

Using F-formations to Analyse Spatial Patterns of Interaction in Physical Environments

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ABSTRACT

There are few conceptual tools available to analyse physical spaces in terms of their support for social interactions and their potential for technological augmentation. In this paper, we describe how we used Adam Kendon's characterisation of the F-formation system of spatial organisation as a conceptual lens to analyse the social interactions between visitors and staff in a tourist information centre. We describe how the physical structures in the space encouraged and discouraged particular kinds of interactions and discuss how F-formations might be used to think about augmenting physical spaces.

Author Keywords

F-formation, spatial configuration, embodied facilitation

ACM Classification Keywords

H5.m. Information interfaces and presentation (e.g., HCI):
Miscellaneous.

General Terms

Human Factors

INTRODUCTION

A common approach to designing technologies for distributed collaboration is to draw implications from studies of co-located conversational interaction. A focus is on analysing what gaps the technologically-mediated system can fill or what subtle embodied processes the technological intervention will disrupt. This approach has been successfully used to examine why computer-mediated technologies, such as video-conferencing, can never really be equivalent to face-to-face situations (e.g., [7]). Alternatively, Hollan and Stornetta [10] in their influential paper *Beyond Being There*, argue that instead of treating face-to-face communication as a gold standard to be emulated, we should be developing new technologies that provide people with added value that is not possible in the

face-to-face situation. We suggest, that it is possible to take this argument one step further: namely, designing transformative technologies to support *co-located* interactions rather than only using face-to-face findings as a baseline by which to inform remote interactions (cf. [29]). Far from being a simple gold-standard, physical environments can limit and constrain opportunities for some shared activities, while encouraging others.

There is therefore an increasing need for more detailed analyses of face-to-face settings *per se* as ubiquitous computing technologies start to be introduced into real world contexts, such as homes, schools, offices and hospitals. We need to ask how they can transform particular physical environments - not just to support - but also extend existing conversational and other social practices. We know both anecdotally [6] and from architectural theories such as Space Syntax [9] that the organisation of space can generate and structure the activities of those who inhabit it. This is not to suggest that space determines behaviour, but rather that there is an interaction between spatial structures and the kinds of social activities enacted within them.

However, we have limited conceptual tools for thinking about how the physical aspects of a setting influence interactions between people. One promising framework is Adam Kendon's [15, 16] F-formation system of spatial organisation. F-formations are the spatial patterns formed during face-to-face interactions between two or more people. An under explored factor is what role the spatial environment plays in constraining social interactions. In this paper we show how F-formations or their absence can be used to explore the influence of the physical environment on co-located interactions and how this might feed into the design of a shared technology where the aim was to transform them.

To begin we describe the F-formation system. We then describe an ethnographic study of visitors and staff who congregated, talked and moved inside a tourist information centre in Cambridge, UK. A main finding was that focussed discussions between more than two individuals were actually quite uncommon. We suggest why this was the case by analysing patterns of face-to-face interaction. Finally, we discuss the implications of this analysis for the design of transformative technologies for face-to-face physical settings.

BACKGROUND

F-formations in social interaction

In *Conducting Interaction*, Kendon [15] describes an individual as having a space called a *transactional segment* into which they typically direct their attention and manipulate objects. The size of this space can vary depending upon the activity in which they are engaged, e.g., watching television versus using an ATM. The transactional segment of an individual is defined in relationship to their lower body. Thus by turning their head or shoulders, they can direct their gaze out of it. An *F-formation* (or *facing formation* [18]) is formed whenever two or more people arrange themselves such that their transactional segments overlap, creating a joint transactional space termed an *o-space* to which they have equal and exclusive access (see Figure 1). The area occupied by the participants themselves is termed the *p-space* and the area outside the F-formation is referred to as the *r-space*. Kendon notes that while the r-space is not directly used by the participants in the F-formation, it is monitored by them and it is where someone who wishes to join the grouping will approach, until the formation reconfigures to include them. The term *F-formation system* refers to the co-operative spatial and postural behaviours by which people create and maintain this *o-space*, for example, by increasing the distance between participants and stepping to the side to provide an opportunity for another person to join the formation.

