DAVI and based on a semantic matching procedure (see [48] for an example of an automatic behavior generator based on linguistics). This generator provides the virtual counselor with multimodal nonverbal behaviors, including gestures [1], head moves, gazes and facial expressions [2], that are synchronized with its verbal content. To support natural communication with users, the agent is also animated with a synthetic female voice and benefits from a system of voice recognition.

2.1.1. Behaviors generation

Verbal Behaviors. The virtual counselor had to answer the tourists' requests by providing tourist information. By relying on a tourism-related ontology, the virtual counselor was able to understand and discuss broad topics; for instance, the agent could indicate toilet location, give information on the artists who created the stained glass windows of the cathedral, or even pro-

[1] Chosen from a library of all-body animations recorded from motion capture of human actors.

[2] Designed based on Ekman's framework on facial expression of emotions [49].

vide recommendations on the best gastronomy places. The agent understood more than 400 tourism-related questions in natural language, and the corresponding answers were manually written in a corpus of tourism-related responses based on real professional exchanges and under the supervision of tourism experts.

In a first encounter with an ECA, users show a strong tendency to test the technical limits and social credibility of the agent by asking personal, private or inappropriate questions that in the worst cases could be deemed sexual harassment [50]. Consistently, to respond to this constraint of real human-agent interactions in field conditions, we created two additional ontologies, namely, a *phatic* ontology enabled the agent to manage communication that served a social function, such as reflecting social norms of pleasantness (*e.g.*, saying hello, thank you), handling misunderstandings (explaining that the agent does not understand the visitor's request), and reacting to verbal assault (*e.g.*, expressing an appropriate response to rude words). A second *social* ontology provided the agent with a social self-representation (*e.g.*, identity, preferences, sexual orientation).

Nonverbal Behaviors. The virtual counselor was initially set in a rest position with folded hands and was provided with automatic "idle" behavior [51]. The agent's idle motions comprised small body posture variations, breathing moves, blinking and small variations in gaze orientation.

In addition to idle motions, the agent was animated by combining 4 behavioral parameters, namely, gestures, head moves, gaze orientation and the facial expression of emotions. Using a semantic matching procedure, the animation engine in this study generated nonverbal behaviors in real time and in accordance with the agent's verbal content. We then created a conversion dictionary of semantic *concepts*; each concept referred to one or several words or phrases and was paired with its corresponding animation in each of the 4 behavioral parameters mentioned above. Thus, every time a word or phrase related to a specific concept was detected, this concept was activated and triggered the automatic generation of corresponding behaviors. To avoid a stereotyped behavior of the agent, each behavioral parameter could include one or several animations (with close physical and emotional characteristics) for a given concept. For instance, two different gestures with small variations in form and amplitude could be assigned to the behavioral parameter gesture of a given concept. Thus, the selection of one animation among the suggested animations depended on an *occurrence frequency* feature assigned

to each animation. However, due to the activation of several concepts in a close time window, incompatible animations could overlap; to manage the consistency of behavior generation, the engine followed priority rules based on a *power* feature assigned to the behavioral parameter of each concept.

Additionally, a *basal* module was created; in the absence of an activated concept for at least 3 seconds, the animation engine generated basal behavior (default behaviors), which included nonintimate gestures (*i.e.*, a communicative gesture, which could be descriptive or explaining), a randomized gaze and nonintimate facial expressions.

2.2. Participants

A total of 68 persons (29 females) were recruited to interact with the virtual tourism information counselor. All the participants were at least 18 years of age ($M = 41$, $SD = 15.11$, $Min = 18$, $Max = 76$) and were native French speakers. The participants recruited in this study were all visitors to the tourist office. To capture the variety of profiles faced by the professional virtual agents, we did not restrict the conditions for the acceptance of the participants (other than by the characteristics specified above). For technical and methodological reasons (*e.g.*, system interruption, incomplete completion of the questionnaire, willingness to stop the experiment), only 60 participants were finally retained in the study.

2.3. Experimental design

In this study, we manipulated one independent variable, *i.e.*, the expression of intimacy in the verbal and nonverbal communication of the virtual counselor during the interaction. Our experimental design included two between-subjects conditions: the participants were randomly assigned to the either *intimate* condition, which involved an interaction with an ECA with intimate behaviors, or to the *control* condition, which involved an interaction with an ECA with nonintimate behaviors.

The intimate behaviors of the agent relied on the ECA model of virtual intimacy used in previous work [45, 42]. Based on the literature on interpersonal relationships, this model includes 3 subdimensions: honesty and genuineness; positivity; and mutual comprehension.

Honesty and genuineness are related to the self and involve sharing personal and private information, opinions and shortcomings [31, 34]. Positivity comprises the expression and perception of positive feelings, enjoyment and

commitment [52, 53, 30]. Finally, mutual comprehension is described in the model as understanding, reassuring and supportive experiences [33, 15, 35].

The dimensions of virtual intimacy are related, respectively, to specific verbal and nonverbal behaviors.

2.3.1. Verbal communication

In the *control* condition, the agent only exhibited task-related verbal behavior. The responses of the agent comprised factual information provided with a nonintimate message style. For instance, to the question "What can we do as a couple?", the agent could answer as follows: "It is possible to plan a canoe tour on the Loire River. The canoe renter proposes different couple options, as you wish. You could also have a French aperitif on a traditional boat.[3]".

In the *intimate* condition, the agent provided additional intimate cues. These intimate verbal behaviors comprised the following: expressions of honesty and genuineness, *e.g.*, self-disclosures and expressions of personal opinion or shortcomings; communications of positivity, *e.g.*, expressions of positive feelings, remarks reflecting enjoyment and commitment, personal recommendations; the use of a first-person writing style; and testaments of a mutual comprehension, *e.g.*, remarks reflecting consideration, reassurance, understanding and supportive behaviors. For instance, to the request presented above in the example, the intimate agent could answer as follows: "I sincerely recommend that you plan a canoe tour on the Loire River. I am sure that the canoe renter proposes different couple options, as you wish. I also love the idea of having a French aperitif on a traditional boat[3]".

Notably, in the *intimate* condition, both in terms of quantity and quality, the additional intimate signs could be different. Indeed, to avoid redundancy and too much scripted communication in the agent's responses, different verbal expressions could be used to elicit the same dimension of virtual intimacy. For example, "personally" and "sincerely" were both used to elicit honesty and genuineness. Additionally, responses related to different topics could include intimate cues related to different dimensions of virtual intimacy. For instance, the response related to toilet location only included one positivity cue, whereas other responses could also include one or several cues related to

[3]Translated from french.

honesty, genuineness and mutual comprehension. Although in the entire corpus of responses, we harmonized the number of intimate occurrences per the dimension of virtual intimacy, visitors were free to discuss any topic with the agent; therefore, each participant did not exactly face the same intimate behaviors. Several examples of conversations between a tourist and the virtual counselor are displayed in Appendix Appendix C.

2.3.2. Nonverbal communication

In the *control* condition, no concepts were activated, and the nonverbal behaviors of the agent were generated with the basal module. This module animated the agent with communicative gestures, semirandomized gazes and nonintimate facial expressions.

Nine communicative gestures derived from the library of animations, including 6 explaining gestures, 2 lean gestures and 1 postural gesture [4], were assigned to the control condition.

The gaze behavior in the control condition was randomized; the agent's gaze was moving into a predefined spectrum [5] around a user fixed-target. The fixation period was randomized and varied from 2000 to 4000 milliseconds. The gaze directed toward the user represented approximately 30% of the gaze.

The agent displayed no head moves or facial expressions.

In the *intimate* condition, concepts related to the expression of intimacy were triggered. These concepts (*e.g.*, "self") generated specific gestures (*e.g.*, oriented toward the self), head moves (*e.g.*, head tilts and nods), gazes directed toward the user and facial expressions (*e.g.*, smiling). The description of possible behaviors related to each concept is presented in Table B.8.

