Would You Do That? – Understanding Social Acceptance of Gestural Interfaces

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ABSTRACT
With gesture-based interactions in mobile settings becoming more popular, there is a growing concern regarding the social acceptance of these interaction techniques. In this paper we begin by examining the various definitions of social acceptance that have been proposed in the literature to synthesize a definition that is based on how the user feels about performing a particular interaction as well as how the bystanders perceive the user during this interaction. We then present the main factors that influence gestures' social acceptance including culture, time, interaction type and the user's position on the innovation adoption curve. Through a user study we show that an important factor in determining social acceptance of gesture-based interaction techniques is the user's perception of others ability to interpret the potential effect of a manipulation.

Categories and Subject Descriptors
H.5.2 [**Information Interfaces and Presentation**]: User Interfaces – *interaction styles*. K.4.m [**Computers and Society**]: Miscellaneous. K.8.m [**Personal Computing**]: Miscellaneous.

General Terms
Design, Human Factors.

Keywords
Social acceptance, gestural interfaces, gestures' design.

1. INTRODUCTION
Mobile devices with integrated sensors that enable novel gesture-based interactions are rapidly gaining popularity. Gestures may be small and subtle, such as the pinching action available on the iPhone to modify the zoom, or large and extravagant, such as drawing out letters in the air to create a text message. Gestural interfaces offer a more natural method of interaction than traditional input devices such as keyboards and mice and promise to have many wide reaching benefits. These include the potential to empower communities of users traditionally marginalized by technology including people who are economically, educationally or physically challenged. However, in order to design successful interfaces and services that utilize gestures, acceptance must be investigated and understood. To date, applications and design of gestural interaction techniques have focused on gesture recognition, or on the design and implementation of metaphors as means of controlling the mobile device [8]. Social acceptance of gestural interaction is also considered an issue and is mentioned by many researchers (for example, Brewster et al [1]). Nonetheless, little research has been done toward capturing and categorizing user behaviours and the public's reactions to them.

In this paper various descriptions that have been proposed for social acceptance are analyzed and a definition derived. We examine some of the main factors that strongly influence social acceptance and look at their interplay. Through focus group discussions we also show that social acceptance of gestural interactions is closely tied to the publicly noticeable effects of the gestures.

The contribution of this paper is therefore: a) an examination of literature to synthesize a definition of social acceptance b) the identification of factors that influence the dynamics of social acceptance, and c) the demonstration that socially acceptable gestures need to have reciprocity in terms of visibility of manipulations and effects so that bystanders can get an impression of the meaning of the action.

2. UNDERSTANDING SOCIAL ACCEPTANCE
Social acceptance is a concept often referred to in the context of mobile device interaction e.g. [4, 6], but is rarely, if ever, clearly defined. This is partially a product of the intangibility of the concept. On the other hand, the concept of user acceptance has been very well researched and defined in the HCI literature. Among others, user acceptance includes factors such as utility, usability and cost [14] and has been referred to as the process of overcoming "uncertainty". User acceptance has also been defined as "the demonstrable willingness within a user group to employ information technology for the tasks it is designed to support" [3]. However, little work has been done to differentiate social acceptance from user acceptance and these terms seem to be often confused. Therefore, without a clear definition of social acceptance designers cannot be expected to create interaction techniques to conform to this concept.

Many researchers have realized the importance of social acceptance when designing gesture-based interfaces, e.g. [1, 12]. Nonetheless, the complex interplay of the various factors that influence social acceptance along with its dynamic nature make defining and measuring the social acceptance of gestural interfaces a difficult task. Lacking a standard definition, researchers have suggested their own.

Throughout the prior work there is an agreement with making the interactions as "natural and unnoticeable" [10] and "unobtrusive"

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[5] as possible and with making "discrete interfaces that allow control of mobile devices through subtle gestures" [2] in order to gain social acceptance. Also, Ronkainen et al [12] carried out a brief study on social acceptance of gestures based on an internet survey. They found that indeed smaller gestures were accepted over larger gestures; but the focus of their work was towards identifying how useful a gesture was for managing a specific phone application. However, these descriptions limit the interaction to be invisible to bystanders in order to be socially acceptable.

