

Embodied Virtual Agents: An Affective and Attitudinal Approach of the Effects on Man-Machine Stickiness in a Product/Service Discovery

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Abstract. Of the objective of this paper is to develop and test a model of the effects of an embodied virtual agent (EVA) on the user of an online interface. The tested interface is a brand website—a possible channel of purchase, but also a media of information about products or services. The process of relationship building between website and user is the focus of interest here, a perspective that is richer than what is often called “acceptability” in the literature. Instead the paper proposes a construct of “stickiness;” i.e. the capacity of the interface to retain the user and to create positive behavioral intentions towards it. An integrative model is proposed. The effects of the presence of an EVA and of its congruency with the website are measured, and two possible routes of influence to stickiness investigated. Simple effects (with no route of influence) are observed on behavioral stickiness, whereas other effects via attitudinal and via affective routes, are observed, on intentional stickiness.

Keywords: embodied virtual agent, attitude, affect, stickiness, relationship, congruency.

1 Introduction

Every year, embodied virtual agents are more widely used on electronic interfaces, including online platforms. Research shows that virtual agents impact human behavior, but most research does not relate this impact to a real, substantive theoretical framework. Yet there are many relevant psychological constructs such as attitudes or affective reactions that may help understand the observed effects. This paper aim to model the influence of an embodied agent and to measure the possible effects of one important construct: namely the agent’s perceived congruency with the site and the brand.

2 Theoretical Framework

2.1 From Selling to Creating a Relationship Online

The internet has become a major vehicle for trade and commerce. Indeed, a number of marketing studies justify studying the internet because of the volume of sales realized online. However, such a view has three limitations.

First the concept of electronic commerce and internet-based commerce is rarely defined and they do differ. The example of the French internet market and of the stock exchange markets, are particularly relevant. Second, the concept of “online purchase” is very reductive: a number of customers do not exactly use internet to “buy”, rather they use the internet in crucial steps of their information search sequence before buying offline [27, 37, 49, 56]. The data collected and available on the FEVAD (French federation of distant sales) also confirms this. Third, it appears that a crucial step in preparing some possible purchase lies in the capacity of the brand or outlet to create a positive attitude, and hence, predisposition, in the potential consumer: a website may therefore be used not only as an informative tool [32, 33, 34, 35], but also as a relationship builder, a service encounter [24] and an experiential tool [23, 56].

Thus a brand web site may have a socializing capacity, particularly if it displays an embodied agent [47, 48]. In this view, interface humanization may play a crucial role, due to the positive or negative emotions it may generate, and to the possible subsequent effects in term of attitude, intentions and behaviors [41, 51, 52, 53].

2.2 Embodied Virtual Agents

Definition of a virtual agent

A virtual agent is a piece of software that can do some task on behalf of an interface user, or help such user doing this task more efficiently and/or rapidly. It is called “agent” because it acts, i.e. it performs some tasks, and it is said “virtual” because it gives the impression of being “alive”, i.e. it shows some characteristics of a living objects, albeit in a virtual world. Previous research often does not define such virtual world, which is a representation of the real world, mediated through an electronic interface. For example, we do not speak of a virtual world for an interaction on the phone or through the TV or a cinema screen. Why? It actually seems that we need the world to be represented on a close-to-us interface, and one that presents various sensorial modalities. That is, it uses animated images, sound, if possible 3D representations and so forth. It may even use in some cases odour and tactile senses. In common situations, animated images and sound are enough; but still, TV or movies are not considered as “virtual worlds”. It seems that the crucial difference is that a virtual world must offer some degree of interaction and some physical proximity to the user. That is what distinguishes between a simple electronic display and a virtual world. In a virtual world the user feels close-to and immersed in the interface.

Intelligence of an agent

One key characteristics of an agent is its “intelligence”, or capacity to be autonomous and to react in a number of situations, which may have not be totally imagined and integrated into a script by its conceivers. Its intelligence makes the agent more likely to be perceived as credible or natural, precisely because it reacts in a way which makes the user feel the agent could be alive. Yet, credibility or naturalness are important drivers of what is called the acceptability of an agent – even if such construct of “acceptability” [25, 26] may have not been conceptualized with a strict enough meaning.

Embodiment of an agent, definition of an EVA

An agent may be embodied, or not: as a piece of software per se it may not have a visible interface: such interface makes it possible for the user to actually “see” the agent performing a task or interacting, with other agents or with the user herself. At this stage we now can adopt the present definition of an embodied, virtual agent: one proposed by [Burgoon et al, p.554]. “Computer interfaces that come in a variety of guises and that present and process information according to a set of predefined algorithms. Agents may be designed to appear more anthropomorphic by fitting them with distinctly human-like (virtual) features such as voice recognition, synthesized voices, and computer animation that simulates human facial expression and gestures.”