Twenty-four additional gestures derived from the library of animations were assigned to the intimate condition. They included 6 explaining gestures and 5 open-hand gestures, both of which differed from those assigned to the control condition by their amplitude and intensity. The set of animations also included 2 suggesting, 2 uncertain, 4 confused and 2 sorry gestures. Finally, 2 gestures oriented toward the agent and 1 oriented toward the user were assigned to the intimate condition. Gaze behavior associated with intimate

[4] Hands on hips.

[5] Defined on an X-Y axis representing the variation (in degree) between eye-target and fixed-target, with the possible following values: X = [0-6] and Y = [0-6].

concepts was mainly directed toward the user and included a fixation period of 2000 milliseconds. Additional down-oriented gaze behavior could also be displayed. In the intimate condition, the agent could display head nods and head tilts. To avoid a stereotyped behavior for an agent, head nods could be of different durations (from 1000 to 3000 milliseconds), frequencies (slow, medium and fast) and amplitudes (from 25 to 100%). Head tilts that could be right- or left-directed were set at 50% intensity [6] and lasted 2000 milliseconds. Finally, as depicted in Figure 3, the agent in the intimate condition could display emotional facial expressions, including the following: closed-mouth, open-mouth and ironic smiles; eyebrows up; frowning; and confused, questioning and sad expressions. The facial expression duration was set at 3000 milliseconds



Figure 3: Illustrations of the agent's nonverbal behaviors, including an example of behaviors in control and intimate conditions (left) and facial expressions (right).

In the absence of intimate concepts, the basal module animated the agent with the same properties described in the control condition.

2.4. Procedure

The experiment took place in a tourism office in Nevers (France). Visitors who spontaneously entered the office were invited by the experimenter to

[6] Degree of variation from the Y-vertical axis = 22.

participate in the study by asking their questions first to a virtual counselor. The participants who agreed to be part of the study were briefly introduced to the nature of the experiment and had to sign a consent form. In a second step, the experimenter launched a new experimental session with the virtual counselor and gave instructions about the use of the device and the agent's expertise. Then, the experimenter left, and the subjects were free to interact with the agent by asking all the questions they wanted. When the participants were done, the experimenter returned and stopped the experimental session. In the third step, the participants had to complete an online survey displayed on a laptop. This survey included 3 perceptive questionnaires (described in section 2.5). Finally, the subjects were thanked and compensated for their participation by receiving a noncommercial gift offered by the tourist office (*e.g.*, a bookmark with pictures of the different tourist places in Nevers), and the aim of the study was revealed. The participants were also encouraged to talk to the office counselor if they needed additional information.

2.5. Measures

The online survey delivered to the participants included 3 questionnaires assessing the perception of virtual intimacy, social presence and user experience. We used the *Virtual Intimacy Scale* (VIS) [41, 45], as well as a French version of the validated *Networked Minds* questionnaire [47] and the meCue questionnaire [54] validated in French language by [55].

The VIS has been developed and used in previous work to assess virtual intimacy in human-agent interactions by using a 0-100% slider. The scale includes 15 items divided into 3 subdimensions of honesty and genuineness (5 items), positivity (4 items), and mutual comprehension (6 items). Cronbach's alphas found in this study and the previous ones are very satisfactory ($0.81 < \alpha < 0.90$). Moreover, this scale shows a satisfactory correlation with a single item explicitly questioning the perception of intimacy ($0.64 < r < 0.71$). These 2 elements are prior evidence of the validity of the VIS.

The networked minds questionnaire assesses social presence by using a Likert scale and is composed of 36 items allocated to 6 subdimensions: co-presence, attention, message understanding, affect understanding, emotional interdependence and behavioral interdependence

Illustrated in Figure 4, the meCue questionnaire measures user experience by using a Likert scale and includes 30 items distributed into 4 modules

of Product perceptions (including the perception of instrumental and noninstrumental qualities), Emotions (including positive and negative emotions), Consequences and Global evaluation. We measured the mean user experience by combining the scores for both product perceptions and emotions, as suggested by the CUE model. We also studied modules and subdimensions separately.

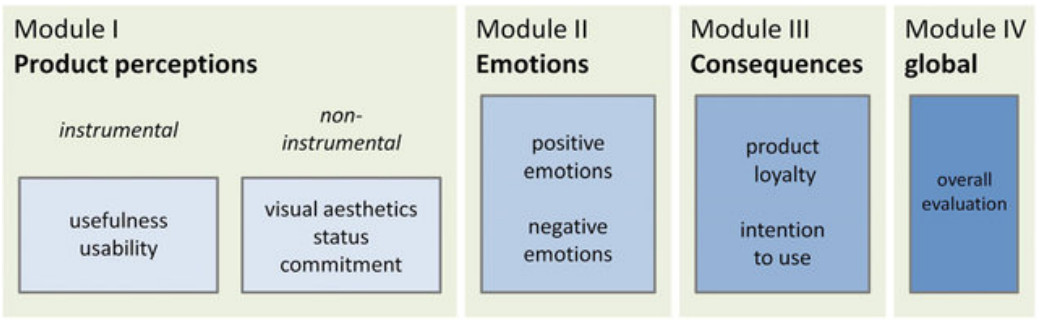


Figure 4: Illustration of the English version of the meCue questionnaire for measuring user experience and derived from Minge et al. [56].

In the present study, we also collected information about the interaction characteristics and the users' behaviors. We reported the length of the interaction as the number of questions raised by the users, and these questions were collected via the conversation logs. We also calculated a social ratio based on conversation logs. This social ratio represents the relationship of the number of questions that specifically include phatic (*e.g.*, "Hi Lea, could you [...]") and/or social (*e.g.*, "Where were you born?") information to the total number of questions raised by the users. In addition, based on the number of questions tagged as misunderstood or leading to ambiguous responses by the dialogue system, we measured a misunderstanding ratio of the agent.

2.6. Statistical analyses

First, except for the distribution of 2 subdimensions related to user experience, the distribution of the data and the Kolmogorov-Smirnov tests support the assumption of normality ($p > 0.05$). However, the sample size is sufficiently high to be consistent with the use of parametric tests [57].

We also provide a descriptive analysis of the user-agent interactions by presenting the number of questions raised by users and the percentage of misunderstanding of the agent. By using separate linear regressions, we test

the impact of the agent's misunderstanding on the users' perception of virtual intimacy, social presence and the user experience.

In this study, hypotheses H0 to H3 are tested by using t-tests: For the 2 experimental conditions (intimate, control), we compare the total number of questions raised by users, the social question ratio and the users' perception of virtual intimacy, social presence and the user experience (as well as their respective subdimensions).

Hypotheses H4 and H5 are tested by using separate linear regressions; we test how perceived virtual intimacy is a predictor of the perception of social presence, the user experience, and, especially, the emotions in the user experience.

In addition, H6 and H7 are tested by using mediation analyses following a bootstrapping procedure. This method first calculates the regression coefficient of the effect between the predictor and the mediator (a) and of that between the mediator and the dependent variable (b) with covariates. The regression coefficient of the indirect effect is then calculated as follows: (a)*(b) = indirect effect coefficient. To test the significance, unstandardized indirect effects are computed for each of 1,000 bootstrapped samples, and the 95% confidence interval is computed by determining the indirect effects at the 2.5th and 97.5th percentiles. Finally, the bootstrapped unstandardized indirect effect is reported with a coefficient value, a p-value and a 95% confidence interval.

For the overall analyses, we present the results for the effect size, with a p-value significance, where $p < 0.05$, by using Cohen's d and R-squared (R^2).

