# The Effect of Location on Perceived Intrusiveness of Mobile Ads

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**ABSTRACT**
Ads are a salient means for supporting the development and sustenance of several computing services free for public use. While ads have potential benefits for users (monetary, informational, etc.) they also have shortcomings such as being perceived as intrusive. With the advent of mobile computing location based services might be able to address the shortcomings of ads. In this paper we study the perceived intrusiveness of location based ads using a virtual environment. We present initial evidence that location has a significant impact on the way people perceive the intrusiveness of ads.

**Author Keywords**
Location based ads, perceived intrusiveness, mixed reality

**ACM Classification Keywords**
H5.1. Information interfaces and presentation

**General Terms**
Human factors

## INTRODUCTION

Since the dawn of media, our daily life is increasingly invaded by advertising. Whether it is our TV set in our living room or a bus stop out in the public space, every day we are being confronted with ads. As a result, people may feel overwhelmed and will react by avoiding ads [18]. Moreover, advertising is generally perceived as being intrusive since most of the times it fails to address the user's goals [13,15].

Perceived intrusiveness of an ad, i.e. a psychological reaction to ads that interfere with a consumer's ongoing cognitive processes, has been presented to have a link to ad avoidance [13]. Thus, if one perceives an ad as intrusive then both the recipient's experience and the advertiser's purpose runs the risk of being thwarted.

Thanks to the steadily growing computing power, miniaturization of processors and integration of sensors, pervasive computing applications are nowadays more able than ever to detect elements of the context of use and adapt to the user. Location Based Services (LBS) running on mobile phone devices are an example of this trend. Although positioning techniques used by LBS (e.g. Global Positioning System and Cell-ID) are still crude - lacking accuracy and mainly suitable for outdoor use - the expectation is that the sophistication with which location can be tracked will enhance as technology and the market progresses. An extensive body of research shows us that the employment of a accurate indoor location tracking system is feasible [14], which could make LBS increasingly interesting for commercial settings (e.g. retail stores, shopping malls etc.)

In the case of advertising, by offering relevant information based on the users' location, advertisers hope that they can respond to the users' situation and lessen the interference with their cognitive processes. Although it sounds plausible in theory, the adoption of such applications still depends heavily on how users experience these location-based ads.

In this paper we set out to research whether location would have an effect on the perceived intrusiveness of an ad presented to a mobile phone user. In order for this research to be relevant with regards to the current technological developments we chose to study the effect of location in a commercial indoor setting.

### Previous research

The user experience of mobile services and applications has been studied extensively and point generally in the direction of personalization and incorporation of the context of the user. Tang et al. [16] study the placement of ads on personal navigation devices (PND) and found that ads were disliked if they were presented with PND functionality with which they felt uncomfortable, if the ads were large in size

and that irrespective of the provided content and incentive, or if users had to interrupt their activities.

Aalto et al. [1] conclude based on a qualitative and quantitative evaluation of a location-aware advertising system that pushed location based ads are generally perceived positive and thus recommend "profiling and personalization so that only relevant, targeted advertisements are offered to the users". On the other hand they did not compare it to the experience of non-location based ads, which leaves room for further investigation.

Ludford et al. [12] look into the timing of Location Based Reminders (LBR) and conclude that the acceptance of LBR depends heavily on the context and the task of the user. Similar to this result Wehmeyer [17] studied the perceived intrusiveness in the context of (non-location based) mobile ads and conclude that ad product relevance and situation impact the intrusiveness one perceives.

Perceived intrusiveness of an ad has been presented to have a link to ad avoidance and would therefore directly affect the adoption of such services [13]. The aim of this study is to research the effect of receiving an ad when the ad presents a product that is related to the location in which users find themselves (location-fit). On the other hand it is not the focus of our paper to cover the technologies necessary to implement a location based advertising system in a real supermarket. Based on the literature our hypothesis is: Location-fit ads will be perceived as less intrusive compared to location-misfit ads.

## METHOD

Our goal was to execute an ecologically valid experiment, aimed at researching the effect location might have on perceived intrusiveness for mobile phone users. However, in-situ experiments that include contextual variables like time and location are very difficult to control and measure [6,17]. Hansen et al. [8] report no less than 19 items of a checklist to consider before actually deploying a prototype in the real setting. Although the setting they were exploring was in a hospital, similar issues such as the software being unstable in untested situations [5] or the participants needing to carry a second device [9] have been reported elsewhere.

In this paper we present an exploratory and novel way of reconstructing users' experience to evaluate a pervasive computing application such as location-based ads for mobile phone users. We present a virtual supermarket environment (Figures 1 & 3) that interacts with a mobile phone. A supermarket seemed to be the most suitable setting since mobile ads are more effective if they are aimed at low-priced and frequently bought products [3]. Previous literature has discussed the potential benefits of pervasive application evaluation with the use of virtual environments [10].

### Experimental design

A between-subjects design was used to test the hypothesis. Participants were randomly assigned to two conditions: 1) Location-fit: The ad with product X was presented when the user was in proximity of product X, 2) Location-misfit: The ad with product X was presented when the user was in proximity of product Y. Proximity was set to 0.5 meter distance of the product.

### Setup

The experiment took place within a virtual environment simulated by a CAVE (Cave Automated Virtual Environment). A simulated 3D supermarket (modeled in Maya and rendered in OGRE) is projected in 4 rear-projection screens (each 3.6 meters wide by 2.6 meters high). Participants can move in the virtual setting with the help of a head-tracking device (Figures 1 & 3). In contrast with head-mounted displays, the CAVE does not block out the physical world, which offers the opportunity to use physical objects and the representation of the participant's own physical body. In this particular case it gave us the possibility to use a real smartphone, in which participants were able to receive location-based ads.

