11. Organisational Behaviour

Competitive Session

# An exploratory study of the connection between office environments and group cognition

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## ABSTRACT

Although many organisations are adopting physical work environments to support group work, such as activity-based offices (Koetsveld & Kamperman, 2011), flex offices (Elsbach, 2003; Hirst, 2011), and open-plan offices (Kim & de Dear, 2013), few researchers have considered how these environments influence group processes (Ayoko, Ashkanasy, & Jehn, 2014). In this paper we draw on affordances theory (Gibson, 1979) and the concept of group cognition (DeChurch & Mesmer-Magnus, 2010) to examine this issue. We provide details of an exploratory study that involved observations and interviews with work groups in a Collaborative Science Precinct. Our preliminary results suggest that the physical work environment afforded interaction and access to artefacts. We relate these findings to research on group cognition.

**Keywords**: Group processes, interpersonal behaviour, managerial thinking and cognition, communication

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In this paper we report the results of an exploratory study that examines the link between the physical work environment and group cognition. The physical work environment is the arrangement of artefacts and stimuli that employees encounter during organisational life, including buildings, furnishings, equipment, workspace layouts, lighting and air quality (Elsbach & Pratt, 2007) . Group cognition is an emergent state that involves the distribution, organisation and representation of knowledge in a group and which enables collective action (DeChurch & Mesmer-Magnus, 2010). In this paper we draw on affordances theory to explore how the physical work environment provides opportunities for group members to interact and access artefacts. In the next section, we briefly outline the research problem, before introducing affordances theory and the concept of group cognition. Next

we describe our research methods and present some preliminary findings. We conclude with a discussion that links our findings to research on group cognition.

## PROBLEM DEFINITION

Although many organisations are adopting office spaces that are intended to support group work, such as activity-based offices (Koetsveld & Kamperman, 2011), flex offices (Elsbach, 2003; Hirst, 2011), and open-plan offices (Kim & de Dear, 2013), there is little research that explores the impact of these offices on group processes and outcomes (Ayoko et al., 2014). Most researchers who examine physical work environments have focused on individual level outcomes such as satisfaction, wellbeing and productivity (Block & Stokes, 1989; e.g. Bodin-Danielsson & Bodin, 2008; Sundstrom, Town, Rice, Osborn, & Brill, 1994), or upon how power structures in organisations are reproduced through organisational space (Brocklehurst, 2001; Dale & Burrell, 2008; Fleming & Spicer, 2004). As a result, there is very little research that has examined how groups *use* physical work environments, and the opportunities and constraints that these environments place on group processes.

Furthermore, few researchers have examined how physical work environment influence employee's access to artefacts in the form of tools, technologies and other objects. This is surprising because many organisations adopt policies such as the paperless office, clean-desk policies and hot-desking that limit group member's access to artefacts (e.g. Meijer, Frings-Dresen, & Sluiter, 2009). This is important in the group context, because we know that artefacts play an important role in group cognition, and that group members can use artefacts such as plans, sketches and models to externalise their thoughts and combine their ideas (Bechky, 2003; Carlile, 2002; Stigliani & Ravasi, 2012). Yet in contemporary office spaces, group members typically have little space to store paperwork, books and prototypes and instead rely on portable technologies such as laptops and tablets (Elsbach & Bechky, 2007). In light of these issues, we undertake a qualitative study that examines the influence of the physical work environment on group work. We draw on affordances theory to anchor our discussion of how the physical work environment influences group interaction and access to artefacts.

## AFFORDANCES THEORY

Advocates of affordance theory argue that individuals perceive physical environments primarily in terms of the possibilities for action that those environments call fourth and that these perceptions influence how individuals use those environment (Chemero, 2010; Gibson, 1979; Volkoff & Strong, 2013). Fayard and Weeks (2007), argue that affordance theory provides a bridge between researchers who assume that the physical work environment causes behaviour and those who assume that the physical work environment has no influence on behaviour. Affordances are defined as the possibilities for action that are inherent to the relationship between a physical work environment and an individual (Gibson, 1979). Implicit in this definition is the idea that affordances depend both on the physical features of an environment and upon the capabilities of an individual (Stoffregen, 2003). For example, while open-plan offices enable employees to hear and see what other people in the office are doing, overseeing and overhearing would not be afforded for employees with sight or hearing impairments. Furthermore, the affordances of a physical work environment are *possibilities* for action, which means that they may enable and constrain human behaviour, but can never determine it (Fayard & Weeks, 2007). This means that employees in open-plan offices may avoid hearing and seeing others by using headphones, averting their gaze, or redirecting their attention, for example. Thus, affordance theory provides a framework for understanding how individual behaviour is shaped, but not determined, by physical work environments (Fayard & Weeks, 2007).