3. Results

3.1. Descriptive analysis

On average, during the interaction, the participants made 11 requests ($SD = 5.87$) to the agent. According to system logs, the agent did not understand 18% ($SD = 15.15$) of requests, and in these cases, she informed the users and asked them to rephrase the requests. We assessed the impact of the agent's misunderstanding on the participant's perception of virtual intimacy, social presence and user experience by using linear regressions, and we found no effect.

We first tested hypothesis H0 and found no effect of the experimental condition on the length of the interaction. In a second step, we compared

the ratio of social questions raised by users, and we found that the intimate counselor elicited more phatic and social questions than the nonintimate counselor ($t(58, 2) = 2.561$, $p = 0.013$, $d = 0.66$, $M = 0.72$, $SD = 1.13$ vs. $M = 0.16$, $SD = 0.45$).

Unexpectedly, a linear regression analysis also demonstrated an indirect relationship between the agent's expression of intimacy and the length of the interaction. Globally, the number of questions raised during the interaction enhanced the perception of negative emotions in the user experience ($F(1, 58) = 9.530$, $p = 0.003$, $R^2 = 0.14$) and consequently damaged the perception of the emotions in the user experience for the entire module ($F(1, 58) = 2.638$, $p = 0.11$, $R^2 = 0.44$). By contrast, this effect totality disappeared in the intimate condition.

3.2. Impact of intimacy-related behaviors

We used t-tests to compare the influence of the 2 experimental conditions of the agent's expression of intimacy-related behaviors (intimate, control) on the perception of virtual intimacy, social presence and user experience, especially the user experience measured by the emotions module. Group descriptives for the perception of virtual intimacy, social presence and user experience are available in Appendix A.4, Appendix A.5 and Appendix A.6, respectively.

A first analysis studied the influence of the experimental condition on the perception of virtual intimacy (H1). No significant difference was found between the intimate and the control conditions ($p = 0.118$, $d = 0.41$). However, as illustrated in Figure 5, the difference between conditions reached significance when we specifically focused on the subdimensions, namely, honesty and genuineness ($t(58, 2) = 2.264$, $p = 0.027$, $d = 0.59$ $M = 58.97$, $SD = 12.33$ vs. $M = 50.56$, $SD = 16.06$).

A second analysis studied the impact of the experimental condition on the perception of social presence (H2) and showed no effect of the agent's intimacy. Nevertheless, the difference between conditions reached significance when we exclusively focused on the copresence subdimension ($t(58, 2) = 2.178$, $p = 0.033$, $d = 0.56$, $M = 5.32$, $SD = 1.49$ vs. $M = 4.45$, $SD = 1.62$).

A third analysis studied the impact of the experimental condition on the perception of user experience (H3). We found no effect of intimacy expression on user experience or on its constitutive modules (product perceptions and emotions), consequences module, or global evaluation module. We only found

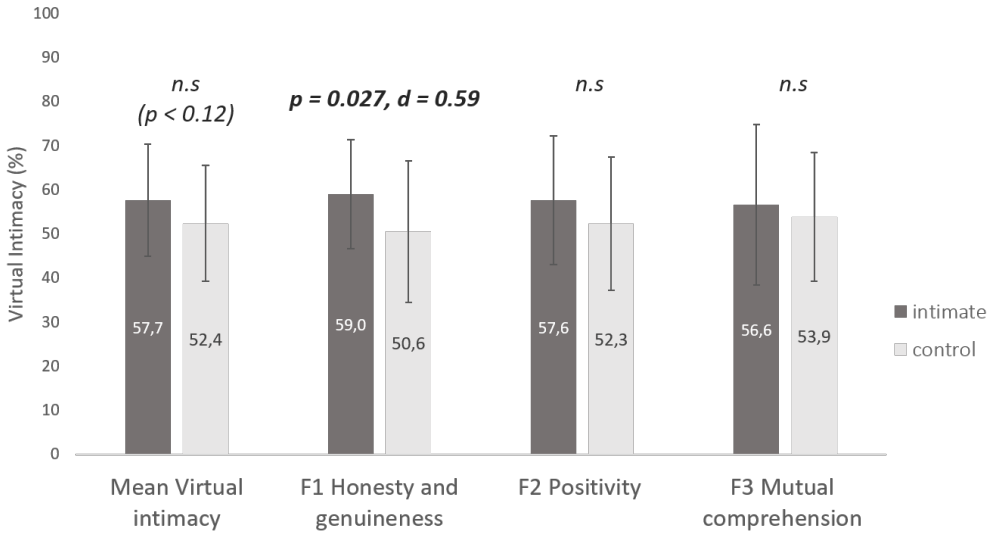


Figure 5: Perception of virtual intimacy and related subdimensions according to the agent's expression of intimacy (Mean, SEM). A t-test analysis between conditions (intimate, control) shows a significant effect of the intimate condition on the perception of F1—honesty and genuineness ($p = 0.027$, $d = 0.59$).

a medium effect of the intimate condition when we focused on the perception of the subdimension status ($t(58, 2) = 2.520$, $p = 0.015$, $d = 0.65$, $M = 3.08$, $SD = 1.77$ vs $M = 2.10$, $SD = 1.22$) and, to a lesser extent, on the perception of the submodule noninstrumental qualities ($p = 0.054$, $d = 0.51$).

3.3. Influence of perceived virtual intimacy on user experience, and the role of social presence

To study the interaction between perceived virtual intimacy and social presence, user experience and, especially, the emotions of user experience, we ran 3 separate linear regression analyses (H4-H5). Additionally, we ran a mediation analysis to study the role of social presence in the interaction between perceived virtual intimacy and user experience (H6).

The linear regression analysis showed that perceived virtual intimacy significantly predicted the perception of social presence ($F(1, 58) = 42.472$, $p < 0.001$, $\alpha = 0.034$, $SE = 0.005$, β=0.650, $R^2 = 0.423$), user experience ($F(1, 58) = 58.762$, $p < 0.001$, $\alpha = 0.046$, $\beta = 0.709$, $R^2 = 0.50$) and the emotions of the user experience ($F(1, 58) = 45.817$, $p < 0.001$, $\alpha = 0.05$, $\beta = 0.664$, $R^2 = 0.441$), as illustrated in Figure 6.

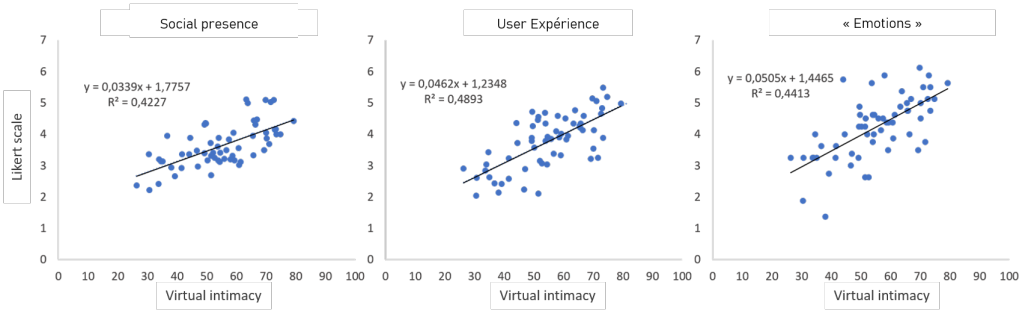


Figure 6: Prediction of social presence (left), user experience (middle) and emotions (right) by perceived virtual intimacy.

Notably, perceived virtual intimacy also predicted the product perceptions, consequences and global evaluation of the user experience.

Additionally, the mediation analysis reported that only the regression coefficient between perceived virtual intimacy and social presence was significant ($\alpha = 0.034$, $p < 0.001$), whereas the regression coefficient between social presence and user experience was not significant ($\alpha = 0.27$, $p = 0.071$). As illustrated in Table 1, the regression coefficient for the indirect effect was $\alpha = 0.009$ with a 95% confidence interval ranging from -4.573E.10-7 to 0.020 and was statistically nonsignificant ($p = 0.070$). There is no statistical indirect effect of perceived virtual intimacy on user experience mediated by social presence.