Based on a series of detailed video-analytic studies of social interactions, Kendon describes different spatial patterns that can constitute an F-formation (see Figure 2), including the *circular arrangement* shown in Figure 1, which is common to free-standing groups of three or more, who might also form, *rectangular*, *semi-circular* or *linear* arrangements; the *vis-a-vis* arrangement formed by two individuals facing each other; the *L-arrangement*, where two individuals stand facing perpendicularly to each other as if standing on the two edges of the letter 'L'; and the *side-by-side* arrangement where two participants stand close together facing in the same direction. The type of F-formation configuration taken up can be influenced by environmental features, such as standing next to a wall or path, but the details of how environmental features influence spatial patterns of interaction have not been studied in depth [15, 16].

F-formations are already known to researchers in CSCW, having been discussed in relation to distributed technologies such as virtual environments (e.g., [17]) and video conferencing (e.g., [31]). However, for the purposes of this paper, studies that have used F-formations in the analysis of co-located interactions by people around technology are more pertinent. In their analysis of how children build physical programs with the AlgoBlock system, Suzuki and Kato [30] described how periods of collaborative working were negotiated by children through

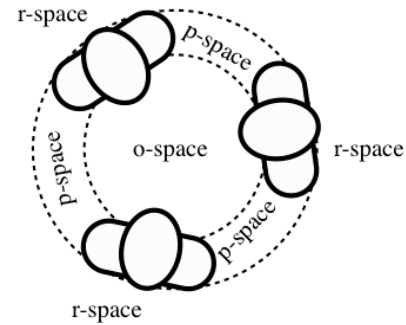


Figure 1: a circular three person F-formation. An o-space is formed by their overlapping transactional segments

standing up and bringing their transactional segments into alignment, whereas when they wished to watch the consequences of running a programme, they would turn away from each other and sit down facing the screen. Hornecker [11] has been influenced by Kendon and by Suzuki and Kato in developing her concept of *embodied constraints*, which suggests that people can be encouraged to collaborate or not through material, hardware and software constraints and affordances. However, the details of what these constraints and affordances might be in particular situations remains to be worked out.

Morrison and colleagues [21] have carried out perhaps the most empirically-grounded study of the impact of a technological intervention on the structure of F-formations in their comparison of hospital ward rounds carried out before and after the introduction of electronic patient records. They describe how the diminished visibility of the electronic records on a small screen, compared with paper, impacted both the ability of consultants to lead discussion and of other medical staff to participate in the conversation.

Space and social interaction around technology

With the growth of research on ubiquitous computing has come about an increase in studies of how technologies influence social interactions in real-world physical contexts. From studies in contexts such as museums, a rich descriptive picture is emerging of how people find out how to use technologies by watching those nearby and create engagement and participation through performative

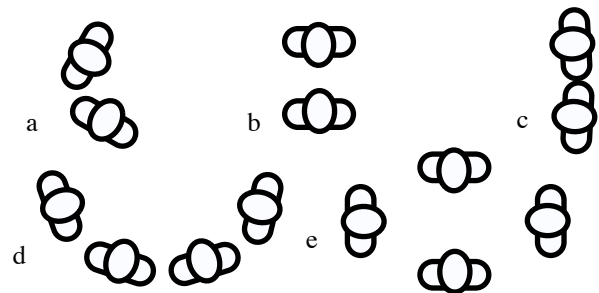


Figure 2: some different F-formation configurations. a. L-arrangement; b. face-to-face; c. side-by-side; d. semi-circular; e. rectangular

interaction [19], but also how the current generation of museum interactives has tended to prioritise constrained interactions and individual use [8].

Detailed analyses are beginning to emerge of how people interact around particular shareable technologies in public spaces, such as interactive walls [14, 25] and multitouch tabletops [4, 12]. However, these have tended to focus on interactions between people and with the technology, but not on the mediating role of material context. An exception, is O'Hara [23] who describes some of the unintended social consequences of when people unintentionally interacted with an interactive surface in a cafe.

Brignull and Rogers [1] noted how physical aspects of the environment could influence the likelihood of people engaging with a large display at an event in a public space. They suggest for example, placing a display in a location with a constant flow of people. They also discuss how other people can create social affordances within a space: the so called 'honey pot' effect. Rodden et al. [26] carried out an analysis of interactions in a travel agency, highlighting that the monitor placed between sales staff and customers created a barrier to successful interaction. Hornecker has described how interactive museum exhibits can index into the surrounding context [13].

