Appliances for Whom? Considering Place.

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Abstract. We discuss homes as potential settings for the products of appliance design. We catalog the large international and regional differences. We look at differences in terms of infrastructure: heating, plumbing, electricity, and telephony. We examine differences in the home itself in terms of number of household members, and size of dwelling. We explore the implications of this variation for future ethnographies as well as product creation as we ask the question "appliances for whom?"

Keywords: domestic, appliances, culture, demographics, infrastructure

1. Introduction

As a community we strive to design the next generation of appliances. We come together from the United Kingdom, the United States, South Korea, Denmark, and other corners of the world, and yet there is very little discussion about these places and how they influence our design. When Rodden and Benford [12] talk about ubiquitous domestic environments they talk about *information appliances* similar to those discussed by Norman [9], *interactive household objects* where the interaction is incorporated into the form of the object, and finally *augmented furniture* where sensors inside the furniture itself detect actions. As all of these falls under the scope of appliances, we must consider the characteristics of the home into which our appliances are situated. Rodden and Benford speak to this as, "Although many technologies appear to be revolutionary in nature it is important that we realise that technology will need to find a place within our homes and that our homes will need to change to accommodate this technology" [12]. Just as Edwards and Grinter [4] confronted us with the need for appliances in ubiquitous domestic environments to be modular and therefore easy to integrate in existing housing stock, we must take stock of what it means to be a *home* throughout the world.

This paper is motivated in part by an earlier study of appliance use in England [10]. This study was led by an American who had worked in England for several years. When the author returned to the US and looked at American life with a new perspective it became apparent that this study of English appliance use had been written with the author's newly ingrained English cultural assumptions. As is so common in ethnography in our community, these cultural assumptions were not made clear. Thus this paper is motivated by a desire to make those cultural assumptions explicit [20], and encourage others to do the same. We as a community we already know we need to be sensitive to the details of domestic environments, looking at the cultural assumptions underling design is just a natural extension.

Consider the following example from the earlier study of how cultural assumptions can impact the usability of design [10]. A young couple living in Cambridge England had recently married. They were given a bread maker as a wedding gift. The purchaser had gone to considerable effort to import a bread-maker from the United States which they considered very high end. In the process of trying it out at the reception they managed to blow it up, due to electricity differences. They later converted the current for the replacement from the standard American 110v to the European 240v, as well as acquired an adapter for the cord. Having passed this obvious hurdle they still encountered additional problems in daily use of the appliance. The couple had a fairly typical home, with a kitchen addition. The kitchen was not centrally heated with the assumption being it would be adequately heated during the daytime because of the normal heat produced by the stove. Like many English homes the owners reduced the thermostat in the main house by several degrees at night. To make bread the owner places water and bread mix in the machine. The assumption is the water will stay 20-23ºC or roughly room temperature. Unfortunately, if it is too cold the chemical reaction with the yeast will not occur causing the bread not to rise. Consequently, our newlyweds could not use the timer on the bread-maker; the delay would allow the water to cool too much. Instead, the husband would steal downstairs in the middle of the night to start the bread-maker to allow his wife to wake to freshly baked bread. The makers of this bread-maker made design decision based on cultural assumptions about the infrastructure of the home.

Wireless networks and Roombas, a type of robotic vacuum cleaners, are both examples of cultural assumptions working their way into the design of appliances. Both were designed with assumptions about the average American house size, large freestanding homes (See Section 3.2 for a discussion of house size). In both cases we see this model break down if used in a higher density housing model. In the case of wireless, when in townhouses or apartments, your neighbors can see your network traffic. This presents a security problem. Roombas on the other hand work best cleaning one room at a time. The manufactures encourage you to close the doors to the room, and provide 'virtual walls' to allow you to segment space. This works well for the living room of a 3000 square foot home, but is inappropriate for a 700 square foot apartment. This suggests we as a community need to use ethnography to uncover how people in other locales are actually living and to make explicit our cultural assumptions, to allow us to be reflective about which to include in our technology designs.

We see this interaction between culture and use of space in Bell and Kaye's ethnographic work [1]. Our perception of space effects our interpretation of how it will be used for others. Bell gives three examples. First, when describing the notion of a *family room* to her Italian informants they remark, "don't they have kitchens in America?" Secondly, her work in Germany suggests a cultural proclivity to eat seasonally, summer in sunrooms and winter in front of the fire. Thirdly, a historical example of how in the United States Taylor's "The Principles of Scientific Management" made efficiency a virtue with kitchen designers like Gillbreth being significantly influenced to provide factory-like efficiency [13]. Each of these examples shows cultural factors influencing the use of space. Thus to design appliances we must understand the variation in domestic environments. These include differences in infrastructure; heating, plumbing, electricity, and telephony, as well as the number of inhabitants, and size of the home.