Table 1: Direct (A) and indirect effect (B) of virtual intimacy on user experience, as mediated by social presence.

(A)							95% Confidence Interval	
			Estimate	Std. Error	z-value	p	Lower	Upper
Virtual intimacy	→	User Experience	0.036	0.007	4.871	< .001	0.021	0.050

(B)								95% Confidence Interval	
				Estimate	Std. Error	z-value	p	Lower	Upper
Virtual intimacy	→	Social Presence	→	User Experience	0.009	0.005	1.813	0.070	2.844e-4	0.021

Note. Delta method standard errors, bias-corrected percentile bootstrap confidence intervals

3.4. A direct effect of perceived virtual intimacy on users' emotions

To study the nature of the interaction between perceived virtual intimacy and the emotions of user experience in relation to product perceptions, we

ran a mediation analysis (H7). In addition, we tested independently the mediation effect of the 2 submodules of product perceptions, namely, the perception of instrumental qualities and the perception of noninstrumental qualities.

The mediation analysis showed that the regression coefficient between perceived virtual intimacy and product perceptions ($\alpha = 0.042$, $p < 0.001$) and the regression coefficient between product perceptions and emotions were both significant ($\alpha = 0.59$, $p < 0.001$). As illustrated in Table 2, the regression coefficient for the indirect effect was $\alpha = 0.025$, with a 95% confidence interval ranging from 0.015 to 0.039 and was statistically significant ($p < 0.001$). Additionally, the bootstrapped unstandardized direct effect was $\alpha = 0.026$, with a 95% confidence interval ranging from 0.008 to 0.044 and remained statistically significant ($p = 0.002$).

On emotions, perceived virtual intimacy has a direct effect and an indirect effect mediated by product perceptions.

Table 2: Direct (A) and indirect (B) effect of virtual intimacy on emotions, as mediated by product perceptions.

(A)						95% Confidence Interval	
		Estimate	Std. Error	z-value	p	Lower	Upper
Virtual intimacy → Emotions		0.026	0.008	3.086	0.002	0.008	0.044

(B)						95% Confidence Interval	
		Estimate	Std. Error	z-value	p	Lower	Upper
Virtual intimacy → Product perceptions → Emotions		0.025	0.007	3.759	< .001	0.015	0.039

Note. Delta method standard errors, bias-corrected percentile bootstrap confidence intervals

In a second step, we distinguished the 2 submodules of product perceptions, namely, the perception of instrumental qualities and the perception of noninstrumental qualities, as 2 independent mediators. We thus conducted a multiple mediation analysis including these 2 mediators, as reported in Table 7.

Table 3: Direct (A) and indirect effects (B) of virtual intimacy on emotions, as mediated by instrumental qualities and non instrumental qualities.

(A)							95% Confidence Interval	
			Estimate	Std. Error	z-value	p	Lower	Upper
Virtual intimacy	→	Emotions	0.025	0.008	3.111	0.002	0.008	0.045

(B)								95% Confidence Interval	
				Estimate	Std. Error	z-value	p	Lower	Upper
Virtual intimacy	→	Non instrumental qualities	→ Emotions	0.007	0.005	1.576	0.115	8.680e-4	0.016
	→	Instrumental qualities	→ Emotions	0.018	0.006	3.248	0.001	0.009	0.030

Note. Delta method standard errors, bias-corrected percentile bootstrap confidence intervals

First, the mediation analysis showed that the regression coefficient between perceived virtual intimacy and perception of instrumental qualities ($\alpha = 0.048$, $p < 0.001$) and the regression coefficient between perception of instrumental qualities and emotions were both significant ($\alpha = 0.38$, $p < 0.001$). The regression coefficient for the indirect effect mediated by the perception of instrumental qualities was $\alpha = 0.018$, with a 95% confidence interval ranging from 0.009 to 0.030 and was statistically significant ($p = 0.001$).

Second, the mediation analysis showed that the regression coefficient for the perception of noninstrumental qualities on emotions was not significant ($\alpha = 0.19$, $p = 0.117$), and as a consequence, the regression coefficient for the indirect effect mediated by the perception of noninstrumental qualities was not significant ($\alpha = 0.007$, $p = 0.12$).

Additionally, the bootstrapped unstandardized direct effect was $\alpha = 0.025$, with a 95% confidence interval ranging from 0.008 to 0.044, and remained statistically significant ($p = 0.002$).

On emotions, perceived virtual intimacy has both a direct effect and an indirect effect that is mediated only by the perception of instrumental qualities (Figure 7).

4. Discussion

To summarize, our results do not support hypothesis H0 and show no effect of the agent's expression of intimacy on the length of the interaction with users. However, we found that users who have interacted with the intimate agent raise more social questions than users who have interacted

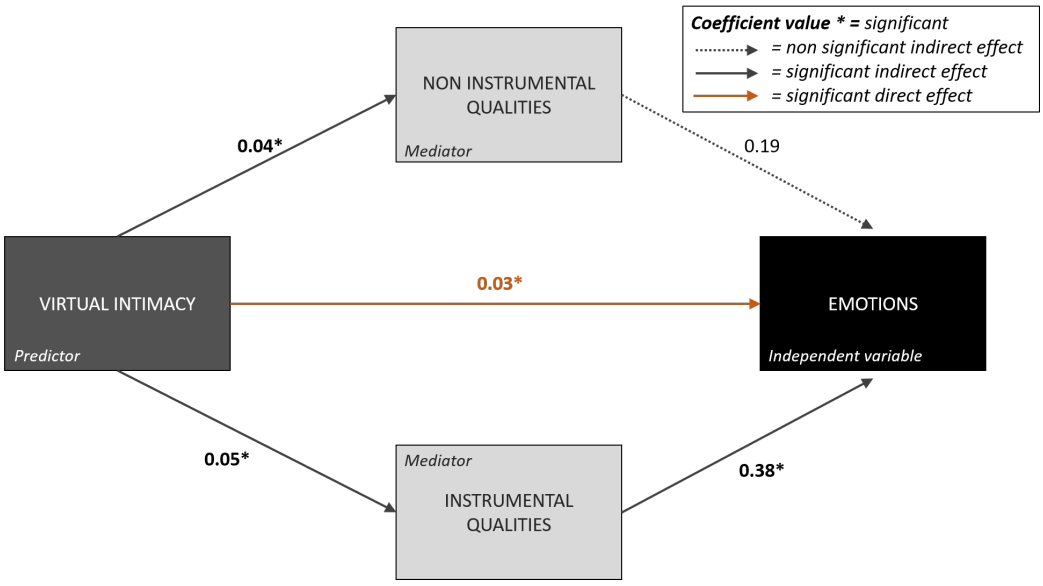


Figure 7: Standardized regression coefficients for the relationship between virtual intimacy and emotions, as mediated by instrumental qualities of the product.

with the nonintimate agent. In addition, our results show that the length of the interaction is related to higher negative emotions in users; however, this effect totally disappears in the intimate condition.

Regarding the influence of the agent's expression of intimacy on the users' perception of virtual intimacy, social presence and user experience, our results only partially support our prior hypotheses. Although the effect of the intimate condition on the perception of virtual intimacy is close to significance and demonstrates a close-to-medium effect, only its effect on the perception of honesty and genuineness is statistically supported (H1).

Moreover, the agent's expression of intimacy has no general effect on the perception of social presence and only shows an effect on the subdimension of copresence (H2).

Additionally, our results show that the agent's expression of intimacy has no general effect on user experience but demonstrates a medium effect on the subdimension of status included in the noninstrumental qualities of the system (H3).