More recently, Scupelli and colleagues [27] have analysed some of the architectural and interior design factors that lead to the success or failure of large information displays and whiteboards for co-ordination in hospitals. They suggest that successful locations, which they term *information hotspots*, comprise a number of features, including (architectural) connectivity, space adjacency and visibility. On a still larger scale, O'Hara and colleagues [24] have detailed how the location of a large urban screen multiplayer game can have an influence on both the experience of playing the game and on the everyday behaviours that happen in the space.

While work on the role of space in mediating social interactions around interactive technologies is emerging, we still have few conceptual tools with which to analyse the social affordances of a space prior to an intervention.

TOURIST INFORMATION CENTRE STUDY

Prior work on technologies for tourism

Previous research into developing technologies for tourism has focussed largely on providing visitors with mobile and augmented reality applications that can be used whilst visiting sites, such as recommenders and guides (e.g., [2, 3, 5, 22]). The ethnographic research that has gone inside tourist information centres has focussed on the interactions between staff and customers in terms of the mechanisms employed in queuing and working across the counter (e.g., [2]) as well as the importance of paper representations, which can be annotated, re-orientated and shared [2, 22]. In contrast, our primary focus is on the interactions that occur

between pairs and groups of customers as they find and share information and then plan their activities in the surrounding city, including those face-to-face situations where groups of visitor interacted with counter staff. The original aim of our research was to document the practices through which visitors planned a day out together and any problems they might face. We hoped to scope out the potential of the space for augmentation with shareable technologies that might provide added value to existing practices.

Method

We followed a rapid ethnography approach [20] spending five days at the tourist information centre in Cambridge. Due to concerns from staff at the centre about the privacy of visitors entering the space, we were unable to negotiate permission to capture either video or still images. Therefore, more traditional ethnographic methods were used. Observational field notes were taken, including simple sketches showing the relative locations of visitors. Field notes were iteratively discussed throughout the study to develop the focus of the observations. Short interviews were also carried out with visitors as they entered and left the centre.

Our analysis focussed on the location and composition of F-formations in order to index what kinds of social interactions were occurring, where, and between whom. We used this data to analyse what influence the physical constraints of the space had on social interactions between the visitors. While the spatial patterns of social interactions might normally be studied using video-analytic methods (e.g., [15, 19]) in CSCW, our focus was on the visible outcomes rather than the details of production of social order. Although it can be difficult to analyse the more subtle interactions of an F-formation *system* without using video we found it was unnecessary to describe more than gross interactions, to gain significant insight into where and why social interactions worked or did not work in the centre.

The tourist information centre setting

The tourist centre is situated near the centre of Cambridge, surrounded by colleges, museums, theatres, galleries and other tourist sites. The study was conducted in August, which is their busiest period, with up to 2000 visitors per day. The main function of the centre is to provide information about Cambridge and the surrounding area, but staff also sell maps, books, and merchandise, help to arrange travel and accommodation, take bookings and payments for tours, and provide information about other parts of the country.

In the front of house space there are a number of different information sources such as leaflets and wall displays for visitors to look at as well as merchandise including gifts, maps and guidebooks. Looking in from the entrance to the centre (see figure 3), there is a small desk to the left where

visitors are able to book accommodation. This is manned by only one member of staff and only during certain periods of the day. Along the left hand wall are a number of bookshelves running perpendicularly to the wall and containing maps and guidebooks about several parts of the UK and other books of interest to tourists. In the centre of the space are a number of free-standing displays with merchandise such as key-rings, pens, etc. At the back wall, under a sign for “Free Local Information” is an area with a number of leaflet holders containing information about local businesses and attractions. This area also has a wall display with information (on leaflets) about some of the more popular attractions. There is seating area next to the leaflets.

Along the right side of the space is the counter area, typically manned by between two and four members of staff and where a large number of the more popular maps, leaflets and brochures are stored, many of which carry a small charge. In front of the counter is a roped off area, designed to channel visitors into a queue. In the area next to the exit from the centre is a small shop where a larger selection of gifts, maps, etc are sold by a single member of staff.

The notes and sketches drawn during the five days of ethnographic study were taken and analysed using F-formation as a conceptual lens. An overview of the various interactions at the centre is presented initially to provide a context for them.

FINDINGS

General patterns of activity

A main observation was that people entering the tourist information centre either wanted a specific item of information, such as directions or a bus time, or didn't know exactly what it was that they were looking for and had gone to the centre looking for inspiration. The counter staff were very skilled at spotting the latter and directing their questions to elicit more information from the visitor they could then use to make concrete suggestions.

