Attract, Inform, and Interact: Working with Product Semantics in an Inclusive Design Project

Daniel Fallman*, Linda Bogren **, Catharina Henje **

* Interactive Institute Umeå
Umeå, Sweden, daniel.fallman@tii.se
** Umeå Institute of Design, Umeå University
Umeå, Sweden, {linda.bogren, catharina.henje}@dh.umu.se

Abstract: While we argue that a deficient interest in product semantics, aesthetical expression, and form may further come to increase the stigmatization some users already experience in society due to their impairment or age, the current inclusive design literature however rarely discusses these issues. In this paper, we describe how we have worked with and focused specifically on product semantics in an inclusive design project commissioned by the Swedish Railroad Administration with the objective to design and implement a prototype of a train information terminal providing accessible information to as wide an audience as possible. We approached product semantics using three zones of user engagement with the product; the attract zone, i.e. the distance from which the product makes itself known and from where it may be seen and identified for what it is within a particular environment; the inform zone, where potential users get increasingly confident in that the device they are approaching will assist them with what they want to achieve; and the interact zone, where users feel invited to come close to, touch, start to interact, and explore the product.

Keywords: Inclusive Design, Product Semantics, Heterogeneous Users, User Experiences

1. Introduction
The process of inclusive design is emerging as a socially sustainable and humane alternative to design for people with special needs, seeking to make designed objects as accessible as possible to the largest number of people [1]. Thus, inclusive design represents a significant shift in attitude away from making specialized design solutions for children, old users, and impaired people towards trying to integrate them in the design of all products, services, buildings, and spaces. In light of this, an underlying theme in this work is the argument that in this shift from specialized design solutions to an embracing inclusive design ideal, we must also address and advance concerns of product semantics, aesthetical expression, appearance, and form—not just continue to stress the traditional special needs issues of functionality, ergonomics, and usability. We argue that a deficient interest in doing so could further increase the stigmatization some users experience in society due to their impairment or age. In the current literature, issues of product semantics, aesthetics, and form are very rarely discussed [2]. Some authors even tend to position inclusive design explicitly in opposition to style and appearance [3]. Yet at the same time, many inclusive design projects, including several of the many highly held projects carried out at the Helen Hamlyn Centre in the UK [4], seem to have a strong, yet often implicit, aesthetically oriented focus as well as engage highly successful professional designers and design consultancy companies in their projects.
In this paper, an inclusive design project commissioned by the Swedish Railroad Administration is used as a vehicle for shedding more light on these issues. First, we will very briefly introduce product semantics. Second, we will describe our user centered design process in some detail as well as discuss issues related to the implementation of a fully functional prototype. Apart from describing a design case of what we see as good practice, we also believe that a thorough description of the process provides the reader with a better understanding of how as well as why the resulting information terminal turned out the way it did by fleshing out some important decisions that were made along the way. Third, we will describe and discuss how the prototype system has been exposed to, tested, and evaluated with users. The fourth and final part of the paper will discuss and reflect upon some of the lessons we have learned in conducting this project, some of which we believe could be of interest to others. In particular, we will reflect on the way we have worked with issues of product semantics in relation to both the heterogeneous user group as well as to the specific context, the train station, in which the terminal system will eventually be placed and in doing so come to discuss why we have chosen to implement the system as a fully functional and very finished prototype.

1.2 Product Semantics

Product semantics, as developed by Krippendorff & Butter [5] and others, can be seen as an attempt to find a new theoretical foundation for design beyond functionalism and the idea of objective design. It has been defined as the study of symbolic qualities of man-made shapes in the cognitive as well as cultural context of their use. More than anything else, product semantics represents a shift from the idea of designers designing for specific functions to designing for meaning to occur in their products’ users. According to product semantics, designers make use of certain design elements—including shapes, material, colors, textures, and so on—to embody in their products an intended ‘message’. Users of the product then respond to this embodied message by making sense of and interpreting the product. According to Monö [6], four basic semantic functions of products can be distinguished. First, the product describes its purpose, defines its task, its way of use, and the way it should be handled. Second, the product expresses values and qualities. Third, the product urges the user to react or act in a specific way, e.g. to be careful or to be precise. Fourth, the product gestalt also operates to identify its origin, its nature and the product area to which it belongs. This connects new products with existing product ranges and with families of similar products. Taken together, these semantic functions allow the designer to communicate a message through the product and to make the product comprehensible. Likewise, all products thus make a statement through their design and consequently never appear neutral, especially as they are always situated and must accordingly be understood in a specific physical and social context.