Furthermore, our results support hypotheses H4 and H5 and demonstrate that the perception of virtual intimacy is a good predictor of the perception

of social presence, the perception of the user experience, and especially the emotions of the user experience. Unexpectedly, our results do not support hypothesis H6 and show that the interaction between perceived virtual intimacy and user experience is not mediated by social presence.

Finally, our results support hypothesis H7 and in addition to the indirect effect mediated by product perceptions, our results support the existence of a direct effect of perceived virtual intimacy on the users' emotions. Moreover, the indirect effect is mainly due to the perception of the instrumental qualities of the system, whereas the mediation effect due to the perception of noninstrumental qualities is not supported.

4.1. Impact of the agent's expression of intimacy-related behaviors on users' perceptions

4.1.1. Perception of virtual intimacy

In the present study, we were interested in the agent's virtual intimacy perception by the users who had freely interacted with our virtual counselor in the wild. In field conditions, our findings demonstrated that the users' perception of the agent's intimacy-related behaviors was less pronounced. While tourists greatly perceived the agent as honest and genuine, they did not perceive positivity and mutual comprehension aspects. Consequently, the participants only showed a tendency to globally perceive the agent's virtual intimacy. Previously, in [41], the honesty and genuineness of the ECA was better recognized than both other dimensions.

An explanation could be an unequal representation of the subdimensions in the design of social behaviors. Indeed, honesty and genuineness comprise the core concept of intimacy (both in common sense and scientific research), and their behavioral manifestations have been extensively studied in the literature, especially within studies on self-disclosure [32, 13]. By contrast, both other subdimensions may have received less interest, and their operationalization in an ECA may not include as many typical intimate cues as the operationalizations for honesty and genuineness include.

Another explanation for the difference in the perception of the dimensions could be that each dimension elicits a distinguishable representation for the users. Prager [58] defined that intimacy is related to self-perceptions and representations, as well as the perception of the other's behavior. A previous study found that the perception of intimacy was dependent on the perceiver's

expectations in terms of social skills [45]. We assume that tourists likely expected the virtual counselor to be positive and comprehensive because these competencies are usually allocated to this job. Consequently, participants did not find the counselor particularly positive and comprehensive because they considered its behavior to be the expected behavior in this professional context. In contrast, honest and genuine behaviors drastically contrasted with the users' expectations in relation to the agent's social behaviors and were greatly recognized.

Finally, our mixed results may also be due to the interactive aspect and the field conditions of the experiment. The participants freely interacted with the virtual counselor, and according to the direction they gave to the interaction, the tourists faced different agent responses, which included different intimate behaviors. Moreover, the participants were directly recruited in a tourism office and likely showed various levels of engagement in the interaction with the virtual agent. This phenomenon may also be enhanced by the actor-observer perspective, which suggests that a single event elicits asymmetric perceptions, depending on whether the perceiver is an actor or observer of the situation [59, 60].

4.1.2. Perception of social Presence

Inconsistent with our hypothesis, we only found a medium effect of the agent's expression of intimacy on the perception of copresence, whereas the global perception of social presence remained unchanged. In the research framework of Biocca et al. [47], copresence appeals to "the sensory awareness of the embodied other", and more generally, copresence refers to the subjective experience, acquired by an individual in an interaction, of being with others [61] (for a review on copresence see [62]). According to Biocca and Harms [63], copresence represents the first perceptive level of social presence and is mainly supported by the sensory experience of the other's embodiment. Thus, the agent's multimodal expression of intimacy-related behaviors, by enhancing the embodied dimension of the agent, may have enhanced the sense of copresence. Therefore, our findings should be considered as a first witness of the recognition of the agent as a social partner of an interaction. By contrast, the other social presence subdimensions, which are related to a higher "subjective" level of social presence and provide psychobehavioral information about the other subdimensions, were not influenced by the experimental condition of intimacy expression. We believe that the lack of effect on the other subdimensions of social presence is likely due to the weak recognition

of the agent's intimacy-related behaviors by the users. However, this should not preclude the existence of a strong relationship between the expression of intimacy and the perception of social presence.

Furthermore, Bailenson et al. [64] posited that focusing on people's feelings regarding embodied agents is only one way to study social presence and that people's social response to embodied agents is also a very powerful indicator. Behavioral reactions are sometimes even better indicators than self-reported measures [65]. We believe that this assumption is also very appropriate for the study of intimacy. Consistently, we examined the users' behavioral reactions and demonstrated that the intimate virtual counselor elicited more social behavior in users during the interaction; the users were more likely to be polite and intimate with the social agent in their communication responses (*e.g.*, "Hello Léa"; "Thanks a lot"; "How have you been created?"[7]). These interesting findings provide evidence that the agent's intimacy-related behaviors contributed to enhancing the social presence and the level of intimacy of the interaction. Indeed, the users' social responses may be considered as the witness of a reciprocal social mechanism (maybe unconscious) in reaction to the agent's intimacy-related behaviors [15].

Additionally, by relying on the perception of virtual intimacy regardless of the experimental condition, we confirmed that perceived virtual intimacy was a serious predictor of social presence. This result is in line with Biocca et al. [47] and suggests that virtual intimacy, as well as its homology in mediated communication, should be viewed as a strong determinant of social presence. Virtual intimacy seems to be, then, a means to enrich the social dimension of human-agent interactions by raising virtual agents to the rank of social beings and partners of interaction.

4.1.3. Perception of user experience

In this study, we examined the impact of the agent's intimate behaviors on user experience. Based on the user experience framework developed by Mahlke and Lindgaard [1], we hypothesized that the intimacy-related behaviors of the virtual agent would enhance the user experience as a whole, as well as the user experience's constitutive dimensions, and in particular, the users' emotional reactions. Our findings underlined a medium-to-large effect of the intimate condition on the perception of status, suggesting that social

[7]Translated from french.

agents could enhance the users' standing among peers and bring them to feel different and unique. By contrast, we found no effect of the intimate condition on the other dimensions of the user experience.

We assume that the poor recognition of intimacy-related behaviors explains their lack of effect on the perception of user experience as a whole. Even weakly perceived intimate behaviors, however, demonstrated an indirect effect on user experience by deleting the negative impact of the interaction length on user emotions. The expression of intimacy could, therefore, attenuate deceptive feelings that often emerge with the use of virtual counselors.

Moreover, we demonstrated that perceived virtual intimacy was a good predictor of user experience, particularly emotional reactions, although it predicted product perceptions, consequences and global evaluation as well. By emphasizing a positive influence of perceived virtual intimacy on user experience and its consequences, our results are in line with the findings of Lee and Choi [13] on user satisfaction and intention to use. Thus, we suggest that in field conditions with real users, virtual intimacy and related behaviors are a means to improve human-agent interactions from a user perspective, as well as to reduce barriers to the adoption of such systems.

Inspired by Verhagen et al. [6]'s findings and by relying on social presence theory [47, 12], we investigated the role of social presence on user experience with an intimate virtual agent. Unexpectedly, our results only demonstrated a direct effect of perceived virtual intimacy on user experience, and we found no mediation effect by social presence. We assumed that the users' experience would not exclusively depend on whether the agent is recognized as a social actor and would also involve other socioemotional processes. Among plausible ones, the emotional contagion phenomenon could explain why participants who are sensitive to virtual intimacy experience more positive emotions, inducing thereby a better user experience. Emotional contagion theory is defined as "a process by which a person or group influences the emotions or behavior of another person or group through the conscious or unconscious induction of emotion states and behavioral attitudes" [66]. Hatfield et al. [67] focused on one behavioral phenomenon in emotional contagion: primitive mimicry, which consists of spontaneously mimicry and synchronizing with the other's social behaviors and, consequently, of converging emotionally. This phenomenon may lead users to mimic and synchronize with a social counselor displaying intimate behaviors and to feel closer to the agent. Un-

conscious mechanisms underlying emotional contagion could likely explain why in our study, although the participants did not strongly perceive the counselor's intimacy-related behavior, they clearly reacted more socially to it.