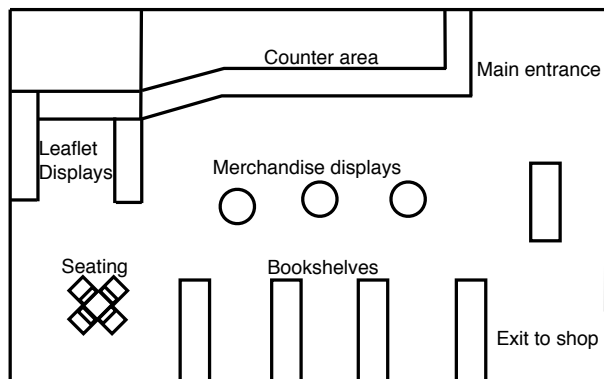


Figure 3: layout of Tourist Information Centre

Many visitors never went to the counter, preferring instead to try to find out information for themselves, either because the queue was perceived to be too long, or because they just preferred to find things out for themselves. There seemed to be quite limited interactions between the groups or pairs who didn't go to the counter when searching for information. Moreover, interactions between members of a group tended to be one-on-one rather than including everyone. Members of a group walked around separately, looking at leaflets or flicking through guidebooks, sometimes commenting on something, but generally saying very little to one another.

Using F-Formations to analyse how pairs seek information at the counter

Pairs of visitors were often seen to wait in the queue and approach the counter at the same time. The counter here was used as a shared transaction space (cf. [11, 30]) where counter staff laid out paper documents while talking visitors through options or asking further questions to gauge their requirements. There was sufficient room for both members of a pair to lean on the counter and look at the documents, which were typically oriented towards the visitors: the information assistants are well practiced in reading and annotating documents upside down. Both the member of counter staff and the visitors gestured towards the paper documents and the counter staff often made annotations, particularly when giving directions. For example, in the following short vignette, two elderly men, wait in the queue:

[Bill and John reach the front of the queue and approach the counter when an assistant, Steve becomes available. Bill first places a hand on the counter, while John stands next to him]

Bill: Do you have a leaflet of the coach that tours the city please?

Steve: Yes...[places a leaflet on the counter oriented towards the two men]

John: We're here? [pointing at a map which is taped to the counter]

Steve: [nods to confirm]

John: Thank you.

[Bill picks up the leaflet. The two men turn and walk away from the counter]

As can be seen from Figure 4, Bill, John and Steve arrange themselves in a circular F-formation with overlapping transactional segments at the counter forming an *o-space* to which they have exclusive and equal access. They also have equal access to the documents positioned on the counter (while Steve looks at them upside down, he is very familiar with looking at these documents in this orientation). While the interaction is quite straightforward, all three contribute and orient towards the leaflet positioned on the counter.

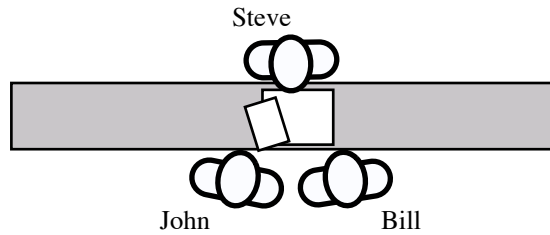


Figure 4: two people form an F-formation with the counter assistant

Focusing the ethnography on F-formations in this way therefore allows us to identify readily when social interactions work well, as well as when there are potential problems, as we shall see in the next section.

Analysing groups of three or more seeking information at the counter using the F-formation

Groups of visitors were also seen to approach the counter together occasionally: most frequently when the centre was quiet. In this situation it could be difficult for all members of the group to see the documents being discussed because they had to stand in a line along the counter. It was even more difficult for small children to see the documents because of the height of the counter, which was at a comfortable leaning height for adults.

In the following vignette, a family of two parents, Susan and Tom, a boy Scott (aged about 5) and a girl Wendy (aged about 7) approach Judith at the counter. Susan places her right hand on the counter. The two children stand between her and the Tom to her left. They aren't tall enough to see clearly the map that the adults are discussing:

Susan: Could you tell us where the college of Isaac Newton is?

Judith: Do you mean Trinity? [Susan nods. Judith points with her pen at the map on the counter]

[Susan and Tom both lean in to look at the map. Scott looks up at his mother; Wendy turns away and scans around the centre]

Tom: And where are we?

Judith: [circling an area with the bottom of her pen] Here



Figure 5: a family seeking information at the counter

Tom: [reading from the map] Trinity college...

