“It’s in Love with You”
Communicating Status and Preference with Simple Product Movements

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Abstract
Sometimes users perceive product movements as an indication of agency. This makes it relevant to gain an understanding of how and why movements communicate attributes related to agency and what impact it has on users. This paper describes an experiment in which users, alone or in pairs, interact with a TV designed to move in way that communicates the agency related attributes social status or likeability. Results show that the TV movements are perceived differently when one versus two users are present. While most single users evaluate the TV positively, most users in pairs find the differential treatment problematic.

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Human-Computer Interaction, Agency, Ubiquitous Computing, Multimodal Interaction, Actuated Interfaces

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation]: User Interfaces, Theory and Methods.

General Terms
Design, Experimentation, Human Factors, Theory.
Introduction
When individuals interact we follow certain social rules, e.g. by using our nonverbal communication to make the interaction run as smoothly as possible [13]. Users also often interact with products as though they were social agents, rather than advanced tools [11]. This happens with products from traditional computers to robotic vacuum cleaners [4]. If products in some contexts are treated as agents with intentions and motives, but do not act according to common social rules the interaction can become problematic. This can potentially affect the user’s perception of the product. If the product is on some level considered an agent that is part of the social context it can also affect the social relationship between users.

In case perceived social agency has a negative impact on users we need to understand how this perception is created in order to avoid communicating agency unintentionally. In case there are positive effects of incorporating social aspects in interaction with technology, we need to understand how we can incorporate these in a sensible way. This makes it relevant to gain a better understanding of how and what social agency aspects can be communicated by product movements, and what impact incorporating social agency aspects has on users.

Social agency may be studied by purposefully providing human technology interaction with characteristics usually associated with interactions between agents, such as emotions and social relations. Research within the field of psychology shows that even very simple physical movements are often interpreted as social and emotional [5]. This happens with minimal visual information and independently of the visual appearance of the moving object [6].

In this paper we explore whether simple product movements can communicate the agency related attributes positive attitude and positive high status and whether users experience this differently when one versus two users are present. We find social status and attitudes towards others relevant because they are an integral part of the individual’s social context in everyday life and as more technologies may be perceived as autonomous they arguably become an active, if unintentional, participant in this. We present an experiment where we translate attraction and social status communication patterns to movements of a TV.

Background
Media equation research show that individuals often behave towards a text based computer system as though it is a social agent, even when aware that it is actually a computer [11]. Design research has studied how movements communicate agency. [7] describe how specific movements of an automatic door were interpreted as different degrees of willingness to let people in. [8] found that movements made by two simple columns are perceived as different kind of affects. Likewise [12] found that movements of a cat-robot and a vacuum cleaner are interpreted as showing the same emotions despite their different appearance. Furthermore [4] describe how movements of products perceived as social, also change how users interact with the products. The interpretation of product movements also depends on the user’s expectation of how certain products should behave [10].
Research in psychology suggest that individuals use nonverbal communication differently when interacting with persons they perceive positively or attribute high status than with persons they perceive negatively or attribute low status [2]. Individuals turn their body more towards and pay more visual attention to individuals perceived to be of higher status [1, 3]. In [9] it was shown that individuals have a more tense body posture with an individual that is perceived as having high status. We seek to investigate if products are able to use some of these forms of communication to make the user appear as an attractive and high status individual both to himself and to others.

**Method**

**Participants**
15 participants (six female, nine male) were recruited from employees and students at a University Department. 10 participants were randomly divided into pairs so that five pairs and five single users participated in the experiment.

**Setup**
The experiment was done in a wizard of Oz setup. We chose a TV to be the experiment object because it is a common object with no specific visual agency related features.

At the same time a TV is often used by multiple users and while doing other things e.g. reading a magazine or talking to friends. This makes it relevant for the TV to autonomously adapt to various contexts such as number of users and attention as it is for instance done in some Sony TVs with Intelligent Presence Sensor technology [14]. There may also be relevant status related activities in relation to TV use, such as who has control of the remote control.

Participants used the TV in a room mimicking a small living room, constructed in a design lab (figure 1).

The TV was connected to a TV PC and a Control PC. The TV screen displayed the video output of the TV PC. An IR sensor was connected to the TV PC enabling key presses on the remote control to be detected and acted

Figure 1 – Top left: Lab with living room setup. Seats on both sides of the room. Top right: Wizard controlling the movement of the TV. Bottom: Wizard’s overview of the lab with marked positions where TV can be turned.
upon. The following key presses where automatically handled by software; turn on TV, turn off TV, channel 1 and channel 2.