Drawing on emotional contagion theory, further investigations are needed to better understand socioemotional mechanisms involved in human-ECA interactions in relation to virtual intimacy and to determine how they affect user experience.

4.2. Emotions in user experience with ECAs

Based on the social response theory [10], we made the assumption that interacting with a social agent would elicit the users' emotional reactions, which would be direct responses to the socioemotional characteristics of the interaction and independent of product perceptions. Our proposal contrasted with the theoretical framework of the CUE model [1], which describes emotions as only resulting from the perceptions of instrumental and noninstrumental qualities of the system.

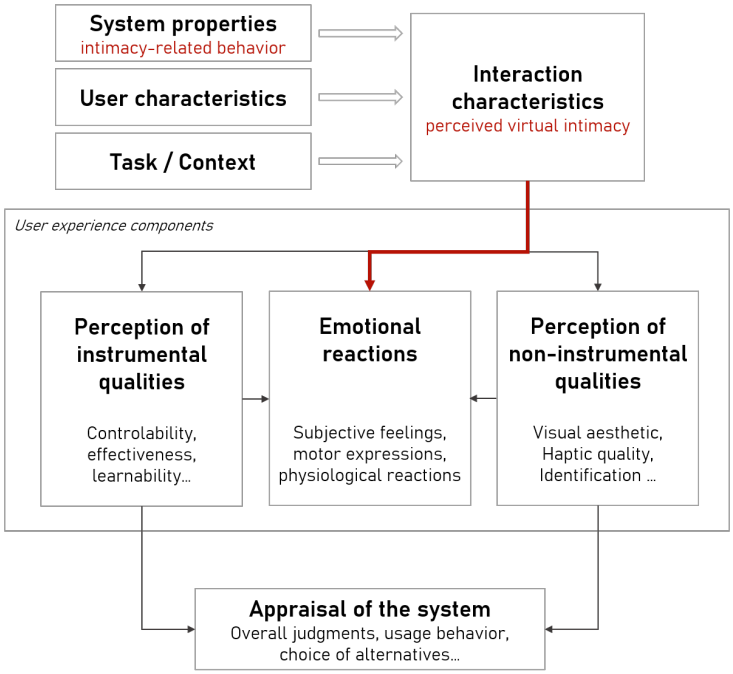


Figure 8: Outline of an ECA-adapted version of the CUE-Model (Mahlke 2008)

Consistent with the CUE model, a mediation analysis confirmed that mediated by product perceptions, perceived virtual intimacy had an indirect effect on the users' emotions. However, the analysis also underlined that perceived virtual intimacy had a direct effect independent of product perceptions, on the users' emotions. In the literature, interpersonal intimacy is described as a dyadic process that jointly engages both partners of the exchange; intimacy is inherent to the interaction and cannot exist outside of an interactive context [58, 33].

In our sense, perceived virtual intimacy can be considered a witness of the socioemotional characteristics of the interaction, and our results suggest that the interaction in its own right could have a direct impact on the users' emotions. This positioning is shared by Aranyi and Van Schaik [68], who proposed a comprehensive user experience model with a new website. Inspired by the CUE model, the outline of the authors' own model describes that perceived artifact characteristics have a direct impact on the users' affective responses. In particular, they demonstrated that the perceived aesthetics of the artifact and the perceived disorientation in the interaction predicted positive and negative effects, respectively.

In our specific context of human-ECA interaction, as presented in Figure 8, we propose that the behavioral features of the virtual agent (*i.e.*, the expression of intimacy-related behaviors) are able to influence the socioemotional characteristics of the interaction (*i.e.*, perceived virtual intimacy) that generate emotional reactions in users.

Surprisingly, an additional analysis demonstrated that the indirect effect of product perceptions exclusively relied on the perception of the instrumental qualities of the system. In other words, perceived virtual intimacy generates effects in users directly and indirectly through the perception of instrumental aspects only. Although this observation is inconsistent with the CUE model framework, Mahlke and Lindgaard [1] already found in a previous study that the perception of instrumental qualities had a stronger impact on the users' emotions than the perception of noninstrumental qualities.

These results therefore shed new light on user experience modeling and call for a deeper exploration of the determinants of user experience and the antecedents of emotional reactions in users. Although the relationship between system perceptions and emotions has already been discussed in many studies [69, 70, 1], further work is needed to investigate it when the system to consider is a social ECA.

4.3. Limitations and perspective

The operationalization of intimacy-related behaviors in our virtual counselor may have limited its perception by users. While the model of virtual intimacy we used is based on theoretical literature and has been validated in role-play interactions [41], in the present study, our virtual counselor's intimate behaviors remained partially empirically implemented. Indeed, the automatic generation of social behaviors was semi-supervised [8] to allow us to support some variability in the expression of nonverbal social signals. Moreover, the participants were free to interact in their own way with the counselor. Each participant was then facing different counselor responses involving different types of verbal and nonverbal intimate cues. Consequently, interaction experiences are incomparable between participants, and each tourist experienced a unique level of virtual intimacy with the agent.

One perspective of our research team would be to implement different levels of virtual intimacy in repeated interactions with our virtual counselor to assess how this impacts building the relationship with the social agent.

A second limitation of our study may be the choice of users. We interrogated tourists who spontaneously visited the tourist office. We consider that our panel largely reflects the variety of user profiles and the reality of use of virtual agents in the market. In view of the average age of our panel of participants ($M = 41$, $SD = 15.11$, $Min = 18$, $Max = 76$), we had to deal with a relatively old audience, among whom the use of technology is not a habit. Since older populations are generally skeptical about and perhaps unaccustomed to interacting with virtual agents, they represent a particular user profile. We claim that the perception of virtual intimacy depends on prior experiences and expectations [42]; the fact that we have obtained at least partly significant results seems very encouraging with regard to this population, leading us to think that virtual intimacy could be expressed all the more in human-agent interactions with different, younger populations that are more familiar with new technologies. Moreover, the choice of a different context of use may be very informative on the consistency of our findings. For example, consistently, researchers have demonstrated that the

[8] Each intimacy concept matches one or several combinations of similar intimate behaviors in the conversion dictionary of concepts. The animation engine automatically triggers one combination among the possible combinations of behaviors, following the *occurrence frequency* feature assigned to each animation (see section 2.1.1 for details).

nature of the relationship between usability/aesthetics and emotions could differ according to the perceived context of use in interactive HCI [71].

Finally, we studied emotions based on the appraisal theory (see [72] for a review). Scherer [24] defined emotional reactions as subjective feelings, motor expressions, physiological reactions, action tendencies and cognitive appraisal. In the present study, we only examined the subjective feelings of users. This approach may be insufficient to capture the complexity of the users' emotions in an interactive situation with a social ECA. Additionally, we mainly focused on retrospective feelings that can present discrepancies with immediate feelings, as suggested by [73]. Further work is then needed to explore emotion components as a whole in user experience with a social ECA.

While the appraisal theory of emotions is extensively represented in the literature, other conceptualizations of emotions have been studied in relation to user experience; for instance, Seo et al. [74] explored emotions in user experience by focusing on*valence, arousal, and the engagement* theory of emotions. The authors' findings suggest the same architectural description of user experience as that in the CUE model. Additionally, they reported that emotional valence and arousal were more predicted by aesthetic aspects, whereas emotional engagement was more predicted by usability. Thus, our outline of an ECA-adapted model of user experience should be extended to several emotions' theory.