2.3 The Concept of Stickiness

A managerial literature exists on the concept of online stickiness, which generally expresses the capacity of a website to retain a user [36, 49]. It was somewhat unquestioned and accepted as a concept of great interest by practitioners, particularly as the driver of a successful branding or commercial website. Unquestioned that is until the internet bubble burst and a necessary paradigm shift became necessary [16, 56]. Mere behavioral retention may be the center of early thinking about internet strategy for a website [13] but it is likely too narrow a view. [23] posits that a more useful construct of stickiness should be composed of behavioral and attitudinal or intentional measurement. This would capture a real desire to maintain a relationship with the interface, and one that could be distinguished from retention driven by mistakes, by poor site ergonomics or by tricky website retention strategies. A more useful construct is therefore defined as a “power of retention”, i.e. of creating a durable relationship with a user [23]. It is operationalised in a single, bi-dimensional construct, composed of a behavioral dimension measured by navigation duration and the number of pages visited, and an intentional dimension measured by both intention to recommend to others and intention to revisit. We posit that the interface stickiness proposed hereafter is also actually a possible – if not exhaustive – measure of the agent acceptability in the following way: agent acceptability would be positively related to the interface (here, the website) acceptability, and interface stickiness is an operationalisation of this interface acceptability.

2.4 Trying to Explain the Effects Via Attitudes and Affect*The construct of attitude*

Attitude may be defined as a durable disposition into answering in a constant way to some situation, stimuli, aspects, characteristics, of an object. The referred “object” may be a person, an environment, and also a brand, a product or service, an outlet [3, 4, 6, 18, 19]. Attitudes would explain intentions and behaviors. The attitudinal approach has been criticized and enriched in a number of works [5] as being too rationalistic and not encompassing the affective dimension adequately. Second, the concepts of attitude and the concept of hierarchy of effects of attitudes have been extended to the internet context [12, 14, 55]. It could explain the effects of an agent on variables such as behaviors and intentions.

The relevance and limitations, of the Environmental psychological approach

A stream of research has integrated the environmental psychology framework [43, 44] into modeling the effects of ambience and design factors on reactions, intentions, behaviors, in a behaviorist and then a modified, enriched approach encompassing the chain stimulus-emotional responses (called “organism”, hence the name SOR)-behavioral responses. Such approach is adopted in marketing and it partly explains behaviors when in an outlet [28, 29, 30, 31, 54], in an advertising context [42], in a service encounter [9, 10] and finally on a website [20, 22]. Important limitations are nevertheless highlighted in a mere environmental approach [38, 39]. These show the need to take into account the important role of cognition, even within an environmental approach. First, there is a need to take into account the perceived congruency of the studied ambience factors with its environment [40, in traditional environments; 20, for an online context]. Second the attitudinal reactions need not be totally discarded when environmental factors are studied, especially when, as here, attitudes are viewed as encapsulating not only cognitive but also affective components. In spite of these qualifications, a crucial contribution of such an environmental approach is the idea of approach-avoidance. This expresses the capacity of a design/ambience factor to make people escape from, or affiliate towards an environment. [9, 10] synthesizes it as the will to stay, explore, return and affiliate. Such concept is related to the relationship building process, and perfectly matches the concept of stickiness used here. If this concept is transferred into man-machine interaction, it corresponds to what research in HCI has called “interface acceptability.” That is, an interface which generates behavioral stickiness and also positive, attitudinal on the one hand, and intentional on the other hand, reactions. Finally the concept of approach-avoidance reactions derived from environmental psychology, here conceptualized as the interface stickiness and operationalised by two measures of actual stickiness, and two measures of intentional stickiness, is actually an operationalisation of what is often called interface acceptability.

Last, an interface user actually socializes with the interface [45, 46] and this is particularly true when it displays an EVA. Agents have the aim of generating behaviors of actual stickiness [25, 26] and such positive effects are observed in a number of situations [11]. Positive effects are also observed, either on attitudes and intentions [15], in term of behaviors [8] or of persuasion [7].