Tom: Thank you [smiling at Judith. The children both look up at their mother, who starts to move away from the counter. The family leave towards the exit]

While the adults in this example were able to form an F-formation, similar to that formed when a pair approached the counter, in this case the two children were unable to visually access the information they were talking about because the counter was too high (see figure 5). Scott maintained an interest in the proceedings, looking up at his mother, while Wendy directed her attention towards the surroundings.

Height was however not the only barrier to the creation of an F-formation at the counter. When groups of more than two people approached the counter, one or more of the group would typically be left out of the focused interaction with the counter assistant. In the following vignette a group in their early thirties comprising, two women (Lucy and Karen) and a man (Mark) enter the centre.

[Karen walks straight to the queue. The other two wander around the centre separately looking at some of the merchandise on sale, but without talking to one another]

[Karen reaches the front of the queue and approaches Steve at the counter]

Karen: [says something inaudible. Mark and Lucy start to walk towards the counter]

Steve: King's College is here [pointing at the map on the counter with his pen] and we are here [points again].

[Mark and Lucy arrive at the counter and close in to look at the map. Mark stands close next to Karen at the counter and is able to lean in to look at the map. Lucy doesn't stand as close, but leans sideways on the counter trying to see the map. She cranes her neck and frowns as if having difficulty seeing it]

Karen: And what's the best way to go?

Steve: If you have time you could walk around the Backs [an area where a number of the colleges back onto the River Cam; Steve traces a line on the map to show the route]. This is the view of King's from there [he turns around and picks up a leaflet, which he places on the counter in front of the Mark. This makes it slightly easier for all of the trio to see it, but Lucy still stands slightly back]

Karen: Thanks [picks up both the map and the leaflet; the three turn and leave the centre as a group talking in low voices]

In this example (see Figure 6), Lucy is partly excluded from the F-formation across the counter by Mark who leans in to look at the map. Thus, she occupies the r-space outside the F-formation and doesn't play a direct role in the focused interaction. Even when Steve positions the leaflet in front of Mark, making it easier for Lucy to see, she continues to adopt a position outside the F-formation, perhaps because leaning in to look closely at the leaflet would mean moving uncomfortably close to Mark.

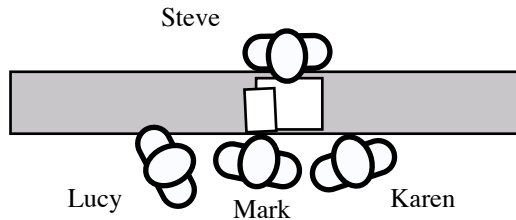


Figure 6: F-formation with one participant occupying an outer position in the r-space

Again, by using the F-formation concept to focus our analysis, we were able to readily identify where social interactions were potentially problematic; where one of the participants although standing close was not playing an active role in the discussion.

Analysing how groups split up to go to the counter

A more common scenario for pairs, and especially for groups, was for only one person to join the queue. The others would then often walk around the centre looking at the merchandise, books or leaflets until the other was finished talking at the counter. The person returning from the counter would then report what they had discussed. In the following vignette, a large group comprising 5 adults and 2 children have entered the centre. One of the women, Marian, enters the queue, while the others spread out through the centre, looking at leaflets, books or merchandise.

[Marian reaches the front of the queue and talks to one of the counter assistants in a low voice. He hands her a leaflet and they continue to talk while he points to the leaflet with his pen. She turns and walks towards the leaflet area and the other members of the group gather in a semi-circular arrangement].

Marian: Okay, so the bus tour seems like a good idea [she holds up the leaflet as she talks]. You can get off wherever you want to get off ...(inaudible)...it's £25 for a family ticket.

Donald: Should we go after lunch?

Marian: Yeah...it takes you by the museum...[inaudible]. If we decide we can get off at Trinity College and we can get off at the botanical gardens...[inaudible]. [The group start to move away, still talking, but inaudible. They leave through the main exit]

While the group do form a spatial pattern around Marian when she returns from the counter, this would better be described as a *common-focus* gathering [16] than an F-formation. This is because the group all orient towards Marian, who has made a decision about what the group should do and is presenting it back to them. The group takes the role of an audience. This was evident in a slight spatial separation between the semi-circle of the audience and Marian the presenter (see Figure 7).