A web camera connected to the Control PC was placed above the door; so that most of the room was captured by it. On the Control PC custom software enabled a wizard to see the video stream captured by the web camera overlaid with information about the angle required to rotate the TV to face various locations inside the room (figure 1). The wizard operating the Control PC made the TV rotate and light up as intended. Rotation of the TV was enabled by a motorized floor stand.

**TV Behavior**
The following behaviors were intended to communicate that the TV has a positive attitude towards the favorite person and that he had a high status in relation to the TV. As we discuss later on, this is of course a matter of interpretation and mapping.

**Greeting:** When person(s) entered the room through the door they faced the TV. The TV performed a number of small movements to greet the person(s) and signal a positive response to their arrival, mimicking tension and attention.

**Following:** One person would become the favorite of the TV and the TV from then on always turned toward this person. This mimics seeking eye contact and turning towards a high status or preferred person.

**Touching:** When the favorite person touched the remote control and the TV was off, the TV lit up by showing a color gradient on the TV screen. This mimics seeking eye contact and attention.

**Procedure**
2 versions of the experiment were carried out. In version A participants interacted with the TV alone and were assigned a high status. In version B two participants interacted with the TV at the same time. One user was the favorite and assigned high status and the other user was assigned low status.

Participants were not informed of the purpose of the experiment, but were asked to move around and interact with the things in the test room, focusing especially on the TV. They were asked to imagine that they had just arrived home, for one participant to pull the curtains while the other turn on a lamp. In version B, the participant pulling the curtains was assigned a high status. This was done to assign status randomly and without bias from the wizard. Participants were asked to explore the room and interact with the TV until they felt they had nothing more to try or talk about. Each session lasted approximately 5 minutes.

After the experiment participants filled out a questionnaire and participated in a semi-structured interview. For half of the participants the interview came before the questionnaire. The interview focused on the movements and perception of the TV, and only in the end asked about agency related aspects. The focus of the questionnaire was communication and attitude of the TV. Participants rated their experience on a 5-point likert scale on the items presented in table 1 on the next page. 1 was very negative or highly disagree, and 5 was very positive or highly agree.
Results
The participants primarily noticed that the TV followed their movements. Very few of them noticed the small greeting movements or that the TV lit up when the remote was picked up.

Questionnaire
Ratings on questionnaire items for participants assigned a high and low status was compared with a Mann-Whitney U test. Participants assigned a high status and single participants agreed significantly more with the items “The TV was attentive to me” ($U = 0.50, p < .002, r = .80$) “The TV was polite towards me” ($U = 0.00, p < .001, r = .82$) and “ The TV wanted to be used by me” ($U = 3.00, p < .005, r = .72$) than participants assigned a low status.

On the significantly different items participants assigned a high status highly agreed that the TV was attentive, polite and wanted to be used (Table 1). Participants assigned a low status highly disagreed on the same items. When asked what they thought of the TV, if it communicated and whether it seemed to be thinking, the participants did not differ in their ratings between high and low status participants. The individual rating of these three items covered all possible values. Participants assigned a high status in pairs and single participants were significantly different on the item “What did you think of the TV?”, so that participants assigned high status in pairs ($Mdn = 2$) rated the TV significantly more negative than single participants ($Mdn = 4$) $U= 2.50, p < .030, r = 0.68$. There was no significant difference between the rating of female and male participants.

In summation participants with a high status and single participants evaluated the TV as polite, attentive and wanting to be used, while participants with a low status evaluated it opposite. In pairs both participants had a negative perception of the TV while single participants had a positive perception of the TV. Participants varied in their evaluation of whether the TV was experienced as communicating.

Interview and video analysis
During the experiment different issues relating to the movements of the TV was mentioned. These are

<table>
<thead>
<tr>
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<th>All participants</th>
<th>Only pairs</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>HS</td>
<td>LS</td>
</tr>
<tr>
<td>What did you think of the TV?</td>
<td>2.5</td>
<td>3.0</td>
</tr>
<tr>
<td>It seemed like the TV was trying to communicate with me</td>
<td>3.5</td>
<td>3.0</td>
</tr>
<tr>
<td>It seemed like the TV was thinking if communicating with me</td>
<td>2.5</td>
<td>2.0</td>
</tr>
<tr>
<td>The TV was attentive to me</td>
<td>4.5</td>
<td>1.0</td>
</tr>
<tr>
<td>The TV was polite towards me</td>
<td>4.0</td>
<td>1.0</td>
</tr>
<tr>
<td>The TV wanted to be used by me</td>
<td>4.5</td>
<td>1.0</td>
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Table 1. Median ratings on all items, divided by high and low status (HS and LS)
described in the following, including what was said during the interaction itself and what was said during the interviews.