2.1 Defining Social Acceptance

Expanding these views, Brewster et al [1] suggest that both how the individual feels about performing the action and how others nearby perceive the users' actions need to be investigated as to determine social acceptance. We term these two viewpoints as the *user's social acceptance* and the *spectator's social acceptance,* the combination of which form an overall measure of social acceptance. Considering both the users' and the spectator's social acceptance will allow a more complete understanding.

User's social acceptance: for every task a user performs, they will be left with an impression – did they feel comfortable or uncomfortable, awkward or natural, relaxed or embarrassed? This will lead to an overall positive or negative impression of the task or technology.

Spectator's social acceptance: user actions are performed in a range of public and private situations, i.e. contexts. The spectator's social acceptance is a measure of their impressions of these actions. Does the audience understand what the user is doing? Do they think the action is 'weird' or 'normal'? The spectator quickly builds a positive or negative impression of the user's actions.

Gestures can be said to be socially acceptable if they are deemed to be appropriate, by both the user and any observers, in the context in which they are carried out. It is also plausible that users base their social acceptance of a gesture depending on how they would react to the same gesture if they were a spectator, thus creating interlinks between user's social acceptance and spectator's social acceptance.

The next section explores some of the main factors that influence the social acceptance of gestures.

3. FACTORS THAT INFLUENCE SOCIAL ACCEPTANCE

There are many factors that influence social acceptance. Among those factors, culture, time, type of interaction and user position in the innovation adoption curve all play an important role. We briefly describe these factors below. Other factors like cost, system's reliability, and user's age group are left for a future study.

3.1 User Type: Innovation Adoption Curve

The innovation adoption curve is a bell-shaped model proposed by Rogers [11] in which users are divided into categories based on the assumption that some individuals are more open to the adoption of new technology than others. According to this model, user types range from innovators to late adopters, with innovators representing the smallest percent of the population. The innovation adoption curve suggests that it is not practical to try to convince the population of a new and controversial idea.

It would therefore appear that user type plays an important role in the *user's social acceptance* of novel gestural interaction as it is expected that late adopters would easily resist new gestures more than innovators.

3.2 Culture and Time

One of the biggest problems when trying to assess the social acceptance of a new gesture is its dynamic nature and dependence on culture, immersion of the technology and the length of time the technology has been in the environment. Some cultures may find a technology more socially acceptable than others (for example, Tan et al's study of Japanese and US populations for controlling a TV interface [15]). Further, the acceptance of a technology, such as gestural interfaces, alters with time as the interface becomes more widespread and embedded in everyday life. These factors can only ever be measured *after* the interface is released and is in the public's hands.

3.3 Manipulation vs. Effect

Looking at factors that can be measured *before* the gestural interface is open to the general public, a user *performance or manipulation* of a device along with the *visible results* of that performance or its *effects* is a vital element that influences social acceptance. As stated before, when a user performs their task in a public context the user's performance elicits a conscious or unconscious reaction from the spectators. The way in which the user performs their tasks in front of others and the visible results of that task has a strong impact on the *spectator's social acceptance*. If an interaction is too loud or obtrusive and there is no real meaning to it from the spectator's view, a negative impression will form.

3.3.1 Gesture Classification

According to how a bystander would perceive the user's interaction, we have placed gestures found in the literature with or without social acceptance evaluation (e.g. [5, 12]), in a manipulations vs. effects plane. Manipulations and effects have been studied in a different perspective by Reeves et al. [9]. In their work, Reeves et al divided the manipulations-effects plane into four categories: expressive, suspenseful, secretive and magical. We will use their nomenclature for consistency.