2. Design Process

The overall aim of the project has been to make train travel more accessible by focusing on information issues relating to train stations, to make all available information about train travel—including arrival and departure information; information about delays, track changes, and announcements; information about train station facilities, etc.—accessible to the wide variety of users that for various reasons could not get this information from the existing sources, a need which was established through various studies carried out by the Swedish Railroad Administration prior to the instigation of this project. A particular goal, following the ideals of inclusive design, has been to try to achieve accessibility without resorting to specialized design solutions for
particular user groups. Fully funded by the Swedish Railroad Administration, we have developed a fully functional prototype of a new train information terminal aiming to attract and enable use from as wide an audience as possible [7]. The design team consisted of a group of professional interaction designers, design researchers, and engineers in the Umeå Design Research Group at Umeå University. The project was carried out during 2006 to 2008 and involved between two (pre-study) and six (design and implementation) design team members. While most of the members of the design team did have previous experience of working in the field of inclusive design, none of us has any known physical disabilities or other impairments.

2.1 Contextual Pre-study
To commence the project, we conducted a number of contextual observations at train stations, airports, bus stations, and subway stations where existing examples arrival and departure information, guiding maps, and other assistive tools for travelers are already at hand. During this phase, the design team explored all currently used accessibility means at the sites; existing information systems used to distribute arrival and departure information; as well as conducted interviews with 40 passengers about their information habits at train stations. The team also carried out an extensive literature review. Our observations and interviews were documented using written notes, video, and photos. We also used this material to discuss our experiences, early ideas, challenges, and potential obstacles with an experienced accessibility consultant. From this, the design team started to formulate some preliminary requirements for the terminal’s product semantics. We believed the terminal would need to clearly signal its functionality and invite use; complement and harmonize with the Swedish Railroad Administration’s existing graphical profile and their organizational values; and be easy to find in its environment. These contextual studies were useful in helping the team to not rely too heavily on our own previous experiences, challenge the pre-assumptions as to the outcome of the project, as well as they provided a number of hands-on implications for the design process. We for instance found that graphical signs are typically placed too high for visually challenged people to read; as lighting conditions vary a lot during the day, reflexes on various kinds of surface materials decreases the contrast and thus the readability of printed signs and displays; people with hearing impairment (and others) cannot take in auditory messages distributed through crappy loudspeaker systems, where these then tend to lead to nothing but confusion.

2.2 Involving Users
Throughout the ideation, sketching, and prototyping phase of the project, a user group consisting of 9 participants with various kinds of disabilities, impairments and other kinds of challenges came to have an important impact on the project. Their ideas, need, requirements, and opinions both guided our process and served as design inspiration. The group’s explicitly heterogeneous nature also naturally inspired design solutions that were not overly specific to for instance one particular kind of disability. This user group consisted of: a participant with visual impairment; a participant with hearing impairment; a participant with intellectual disability; a participant with mobility impairment depending of a wheelchair; a participant short in stature; a very tall participant; a participant with deficits in motor control and perception; a participant with dyslexia; and a participant which in traditional user studies would have been considered to be a fairly average, ‘everyday’ user.
Second, during the user exposure, testing, and evaluation phase our fully-functional prototype was assessed by a different, equally heterogeneous group of 18 participants. These more formal tests focused on issues of usability and user experience and were carried out with the members of the test group one by one during the course of three days in situ at Örebro train station, Sweden. Hence, the first group of heterogeneous users helped the design team in getting the right design, where the latter helped us in term of getting the design right [8].

Involving real users at all stages in the design process has been vital for us, not only because it is good practice but also due to the cultural and experiential gap that always exists between designers and users—but which is even more evident when dealing with a group of users that has been explicitly put together because of the heterogeneity of its members. Involvement and engaging ‘real’ end users in all phases of the project hence becomes a crucial means in finding ways of bridging this experiential gap [9, 10].

2.3 Ideation, Sketching, and Prototyping

The design process consisted of iterative cycles of ideation, scenario building, sketching, low-fidelity prototyping in cardboard and simple print-outs, testing, discussion, and evaluation together with members of the user group. To be able to deal with user inclusion early on in the design process, we used an approach using low-fidelity prototyping with participatory elements, where the main objective was to find ways to allow users to engage hands-on with possible futures [11, 12]. The rich input we received from working closely with our users inspired and guided our design during these cycles. Examples of such insights include: that the product must be easy to find and have a central physical location in the context in which it appears; if the product is designed to feature a display screen, it must be possible to adjust it vertically to allow access by users in wheelchairs, children, visually challenged, or by users short in stature; the product should only present a limited amount of information at any given time; visual information such as printed text, symbols, maps, etc. must also be made available in auditory form, as well as all auditory and verbal information must be made available as text or represented visually.

