

The fine art of surfacing: practices of use at the tabletop

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ABSTRACT

We present an examination of how horizontal surfaces are made use of in homes and offices, contrasting this with the implicit design assumptions underlying tabletop computing. We present our findings on their conflicting demands between availability and use, issues of orientation, embodied material and their social embeddedness, and consider theoretical and design implications.

1. INTRODUCTION

"In treating this commonplace phenomenon as the problematic achievement of members, we hope to build towards a greater understanding of social phenomena as on-going, situated accomplishments. It is, after all, these methodic practices that make the phenomena [...] so utterly unnoteworthy at first glance to both lay and professional social analysts alike; indeed it is through these methodic practices that the commonplace presents itself as ordinary, and the exotic as extraordinary." ([7], p.265).

With this stance in mind, we turn to surfaces as sites of methodic practices. Surfaces are a much discussed, but little empirically examined resource for action. Tables, desks, shelves and other horizontal surfaces offer resources for social, organisational and individual activity that we routinely encounter and use on an everyday basis. Yet (and possibly because of their seemingly unproblematic use) their purposes, informational structures, practices of use and roles in social and organisational action are hardly touched upon in the academic literature, other than in passing whilst discussing some other topic of analytic interest. This lack of concern is perhaps surprising, given the role of surfaces in the development of the desktop metaphor in the graphical UI. This topic has recently become more topical with developments in surface computing and tabletop displays, which in a circular and rather paradoxical turn, extend the (vertical, virtual) PC desktop to the (horizontal, mixed media) surface computing environment. All this with little attention to the practical use of surfaces in everyday action. Further to this, a great deal of the academic research that relates to the use of surfaces lies in the area of personal information management, yet our experience of tables, desks and other mundane surfaces is that they are used for a larger range of activities other than *merely* information management tasks. In practice, surfaces are utilised in many other activities other than those related to their informational role, and the material properties of the objects and the surfaces on which they sit, and the broader contexts of use within which the surface objects and the surfaces themselves are set appear to have an important role in their use.

The lack of a detailed, wide-ranging and empirically founded examination of horizontal surface use, in concert with its applied importance in technology development has led us to our own studies of this most mundane of technologies. If we are to inform the design of tabletop-based computing systems, we need to know more about the use of surfaces, leading to our research question: *how are horizontal surfaces used?* We present a study of surface

use in offices and homes, paying particular attention to the role of surfaces within their physical environment (i.e. their place, e.g. at a doorway or in a thoroughfare), how the use of surfaces differs between social settings (e.g. in homes or offices), what is placed on surfaces, and the reasons for this.

2. RELATED LITERATURE

Research on the use of horizontal surfaces lies at the intersection of two extensively examined research areas within the literature: personal information management and ethnographic studies on homes and offices. The attention towards surfaces in these fields stem from two important questions: 1) how information embodied in artefacts such as paper is organized, classified or managed, and 2) how different locations in space—such as walls, fridge doors and kitchen tables—are used for communication.

As the prevalent physical form for carrying information, *paper* has gained a good deal of research attention. People tend to gather papers in *piles* that often represent loosely configured, *ad hoc* categories of information. This is in contrast to another, more structured forms of organization based on *filing*. It appears that piles are more common because they do not require the cognitive effort of classification decisions, and the physical effort of fetching a folder, finding the right place for the paper, and putting the folder away. Given that paperwork can be hard to categorise, surfaces often tend to get cluttered with piles and free-roaming papers that stays there [4]. This preference to use paper and organize it by piling seems to be a solid phenomenon [8], and therefore piling and clutter should not only be considered as a sign of disorganized work. Some attempts have even been made to translate the pile metaphor to computer interfaces [5]. By their visibility, the papers that make up clutter serve an important function of *reminding* a person of pending tasks [3,4]. In fact, many papers are left lying around with the very purpose of reminding. This holds for objects other than paper; for instance, in order to remember to take out the garbage, a bag may be left at a doorway in a visible place. More examples of such possibilities for offloading cognitive effort into the environment can be found in the literature of distributed cognition [2].