Secretive gestures have both the manipulation and effects hidden such as tapping on the phone to change its volume when talking as proposed by Ronkainen et. al [12].

At the other end of this plane are *expressive gestures* with both manipulations and effects revealed like slapping the phone to mute the ring tone [12].

Magical gestures have their manipulations hidden but the effects revealed or amplified and *Suspenseful gestures* have manipulations revealed but the effects hidden. For example drawing an exaggerated "X" mark in air to turn silent profile ON.

We hypothesized based on the limited previous evaluations that both secretive gestures and expressive gestures will have a greater chance of being socially acceptable, whereas suspenseful gestures will be more often seen socially unacceptable.

In order to test the above hypothesis and to see if user type has an effect on the above gesture types we carried out a user study described in the next section.

4. USER STUDY

We carried out two separate sessions of semi-structured group interviews where participants in the group were asked to fill in a questionnaire followed by a discussion. One session involved late adopters, while the other consisted of early majority adopters all recruited from the local community. Interestingly, while participants were recruited based on their technology usage patterns, we also found that the groups aligned around participants' ages: early majority adopters ranged from 20 - 40 years, while late adopters were all 61 years or older. The late adopters group consisted of ten participants (four females, six males) whereas six people (two females, four males) formed the early majority adopters group. This form of semi-structured group session was preferred over online surveys because of the interactive nature of our task and the freedom for the participants' to change their views following a group discussion.

Table 1 shows the description of each of the eight gestures used in our focus group along with their corresponding categories. For three of the gestures categories (expressive, suspenseful and secretive) two different gestures were devised based on examples in the literature. For the magical category, as we did not find gestures with hidden manipulations and amplified effects, the gestures and scenarios used were of the authors' creation.

Table 1. Gestures descriptions and categories (see accompanying video for gesture visuals)

	Description	Category
G1	Throwing money vending machine[13]	Expressive
G2	Slap phone to stop ringing [12]	Expressive
G3	Writing big letters in the air [12]	Suspenseful
G4	Swing phone to operate it [12]	Suspenseful
G5	Tapping on the phone [12]	Secretive
G6	Orienting phone to control player[6]	Secretive
G7	Controlling slide show with phone	Magical
G8	Turning on/off lights with phone	Magical

Participants were shown a video of each gesture (average time = 10sec) after which they filled out a short survey. The survey consisted of two questions: an open question (Q1) and a six-point scale data question (Q2) as follows:

i) Q1- What would you think if you saw someone else performing this gesture (for example, when walking down the street)?

ii) Q2- How would you feel performing this gesture in the following situations? a. in public places b. at home. The scale ranged from 1 (Embarrassed) to 6 (Comfortable). This scale will give us insights on the social acceptance of the gestures.

After a gesture was shown, the participants were asked to fill in Q1 with their first impression in two or three words; no explanation of the gesture was given at this time. Once Q1 was filled a brief explanation of the gesture and its purpose was given and then the participants were asked to complete the survey filling out Q2. This process was repeated for each video. Following this there was 15 minutes open discussion of the reasons for their answer. After the discussion, the participants were again asked Q1 for the gestures they had already discussed. With this we were trying to identify how the views of the group influenced the opinion of the individual. We found that the participants did not change their original opinion about a given gesture when answering Q1 before and after the discussion.

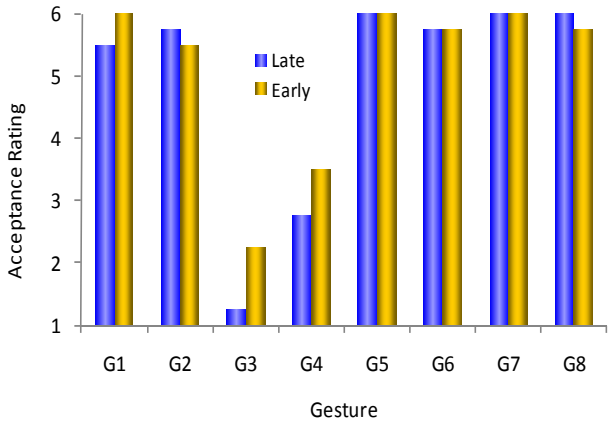

Figure 1. Median of responses to *Q2.a using gestures in public places* for late and early majority adopters