The tracking device determines the participant's position in the physical room and this position is used to control motion in the virtual supermarket. In essence, the participant acts as a "human joystick", whereby the virtual camera will strafe in the direction the user is stepping, relative to the CAVE's center. The simulation was sensitive to the magnitude of the participant's step that determined the speed with which participants walked within the environment. The simulation also corrected the first person view for the vertical axis, thus in the case where the user, for example, jumped or ducked the simulation corrected the perspective according to the vertical position of the participant's head. When it comes to shopping within the supermarket our simulation does not yet support interaction with the virtual products. In order for participants to simulate the act of selecting groceries, they were asked to make a grabbing gesture, without actually attempting to interact with the virtual product (Figure 1).

**Figure 1. Participant "picks up product" by making a grabbing gesture (reenacted)**

The interior of the supermarket, with regards to corporate style and spatial arrangement, was based on common

denominators found in stores of popular Dutch supermarkets. The virtual supermarket is still in development; the entire supermarket inventory was apparent and about one sixth of the shelves were filled with products at the time of our experiment. We are modeling products on a daily basis and in the near future the supermarket will be filled with a representative product set.

An Android application was developed which communicated with the CAVE through Bluetooth sockets. The application would sound an audio message, vibrate and present the ad to participants. The ad was presenting a chewing-gum product (Figure 2). The application offered the option of receiving or rejecting more information about the product offer. This ad was presented when within 50 centimeters perimeter of a specific area of the virtual supermarket. The area was customizable.


**Figure 2. The mobile ad presented to participants from both the location-fit and location-misfit group.**

### Participants

While having 27 participants, for the results described in this paper we decided to include the 12 participants whose experiment proceeded according to protocol; i.e. they noticed the ad on the mobile phone. These 12 consisted of 8 who witnessed the location-misfit setup (4 males and 4 females; average age: 23) and 4 who witnessed the location-fit (2 males and 2 females; average age: 21). All of them were international university students. Moreover, they all owned a mobile phone and were familiar with smartphones equipped with a touch screen interface. For their effort participants received a gift certificate incentive.

### Procedure

During the briefing we covered different topics: the operation of the smartphone and the CAVE, instructions for shopping within the environment, notice for the slight risk of physical inconveniences (dizziness and nausea) due to disorientation in the CAVE, the length of the experiment (~30') and the confidentiality clause regarding the collected data. After the briefing, participants were led to the CAVE where the head tracker was mounted. Before starting the virtual environment the head tracking system was calibrated according to the specific height of the participant. The initial task was to navigate through the supermarket for a few minutes to get familiar with the controls and the interaction. Next, participants were asked to go to the main entrance of the supermarket to receive the second task: buying a pizza. While executing the second task participants were given a pre-scripted phone call before reaching the pizza refrigerators. During this call the extra task of getting a soft drink and a soup package was given. After completing the task participants had to go to counter number 3. The shelves above the conveyor belt at that counter were filled with products including the advertised chewing gum. Depending on the condition a participant was assigned to, the chewing gum ad was triggered at one of two locations. The location-fit condition triggered the ad within two meters of the chewing gum shelf (Figure 3) while the location-misfit condition triggered the same ad within two meters of the soup shelf.

This scenario ensured that both groups visited their trigger area without giving away our research goal. In the case of the location-fit group we did not need to ask participants to seek the chewing gum shelf, since they would visit it while checking out at counter 3, regardless. In the case of the location-misfit group the task to pick up soup ensured that all participants within the misfit group experienced roughly the same conditions while receiving the mobile ad.

**Figure 3. Participant from the location-fit group receives mobile ad at the counter (reenacted)**

### Measurement

Immediately after the virtual shopping experience, participants filled out a questionnaire that assessed their perceived ad intrusiveness of the received mobile ad [13]. In order to take into account the complexity of an everyday commercial setting we also measured several control variables that have proven to affect the evaluation of advertising and location based advertising. Based on our literature study we included the following scales: product involvement [17] (regarding chewing gum), privacy concerns [1] and the attitude towards advertising in general [2,17].

## RESULT & CONCLUSION

First of all the 12 respondents rated more or less homogeneous with regards to the control variables, thereby excluding the possibility of these variables explaining the measured effect. The median scores on the ad intrusiveness scale for the fit and misfit group were respectively 2.64 and 4.57 (7 point scale). Based on the Mann Withney U test we conducted we can conclude that the median scores on the intrusiveness scale differed significantly (z= -2.722

p=0.003). It can be further tentatively concluded that (virtual) location based ads lead to less ad intrusiveness than non-(virtual) location based ads.

## DISCUSSION & FUTURE WORK

The result of our preliminary study is promising but not conclusive. Although it seems that the effect location has on perceived intrusiveness is statistically significant, there are still some methodological improvements to make before this conclusion gains explanatory power.

In a follow-up study we are planning a sample of 80 participants randomly selected from a panel of 60.000 people representative of the Dutch population. Since the use of a larger sample allows for extensive statistical analysis we plan to include more control variables to exclude possible factors that could potentially explain the result.

With regards to the design of the experiment we are planning to manipulate the location fit/ misfit by changing the product set instead of the location, thereby keeping the conditions for both groups as constant as possible.

The implications of this line of research might extend to other location based services. For example, push notification messages of news items or customer recommendations of restaurants or cafes. Specifically for mobile apps in a supermarket context our preliminary results point to clear design recommendations.

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