3 Modeling and Testing Hypothesis

3.1 Model and Hypothesis

The model generally posits positive effects of an EVA on affective reactions, on attitudes, and through them on online stickiness. An EVA should have positive effects on affective reactions first, and through them on stickiness. Positive effects of EVAs are also posited on attitudinal reactions, which should partly explain effects on behavioral and intentional stickiness. That is, effects on stickiness may appear either in a stimulus-response approach (Hypothesis H1 to H4), through an attitudinal route (H5 to H18) or an affective route (H19 to H22), of influence (Figure 1):

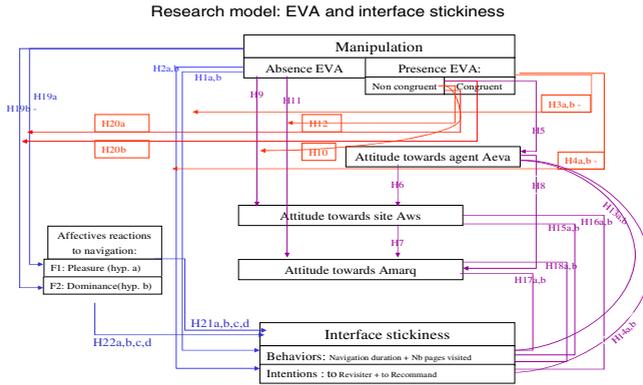


Fig. 1. Research model

3.2 Description of the Experiment

A laboratory experiment has been conducted in 2004 with 300 randomly recruited subjects, in the France Telecom R&D Center, HCI Division, near Paris (France). Subjects were exposed to one of two real brand sites and to 4 virtual agents (or no agent) created ad-hoc, 2 agents being tested on each sites . The log files, which allow behavioral stickiness measurement though the navigation duration and number of pages visited, could be collected for one site only. The two tested sites were: PRIMOLEA, presenting French high quality olive oil, and TRASER, promoting diving watches.

3.3 Results of the Research and Discussion

The constructs measurement and validity

The used measurement scales range from 5 to 21 items per construct: for Attitude towards the Agent AEVA, Attitude toward the site As, Attitude towards the brand Ab, Emotional reactions, agent Congruency with the website, and website Stickiness. All constructs are related to a relevant literature in psychology, man-man and man-machine interaction [23]. The measurement scales used here were developed by standard methods. All attitudes and congruency are unidimensional. Affective reactions are bidimensional: the dimension of Stimulation disappears in the factor analysis but Pleasure and Dominance – which has been most often eliminated in previous research – result in two, weakly correlated, dimensions. The nomological, convergent and discriminant validity of all here above proposed constructs are confirmed. Last, behavioral stickiness components are assessed through data extracted from the log files collected during the navigation.

Simple effects of the agent on stickiness

Effects on behavioral stickiness (only one site): the presence of an agent has a very significant effect on navigation duration (H1a***) and a significant effect on the number of pages (H1b*); but the congruence of the agent with the interface (here the site and the brand) has no significant effects on navigation duration (H3a NS, 5%<p)

nor on the number of pages (H3b NS α , 5% $<p<10\%$). Effects on intentional stickiness (two sites): the presence of an agent has no significant effect on both components of intentional stickiness, the intention to revisit (H2a NS) and the intention to recommend (H2b NS). The effects of the congruence of the agent are also non-significant on both components of intentional stickiness in the aggregated navigations, but non-homogeneous across the sites: effects are not significant and positive on PRIMOLEA site (H4 NS), negative and significant on TRASER site (non-H4*), and globally not significant and negative on the aggregated navigation on both sites (H4 NS). Results are similar if we divide intentional stickiness into its two components, intention to revisit and to recommend.

Effects observed into and through the attitudinal hierarchy of effects

For the attitudinal hierarchy of effects (H 5 to H18, in the right part of the model) the effects of presence/congruency of the agent on the three attitudes (H5, H9 to H12) are examined. In case of presence of an agent: the agent congruency has no significant effect on the attitude towards the agent (H5 NS) and the observed effect of the agent congruency is negative (even if non significant), which is not expected. That is, users show a more positive attitude towards a surprising, non-congruent agent. For the two other attitudes Aws (towards the site) and Ab (towards the brand), the effects of agent presence are positive and highly significant (effect of presence on Aws: H9**, effect on Ab: H11***) but non-homogeneous across the sites. Last, the effects of agent congruency are not significant; and again non-homogeneous across both sites (effect of congruency on Aws H9 NS, and on Ab: H12 NS). Globally the effects of the presence of an agent are then confirmed, but not those of congruency. However, looking more closely into hierarchy of effects of attitudes, among the attitudes and then from each attitude towards stickiness reveals more subtle effects. The effects of each of the attitudes on the following one are validated, as well as the effects of each attitude on the intentional and on the intentional stickiness. But the effects of each attitude on the behavioral components of stickiness are not validated. When hypothesis are validated (i.e. among attitudes and from attitudes on intentional stickiness) close levels of explained variance and of correlations across both sites are observed, and above all, with high to very high effects. The correlations here range from 0.40 to 0.80. Since all constructs have adequate discriminant validities, [2], such high correlations are not problematic. The effects are quite homogeneous, without being equal, across the two tested sites, as the Chow tests conducted on each step of the hierarchy demonstrate. That is, the site in itself seems to have little effect on the validation of such route of influence of the agents. Last, the hierarchy explains quite well the effects on attitudes and on intentional stickiness, but not on behavioral stickiness. We had observed effects in a simple approach, on behavioral stickiness and those do not pass through the attitudinal hierarchy.