THE TV AS A SOCIAL AGENT
Most participants had strong reactions to the movements of the TV. In four out of five pairs, participants made comments about the TV as if it had preferences similar to a social agent:

LS: It's still you it’s...
HS: It’s in love

Participants use the words love and like to describe the TV’s relation to the participant assigned a high status. It seems obvious that positive attitude was clearly communicated. How this relates to status is debatable. Only one single participant made comments about preference during the interaction, probably because participants spoke less when interacting alone. When asked about the interaction during the interview three out of five single participants (P) made comments that also indicate that the TV was perceived as an autonomous agent:

P: ...that’s maybe where it was a bit provocative. Look at me, I’m here! And then you look; now what?

It seems as though the focus of the single participants is different from the participants in pairs. When they interact with the TV alone, they focus more on the TV being attentive, than on aspects such as likeability or status. This indicates that the discriminatory treatment in pairs plays a large role in the participants understanding of the TV. This underlines the fact that having status or likeability is something that lies in the relation with others. Even though the participants react to the TV as an agent, the attention of the TV is not enough to induce a feeling of having status.

During the interviews one pair and two single participants stated that they did not feel like the movements of the TV communicated to them. In the eight sessions where participants reacted to the TV as a social agent some of them clarified that they did not consciously think of the TV as a living thing. It seems that participants’ reaction to the TV as a social agent is an automatic reaction outside of their conscious focus.

POSITIVE AND NEGATIVE EXPERIENCES
Most participants had both positive and negative comments about the TV. In some situations the movements of the TV were perceived as unpleasant because they were autonomous:

HS: Since I was the one being followed it became a little uncanny. Devices rarely do this type of thing and following me is something that I attribute to humans and animals for example, but not electronic devices.

Only a few participants commented that they did not like feeling that the TV was trying to communicate. This indicates that creating agency-like interaction is perceived as problematic by some users.

All participants in pairs and 3 of the single participants commented that they felt like the adjustment to their movements was highly problematic when two users were present:

HS: It wouldn’t work in my home (...) I think the others would get pretty tired of it if it moved every time I move. I very rarely sit down and watch TV.

A large part of this is participants thinking of how they might use the TV when they are not alone. When the TV discriminates between them for no apparent reason they feel uncomfortable. If the interaction with the TV is only optimal for one person it does not become a positive experience because the other person is left
out. Despite the problematic areas participants also expressed positive opinions about the TV in nine out of ten sessions, thinking of everyday situations in which it might be practical.

**Discussion**
The results contribute to existing research on product movements by showing that it is possible to communicate likeability nonverbally using simple product movements, but only under some circumstances. When participants interact with the TV in pairs they interpret the TV movements as if the TV likes one of them or rates one of them higher than the other. When participants use the TV alone they rate the TV as polite and paying attention, but they do not use words relating to likeability or status. It is unclear if status was communicated. The questionnaire does not directly test this and participants did not use words directly related to status.

A primary contribution of this paper is the finding that the product in some ways became a part of the users’ social context when more than one user was present. The presence of other users was important to the participants’ perception of the TV and it was perceived as breaking social norms when more than one user was present. To the best of our knowledge the social impact of multiple users has not been researched in previous studies on product movements. This finding underlines the importance of considering the social context when studying the relation between an autonomous product and the user. Future studies exploring this should be aware that the number of users may change the perception of the product dramatically. It appears that it might be possible to instigate conflicts between users via product agency and it is important to consider this.

Negative emotions and social conflicts are an inherent part of our social relationships so it also becomes an inherent part of interaction with products that appear to have agency. In the present study the TV was specifically designed to elicit social reactions from the participants, but it can be argued that as automated technology becomes more commonplace this is something that must always be considered.

In future studies it would be interesting to further explore the social context and how different relations between the users influence their perception of the product. As a part of the social context it would also be important for future studies to consider the experimental context as part of the social context. The qualitative analysis in this study is based on our interpretation of the participants’ statements. This method has an inherent risk that we attribute things to the participants that they did not experience. This is interesting in the context of the subject and relevant to explore further. Future studies may consider other ways of analyzing results that are not as based on subjective interpretations. Other interesting aspects for future studies are the personality of users and the culture in which the product is used.

This study has focused on the nonverbal communication of likeability and status. This is just one example of what it may be possible to communicate through very simple product movements, and we suggest that many other social relations may be found by taking research in nonverbal communication as a starting point.
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