The second question – how surfaces facilitate communication – has been addressed in a number of ethnographic studies at work (e.g. [6]) and at home. For example, in a domestic context, some locations can hold *coordinate displays* [1] for communication between family members. These include kitchen tables and places in living rooms where people often sit, with dedicated notice boards and doors. ‘Pending piles’ tend to form in these locations. These are not necessarily the places where media such as papers are produced or consumed, or where they accumulate if not used at all: there can be different locations for each, creating patterned routes of traffic for objects at homes (ibid).

Taken together, there is a considerable research emphasis on the role of paper, arising from an underlying interest in information and communication, but not on the use of the surface as a resource

for that set of actions. As a prominent resource for supporting paper and objects, and making them accessible, surfaces would seem to deserve closer examination. In the following sections, we make an attempt to fill this gap, drawing from our own studies in both domestic and office spaces.

3. METHOD AND APPROACH

The authors undertook 10 home and 7 office visits, involving interviews and ‘guided tours’ of these spaces. Interviews at the homes lasted between forty minutes to an hour with each family member, and in offices, around half an hour. In all cases the surfaces were photographed. The home participants ranged from single people, couples, families with different aged children, and across a wide selection of ethnicities and backgrounds. They showed each room in their house, explaining the use of surfaces, and kept a photographic diary of material changes over the course of a week. In a second study of office participants, all worked at Brunel University, ranging across academic fields, from administrators to lecturers. They were asked to show and describe the materials on the surfaces and inside their desk drawers or filing cabinets. All interviews were recorded and transcribed.

4. FINDINGS

4.1 Conflicting demands: availability vs. use

Household members and office workers routinely use surfaces - tables, desks, floors and other horizontal planes - to manage and organise the material of their everyday existence. This has a tendency to cause conflicts in the use of surfaces in that they often serve a dual purpose, catering for long-term activities that require relatively persistent spatial arrangements (e.g. for retrieval or categorisation) but are also usually simultaneous active use (e.g. needing to be clear for meetings or writing), with neither purpose usually consistent with the other. This presents a practical management problem for users who require physical space for these different (although sometimes interrelated) activities. To reconcile this conflict, the participants seem to make deliberate choices about how they structure their use of their surfaces, as can be seen in fig 1. Here, the participant has separated her office space into multiple active working areas and makes clear differentiations between these areas (in this case, between the computer keyboard and desk edge): “*This is a pile of stuff to do[...] that I was looking through[...]]. Then when I come in the morning I kind of know, OK, I still got these things to go now*”. Other users (and some surfaces) have less formalised practices, with material being shifted around as surface space is needed.

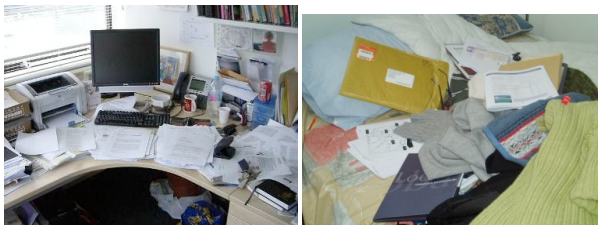


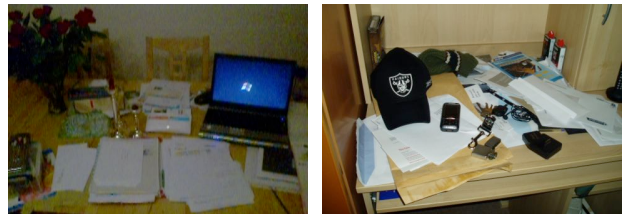
Fig 1. Separated activity spaces. Fig 2. Spare bed as a surface