2. Understanding the Culture of the Home

In order to illustrate these differences we will use data from a number of government censuses, and international organizations like the UN, and the WHO. While international organizations provide a central repository their data is not always complete. The UN survey, for instance, is missing Australia and most of

Africa, and the data for many other countries is incomplete [21]. For our comparison of infrastructure, average number of inhabitants and home size we will include countries who participated in last year's Appliance Design. whenever possible, as a benchmark. Countries from South America, Asia, and the Middle East will be included as well to give a better sense of global variation. These countries are not assumed to be representative of their region, but rather intended to give an indication of global diversity.

3.1 Infrastructure and Appliances

Infrastructure differs by country. We will examine infrastructure differences focusing on heating, plumbing, electricity and telephony. Infrastructure is not ubiquitous even in prosperous wealthy countries. We will compare and contrast the US and the UK to illustrate this point. Finally, we will discuss the relationship between infrastructure and culture.

Consider the plumbing and the heating systems in the US and the UK which are far from identical. We will consider the differences in what is considered an acceptable quality of service, and then discuss variations in the ubiquity of these services. With regards to quality of service, many Americans have come to expect homes with a thermostat to heat air day and night to a constant 72ºF and hot water even in the dead of night. This is not the case for the UK. Often in the UK there is a thermostat that allows the user to program up to three periods a day for heat to turn on and off and the temperature for each of these periods. Each day of the week can be set up independently. These parameters can be set independently for heat and water. Because of the complexity of these devices they are set up by plumbers. Water pressure is often generated from gravity as the water goes down pipes from a tank in the attic, or by a "powered shower" a pump that increases the water pressure. Legislation from the days of exploding water-boilers limits the installation of "mixer taps" (the taps which mix hot and cold water instead of two separate faucets). In both the US and the UK we still see portions of the population without access to these facilities. Ten percent of the Great Britain lacks either one or both of central heating and sole use of bath/shower and toilet [14][1]. This ranges up to 27% of

1 Comparable statistics are not included in the US census, as it breaks heating us down by fuel type rather than central heat or room-by-room heating. 96.89% of the US heat their home with

homes in Liverpool lack central heating [15]. In United States the figure of homes that lack complete plumbing is 0.4% [22], and 0.5% of homes in England & Wales do not have exclusive access use of a bath and shower [19] (there is considerable regional variety ranging from 0.1% in Castle Morpeth to 2.6% in Camden [16]). The situation is considerably more variable throughout the rest of the world. The World Health Organization's report on Asia shows 80.9% of the population has access to safe drinking water with 48.4% of the population having a connection to the house [23]. 69.8% of the population has access to sanitation services, 42.7% of which have a house connection to sewer/septic system. For the remainder access to these services often means going to public facilities or doing without. Our point here is to underline the variation of heating and plumbing infrastructure even in prosperous Western countries, and that this variability is more significant globally.

Electricity and teledensity are two more dimensions of variability. Neither the US nor the UK census' include electricity in the list of more modern amenities like phone or internet, suggesting their ubiquity. Yet, the imperfections of technology grids, means reliable electricity is possible for only 90% of the population in urban Asia, and 70% of rural populations [6]. Fixed line teledensity is another access of concern. While in the US fixed line telephones are prolific reaching a density of 96.6% [22], where as the teledensity of South Asia, which comprises Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka is only 3.2% of the population [7]. Often we hear fixed line teledensity is compensated for by mobiles, but here the mobile phones are owned only 0.63% of the population (the reach may extend further as there is some evidence that phones are shared by a village or family). This makes the degree of "always on" connectivity that many of us have come to expect in the West is not feasible. Additionally, such infrastructure as exists in some parts of the world is prone to fail due to poor maintenance and age of the equipment, and climatic factors like Monsoons have significant impact on the long-term availability of whatever infrastructure may be available today.

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utility gas, bottled, tank or LP gas, electricity, or some sort of fuel oil, with .84 not heating their homes (and therefore not having central heat) [22]. 70% of these are western states. Of the remainder 61% of Hawaii is additionally unheated [3].