During this phase of the project a number of sketches, mockups, and prototypes were constructed, ranging from very early mock-up models (Figure 1), used primarily to discuss and visualize ideas in relation to physical form and basic product semantics, to more realistic, full scale models used to discuss and try out various design ideas—ranging from user interface issues to ergonomics—directly with the users (Figure 2).

![Figure 1. Examples of early models](image)

Some of the design implications that were unveiled challenged the design team’s expectations and pre-understandings and would have been unattainable without close collaboration with real users. For instance, users with perception challenges did not deal well with the popular horizontal wide-screen 16:9 format, causing...
confusion, disorder, and loss of meaning and context. An early prototype featured a large display screen (40” in diameter). Fairly quickly however, we realized that some visually challenged users are only able to read at a distance of around 20 cm (8”), which means that such a large screen is very difficult to take in as a whole.

Figure 2. An example of a full-size mockup (of a later abandoned design) being discussed with a user

2.4 Implementation

Contrasting typical design research projects, we designed and implemented a fully functional prototype system. The resulting prototype combines a physical casing in sturdy outdoor materials, finished in stainless steel and acrylic; a fully functional touch-screen and speech-synthesis based user interface; with a comprehensive set of middleware computer systems interfacing the information terminal to all necessary sources of data for it to operate properly on-line. The terminal has been given a simple yet elegant physical form, with details to allow it to blend in with the Swedish Railroad Administration’s other systems and signs. Several blue light sources aim to attract users to the terminal.

Figure 3, 4, 5. The prototype (left, middle) and a rendered picture of the revised design (right)

The terminal has a vertically adjustable screen, which slides up and down (Figure 3). The main display conveys information about all near-future arrivals and departures, and provides users with the opportunity to both listen to and read transcripts on the most recent calls (Figure 4). All hardware buttons and other non-graphical user
interface interactional means have been located on the lower left of the prototype (Figures 3). The user interface has been designed to be imminently accessible and usable without the need for the user to spend much time learning how to use the interface. Users interact directly with information on the screen by touch, or by using Braille-enhanced soft buttons located at the bottom of the screen (Figure 4). All on-screen graphics has been designed to provide good contrast. The graphical user interface model is flat, avoiding interface depth and unnecessary modes. From the user’s point of view, the interface stretches, expanding and contracting sections vertically on the screen. This design allows users to keep track of where they are at the same time as the amount of information given at any given point is limited, the latter being a specific request from perception-challenged users participating in the study. If required, the terminal can provide a digital map of the station area with information about the layout of the station, including staircases, elevators, tracks, etc, where a legible on-screen animation helps the user with directions to get to a certain point or a certain track. Synthesized speech is used to also talk the user through the route, along with the animation. All information is available both as text and as synthesized speech, while the latter being optional. Because train stations are generally noisy environments, users also have the opportunity to plug in and use their own headphones or other kinds of hearing aids.

3. User Testing and Evaluation

The resulting prototype was exposed to users in situ at Örebro train station in Sweden. All information provided to the users by the terminal during these trials was real in that it actually represented the current situation as it unfolded in real time at the station; trains were leaving from the right platforms, trains the system claimed were delayed in fact came in late, all maps pointed in the right direction, and so on. The reason we chose to test the system in situ using real information rather than in a more controlled, off-line environment such as our usability lab is that we believe that the former provided the participants with more complete user experiences. Testing it in situ provides, for instance, realistic noise levels, lighting conditions, and—not least—real physical turmoil. We argue that for a system like ours, these are all very important factors influencing how users experience the system.