Interestingly, the space typically required for active use seems to be relatively small compared to the total area on the surfaces. We observed that where material accumulates, people tend to wait until a certain threshold of inconvenience is reached, after which the accumulated material is sorted out: for example, one of the participants piled all incoming material into the house on her

spare bed (see fig. 2), and only tidied it when it was needed for guests. Thus, rather than sort material out as it arrives, people seem to prefer to deal with ‘tidying’ as a separate task in itself. Notably, participants did not term these tasks as categorisation or organisation, but tended to refer to the term ‘tidying’, which denotes reference to the *material* of the surface rather than *structural* re-organisation (i.e. by content). One of the reasons that seems to cause these conflicts in desktop estate use is the huge amount of ephemera that accumulates around both the home and office. It is not that this material cannot be stored efficiently, as most people have storage spaces, but that these storage spaces are inappropriately configured for the sorts of material configurations or media that require storage and retrieval. Indeed, different forms of surface piling tend to offer the same properties for classification and retrieval as more formal methods of storage and archival, at the same time as requiring little effort to create and manage. This “perceived effort : value” ratio may also be important, as poor or sub-optimal archival (in a relative sense relating to space use and item retrieval) on surfaces may suit the needs of people as a strategy better than an ongoing process of formally categorising and finding off-surface sites for storage.

4.2 Orientation and access

The majority of objects on the surfaces observed in the data have been designed to have a natural orientation (consider for example printouts, computer peripherals, appliance controls and displays, books and CD covers, e.g. fig. 3), and these are hard to use and view if they are oriented inappropriately. In practice, many surfaces are pushed up against walls (e.g. fig. 4) and are otherwise inaccessible from all but one side, or are oriented towards something (e.g. TV or computer), so that people sit facing one direction. In social spaces, people may also not wish to occlude the gaze of others (e.g. watching the TV). In other cases their orientation and layout is determined by physical wires and cabling: “*I would like I put the table this way, but unfortunately because of the internet connection, this is impossible.*”



Figures 3 and 4. Oriented surfaces and objects

What these observations illustrate is how material artefacts have a relative configuration to their physical contexts of use (i.e. where they are positioned in relation to other objects) and to the broader set of activities (i.e. the other activities that are being carried out alongside their use) that they occur within. This applies on two levels: on the level of placement and use of furniture in rooms, and on the level of things that have been placed on these surfaces.

Thus, we should not see information on surfaces or the surfaces themselves as things that sit independently on their own ‘outside’ of the space, but which are part of a rich set of activities and other physical things. When seen in this light, we observe that people are oriented to surfaces by the ways that they position themselves in relation to their spatial contexts (be this towards the TV, towards other people, or towards the accessible side of a table pushed against a wall, e.g. fig. 4). A few surfaces were observed that had multiple access points (e.g. dining and meeting tables),

but these were usually for particular purposes, such as supporting face to face interaction. So we do not normally seem to have many surfaces that we approach from no side in particular. This might sound obvious, but it has consequences that contrast against the model of tabletop interfaces, which are usually explicitly designed to support simultaneous, multi-user access from different sides. Yet even the marketing literature for these technologies seems to suggest that this is unlikely (see fig. 7 for a typical example), as can be seen in the way that the users pictured are oriented to the surface from a near identical position.

4.3 The ‘stuff’ of surfaces

In almost all instances observed, both in the domestic and office settings, surfaces supported a great deal and variety of ‘stuff’. Although it is not our intention to provide a taxonomy of these objects, it may be helpful to think about the range of materials seen. These include what we have called nomadic (pens, mugs, mobile telephones, paper) and immovable (e.g. hi-fi, monitors, desk lights) objects, things kept because they might have value in the future (e.g. books, vouchers, tickets), material that belongs to other people and cannot subsequently be moved or discarded, material in transit elsewhere (e.g. for later filing), and material waiting to be thrown away. Similarly, the form of organisation of the materials (where indeed it was organised) was also interesting, because it reflected both the material properties of the objects as well as the more prosaic relationships between things. Thus the different sizes and shapes of materials permitted stacking in ways to separate and identify conceptually different content without obscuring each other. For example, we saw a Tower of Hanoi effect, in which piles of smaller objects sat on top of larger ones; zigzag piles, in which, typically paperwork, is placed at right angles to one another, and even ‘pillar/beam’ stacks (e.g. books stacked vertically on bookshelves, with other items stacked horizontally on top of these books). What this brings us to is that the material properties of what is present on the surfaces (the ‘thing-ness’ of stuff) is important in how that material is used, making it visible and accessible. It is not just the information on these surfaces, but their physical embodiment that allows them to be placed, interpreted and used in particular and meaningful ways.