Although affordance theory has conventionally been used to understand the influence of the physical environment on individual cognition and behaviour, Fayard and Weeks (2007, p. 606) develop the concept of a "social affordance". We extend this line of reasoning by focusing on affordances at the group-level. In particular, we examine how the affordances of interaction and access to artefacts enable and constrain group cognition.

## GROUP COGNITION

Group cognition involves the distribution, organisation and representation of knowledge in a group and emerges when group members work together to achieve a collective task (DeChurch & Mesmer-Magnus, 2010). We conceptualise group cognition as both distributed (Weick & Roberts,

1993) and extended (Clark, 2008). Distributed cognition refers to the idea that group members can draw on each other's knowledge to facilitate cognitive processes (Hollingshead, 1998b). Often a single group member does not have the total knowledge required to complete a task and must draw on other people's knowledge. For example, an individual does not have all the information required to safely fly and land a plane (Weick & Roberts, 1993). The pilot must rely on their own knowledge about how to land a plane as well as communications from flight directors on the ground, the person responsible for desk operations, and other crewmembers. Communication is an essential aspect of group cognition because it allows group members to retrieve and access each other's knowledge (Hollingshead & Brandon, 2003). In contrast to distributed cognition, extended cognition refers to the idea that individuals can manipulate artefacts in the physical environment to facilitate cognitive processes (Hutchins, 1995). We typically incorporate artefacts into our cognitive processes to make a task easier (Clark, 2008). For example, rather than working out a mathematical equation in our heads, we may write it down or use a calculator (Clark & Chalmers, 1998). Sometimes group members use artefacts to help other people understand what they are thinking, or to help connect their ideas with other people's ideas. For example, Stigliani and Ravasi (2012) showed how product designers grouped together product samples, pictures from magazines and post-it notes and so that group members were able to "see" each other's thoughts and how they related to each other. In line with the concept of group cognition, we argue that the physical work environment can influence group work by affording group interactions (distributed cognition) and access to artefacts (extended cognition). We examine this idea by conducting a qualitative study of group work in a Collaborative Science Precinct.

## METHODS

In this study we asked the following research question: (1) "What is the influence of the physical work environment on group work?" To explore this research question, we took a naturalistic approach that involved theoretical sampling and an emergent design (Lincoln & Guba, 1985). This allowed us to respond to emerging themes, and to seek answers to questions that arose over the course of the research (Glaser & Strauss, 1967; Lincoln & Guba, 1985). Data collection involved a combination of unstructured observation and semi-structured interviews with employees working in a Collaborative Science Precinct. We adopted an outsider's perspective (e.g. Corley & Gioia, 2004)

because we were interested in the influence of the physical work environment on group cognition and behaviour, rather than on employee experiences of their physical work environment. The first author spent time sitting in open-plan offices, engaging in informal interactions and attending morning teas, lunches and other events with participants. By focusing on taking observations, rather than participating, the first author was able to make detailed notes about the interactions among participants at the Precinct.

**Research site**

The research site was a Collaborative Science Precinct that consisted of three large buildings, and which was occupied by employees from three different science-based organisations. The Precinct was intended to foster a collaborative approach between the occupying organisations, to promote serendipitous meetings between scientists, to make working together physically easier and to enhance opportunities for interdisciplinary research. The three buildings at the Precinct were four stories tall and contain an eastern and a western wing. The buildings were joined on each level by a series of walkways and Interaction Areas, and from the outside appeared to be a single building. The interior of the Precinct incorporated open-spaces and the widespread use of glass to maintain a visual connection between the three separate buildings. The 20 open-plan offices in the Precinct were of different sizes and contained desk space for between 20 and 90 people each. Each open-plan office was fringed by between three and thirty individual enclosed offices and contained one or two meeting rooms. There were laboratory facilities adjacent to twelve of the open-plan offices. Preparation areas, storage spaces, car parking and other facilities were located below ground on one of three basement levels. Employees at the Precinct included scientists, science technicians, science engagement officers, managers, human relations officers, occupational health and safety offices and administrative officers.