5. Conclusion

We conducted an interactive study in field conditions in which real tourists interacted with a social virtual counselor. The participants behaved more socially toward the intimate agent and greatly perceived its honesty and genuineness. Although intimacy-related behaviors were implemented based on a theoretical model of virtual intimacy previously validated in video-clip interactions, the participants failed to significantly perceive both other dimensions of virtual intimacy (*i.e.*, positivity and mutual comprehension). In a general way, the intimate counselor slightly enhanced social presence by increasing copresence and was associated with a better perception of the user's social status, while the other dimensions of user experience remained unchanged.

However, we confirmed that virtual intimacy, when perceived, is a good predictor of social presence and user experience, especially emotional reactions. Mediation analyses suggested that on user experience, virtual intimacy

demonstrates a direct effect that is not mediated by social presence and may involve intimacy-related mechanisms, such as emotional contagion. By contrast with those of the CUE model, our findings suggest that virtual intimacy, as a characteristic of the interaction, in addition to an indirect effect mediated by product perceptions (supported by the CUE model), has a direct influence on the users' emotions. In our study, the indirect effect of virtual intimacy seems to be mainly mediated by the perception of the instrumental qualities of the system.

As a direct source of emotions in users, virtual intimacy represents an interesting lever to solve ECA adoption issues. Thus, further work is needed to better understand the psychological mechanisms related to virtual intimacy, and a particular focus should be placed on emotional contagion. Another research perspective for our team would be to explore user experience and relationship building in repeated interactions with an ECA that displays an increasing level of virtual intimacy.

6. Acknowledgments

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Appendix A. Group descriptives

Table A.4: Group descriptives for the perception of virtual intimacy and related subdimensions

	Group	N	Mean	SD	SE
Virtual intimacy	intimate	29	57.667	12.719	2.362
	non intimate	31	52.353	13.165	2.364
Honesty and genuineness	intimate	29	58.966	12.332	2.290
	non intimate	31	50.555	16.058	2.884
Positivity	intimate	29	57.612	14.553	2.702
	non intimate	31	52.347	15.091	2.710
Mutual Comprehension	intimate	29	56.621	18.269	3.392
	non intimate	31	53.855	14.648	2.631

Table A.5: Group descriptives for the perception of social presence and related subdimensions

	Group	N	Mean	SD	SE
Social Presence	intimate	29	3.710	0.671	0.125
	non intimate	31	3.565	0.698	0.125
Copresence	intimate	29	5.322	1.489	0.276
	non intimate	31	4.446	1.616	0.290
Attention	intimate	29	5.138	0.903	0.168
	non intimate	31	5.452	1.107	0.199
Message understanding	intimate	29	4.621	1.319	0.245
	non intimate	31	4.731	0.962	0.173
Affect understanding	intimate	29	2.948	0.888	0.165
	non intimate	31	2.651	1.265	0.227
Emotional interdependance	intimate	29	1.845	1.083	0.201
	non intimate	31	1.806	0.992	0.178
Behavioral interdependance	intimate	29	2.385	1.507	0.280
	non intimate	31	2.306	1.317	0.237

Table A.6: Group descriptives for the perception of user experience and related subdimensions (1/2)

	Group	N	Mean	SD	SE
User Experience	intimate	29	4.140	0.869	0.161
	non intimate	31	3.935	0.822	0.148
1- Product perceptions	intimate	29	3.993	0.888	0.165
	non intimate	31	3.787	0.796	0.143
2- Emotions	intimate	29	4.323	0.997	0.185
	non intimate	31	4.121	1.002	0.180
3- Consequences	intimate	29	2.672	1.385	0.257
	non intimate	31	2.511	1.171	0.210
4- Global perception	intimate	29	3.379	0.942	0.175
	non intimate	31	3.323	0.871	0.156

Table A.7: Group descriptives for the perception of user experience and related subdimensions (2/2)

	Group	N	Mean	SD	SE
Product perceptions					
Instrumental qualities	intimate	29	4.897	1.002	0.186
	non intimate	31	5.032	1.217	0.219
Usefulness	intimate	29	4.000	1.360	0.253
	non intimate	31	3.968	1.583	0.284
Usability	intimate	29	5.793	1.187	0.220
	non intimate	31	6.097	1.286	0.231
Non instrumental qualities	intimate	29	3.391	0.991	0.184
	non intimate	31	2.957	0.700	0.126
Visual aesthetic	intimate	29	5.540	1.271	0.236
	non intimate	31	5.548	1.228	0.221
Status	intimate	29	3.080	1.770	0.329
	non intimate	31	2.097	1.221	0.219
Commitment	intimate	29	1.552	0.879	0.163
	non intimate	31	1.226	0.442	0.079
Emotions					
Positive emotions	intimate	29	3.034	1.501	0.279
	non intimate	31	2.621	1.345	0.241
Negative emotions	intimate	29	5.612	1.406	0.261
	non intimate	31	5.621	1.368	0.246
Consequences					
Product loyalty	intimate	29	2.506	1.187	0.220
	non intimate	31	2.645	1.398	0.251
Intention to use	intimate	29	2.839	1.703	0.316
	non intimate	31	2.376	1.225	0.220

Appendix B. Conversation dictionary

Table B.8: Conversation dictionary of concepts (1/2)

Concept name	Example of trigger word	Gesture	Head	Facial expression	Gaze
Salutation	hello	open-hand (x2) explain	tilt nod	medium smile big smile open-mouth smile	toward user
Introduction	my name is		tilt nod	medium smile big smile open-mouth smile	toward user
Self	myself	self-directed (x2)	nod	medium smile big smile eyebrows up	toward user down
Enjoyment	great	open-hand(s) (x3) explain (x3)	tilt nod	medium smile big smile open-mouth smile	toward user up
User	you	open-hand (x2) user-directed	tilt	medium smile big smile	toward user
Uncertain	not sure	uncertain (x2) confused (x4) sorry (x2)	tilt shake	ironic smile confused questioning frowning	down
Support	at your disposal	user-directed explain suggest (x2)	tilt nod	medium smile big smile	toward user
Opinion	I think	self-directed open-hand (x2)	nod	medium smile big smile open-mouth smile	toward user
Self-disclosure	honestly	self-directed open-hand (x2)	nod	medium smile big smile open-mouth smile	toward user
Positive feelings	I appreciate	self-directed open-hand (x4)	nod	medium smile big smile open-mouth smile	toward user up
Negative feelings	I don't like	hands on hips	shake	ironic smile frowning confused	toward user down
Thanks	thank you	open-hand (x2)	tilt nod	medium smile big smile open-mouth smile	toward user

Table B.9: Conversation dictionary of concepts (2/2)

Concept name	**Example of trigger word**	**Gesture**	**Head**	**Facial expression**	**Gaze**
Goodbye	Bye		tilt nod	medium smile big smile open-mouth smile	toward user
Disappointment	I'm sorry	sorry	nod	ironic smile frowning confused questioning sad	toward user down
Personal advice	recommend	suggest (x2) explain (x6)	nod	medium smile big smile open-mouth smile	toward user
Reassuring	no worry	user-directed explain	shake	medium smile big smile open-mouth smile	toward user down

Appendix C. Examples of conversations between visitors and the virtual agent

Dialog A (intimate)

- Visitor: "Que visiter à Never ?" (*What can we visit in Nevers ?*)

- Agent: "Personnellement, je vous conseille les boucles de promenade identifiées par une ligne bleue tracée au sol. Elles vous permettront de vous guider et d'accéder aux principaux monuments remarquables de la ville de Nevers. Je sais aussi que des visites guidées ou audio-guidées sont possibles, je vous invite à demander conseil auprès de mes collègues à l'Office de Tourisme de Nevers." (*Personally, I recommend the walking loops identified by a blue line drawn on the ground. They will allow you to guide you and to access the main remarkable monuments of the city of Nevers. I also know that guided or audio-guided tours are possible, I invite you to ask for advice from my colleagues at the Nevers Tourist Office.*)