While it is clear from this example that the group had talked about taking a bus tour prior to Marian joining the

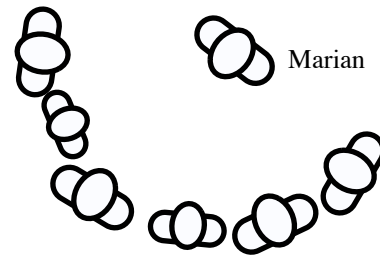


Figure 7: presenting a plan back to the group

queue, she takes most of the responsibility for making the decision of whether to go on it or not, and is party to information from the counter assistant that she doesn't necessarily share with the group. We suggest that this isn't the optimal way to make a decision that the other seven people have a stake in.

Two members of a larger group were also seen on a number of occasions to approach the counter, while the others waited.

A group of young (aged approximately 20) American tourists enter the centre. Two men, Jonathan and Robert walk up to talk to Steve at the counter, while three women stay near the entrance talking in low voices and standing next to a pile of rucksacks.

Robert: I want directions to a proper British pub.

Steve: (inaudible) [points at two locations on the map on the counter. Both men lean in to see where he is pointing]

Robert: That one sounds cool.

Jonathan: Yeah.

Steve: If you like I can sell you a map for 30p

Robert: Sure [reaches into his pocket for change and passes 30p to the Steve, who has circled the pub on the map]. Thanks.

[the two men walk back to the group by the door]

Robert: Alright, we found one [holds map up so that the others in the group can see it. He talks inaudibly, then the group leaves]

Again, because Robert is reporting back what they've found out (Jonathan plays a more passive role), it might be better to think of this as a *common-focus* gathering even though the group did form a spatial arrangement like a circular F-formation. What is notable is that the spatial pattern of the group forms to receive information about what pub to go to only after the decision has been made by Steve and Tom. They play no part in the decision making process with the information received at the counter. Given the discussion above about how difficult it was for large groups to position themselves at the counter, it seems understandable for part of the group to stay back. However, this may be sub-optimal for group decision making.

It was particularly common to see groups split up in this way with one or two people going to the counter and then

reporting back when they had luggage or young children that had to be looked after.

Analysing how people find out information themselves

Many people went to the counter to find out information. However, approximately half of the visitors to the centre preferred, at least initially, to find out information for themselves. The most striking thing about this information seeking behaviour was how infrequently focused discussions took place between members of a group or pair. Groups would split up and seemingly meander around the centre, picking up a book or leaflet here or there, but rarely talking to one another or discussing the information that they had found beyond sharing a cursory acknowledgement. They would then often leave together still with little discussion about the handfuls of leaflets they had gathered. Interviews with people leaving the centre and observation of the area surrounding the tourist information centre suggested that visitors would often take these documents to somewhere with space to sit down, lay the leaflets out and discuss what to do, such as a cafe. This often meant having to return to the centre once a potential course of action had been decided to find out more information, book tickets, etc.

There were, however, some situations where there was more joint attention and engagement between pairs and groups (although very infrequently for groups) in the centre. F-formations served as a visual index of shared activity. These seemed to occur in particular areas of the centre, which allowed members of the group to jointly orient towards the source of information. However, they were relatively rare.

In the vignette below, a couple (Sara and Brian) seemed to have a pretty good idea of what things they wanted to see in Cambridge, but spent some time gathering and discussing possibilities while annotating a map. They used a table as a shared surface to which they both had visual access to the paper documents they used (see Figure 8).

[Sara and Brian are standing next to a table near the space in the centre with leaflets for free local information. Brian has picked up a city guide to Cambridge from a shelf next to the counter. He pushes a rack of leaflets back slightly to give himself room and opens up the book on the table. They both lean over it as he turns the pages]

Sara: (inaudible)...the colleges.

Brian: I think the leaflets are basically behind the counter [many of the more informative leaflets carry a cost and are stored behind the counter]

Sara: We could get them to cross them off

Brian: I'd prefer to do it.

[Sara walks over to the counter (there is no queue) and pays 30p for a map. She walks back over and hands Brian the map. He puts it down on the table next to the guidebook, takes a pen out of his pocket and starts to circle things on the map, holding the guidebook on the table with his left hand. He turns through the pages,



Figure 8: a couple annotating a map on a table

marking more. Sara reaches over and takes the guidebook off the table and turns the pages]

Sara: How about the botanical gardens? [she turns the guidebook to him showing him the page. He seems to be having some difficulty matching the location in the book to the location on his own map. He looks back and forwards several times frowning, before finally working it out].

