

Attractivity in Virtual Environments: Getting Personal with Your Agent

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Gloria Mark and Angi Voss

GMD-FIT: German National Research Center for Information Technology
Research Group CSCW

D-53754 Schloß Birlinghoven, Germany
gloria.mark@gmd.de, angi.voss@gmd.de

Abstract

In this paper, we argue that the notion of attractiveness is a valuable concept that can be used and implemented in agent design. Agents must apply prediction, preferences, and strategies to select suitable matches for their client. Ideally, the results of an agents' search should be a confirmation of what the client considers to be attractive. Based on results from social research, some determiners of attractivity in real social situations are first discussed. These descriptions are examined and translated into a proposal for a computational design for social agents. Implications for how attractivity would be reconsidered in a virtual environment are also discussed.

Introduction

The idea for the Social Web project at GMD-FIT was motivated by our belief that the Internet has the potential of being developed as a comprehensive social medium. The Social Web research program will explore the possibilities of enhancing the social facility of the Internet by developing a new infrastructure and incorporating social agents, to achieve three socially relevant objectives: inventing new forms of culture that people can co-enjoy, facilitating knowledge exchange and sharing, and reducing social isolation. It is this last objective that we will address more closely in this paper.

The advantage of an Internet-based social medium is that people can expand the radius of their social space independent of geographical bounds, to find other people to satisfy certain social needs: simple companionship, emotional fulfillment, or possibly for entering into relationships. Agents are one means to help people find others on the Internet. To accomplish their task, agents must apply prediction, preferences, and strategies to make judgements on whether another person would be considered a suitable match for their client. When considering the question of how to build a social agent for this task, we argue that the notion of attractiveness is a valuable concept that can be used and implemented in agents.

Towards New Models of Virtual Interactions

By a Social Web, we understand a system based on the Internet that allows people to build their own virtual environments and to adapt them as their social relations change. People can choose and build representations of themselves that can express their feelings and attitudes. They can use their true identity, explore new roles under pseudonyms, or interact anonymously. People can form new communities with their own traditions, culture, norms, and conventions. People can actively tailor interfaces to their particular needs, letting them signal particular events and monitor multiple places.

Through the integration of a number of different mechanisms, many which already exist, and some which will be developed, a Social Web will provide the infrastructure to make new forms of social interaction possible; we expect that new concepts for the design of places and events will lead to new cultural models of on-line environments.

Web sites will become more like places. We refer to a "place" as having behavioral expectations, and cultural meanings, similar to a home, library, railroad station, museum, or pub. On-line places should be unique, but also recognizable as certain types, being invested with appropriate behavioral functions and cultural understandings: roles, purpose, and function. They should have an atmosphere that can convey these aspects to the visitor upon entering and while staying there. While links are technical connections between Web sites at present, we need to recognize that places are meaningfully connected and grouped into distinct clusters: e.g. campuses, neighborhoods, and larger cities. Although presently on the Web there exist "places" such as shopping malls and libraries, we believe that while functional, they only weakly (if at all) convey social aspects. Others, while alluding to a metaphor, fail to provide functionality, as well as a means for social interaction. We expect that new types of places will come into existence on the Web that have no analogy to real-world sites, in the same way that FAQs have arisen as a new form of literature on the Internet, in the sense that they are collectively constructed.

We expect that people will develop new models of on-line places, events, and social processes, in which they can have expectations of, and preferences for, what they can experience. Such models can be a basis for initiating new events and processes in an on-line environment. However, we expect that people will also develop new models of individuals in such a virtual environment. The question of who we choose to interact with in such an environment takes on a new significance.

Introducing New Sensory Information

Much information that we gain through our senses in the real world is lost when entering an electronic environment. We lose the sense of touch, of background noise, the scent of odors, kinesthesia (the sense of bodily movement), the sensation of taste, and visual cues which give us a peripheral awareness of the presence of others. With the loss of such sensory impressions, the design of an electronic environment takes on an added importance. In the same way that a blind person compensates for the loss of one sense by acutely developing other senses, we must also consider how an electronic environment can provide new kinds of sensory information to make up for the loss of physical sensory information.