**Data collection**

The first author spent three weeks making observations in an office occupied by a group of administrative staff and managers, and three weeks making observations in an office occupied by a group of scientists and science technicians. The first author occupied a desk in each open-plan office and recorded observation notes directly onto a laptop. In the beginning, participants appeared to be highly conscious that the first author was taking notes, and made intermittent comments about the fact

they were being observed. After a few days, however, they became less interested in what the first author was recording and included her in Christmas celebrations, after work drinks, and social-club events. For the interview phase of the study, the first author conducted face-to-face interviews with 40 employees who worked for the three organisations that occupied the Precinct. Interviews were semi-structured and were based around and 10 core questions. As these questions provided only a guide, the first author was free to follow up on interesting comments and themes that arose during the interview. This allowed each interviewee to present their individual perspective and to cover issues that were important to them in more detail.

**Data analysis**

We uploaded interview transcripts and observation notes to the qualitative analysis program, nVivo. We began formal data analysis by reading through interview transcripts and observation notes, looking for statements that might answer our research question (Strauss & Corbin, 1990). During the process of *open coding*, we assigned statements in the data with labels that summarised their meaning. We continued to read through the data and grouped similar statements together into first order categories. We then followed the procedures for *axial coding*, which involved looking for connections between the first-order categories, and grouping similar categories into tentative second-order themes. In the final phase of the analysis we engaged in *selective coding*, which is very similar to axial coding, but is more abstract. We continued to compare and combine themes into higher order dimensions until a single, encompassing theme emerged. In the final stage of analysis, we searched for relevant literature to ground the model in existing theory.

## PRELIMINARY RESULTS

In this section we report preliminary results based on key themes in the data that relate to the group-level affordances of the physical work environment at the Precinct. For groups at the Precinct, the physical work environment afforded interaction and access to artefacts**.** The physical work environment influenced group member's interactions through display, distraction and face-to-face communication, and their access to artefacts through sharing equipment, providing storage spaces, and personalisation.

**Display**

The Precinct incorporated glass walls and open areas to facilitate visual connection between different spaces within and outside of the buildings. Many employees suggested that these features of the Precinct led them to feel like they were on display. For example, some employees reported that they were regularly conscious that they could be observed and overheard by their colleagues. For example:

> *For me personally, I feel like we're kind on display. Like, there's people walking past, there's clients coming in. You always feel that someone's sort of watching you. [Human Relations Officer, Organisation 2, I25]*

Employees reported that the experience of being on display could have both positive and negative consequences. On the positive side, employees suggested that their colleagues always knew when they were at work and would easily pick up if something was wrong or if that they needed extra support. On the negative side, employees found it difficult to have private or confidential phone calls when others were watching them, and suggested that they were worried that others might misinterpret their actions or think that they were not working very hard.

**Distraction**

The co-location of employees in shared open-plan offices and at a single site led many employees to report that they experienced a lot of distraction, in the form of noisy conversations, phones ringing and people moving around the office. For example, one employee suggested,

> *Noisy neighbours, the foot traffic going back and forth past your desk all day, the people dropping in and throwing things on your desk … it's quite a distracting environment [Occupational Health and Safety Officer, Organisation 3, I39].*

Although employees commonly spoke about the negative consequences of distraction such as difficulty concentrating and overhearing other people's private discussions, distractions also had positive consequences. For example, some employees suggested that distracting conversations sometimes allowed them to overhear useful information, or provided them with an opportunity to help group members with a question or problem.

**Face-to-face communication**

The physical work environment at the Precinct facilitated face-to-face communication. Most employees suggested that the open-plan offices made it easier to engage their colleagues in short, spontaneous communication. For example, one employee suggested,

> *In the other building, because people were in offices you almost felt like you had to be going there for a particular meeting versus the good thing with open-plan you really can wander past and have a quick chat to people that's getting to where you're really trying to get to. [Manager, Organisation 1, I18]*

Employees who sat near an office entryway or adjacent to a central pathway suggested that they engaged in more unplanned communication than colleagues who sat near the edge or the back of the office. The positive consequences of communication included being able to ask for help, provide help, joke around, bounce around ideas and socialise. Face-to-face communication could also be negative if it took the form of an interruption that prevented employees concentrating on their work.