Brian: Ah [he circles something on the map and writes next to it]

[She hands the guidebook back to him and he lays it on the table again. They both talk in low voices. He takes a highlighter out of his pocket and highlights some of his annotations on the map. They both stand upright as he puts away his pen and highlighter in his pocket. He folds the map as they walk towards the main exit].

In the next example, a mother Helen and daughter Vicki (aged approximately 12) first spend time looking for sources of information and then sit down to discuss their plans:

[Helen and Vicki are standing side-by-side looking at the leaflets, but without talking to one another. Helen turns and walks into the middle of the space, scanning around the centre. Vicki moves around the leaflet display and picks up a Cambridge guidebook from a shelf. She walks over and gives it to Helen, who looks at the cover of the book and then opens it at one of the pages. They talk in low voices and then Helen goes to the counter with the guidebook. She doesn't buy it, leaving it behind and coming back with a paper map instead. They both sit down on the seats next to the leaflet displays. Vicki holds the map in front of both of them. They turn slightly towards each other (the seats are at a 90 degree angle).

Vicki: Do we want this one [she points at the map]?

[Helen leans forward to look more closely at the map; they talk in low voices for about a minute, while both occasionally pointing at something on the map. The mother takes the map. She folds it up and puts it in her handbag as they both stand up and move towards the exit].

In the next vignette, a rare example of focused discussion between a group rather than a pair, a family gather in front of a wall display.

[A family of two girls, Beth and Mary, aged about 9 and 10, mum Marilyn and dad Aaron, stand in a semi-circle in

front of a wall display which has a number of leaflets pinned to it giving information about some of the more popular tourist attractions and tours]

Beth: Can we go on the open-top bus? [points at the leaflet on the wall]

Marilyn: Hmm...I'm not sure that we've got enough time.

Aaron: [looks closely at the leaflet] (inaudible)...and it seems quite expensive [Beth and Mary both turn towards their father with pleading expressions]

Marilyn: It does stop near the restaurant

Beth: yeah.

Aaron: (inaudible)

Marilyn: (inaudible)

[The family move towards the counter, where they ask for a bus tour leaflet. They move slowly towards the exit with Aaron and Beth looking at the leaflet while walking]

In this case, the family were able to form a semi-circular F-formation around the wall display (see figure 9), to which they all had equal visual access. They were thus all able to participate in this short discussion (although Mary didn't say anything, the expression directed towards her father indicated that she was fully engaged)

On only two occasions were couples observed engaged in a prolonged discussion about some information they had found while located in an open space near the middle of the centre. On both occasions they stood very close together reading and discussing a document which was held in a position that both could see. For example:

[A couple, after first walking around the centre scanning the shelves and displays stop at a shelf containing a Cambridge guidebook. The man picks up one of the books. He holds it up with his right hand so that they are both able to see it. She touches the left hand corner with her left hand. Each puts an arm behind the other's back. They both lean in close together and talk in in low voices in Spanish. At different times both hold the book and turn the pages and she occasionally points at something in the book with her left hand. They flick through the book for about two minutes, before putting it back on the shelf]

It seems likely that this was very rare because of the difficulties inherent in jointly orienting to a small paper leaflet.

Summary of findings

In the interactions of pairs of visitors with the counter assistant, they were able to share equal access to the transactional space formed by the counter, where paper documents were viewed and annotated. When more than two visitors came to the counter at the same time, it was more difficult to maintain this formation as the long straight shape meant that one or two of the visitors had more privileged access to the space on the counter than others. Similarly, young children had less privileged access to the counter because of their shorter height.

With other groups or pairs, typically only one person went to the counter and therefore they tended to take a more

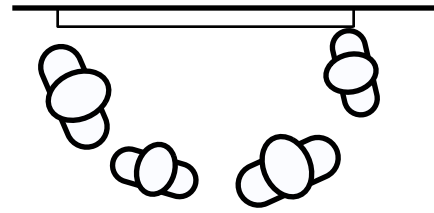


Figure 9: A family gathered around a wall display

dominant role in any decision making, reporting back to the group what they would be doing (or at least narrowing down the options). For those pairs or groups who preferred to find out information for themselves and didn't go to the counter, we saw few examples of engaged shared planning or discussion. The most common activity seen was individual information foraging with occasional comments or short discussions made one-on-one rather than in larger groups.