The prototype was exposed, tested, and assessed with a group of 18 participants (10 female, 8 male). None of these participants were part of the first user group, nor had they any previous contact with the system or the design team. This group was equally heterogeneous to the group of participants we worked with during the design phase. Our tests were carried out with individual participants during the course of three days. Each participant was asked to provide some information about their experiences of public transport and what kind of challenges they face when going by train, bus, or subway. We then provided the participant with a genuine train ticket and asked him or her to use our terminal to get information about the upcoming travel. While approaching and starting to use the terminal, we asked the participant to explain to us what he or she was doing or trying to achieve. The test team video filmed each use situation for later review and also took written notes about the various problems the users came across. After having used the system for as long as they wanted to, the participant was asked to reflect on his or her user experience as well as to provide any immediate suggestions for improvements.
Based on the results of the test and from our own reflections of seeing it in use, a number of improvements were made to the prototype system, ranging from radical redesigns to minor interface issues. Our revised design suggestion has been rendered in a 3D application for visualization purposes (see Figure 5). First, the terminal has been made easier to recognize and locate in the physical environment through various signs, including a large, blue ‘i’ sign hanging over the prototype from the ceiling. The terminal has also been given a partly different color scheme, where bright yellow elements have been added for it to be clearly distinguishable from other things in the physical environment. Second, to improve the accessibility for people in wheelchairs, the horizontal depth of the terminal has been increased. Third, all static navigation buttons has been moved from the lower screen area to off-screen areas.

4. Reflections and Discussion

With the benefit of hindsight, one of the most important decisions in this project was to opt for constructing a fully functional prototype with a very finished exterior. There were two related reasons behind producing such an integration prototype [13], i.e. a system that at least on the surface appears very finished and incorporates almost all the intended functionality of the final product, even through current best practice tends to propose the construction of several different prototypes of lesser resolution [e.g. 13, 8]. First, we wanted the system to be able to provide our users with the chance of having a whole user experience when interacting with the device, without having to imagine certain features of the system or work with off-line or made-up information. Rather, through an integration prototype, the terminal conveys and allows the user to explore meaningful information to that particular user in a real situation. Second, we were particularly interested in getting insight into the relationship between our group of heterogeneous users, the artifact, and the context of use especially in terms of product semantics.

4.1 Levels of Product Semantics

Because of the kind of artifact we were designing, the role it has for its intended users, and aspects of the environments in which it would be placed, we began discussing what we thought of as three important levels or zones of product semantics during the sketching and prototyping phase:

Attract Zone

We discussed the attract zone as the distance from which the product may be seen and identified within a particular environment. Within this zone, the product should make itself known and it should be possible to work out without too much effort what the product ‘is’ and what it can do for me as a potential user, in our case assist with information about arrival and departure, way-finding, etc. As some of our users have visual impairments, the attract zone for this particular product varies quite a lot from user to user. In addition, the size of the attract zone is influenced by crowds moving and noise in the environment. To assist users for which the product has a very narrow attract zone, we have experimented with subtle auditory cues, ambient lighting, and tactile pathways leading to the terminal. Quite a lot of effort went into trying to weave different kind of values and semantical expressions into the aesthetics of the device. At this level, we sought to achieve at least three things with the design. First, we wanted the user to recognize that the product is present within the context. From our user studies, we knew that the user group required the product to be easy to find, which has impact on both the design
of the actual product but also on its location in the physical environment in which it is placed. In terms of its physical design, we gave the terminal its own identity in terms of shape and color, while still adhering to the existing graphical profile. The design team also worked with lighting and graphics to call for attention from travelers. Second, we wanted the product to convey as much as possible about its own explanation as to what is its purpose, which would help users in deciding whether or not they felt it worthwhile to approach the device. During our tests, we found that the most common misunderstanding was to mix up our terminal device with ticket vending machines. This has of course to do with users’ pre-assumptions, i.e. that users who find terminals in a train station tend to interpret them instantaneously and without much thought as ticket vending machines. While it would have been useful to play along with this assumption and also incorporate the handling of tickets into the terminal, organizational issues (tickets are handled by the private train operators while the actual stations are handled by the Swedish Railroad Administration, and their information systems are not connected) made this impossible to achieve within the scope of the project. To overcome this issue, we sought ways of expressing the terminal’s purpose, e.g. by sketching different ways in which the ‘i’ (as in information) could be made more visible and legible. Third, we also sought to express as much as possible about the values and the brand identity with which the Swedish Railroad Administration would like to be associated, which in translation roughly equals confidence, reliability, quality, and durability.

**Inform Zone**

We envisioned the inform zone as where potential users get increasingly confident in that the device they are approaching will assist them with what they want to know. Typically, at this distance from the product, seeing users are able to read text on the device’s screen. It is also in this zone that most users, as a result of the form of the device, its graphics, and the way in which information is presented on the screen, actually realize that the terminal can accommodate a wide variety of users with very different needs. Through its size and shape, we also try to communicate its interactivity and invite users to it, i.e. that it is mainly intended for a single user who should feel invited to walk up to and start to interact with the device, and that it is the single user in front of the device that decides the turn of event from there. In this zone, we rather unsuccessfully experimented with various auditory greeting messages to invite and inform users of the services provided, triggered by physical presence in vicinity of the terminal. Our users reciprocally rejected these messages; both because of the design of the actual message, which was found to be too extensive and tedious, but also because of how it affected the larger use situation. Users might want to sneak up to the terminal, not showcase their actions to the whole surrounding.