**Sharing equipment**

Alongside influencing interactions, the physical work environment at the Precinct also influenced employee's access to artefacts, particularly scientific equipment. A number of scientists suggested that the key benefit of sharing the Precinct with other organizations was that they were able to access expensive scientific equipment. In general, participants indicated that employees were willing to share equipment and that it was easy to find out if the equipment they needed was available onsite. As one employee suggested,

> *There's some email stuff that goes around so that people, if they are looking for some equipment, will send an email and you should get an answer if someone in the facility has some equipment. Most people are happy to share. [Science Technician, Organisation 1, I2]*

Employees suggested that the large number of scientists at the Precinct meant that it was more likely that someone could provide them with access to the equipment that they needed. They also argued that it was much easier to access the equipment onsite, rather than going to another institution.

**Space for storing books, field gear and resources**

Although most employees agreed that the Precinct improved their access to scientific equipment, scientists reported that they had difficulty storing books, field gear and other resources. Many scientists lamented that they had no space to store their personal libraries in the open-plan offices at the Precinct, and that they had been forced to throw out books before moving from their old sites. As one employee suggested;

> *I said I wanted more space for storing books and so on, I was told "You're not going to get it. Just forget it". And you could put up all the arguments in the world about whether you had a greater need for books or whatever and whatever, and they just sort of said "You can have no more space". [Scientist, Organisation 1, I19].*

Some scientists worried that files, records and old reports had been destroyed and that the information contained in those reports were lost. Others were particularly frustrated that they had not been given support to digitalize physical resources or to build digital libraries. A number of employees also expressed frustration that field gear had to be stored in communal storage spaces in the basement. They suggested that this made it more time consuming to collect up the gear to go on fieldwork and suggested that gear sometimes went missing. Although most employees suggested that they could still access the resources they needed to do their work, they also suggested that they wasted a lot of time storing and retrieving these resources.

**Personalisation**

Employees expressed some control over the artefacts that they had access to by personalising their workstations. Although some employees suggested that there were rules that limited the personal artefacts that they displayed at their desk, these were rarely adhered to. Employees at the Precinct personalised their workspace by displaying personal photos, office toys, plants, awards and posters. Some employees suggested that these artefacts were about expressing work or family roles, while others claimed that they brought in personal artefacts to make their workspace comfortable or to create a sense of personal space. Finally, some employees spoke about personalising their workspace to make it easier to carry out work tasks. For example, one employee suggested,

> *If I'm working on a particular project I might have something up about maybe objective of the project or something I can refer back to, or a Gantt chart or a time management matrix or something like that, just to – yeah, again, it's just about work productivity and keeping track of where you're at and those sorts of things [Science Engagement Officer, Organisation 2, I24]*.

Employees also reported moving microscopes from the lab and onto their desk, creating piles of project folders or documents around their desk, and writing to-do lists on their whiteboards. Other employees suggested that their colleagues had constructed cubicles out of cardboard boxes or melamine to block out distractions. Overall, employee's access to artefacts at work was influenced by the way that they personalised their workspace.

## DISCUSSION

Based on our study of the Precinct, we suggest that the physical work environment affords interaction and access to artefacts. We now discuss why and how this may be important for group cognition. Firstly our research suggests that physical work environments influence the terms on which group members interact. Most research that has explored interactions in office environments has focused on verbal communication (e.g. Kim & de Dear, 2013; Sundstrom, Herbert, & Brown, 1982; Zahn, 1991), rather than examining interactions in terms of display and distractions. Where researchers have focused on distractions (e.g. Banbury & Berry, 2005; Roper & Juneja, 2008), they have tended to emphasis the negative aspects of distraction on individual concentration, rather than positive consequences at the group-level such as allowing group members to overhear useful information or to discover that someone needs help. Similarly, research on display and surveillance in open-plan offices has tended to emphasise managerial surveillance and focus on the power disparities created when employees are subject to the managerial gaze (e.g. Collinson & Collinson, 1997; Fleming & Spicer, 2004). Our research suggests that employees in open-plan offices may also be subject to peer surveillance, and that this can have some positive consequences at the group level, such as allowing group members to keep track of each other's activities. Overall, the affordance of interaction takes the form of display, distraction and face-to-face communication, which can facilitate helping, information sharing and co-ordination within work groups.