Those visitors who did engage in more shared discussion were able to find ways to form an F-formation: such as the couple adapting the space by pushing things out of the way to enable them to lean over a table together to read through a guide book and annotate a map. Again these interactions tended to only be between two people. We speculate that this happened rarely for larger groups because of the small size of most of the documents used in the course of these discussions: leaflets, guidebooks, and the paper maps are not designed with multiple people in mind and it is difficult for more than two people to have visual access to them at one time.

Direct visual access was possible for more people at the display board, where larger groups were able to arrange themselves into a semi-circular F-formation, establishing a joint visual attention and equal access to the information being discussed.

DESIGN IMPLICATIONS FOR TRANSFORMATIVE TECHNOLOGIES

Using F-formations as a conceptual lens to frame the observations in this ethnographic study allowed us to quickly survey the social interactions that occurred in this space. This highlighted how rarely groups larger than two discussed options with each other and with counter staff. This seemed to be largely caused by the constraints of the physical space, which were not conducive to larger groups sharing access to the varied sources of information in the centre. Many of these constraints were for perfectly valid reasons: for example if the centre had provided tables on which visitors could lay out materials to discuss options, then it would have very quickly clogged up with people and the mess of discarded leaflets. With limited resources, the staff were very explicit about the need to keep working the queue and moving visitors through the centre (cf. [2, 3])

The main goal of this study was to understand how existing social practices were enacted within a space, and therefore the findings do not necessarily map neatly onto a set of

design implications. However, this work took place as part of an ongoing programme of research investigating the potential of shareable interfaces to transform existing face-to-face interactions.

We adopted a design approach with the ethical goal of democratising involvement in the decision making process, reasoning that while it might not always be better for visitors to the tourist centre to make decisions together (for example when time is limited, or where parents want to make a decision without the involvement of their children), that it might be better to provide them with the opportunity, which they can then accept or not.

Following Hornecker [11] we predicted that encouraging the creation of F-formations when seeking information and planning a visit might enhance the group experience. One possibility we considered was to place an interactive tabletop inside the centre, able to support information-seeking through promoting the visitors and a member of staff to congregate around it in an ad hoc fashion. This would allow more people to have direct visual access to the representations being discussed, forming an F-formation around the table. It would also enable the staff member to use their local knowledge and expertise to guide the group through the possibilities in a more equitable way than would be possible at the straight counter (this would only be possible when the centre is quiet however, as at busy times the staff must focus on moving through the queue as quickly as possible). A second possibility is to provide a shared stand-alone application on a tabletop that again would allow a group of two or more to form an F-formation, and in doing so, could encourage more collaboration and discussion amongst the groups, but would also support individual information of the kind already seen in the centre. Constraints could be built into the software to encourage different sized groups to come together to plan their day out together, but to do so quickly so as to not clog up the centre with visitors or to generate mess that would create work for staff.

CONCLUSIONS

Using Kendon's framework has shown how some features of the physical environment work to discourage the creation of F-formations, e.g., at the counter with more than two people, while some features encourage their formation, e.g., when people had a clear idea of the kind of information they were looking for and where they all oriented towards the same paper documents, or when people were standing in front of the wall display.

Similar to the late Leigh Star's [28] popular notion of *boundary objects*, used to describe objects which "are plastic enough to adapt to local needs and constraints of the several parties employing them, yet robust enough to maintain a common identity across sites" [28, p. 46] we argue that F-formations are easy to recognise and apply, and could rapidly be taken up by researchers and designers

as a way of better articulating overlooked or ill-formed ideas of what happens in face-to-face settings.

Being able to map out whether a space provides adequate opportunities for social interactions is a good starting point from which to consider what kind of technology interventions can transform the space. More generally, our analysis has shown how face-to-face interactions do not necessarily meet a gold standard, at least if it is considered important to include multiple members of groups in decision-making conversations. In particular, environmental features such as the horizontal length of a counter make it difficult for groups larger than two to engage in discussions with counter staff sitting behind them. Similarly, the small size of the books, leaflets and flyers on which tourist information was provided and the lack of surfaces where these artefacts could be laid out and compared restricted the kinds of face-to-face discussions that could be had. Charting how the various features constrain or encourage groupings and interactions provides a way of informing the design of technologies that can go some way towards overcoming and enhancing them.

ACKNOWLEDGMENTS

We are very grateful to the staff of the Cambridge Tourist Information Centre, in particular Frankie McGhee, for their enthusiastic support. This research was supported by the EPSRC ShareIT project grant EP/F017324/1.

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