As stated earlier, the main purpose of the project has been to make existing information available to a wide variety of users that for various reasons cannot get it from existing sources without turning to specialized design solutions for each user category. Still, the design team found it very difficult to be able to convey both the purpose and the ‘inclusiveness’ of the artifact on the attract level, which would have been advantageous. Thus, as the prototype currently stands, the attract level speaks of the product’s purpose, while users have to step into the inform zone to understand its inclusiveness in terms of audience. This resulted in a number of discussions between the design team and various disability organizations, where a potential solution may be that a launch of an information terminal like this would probably need to be complemented by an information campaign within these organizations where their members are made aware as to the existence of these terminals.
Interact Zone

When entering the interact zone, users should understand and feel invited to come close to, touch, start to interact, and explore the product. At this distance, we sought to make the terminal convey its own functionality to the user. When in front of the device’s, users should be able to comprehend that it can provide information about trains arriving and departing; messages; delays and cancellations; and how to get to a certain platform or other location of interest to the traveling user. Also, we wanted users should to understand that the device had the potential to provide this information in several modalities and that it supported a broad variety of users and a broad variety of assistive equipment. One of the basic product semantics issues we worked with at this level concerned expressing the functionality of the touch screen. How do you actually get users to realize they can interact directly with the screen, resorting neither to blunt messages (such as ‘This is a touch-screen, press me!’) nor to excessive screen real estate-eating emphasis on graphical interface expressions (such as giant bevels on buttons)?

The way we chose to approach this was simply to have the user interface reflect and respond to whatever the users were doing as if they would have interacted directly on the screen, irrespective of whether they did or not, thus indirectly affording direct interaction with the screen. The prototype featured a number of static soft keys on the lower part of the screen on to which see-through Braille was added (Figure 5), which also helped users realize the interactive potential of the screen. For various reasons however, our revised design suggestion (Figure 5) moves these buttons off the screen, which while improving their tactility for some users might in turn make the touch-ability of the screen less obvious. During the design phase, we also experimented with various kinds of animations in the user interface to elucidate its touch-ability as well as help users understand arrivals and departures. After several attempts however, we abandoned the idea of animations altogether, as they added nothing but confusion to our uses—especially those with cognitive disabilities.

4.2 Placing the Terminal in Context

When we tested the terminal in situ at Örebro train station, some interesting variations occurred as to how members of the new user group perceived the device compared to they way users from the original user group had perceived the device throughout the design phase. During the test, at an ‘attract’ distance of about 5 meters from the device, all users (which had never seen the terminal before) one at a time were asked how they perceived the device, for what they thought the device was there, and what they thought it could do for them. Several users interpreted the terminal as a ticket vending machine. Hence, when we placed the terminal in its intended environment, a train station, users began to ascribe new meaning to it, derived from the environment. To come to terms with these interpretations—and the fact that we for organizational reasons that were beyond the scope of this project could not allow it to also serve as a ticketing machine—we chose to reinforce the graphical expression of the device, i.e. add an overhead plate with an illustrative ‘i’ symbol as well as make some quite radical changes to the color scheme.

5. Conclusions

In this paper, an inclusive design project commissioned by the Swedish Railroad Administration with an objective to design and implement a prototype of a train information terminal providing accessible information to as wide an audience as possible, has been used as a case to shed light on issues of product semantics in
relation to inclusive design. We have argued that a deficient interest in product semantics, aesthetical expression, and form may further increase the stigmatization some users experience in society due to their impairment or age. In this project, drawing on the work of Krippendorff & Butter and Monö, we started to approach the issue of product semantics from what we see as three zones of user engagement; the *attract zone*, the distance from which the product makes itself known and from where it may be seen and identified for what it is within a particular environment; the *inform zone*, where potential users get increasingly confident in that the device they are approaching will assist them with what they want to achieve; the *interact zone*, where users feel invited to come close to, touch, start to interact, and explore the product. Several examples, lessons learned, and insights have been provided for each zone of engagement. In conclusion, we have also reinforced the notion that all products must be understood in their specific physical and social context, as when placed in its intended environment, a train station, users started to ascribe new meaning to the terminal, derived from the environment.

6. References