Effects observed into and through the affective route of influence

Also tested is the possible affective route of influence (H19 to H22) visible in the left part of the model. Interestingly, the results are quite similar to those observed in the attitudinal hierarchy. The first step of the sub-model is not confirmed: the agent presence and congruency have no significant impact on affect (H19 NS, H20 NS). That is, the manipulation of agent presence/congruency had very surprisingly no significant effects on affective reactions. The second step of the route is partly

validated on intentional stickiness only. Pleasure has a very significant effect on intentional stickiness (H21c,d^{***}) and Dominance has a significant effect on one component of intentional stickiness (H22c NS on the intention to revisit, H22d* on the intention to recommend). But both affective reactions have no significant effects on behavioral stickiness (H21a,b NS, H22a,b NS). Last, correlations between attitudes (AEVA, A_s, A_{brand}) and Pleasure and Dominance are significant (Table 1).

Table 1. Correlations between Affect and Attitudes

Correlations (Pearson) AFFECT/ATTITUDES, aggregated navigations	Sig. level, r_{st} :
Pleasure <+> A _{EVA}	(**) +0.46
Dominance <+> A _{EVA}	(*) +0.13
Pleasure <+> A _s	(**) +0.66
Dominance <+> A _s	(**) +0.28
Pleasure <+> A _{brand}	(**) +0.55
Dominance <+> A _{brand}	(**) +0.23

As a conclusion, simple effects of the agent presence/congruency are observed on behavioral stickiness in the simple-effect approach. But if the approach is refined and two possible routes of influence are studied instead, significant effects are observed only on intentional stickiness, via the attitudinal route and via the affective route. Such routes do not capture all possible sources of influence and the proposed model may not include enough factors.

4 Limits of the Research and Contributions, Research Avenues

In this paper a theoretical framework is proposed that might help explain the observed effects of the agent, via an attitudinal route and an affective route. Most prior research on the effects of embodied agents does not propose a theoretical framework, but instead asserts that the agent must be “natural” and/or the interface “acceptable,” leaving the actual process of influence largely a black-box. The framework proposed here partly explains the observed effects of embodied agents. It relies on previous research in traditional and online-based communication in marketing and psychology, in human-to-human communication, and in man-agent interaction, and seeks to go beyond the black-box approach to suggest routes of influence. A number of hypotheses are proposed and some effects are not significant on the sites taken separately, some effects are even significant in a direction opposite to what was expected. Above all, the two routes of influence do not account for the effects on behavioral stickiness. They do however, account for the effects on intentional stickiness. While this is an encouraging start, it does mean that the framework and model, is as yet incomplete in some areas.

Designing an EVA encompasses many possibly influencing variables: voice (and its many cues), non-verbal language, colors, the agent size, its functionalities and level of intrusiveness, its gender, age, personality, et cetera. All of these are potentially have impact on stickiness. Equally the gender, age, internet expertise—a construct still to be refined—of the users could also have impact. And all these

variables could be taken independently from the site, or taken into account through their congruency with the site. Thus a large field of questions and research is still open. Last, one limitation is inherent to any experiment: a number of variables, such as the real navigation on the site and exposition to the agent, gender, age, have been controlled; but in spite of a large sample (about 392 navigations, among which 344 valid navigations) our ability to generalize these results is limited by the fact that we cannot know if other non-controlled variables have had an effect, such as for instance and without being exhaustive: proneness to innovation adoption, attitude towards internet in general, social and leisure uses of internet with avatars, etc. All these limitations of our research are research avenues which might help better modeling man-agent interaction, taking into account more characteristics of the agent and of the user herself.

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