4.1 Results

The median rating of the Q2 scale data for each gesture when performed in front of bystanders for the two groups is shown in Figure 1. The results reveal that the suspenseful gestures (G3, G4), with manipulations revealed and effects hidden, were not acceptable to be performed in public by both late and early majority adopter group of participants with a Q2 median of 1.25 and 2.75 respectively for the former group. G3 particularly was described as "odd", "crazy", "silly", "over the top", "ridiculous", "undesirable", and along with G4 was depicted as too "large and noticeable" and "impractical". Concern was expressed for performing these gestures even when in private. Knowing the purpose of these gestures did not seem to aid their social acceptance. In contrast, the magical gestures (G7, G8), with manipulations hidden and effects revealed, were found openly accepted by both groups even when the participants did not understand or see what the gesture was. These findings are in agreement with our original hypothesis and are also confirmed by an ANOVA, with Tukey's HSD which found a significant effect of gestures on social acceptance for both late ($F_{(7, 63)} = 29.54$, $p < .001$) and early majority ($F_{(7, 35)} = 3.56$, $p < .05$) adopter groups.

Along these results, expressive gestures (G1, G2), with both manipulations and effects revealed, were in general openly accepted by both groups for public and private contexts. In fact, for private context we found no statistical difference in rating between (G1, G2) and secretive gestures (G5, G6). Gestures (G1, G2) were also rated significantly higher than suspenseful gestures (G3, G4) in both public and private settings ($p < .05$ for all comparisons). However, G2 (slapping the phone to stop it ringing) was considered to have an aggressive negative connotation by two of the participants in the early majority adopter group and was therefore scored lower. G1 was generally considered normal by both groups for the environment in which it was applied. This reaction was expected in the context of our hypothesis, where the manipulations are revealed along with their effects and therefore bystanders are not left wondering what the meaning or purpose of the gesture is, and as a result it becomes "natural" and acceptable.

Secretive gestures (G5, G6), with both manipulations and effects hidden, were highly rated by the two groups for both public and private contexts. This finding agrees with intuition and with the literature [10].

The median rating of the Q2 scale data for all of the gestures when performed in private (Q2.b at home) was found slightly higher than the ratings for the public performance scenario, with secretive, expressive and magical gestures reaching a median rating of 6 for both groups of participants. However, even when performed in private, suspenseful gestures (G3, G4) were rated much lower than the other gestures and in general their overall social acceptance tendency was similar for both scenarios.

4.2 Discussion

Our results demonstrate that the social acceptance of a gestural interaction is closely tied to the publicly noticeable effects of the gestures. As hypothesized, suspenseful gestures (G3, G4) were not socially accepted. One explanation for this could be that users find it important that a gestural interaction embodies its meaning for both the user and the bystanders (as implied by Dourish [4]). A good embodiment of the meaning of a gesture in the user's action allows both the user and the bystander to get an impression of what the action means and therefore perceived as socially acceptable. This becomes particularly pertinent to suspenseful gestures where only the manipulating part of the interaction is seen which makes bystanders uncomfortable as the effects of these manipulations are concealed. This does not imply that bystanders need to know all details of the interaction, the key element is that bystanders have a notion of what the manipulation means without necessarily knowing all the details.

Embodying meaning also makes magical gestures such as (G7, G8) more socially acceptable as bystanders only observe the effect of a hidden manipulation and therefore have no specific person or action to target their unacceptance towards. We believe this helps making magical gestures more socially acceptable than suspenseful gesture.