The problem is more than just about infrastructure. Bell's work discusses how households in Asia adapt to intermittent electricity [2]. In the UK plumbers are often called in to program thermostats removing the technological burden from the user. In the US heat and water temperatures are controlled by the end user consistent with the American priority for autonomy. One could characterize the infrastructure differences in the US and UK in terms of cultural attitudes towards energy, and paint them in terms of environmental protection, consumerism, or a value for thrift in the UK which comes from World War II rationing extending into the mid 1950s. All of this suggests the interdependence between culture and infrastructure which we must continue to address as we distribute our domestic technologies and publishing to a global audience.

3.2 Average House Size & Occupants

Considerable variation exists in both overall size of the home, and the number of inhabitants. The Statistics Division of the UN tracks these factors in many countries in their Compendium on Human Settlements Statistics 2001 [21]. We see the average number of people per housing unit range from, for instance, 2.1 in Sweden to 6.7 in the Syrian Arab Republic [21]. This is indicative of considerable global diversity of family size and structure. The smaller average house size in the US and the UK has been attributed to the rise of single occupant homes [5, 17]. Of course, these home sizes are only averages and considerable variation exists within countries. The England & Welsh average, for instance, is 2.4 people per home ranging from 1.58 in London to 2.64 in Newham [19]. This suggests we need to be sensitive to differences in household size both on a country level, and on a city or town basis.

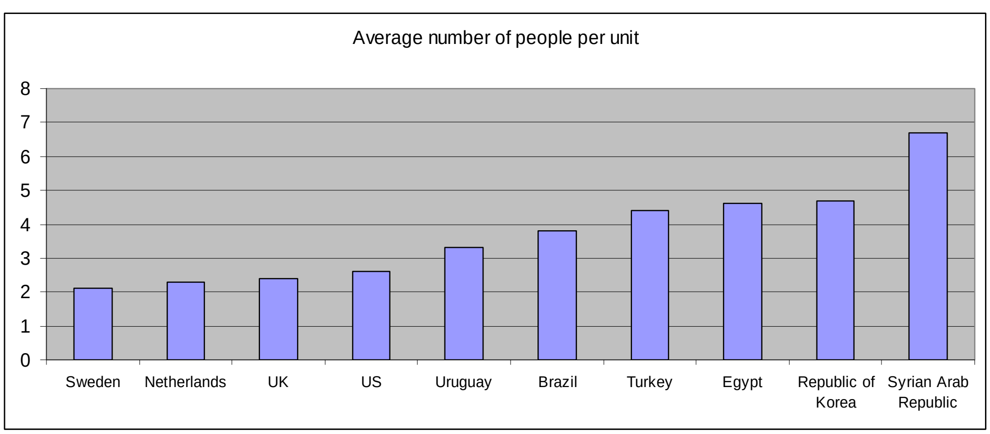

Figure 1. Average number of people per dwelling [21]. (This represents a selection of the countries for which the UN keeps statistics.)

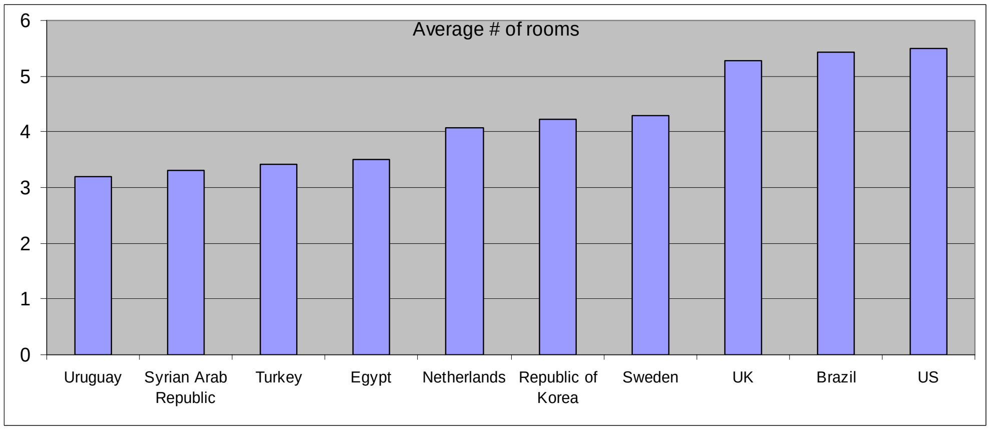

Figure 2. Average number of rooms per dwelling [21].