- Visitor: "quel est le meilleur restaurant à Nevers?" (*What is the best restaurant in Nevers ?*)

- Agent: "Personnellement je vous conseille le "Restaurant Le Bengy" à Varennes-Vauzelles ou encore la "Brasserie Le Carnot" à Nevers. J'adore les recommander, ce sont des restaurants très appréciés des visiteurs." (*Personally I recommend the "Restaurant Le Bengy" in Varennes-Vauzelles or the "Brasserie Le Carnot" in Nevers. I love to recommend them, they are restaurants very appreciated by the visitors.*

- Visitor: "Où se trouve la Sainte Bernadette ?" (*Were is the Sainte Bernadette ?*

- Agent: "Sincèrement, j'aurai du mal à vous répondre. Il est préférable de regarder sur un GPS." (*Honestly, I will have difficulty answering you. It is better to look on a GPS.*

Dialog B (non intimate)

- Visitor: "Bonjour je voudrais savoir s'il y a un festival de musique proche de Nevers s'il vous plaît." (*Hello, I'd like to know if there is an music festival near Nevers, please.*)

- Agent: "Bonjour." (*Hello*)

- Visitor: "dois-je formuler ma question?" (*Should I rephrase my question?*)

- Agent: "Je n'ai pas compris. Il faudrait reformuler la question." (*I did not understand. The question should be rephrased.*)

- Visitor: "où puis-je me baigner?" (*Where can I go swimming?*)

- Agent: "Le Centre aquatique L'Ilot Corail propose 2 bassins et un toboggan. L'Aquabalt à Nevers dispose de 900m^2 de bassins. Quant à la Piscine municipale de Pougues-les-Eaux, c'est une piscine de plein-air, ouverte durant la saison estivale." (*The Aquatic Center L'Ilot Corail offers 2 pools and a slide. The Aquabalt in Nevers has 900m^2 of pools. As for the municipal swimming pool of Pougues-les-Eaux, it is an outdoor swimming pool, open during the summer season.*)

- Visitor: "je cherche un festival de musique." (*I am looking for a music festival.*)

- Agent: "Il y a plusieurs festivals organisés à proximité comme Garçon la note, Nevers à Vif et bien d'autres ! La programmation de tous les festivals est disponible sur l'agenda culturel à l'Office de Tourisme intercommunal de Nevers Agglomération." (*There are several festivals organized nearby such as Garçon la note, Nevers à Vif and many others! The program of all the festivals is available on the cultural agenda at the Tourist Office of Nevers.*)

- Visitor: "j'aimerais réserver des chambres dans un camping." (*I would like to book rooms in a campsite.*)

- Agent: "Il est possible de camper près d'ici, au Camping de Nevers ou au Camping des Chanternes de Pougues-les-Eaux." (*It is possible to camp near here, at the Camping de Nevers or at the Camping des Chanternes de Pougues-les-Eaux.*)

- Visitor: "En fait j'aimerais faire un petit peu de randonnée, que me conseillez-vous?" (*Actually I would like to do a little bit of hiking, what do you advise me to do?*)

- Agent: “Le club de randonnée l’ARNI est joignable au XX XX XX XX XX.” (*The hiking club ARNI is reachable at the XX XX XX XX.*)

- Visitor: “Que me conseillez-vous pour dîner le soir en terrasse?” (*What do you recommend for dinner on the terrace?*)

- Agent: “Désolé mais je ne comprends pas votre demande. Merci de reformuler votre question.” (*Sorry but I do not understand your request. Please rephrase your question.*)

- Visitor: “J’aimerais dîner ce soir en terrasse que me conseillez-vous ?” (*I would like to have dinner tonight on the terrace, what do you recommend?*)

- Agent: “Le ”Restaurant Le Bengy” à Varennes-Vauzelles ou encore la ”Brasserie Le Carnot” à Nevers, sont des restaurants très appréciés des visiteurs.” (*The ”Restaurant Le Bengy” in Varennes-Vauzelles or the ”Brasserie Le Carnot” in Nevers, are restaurants very appreciated by visitors.*)

Dialog C (intimate)

- Visitor: “Bonjour Léa” (*Hello Lea*)

- Agent: “Bonjour, je suis enchantée !” (*Hello, I am delighted !*)

- Visitor: “Quelle est l’histoire du Palais Ducal ?” (*What is the history of the Ducal Palace?*)

- Agent: “Je pense que le Palais Ducal est considéré comme un des 1er châteaux de la Loire. Il était la résidence des comtes puis des ducs du Nivernais. Edifié à la fin du XVe siècle, je sais qu’il abrite aujourd’hui des espaces d’expositions et de réceptions de la ville, la salle du conseil municipal et un étonnant aquarium de poissons ligériens. Je crois qu’il est classé Monument Historique depuis 1840.” (*I think that the Ducal Palace is considered as one of the first castles of the Loire Valley. It was the residence of the Counts and then the Dukes of Nivernais. Built at the end of the 15th century, I know that today it houses the city’s exhibition and reception areas, the city council room and an amazing aquarium of Loire fish. I believe it has been classified as a Historic Monument since 1840.*)

- Visitor: “Parle-moi de Nevers.” (*Tell me about Nevers.*)

- Agent: “Si cela ne tenait qu’à moi, je vous conseillerais d’opter pour la Visite de la tour de la cathédrale, la Tour Boyer. À 52 mètres de haut, vous aurez une vue sur la Loire à couper le souffle !” (*If it were up to me, I would advise you to opt for a visit to the tower of the cathedral, the Boyer Tower. At 52 meters high, you will have a breathtaking view of the Loire River.*)

- Visitor: “Quoi faire avec des enfants à Nevers?” (*What can we do with kids in Nevers?*)

- Agent: “Je suis virtuelle, je ne peux malheureusement pas avoir d’enfants. Mais je sais qu’il y a une aire de jeu pour les enfants au Parc Roger Salengro.” (*I am a virtual human, unfortunately I cannot have children. But I know that there is a playground for children at Roger Salengro Park.*)

- Visitor: “Qui est le maire de Nevers?” (*Who is the mayor of Nevers?*)

- Agent: “Notre Maire s’appelle Denis THURIOT” (*Our Mayor is Denis THURIOT.*)

- Visitor: “Où manger à Nevers ?” (*Where to eat in Nevers ?*)

- Agent: “Je sais que le centre ville de Nevers accueille de nombreux restaurants, dont le ”Restaurant La Cour Saint-Etienne” (Rue Abbé Bouteillier 58000 NEVERS) que je vous recommande fortement et qui propose une cuisine simple et traditionnelle. Je vous suggère aussi d’aller déjeuner dans un jardin à l’ombre de noisetiers au Restaurant Le Bengy”, (Rue Abbé Bouteillier 58000 NEVERS).” (*I know that Nevers town center hosts many restaurants, including the ”Restaurant La Cour Saint-Etienne” (Rue Abbé Bouteillier 58000 NEVERS) which I highly recommend and which offers a simple and traditional cuisine. I also suggest you to have lunch in a garden in the shade of hazelnut trees at the Restaurant Le Bengy”, (Rue Abbé Bouteillier 58000 NEVERS).*)

- Visitor: “Où est la gare de Nevers ?” (*Where is Nevers train station?*)

- Agent: “Ce qui est très pratique, je trouve, c’est que la ligne de TER pour Paris dessert la gare SNCF de Nevers. Je vous conseille également d’utiliser les transports en commun Tanéo et la navette La courcinelle.” (*What is very convenient, I find, is that the TER line to Paris serves the Nevers train station. I also advise you to use the public transportation Tanéo and the shuttle La courcinelle.*)

- Visitor: “Au revoir Léa” (*Bye Lea*)
- Agent: “Je vous remercie! A très bientôt.” (*Thank you! See you soon*)

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