It is possible that some actions for users and bystanders could be seen as lacking meaning but over time become acceptable as awareness of the action and its meaning grows. Monk et al [7] found an analogous behaviour with the usage of mobile phones: making calls in public is still annoying for bystanders (a suspenseful interaction as bystanders only hear half the conversation).

Although our results did not reveal any significant difference in social acceptance tendency between early majority and late adopters we feel that further comparisons are necessary between innovators and late adopters to explore more deeply this aspect.

5. CONCLUSION

In this work we provide a synthesized definition of social acceptance of novel gestural interaction. We also looked at the interplay of two determinant factors that influence social acceptance - gestural manipulations versus visual effects of a mobile communication device, and user type according to the innovation adoption curve.

We hypothesized that the social acceptance of a gestural interaction is closely tied to the publicly noticeable effects of the gestures if the interaction is also visible. This hypothesis was proved valid through focus groups discussions. Results show that it is not advisable to design gestures with large, revealed manipulations and hidden device effects as they are more likely to be socially unacceptable. We also found that not only small discrete gestures are acceptable, but big expressive gestures are also acceptable given their accompanying device effect is visible. More research is needed in order to investigate how culture, age group, costs and system's reliability influence the acceptance of novel gestures.

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7. REFERENCES

[1] Brewster, S., Murray-Smith, R., Crossan, A., Vasquez-Alvarez Y. & Rico, J. The GAIME project: Gestural and Auditory Interactions for Mobile Environments. British computer Society, 2009.

[2] Costanza, E., Inverso, S.A. & Allen, R. Toward Subtle Intimate Interfaces for Mobile Devices using an EMG Controller. Proc. CHI 2005. ACM Press, 481-489.

[3] Dillon, A. User Acceptance of Infomration Technology. W. Karwowski. Encyclopedia of Human Factors and Ergonomics. London: Taylor and Francis, 2001.

[4] Dourish, P. Where the Action Is: The Foundations of Embodied Interaction. 2001, MIT Press

[5] Feldman, A., Tapia, E.M., Sadi, S., Maes, P. & Schmandt, C. ReachMedia: On-the-Move Interaction With Everyday Objects. Proc. ISWC'05, 2005, 52-59.

[6] Keränen, J., Bergman, J. & Kauko, J. Gravity Sphere: Gestural Audio-Tactile Interface for Mobile Music Exploration. Proc. CHI 2009, ACM Press.

[7] Monk, A., Carroll, J., Parker, S. & Blythe, M. Why Are Mobile Phones Annoying? Behaviour & Information Technology, 2004, Vol. 23, 33-41.

[8] Pirhonen, A., Brewster, S. & Holguin, C. Gestural and Audio Metaphors as a Means of Control for Mobile Devices. Proc. CHI 2002, ACM.

[9] Reeves, S., Benford, S., O'Malley, C., & Fraser, M. Designing the Spectator Experience. Proc. CHI 2005, ACM Press.

[10] Rekimoto, J. GestureWrist and GesturePad: Unobtrusive Wearable Interaction Devices. IEEE Computer Society, 2001.

[11] Rogers, E. Diffusion of Innovations. New York Free Press, 1995.

[12] Ronkainen, S., Häkkilä, J., Kaleva, S., Colley, A. & Linjama, J. Tap Input as an Embedded Interaction Method for Mobile Devices. Proc. TEI'07, ACM 2007.

[13] Scheible, J., Ojala, T. & Coulton, P. MobiToss: A Novel Gesture Based Interface for Crating and Sharing Mobile Multimedia Art on Large Public Displays. Proc. MM'08, ACM Press 2008, 957-960.

[14] Shackel, B. Usability-Context, Framework, Definition, Design and Evaluation. J Richardson, B. Shackel. Human Factosrs for Informatics Usability. Cambridge University Press, 1991.

[15] Tan, G., Takechi, M. & Brave, S. Effects of Voice vs. Remote on U.S. and Japanese User Satisfaction with Interactive HDTV Systems. Short Talk: Domesticated Design, CHI 2003, ACM 714-715.