It takes no great analyst to observe that surfaces are covered with real things, not just information, and that these have unique physical forms and may have encultured practices of use. Thus surfaces have a hybrid function, in organising as well as simply supporting things. Both of these properties are highly interrelated, as people make creatively use of physical properties in organising information. We therefore see books appropriated as separators between piles of paper and objects such as flat-topped or sided external computer peripherals being used as separators (see fig 5 below), allowing different forms of categorisation to be made. In this we can see that the objects on the surfaces themselves become surfaces: the microwave in fig 6 illustrates this by providing a place for a collection of small objects and papers.

Following the discussions of the material of piling, there is a quality of ‘top-ness’ to piles or objects such as the microwave, allowing them to act as peculiarly notable surfaces in their own right. Thus, items such as mobile telephones, remote controls, or diaries are routinely placed on top of such piles, despite their bearing no relation to the content of that pile, but through which they become more visible and easily accessible by their placement. The limit on the height of a pile rarely appears to be the lack of suitable, similarly related materials to the content of a



fig. 5. Vertical/horizontal separation.



fig. 6. Surface on surface.

pile (we have seen that piles commonly contain mixed categorisations), but tends to be more to do with their stability—at some point piles become unbalanced and are likely to topple. This instability, of course, depends on the care of stacking and the media stacked. This point brings to light one of the major problems in surface use, that wires and tilted or curved computer hardware make large areas of many domestic and office surfaces unsuitable for practical use. These objects are in many cases hard, or impractical to move, and provide physical limitations on what a surface can be used for. Other surfaces present related problems, for example, kitchen surfaces are frequently wet, and cannot usually be used to support paperwork. Yet even here in these damp conditions, we have seen kitchen surfaces used in paper piling where waterproof or disposable materials, such as plastic bags, can be enrolled. What we are pointing to here, again, is that the material qualities of the objects on the surface are important in their use, and that their informational function is not the only analytically interesting feature of investigation.

4.4 Social surfaces

Most of us do not live and work in a social vacuum. Often, we do not have (complete) ownership of places, which may be used for and by multiple people. Our use of surfaces reflects this, in our eating and working arrangements, in the ways that we structure them and exhibit ownership, and in the ways that we attenuate our own needs to accommodate those of others. In the homes that we visited, many of the surfaces were in shared areas, although it was often clear from the data that these areas were managed by someone (usually the mother) who sorted and tidied them. In the office, social surfaces formed two distinct categories, in terms of desk spaces that were physically shared with other people in open plan areas, and in individually ‘owned’ areas that were used for social activities, such as meeting tables. In all of these social areas, the pattern of use was typically to keep these areas relatively clear of clutter, although some objects were present, due to their being useful (e.g. lamps), or difficult to relocate (e.g. IT equipment). Where other materials were present on these surfaces, these were usually there on a temporary basis. Of course, having clear surfaces for social interaction also makes them available for individual work when a differentiated space is sought: *“Like, this is a table where I do my stuff. Then I would go to this side of room to have my meetings. Sometimes I sit over there when I need to read something.... It was a quiet area for me to work, and also a social space”*. Clearly, these surfaces are not purely areas for undertaking social interaction, but their social role has an impact on the broader uses to which they can be put.

In addition to their role in co-present interaction, the materials on surfaces can greatly constrain the uses to which they can be put. For example, doing the annual tax returns on the dining room table makes that shared resource hard to use by others, who would have to move these (clearly organised, yet visibly fragile) materials to make use of the tabletop as a surface. But the home is

not the only place that we have seen this, and several people had material on surfaces that belonged to other people, either because they were looking after it, or it had been temporarily left there. As in the home, this can effectively make these surfaces hard to actively use as surfaces because of the social obligations *not* to disrupt or disturb the organisation of the materials on them.