At the same time as we see considerable variation in terms of number of *rooms* per house. The UN for this study defines a *room* as a space of at least four square meters (e.g. big enough for a bed) with a roof or ceiling of at least two meters height. These numbers do not include bathrooms, passageways or verandas. The average number of *rooms* per home ranges from 5.5 in the USA to 3.1 in Uruguay. Home size is composed of two factors number of rooms and size per room. The UN numbers only takes into account number of rooms. Variation exists in room size as well. Not only do houses in the US have more rooms they have more space in each individual room, "The average usable floor area for all dwellings in England in 1996 was 85 square metres, which was virtually the same as for France (85 square metres) and Germany (86 square metres), but only half that of the USA (152 square metres)." [17]. We must be cognizant of this considerable variation in home size both in terms of room number and size in our designs.

The combination of housing size and family size leads to significant differences in housing density. Western countries like the US, UK and Sweden having an average of only a half a person per room, a factor of four lower than the Syrian Arab Republic. Person density has huge impact on the multitasking of space, and traffic which impacts appliance usage. This combined variation in the number of members in the household, the number of rooms, the density of people per room, and the average size of rooms will remain a significant challenge for our community.

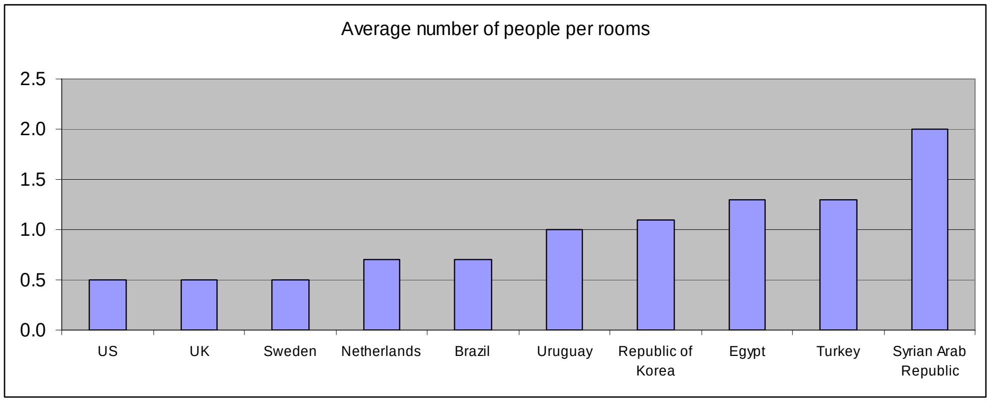

Figure 3. Average number of people per room. (This is a weighed average calculated based on UN raw data of number of households in each country with a particular number of rooms. The survey categorizes eight rooms or more together, with the exception of Egypt where they bin rooms with five or more. This maximum room number is used in the weighed average, thus the figures can only be considered descriptive of general trends.) [21].

6. Conclusion

We have attempted to set appliances amongst their context of use. We acknowledge the differences infrastructure. We have established that while houses in the US and Europe might have the same number of rooms they are of tremendously different sizes. We have examined the differences in household structure, as well as number of rooms. The questions are “where do we go from here”, and “for whom are we designing”.

We as a community have acknowledged the importance of being sensitive to the details of domestic environments by fitting our technologies into existing homes. This paper proposes an extension of this, rather than looking at homes in general, we should look more carefully at the culturally specific features of the home. This requires more cross-cultural ethnography to uncover how people in other locales are actually living which may help us from unintentionally including cultural assumptions in our designs. We should include statistical data on infrastructure, family structure and house size when publishing our work to make our data more understandable and transferable to other members of the Appliance Design community. However, we need to extend beyond mere statistics to understand the cultural, physical and social assumptions which we encode into the appliances. As homes are often the locale for appliance use we must engage them as a cultural construct, and look at the difference in answers to the question “what is a home" in terms of the people and activities that may be found there. This is important because we are designing appliances which will be integrated into homes around the world. Homes are not offices, and we can not assume their differences will wash away in favor of progress and efficiency. Cultural differences are critical to designing for domestic spaces, and we do have a tendency as a community to design for large, loosely populated, wealthy homes with stable infrastructure. By acknowledging this we open new avenues for research. The challenge of appliance design is broader than the task we have set out for ourselves. More mundanely, better understanding the locations for which we are designing and making our cultural assumptions explicit might just help insure that waking up in the middle of the night to bake bread is a thing of the past.

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