The reduction and difference in sensory information affects how we perceive ourselves in a virtual world, and how we perceive others. In real life, there is a primary contact between ourselves and others through our bodies; in virtual communication, the physical body is either portrayed in words in a text-based environment, or in simplistic avatars in a graphical environment. Both representations imply a lack of nonverbal communication strategies and social cues: gesture, facial expression, body language, age, gender, etc. It is vital to understand the processes of communication and interaction in a virtual environment with different physical representations. Sensory information should provide social cues so that members in a digital community can express themselves and comprehend a wide range of nuances in communication. Members need to feel comfortable in interacting. They need to understand others as multi-dimensional beings, and not only as single-dimensional representations. This means that people must be able to portray and express their affiliations, beliefs, and interests.

What Constitutes Attractivity in a Virtual Environment?

Attractiveness is an important determiner of who we are drawn to, to watch, to initiate conversations with, and possibly even to develop social relationships with. By attractiveness, we refer to an early selection process in the course of developing social relationships; this involves

choosing who to initiate contact with, and if the other is deemed attractive, deciding to continue further with acquaintanceship. Acquaintanceship, can of course, further develop into a relationship which some researchers describe in terms of further stages: build-up, consolidation, deterioration, and ending (e.g. Levinger, 1983).

Why should we consider attractiveness? In its role in the early selection process of meeting people, attractivity plays an important role in determining which social relationships will be pursued. When we meet others, we attempt to incorporate information about them into our framework of intentions, motives, and causal relations, all of which are used to compose a model of the other and can be used to predict how the other may act (Johnson-Laird, 1983). One of the values of attractiveness is that it reduces cognitive overload in evaluating and selecting others. Judging another upon meeting, using a criteria of attractiveness, has decided advantages; it is not possible to systematically evaluate each single characteristic of another, since it would exceed the capacity of our working memory. Thus, we can select information about another to process, which enables us to reduce cognitive overhead. Applying stereotypes is one example of how judgments are made via category formation. A second value for attractiveness is that the continual development of a social relationship involves a high investment, and therefore attractivity is important in finding the right candidate. From a cost-benefit viewpoint, a model of attractiveness becomes a normative method to reduce risks of failure, and to optimize success in finding the right people.

To answer how we can design agents to apply their clients' model of attractiveness to others, it first leads us to examine other questions. First, we begin by considering what constitutes attractivity for people in real life social situations. We can then think about what assumptions about attractivity from real life we can apply to a virtual environment. Since a virtual environment is different from a real social situation, we cannot expect that attractivity would operate in the same way. Thus, how should attractivity be reinterpreted? Lastly, we can then ask how we can communicate these notions to an agent who searches for people in a virtual environment. And what characteristics about ourselves must we communicate to our agent as our representative, so that others can judge whether we are attractive for them?

Determiners of Attractiveness

The process involved in selecting persons to pursue in acquaintanceship and later stages of a relationship has been investigated by a number of social scientists. Whereas the number of determining factors is too extensive to discuss here, we have selected several to illustrate a point, namely that dimensions of attractiveness which may apply in real

social situations are subject to other influencing variables when we apply these in a virtual environment.

First, physical appearance is regarded by some researchers as a filter for determining contact selection (e.g. Stroebe et al., 1971). However, physical appearance may play even a more vital role in maintaining relationships than simply facilitating contacts, since the correlation between attractive appearance and length of relationship is quite high (Murstein and Christy, 1976). Attractiveness in physical appearance is not consistent across cultures, nor even for groups within a culture; attributes such as body build, facial features, tattoos and body markings, or aging, are perceived and regarded differentially among people. Young women in the Ainu culture of Japan used to have elaborate tattooed moustaches, which were considered physically attractive by Ainu men. Whereas corpulence is attractive to the Chukchi of Northeast Siberia, it is considered repugnant to the Dobuan from New Guinea. One explanation for the strength of physical attractiveness as a determiner is that there is a halo effect, i.e. one attractive characteristic is positively associated with others; attractive people are also considered to be warm, social, benevolent, etc (Berscheid and Walster, 1978).

Another determiner of attractiveness is frequency of encounters. This leads to familiarity, which applies to a wide range of stimuli such as products, music, nonsense syllables, and even language (e.g. Zajonc, 1968). Whereas frequency of encounters can lead to choice of friends, as was found with those living in close proximity (Festinger, Schachter, and Back, 1950), it can also lead to polarization among people when there is a trait existing that people do not like, e.g. personality style or ethnicity (Warr, 1965).