Existing research suggests that interaction can facilitate group cognition by enabling group members to develop knowledge about who knows what in the group, and to retrieve that knowledge when they need it (Hollingshead, 1998a). For example, Wegner, Giuliano, and Hertel (1985) emphasise reciprocal self-disclosure as a key mechanism through which individuals can develop knowledge about what other people know. Through interactions group members are able to overcome initial impressions each other's expertise that may be based on stereotypes, and have the opportunity to directly observe each other using their expertise (Hollingshead & Brandon, 2003; Hollingshead & Fraidin, 2003). Hollingshead (1998a) also demonstrated that being able to observe paralinguistic cues (e.g. tone of voice, pauses) and body language (e.g. eye contact, shrugging) can help people retrieve relevant information from one another. In this study, we link existing research on group cognition with research on the physical work environment, by suggesting that physical work environment can provide group members with opportunities to learn about each other's knowledge and retrieve it when it is required.

Secondly, our research suggests that physical work environments can influence how easy it is for group members to access and retrieve artefacts. Existing research has tended to focus on how employees display artefacts such as personal photographs, awards and artworks to express identities and communicate ownership over their workspace (Brown, 2009; Elsbach, 2003, 2004, 2006). There has been relatively less discussion about how employees personalise their workstations by displaying charts, creating filing systems and positioning equipment in a way that makes it more convenient for them to complete work tasks (Kirsh, 1995). Furthermore, few researchers have examined the implications of the physical work environment for storing and accessing artefacts such as scientific equipment, books and field gear. Our research suggests that the use of communal storage spaces can make it difficult for group members to retrieve artefacts and that space restrictions can lead groups to lose access to information stored in paper resources. We suggest that the affordance of access to artefacts manifests in the way that group members personalise their space, store artefacts and share equipment. In turn, these activities impact on the information that group members can access, and how much time they spend looking for and retrieving artefacts.

Existing research suggests that artefacts can facilitate group cognition by allowing group members to externalise and combine their knowledge. For example, Stigliani and Ravasi (2012) demonstrate that artefacts such as picture boards, sketches, post-it notes and samples can facilitate group cognition by allowing group members to see what other people are thinking, make connections between these thoughts, remember how the project has progressed, and to immerse themselves in the project. Similarly, Sutton and Hargadon (1996, p. 699) show that prototypes can act as, "a collection of ideas" and are used to communicate ideas to group members in brainstorming sessions. Artefacts can also help group members from different disciplinary backgrounds to come to a common understanding (Carlile, 2002). Bechky (2003), for example, argues that engineers and product assemblers have different vocabularies and often need to physically examine a product together before they can understand each other perspectives and can address a problem. In this study, we link research on the role of artefacts in group cognition to research on the physical work environment, by suggesting that the physical work environment provides group members with space to store and display artefacts. Furthermore, by affording access to artefacts, the physical work environment can enable group members to share artefacts with one another and personalise their work environment in a way that facilitates group cognition.

## LIMITATIONS, FUTURE RESEARCH, AND CONCLUSIONS

This paper has a number of limitations that could be addressed in future research. For example, we only focused on groups working in open-plan offices. Future researchers could compare groups that occupy different physical work environments, such as flex offices (Hirst, 2011), project rooms (Teasley, Arbor, & Olson, 2000), or activity-based offices (Koetsveld & Kamperman, 2011), because these physical work environments provide group members with different levels of interactions and access to artefacts. We also examined the affordances of interaction and access to artefacts in very broad terms. Researchers could consider the implications of having too much or too little interaction or access to artefacts, and how this might be managed. It is possible that too much interaction between group members may lead to territoriality or conflict over space (Ayoko et al., 2014) or artefacts (Brown, Lawrence, & Robinson, 2005). Furthermore, high levels of interaction may be positive when a group is performing well, but may also facilitate the spread of negative emotions through emotional

contagion (Barsade, 2002). Finally, researchers could focus more on the content of the interactions that take place in the physical work environment, for example whether interactions take the form of conflict, gossip or information sharing. They could also identify specific artefacts that are involved in group cognition and examine how these artefacts are stored and retrieved by group members.

In conclusion, we have examined how physical work environments influence group cognition in the context of a Collaborative Science Precinct. Specifically, we adopted an affordance perspective to explore how physical work environments afford interaction and access to artefacts. This involved undertaking a qualitative study of groups working in open-plan offices at a Collaborative Science Precinct. We argued that the affordances of display, distraction and face-to-face communication have implications for group cognition because they enable group members to learn about each other's knowledge and retrieve this knowledge when they need it. Furthermore, the affordances of sharing equipment, storing artefacts and personalisation can provide opportunities for group members to externalise their cognitive processes and to combine their knowledge with each other. Overall, this research suggests that managers and researchers should consider group member's interactions and access to artefacts when planning, implementing and conducting research about physical work environments that are intended to support group work.

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