As has been noted elsewhere in the literature, surfaces are also used as resources for sharing information and things. However, this can also have an impact on what else can be put onto these surfaces; important material for the attention of others could easily be lost in a mass of other material competing for the intended recipient's attention. Where such surfaces are in use by multiple people for the same purpose, these surfaces are recognised as requiring more formal methods of organisation (e.g. labelling, or co-articulated patterning), so that particular areas or patterns of organisation are understood to be used in particular ways or for particular things. This is often harder to manage in the home than in office spaces where work is often well articulated in processes and responsibilities are more clear-cut between colleagues. At home, such responsibilities are likely to be less well defined and change dynamically over time, with a vast diversity of activities requiring collective action.

5. DISCUSSION

The data in this paper articulate and problematise some of the truly ordinary methodic practices through which we go about using surfaces. While these practices cannot tell us about how future surface technologies will be used, they do provide insights into the ways in which the properties of surfaces are utilised and made useful. Such a comparison between non-interactive and digital surfaces can be justified due to their similar physical affordances and competition for the same physical space in our everyday homes and offices, and it is therefore likely that digital surfaces will be used as ordinary surfaces in the precisely the kinds ways described above.

Taking current tabletop surfaces and MS Surface as instances of surface computing environments, we can immediately see potential problems arising through their deployment in the contexts described, and how we might begin to better support their design. The data illustrate how surfaces are not always available for interaction, and can get extremely cluttered. Surfaces afford supporting materials for a variety of reasons, and they can become cluttered either for short periods of time (e.g. dining tables appropriated for temporary use), or becoming sites of almost archaeological concern. Our evidence suggests that people rarely neatly sort, categorize or tidy the materials on their surfaces, and objects may remain in place for a host of useful reasons. It would also appear that clutter is not always detrimental to the retrieval and use of these objects. Contrast the images of surfaces in the rest of the paper with the vision of the digitally augmented surface seen in fig. 7. The space shown is not in any way representative of the places that we have observed. Clutter, then, should perhaps be accepted as a part of 'normal' practice. However, while digital surfaces can be used both for manipulating digital information or for supporting physical objects, in doing so, this tends to make them (or at least, parts of them) unusable for other forms of use. There is a design-relevant point here: a digitally enhanced table should understand what parts of it are occluded, and either not use them, or indicate that these objects need to be moved to access part of the digital system, for example, by highlighting the edges of the occluding objects.



Figure 7. An idealised interaction

A similar point can be made about the places that surfaces (and particularly, tables) can be placed: the form of the spaces that are available and the settings that surfaces are placed within can greatly constrain the angles that people are able to approach or use the surfaces from. Even the contrived image seen in fig. 7 shows the participants sitting side by side and orienting their gaze to the same angle suggests why such 'any angle' access might be an unusual state of surface use. The ideal of approaching a digital surface from any side is therefore unlikely to be a practical proposition for many users. A table that was aware of where users approach it from and which parts of it were inaccessible (perhaps through proximity sensors) might enable the interface elements to be more appropriately oriented.

Several other issues for discussion have also arisen from our own thinking around this paper, including the following:

- How do people 'make ordinary' the tabletop computers in their homes and offices to mesh with their existing practices and their local physical and social arrangements? How might a tabletop computer intrude on routine practices at home or at the office?
- What is it about the 'technology' that makes the phenomena of mundane digital technology interesting? Studies on simple, minimalist non-digital technologies (pens, tables etc.) are also able to reveal practices that play a fundamental role on understanding the ecologies of domestic and work life.
- There is a general question of examining mundane technologies: when does this become merely dull? Is everything mundane topically 'interesting'? What is the theoretical value and motivation that most matters when researching mundane technologies and their use?

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