Proximity alone is not a strong predictor of attractiveness, but when similarity also exists in attributes then relationships are likely to form (Lea and Duck, 1982). Similarity can influence attractivity when attributes are in common such as interests, intelligence, attitudes, values, habits, ethnicity, race, social patterns, educational level, or socioeconomic status. However, it is not possible for people to evaluate all attributes at an early stage of selection; some traits are not obvious at initial encounters, and even if they were, people could not process too many attributes at once. Thus, people will commonly select attributes in another to evaluate, and generally it is those that are most salient. This can result in a distorted view of the other at an initial encounter (Kahneman, Slovic, and Tversky, 1982).

The social cues that people communicate at first contact also play a strong role, such as how another person can provide reinforcement of one's positive idea of oneself. Cues such as facial expression and eye gaze can provide essential feedback as to how one's image appears to others (Argyle, 1988). We seek others who can provide cues to

reinforce positive aspects of ourselves and that de-accentuate negative traits. People who provide such positive feedback and reinforcement are deemed by us to be attractive. In fact self-evaluation is described by the influential psychologist Festinger (1954) as so strong that it is a drive; it is a force which determines not only choice of contact, but stability of association and group membership.

The context of meeting is also a determiner of what makes people attractive, context including place, time, occasion, activity, presence of others, etc. An important dimension of context is its degree of intensity, i.e. whether it lies in a person's perceptual foreground or background. One of the strongest illustrations of the role of context in person selection is found in the research of Schachter (1959), in which he describes that in conditions producing high anxiety, i.e. when the context produces strong emotions, the desire to affiliate with another (or preferably others) is intensified. In this case, physical attractiveness plays less of a role than other factors, such as who may be near, or who can provide assurance.

Thus, we have briefly presented a few criteria which are found to be predictive of people's selection choice for contacting others in a real social situation. When we enter a virtual environment, however, these criteria are reshaped, even distorted, by influences such as: different levels of sensory information (e.g. loss of facial expression or texture details); complete absence of certain senses (e.g. kinesthesia, smell, touch); limitations on senses (e.g. restriction of the radius of peripheral awareness); and the potential for anonymity through various representations. These influences affect how the determiners of attractiveness can work for us. For example, the problem with applying physical attractiveness in a virtual environment is that one's representation may not be a stable image, but may mutate, distort, be in multiple copies, or even multiple genders. This holds true if one is represented by text or by avatars, although, audio and video information can reveal one's gender.

How might we predict how attractive people would find representations of others, or of agents, in a virtual environment? We can gain some clues when we look at some evidence which shows that factors affecting people's attitudes toward embodied agents mirror some of the factors that apply in some of the above described principles of social behavior. The halo effect was found with agents who were more pleasant-looking; other positive characteristics were also attributed to this agent (Warner and Sugarman, 1986). The same researchers found that a human-like quality was also applied as a criteria; those agents who appeared more human (video vs. text) were also treated more humanly, by using pronoun referents ("she") and direct gaze. Familiarity was a determinant of how attractive people find photographic images of other people (Jorgensen and Cervone, 1978); this notion can also

apply to pictorial representations of either agents or people in an electronic environment. An interesting research finding is that people chose to cooperate highly with those social agents whose embodiment resembled most closely that of a real person (Parise et al., 1996), although, it is not clear whether selecting someone for cooperation is correlated with attractiveness. What these findings suggest is that some determiners of attractiveness in real social situations can carry over into electronic encounters.

Thus, we need to consider attractiveness in virtual environments as a notion when using agents and recommender systems to find other people for us to meet. Ideally, the agents' results should be a confirmation of a person's interests, i.e. a match of one's model of attractiveness. We have thus far begun by examining a few aspects of what constitutes attractiveness in real social situations, in order to gain some insight into what motivates people to select others to make contact with. However, we must also consider that our perception changes when we enter a virtual territory; a social situation there is different than in real life, influenced by different purpose, and different sensory information. We must then address the question: how does our concept of attractiveness change when we enter such a world?

A First Computational Interpretation

In the following, we give a tentative answer to the question which has been raised at this point: how can agents select people whom their clients would find attractive? We begin by first examining some of the descriptions of what constitutes attractiveness in real life, and translate them in a straightforward, if not to say naive, way into a computational design. We then discuss the special issues encountered.

We expect some advantages and disadvantages due to the differences between agents and humans in virtual environments. As disadvantages, agents are not good at understanding text, pictures, video, and audio. They need to obtain a formal description of their client and are ignorant of their client's context in real life. As advantages, agents are fast at performing formal operations, they can use any digitally available data, they can work permanently, and they are not bound to human etiquette and conventions.

A functional specification of attractiveness can be derived from our knowledge obtained through social research. Given a set of candidate agents, a subset of the agents shall be selected whose clients are deemed to be attractive to a particular agent's client. The selection process shall be fast, relying on the exchange of readily available data rather than on elaborate interactions, and it shall produce reliable predictions, i.e. precision is more important than recall.

The process shall use a model of the client which can be improved, given feedback from the client.

The model must have a representation of the client; in real life this can include, for example: physical appearance, more difficult to acquire attributes like habits, and a positive self-image. The model should have positive and negative prototypes of other persons, and a list of positive and negative previous contacts with other agents. All this knowledge should be relative to particular contexts. Attributes of positive stereotypes are used to reinforce other agents.

In order to predict the attractiveness of some other agent's client in a current context, the model provides several functions: to compare contexts, to count how often the other agent has been met in a comparable context with positive feedback from the client, to compare the other client's representation with one's own and with the positive and negative stereotypes, to reinforce the other agent, and to compare the other agent's reinforcement with the client's positive self-image. Finally, a function is needed to integrate all this information into a recommendation. In order to instantiate this framework, several questions have to be answered:

What data should be used for the self-representation?

Physical appearance attributes differ from the other attributes because the former are more easy to obtain for people. For example, discovering another's religion or habits may be more difficult for people than perceiving body build or facial expression which are physically apparent. For agents, it may be the other way around. Interpreting facial expression, or even a homepage, may be very difficult for agents, but they need not bother about etiquette (e.g. in a real social situation, one may choose not to directly ask about religion), or they may use records of past behavior (instead of predicting future behavior); however, interpreting facial expression for agents may be very difficult. So, for agents, other differences seem to matter, such as the amount of data to be exchanged or the sophistication of interpretation required to process the data.

How to capture context? Context, almost by definition, can never be fully formalized. What features of the situation should be stored in a context representation? What, for instance, constitutes a place or an occasion on the Web? How should intensity of context be represented and measured? And how should the similarity of contexts be defined? A very autonomous agent definitely has to learn what features of contexts are relevant and how to categorize contexts. But it can never capture contextual aspects of the real world that are not digitized. For instance, it is ignorant of its client's current mood if the client does not tell it.

What parts of the model should be learned or adaptable? The more autonomous an agent shall be, the more it must be able to adapt its model. Apart from

context, positive and negative stereotypes should be learned. Thresholds can be learned, like the one that turns frequent encounters into familiarity. Similarity functions can be fine-tuned, as well as the function which integrates them into a recommendation. Also, many attributes of the client's self-representation could be acquired automatically. Weights could be learned that influence the relevance of the attributes in a particular context. However, care must be taken that the agent's view of its client still agrees with the client's own self-image. So, automatically acquired attributes may have to be confirmed by the client.

How to obtain the remaining knowledge and how to interpret it? Everything an agent does not acquire automatically, it must be told explicitly. How much effort will a person invest in briefing his or her agent? What other information could the agent use about its client? Unlike people in real life, agents may, in principal, use all available knowledge. They may use any records of a person's past behavior, records of a person's ratings, a person's publications, outgoing email, etc. In contrast, agents are not good at interpreting text, video, audio and the like. Therefore, the attributes that agents can obtain and process will deviate from the attributes people would prefer.

Agents that look for potentially attractive people are a kind of recommender system (Resnick and Varian, 1997). Some of them aim at recommending people. Firefly recommends persons that rate films or music in a similar way as the client (Shardanand and Maes, 1995). Yenta is planned to recommend persons whose outgoing email can be clustered to similar topics (Foner, 1997). Obviously, the representation of persons in these systems is very poor, based on a single dimension. The systems have a notion of similarity, restricted to their simple representation of persons. Learning is restricted to the acquisition and clustering of new ratings or emails. But the systems lack a notion of familiarity, positive self-image, positive and negative prototypes, reinforcement, or context. So, a feasible next step would be to build recommender systems with a richer user model.

Conclusions

We have presented an argument in this paper that attractiveness is a notion that should be implemented in the design of social agents. Attractiveness is important in determining which relationships to pursue, particularly in the early selection stages of meeting people. However, considering how attractiveness would function in a virtual environment, where people would be presented with unfamiliar forms of sensory information, is an issue that needs to be empirically researched. A second important issue arises when we consider how a model of what constitutes attractivity for a client can be implemented in

an agent. In this paper, we presented a first approach toward a computational interpretation, based on certain basic factors proved to be instrumental in determining attractivity in real life. However, empirical testing needs to be done to understand better how our perceptions and models of others change when we enter a virtual world.

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