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On finding balance between collaborative noise and speech privacy in open offices

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Abstract

A growing number of businesses are moving towards open-plan offices as a way of encouraging impromptu collaborative problem solving among workers. However, while collaboration increases in open-plan offices, a commensurate increase in general noise can hinder employees that need quieter conditions to prosper. In this paper, the effects of conversational noise within an open plan environment are quantified, and the degree to which noise restrictions compromise problem-solving examined. Measurements indicate that the noise levels from six people conversing (two conversations) in a 1,300 square foot room were sufficient for collaboration, but were near the boundaries for disturbing those working nearby. This suggests a limit on appropriate densities of spontaneous collaborative talk in open offices. At the same time, concern about disturbing others may have hampered creativity during collaborative talk. Subject surveys also indicated an increase in non-verbal collaboration in later tests, suggesting a willingness from occupants to seek a balance between collaboration and quiet.

Keywords: open-plan, collaboration, office design, speech privacy, building performance

1 Introduction

There has been a recent shift away from enclosed offices towards open plan designs. Around 70% of office workers now sit in open-plan offices (IFMA 2010). These kinds of spaces remove the dividing walls between workstations, and instead provide minimal separation between each employee, as a way to promote interaction. These spaces are believed to encourage impromptu conversations, which in turn, makes collaborative problem solving easier.

The use of open plan offices to encourage innovative and collaborative problem solving is perhaps a good one. One study suggests that more than 80% of office workers prefer engaging in casual conversations over more formal meetings (GSA 2006). However, the decreased amount of separation between people and more talking in open plan offices also leads to more office noise. The lack of acoustic separation in open offices especially allows conversational noise to travel. Surveys have shown that over 50% of open-office workers are irritated by the inability to conduct private conversations and the inability to avoid overhearing the conversations of others (Jensen, Arens et al. 2005).

In general, there is discomfort with the lack of privacy found in open-plan offices, as

well as concern over the reduced productivity and job satisfaction they may cause (Oommen, Knowles et al. 2008). Noise spill-over affects those attempting to do focused work, as reported in several surveys of office workers (Hedge 1982, Inalhan 2003). Laboratory studies have also shown that office background noise, with and without speech, lead to poorer performance in mental recall and arithmetic tasks (Perham, Hodgetts et al. 2013). Additionally, many workers simply prefer privacy over increased intra-group accessibility (Sundstrom, Burt et al. 1980, Baldry and Barnes 2012). While employees may approve of the increased communication available in open-office plans, a lack of privacy may make them prefer closed environments (Davis 1984).

Clearly then, balance is needed to maximize the value of impromptu collaborative conversation and that of focused work. Finding this balance requires an understanding of the level of noise produced by people working together on a problem, and how restrictions to noise alter the collaborative dynamic. This study examines both issues.

2 Data and Method

The study was performed in a 'collaboration hall', at a US junior college. This hall sits in a quiet section of campus, away from large roads and other significant sources of outdoor noise. The hall was designed to encourage student collaboration and was intended for use by up to 100 students. The hall itself is approximately 1,300 square feet (120 square meters). The size and capacity of this hall make it a good proxy for an open plan office space.

Acoustic measurements were performed both when the hall was empty and while occupied. The baseline measurements, taken when empty, were completed with all windows closed and with the mechanical system operating in a typical fashion. Measurements were also taken from a random interval during the problem-solving process under whispering and normal speech conditions; Table 1 shows the acoustic conditions as measured for this study.

Table 1: Acoustical conditions tested in this study.

Test No.	Working Environment	Communication level	Distance between groups
1	Open	Whispering only	At least 5ft (1.5m)
2	Open	Normal	At least 5ft
3	Semi-shielded	Normal	At least 5ft
4	Open	Normal	Less than 5ft

The baseline measurements were compared to the whispering and talking conditions. A difference of 15dB(A) or greater between the two is suggested when the goal is to hear and understand (ANSI/ASA). This might constitute an optimal condition for workers engaged in collaboration. These same conditions however, would likely disturb those workers needing quiet.

Six volunteers were chosen for the purposes of this experiment, consisting of both

males and females. Each volunteer was given a survey to determine their openness to collaborative talk. The survey is based on the 'Big Five' personality traits: extraversion, agreeableness, conscientiousness, neuroticism, and openness. Optimal values for collaborative work are approximately 3 for extraversion, with 5 each for agreeableness and conscientiousness (Buchanan1998). Results from this survey are shown in Figure 1, and indicate that all subjects displayed characteristics consistent with a moderate aptitude for collaborative work.

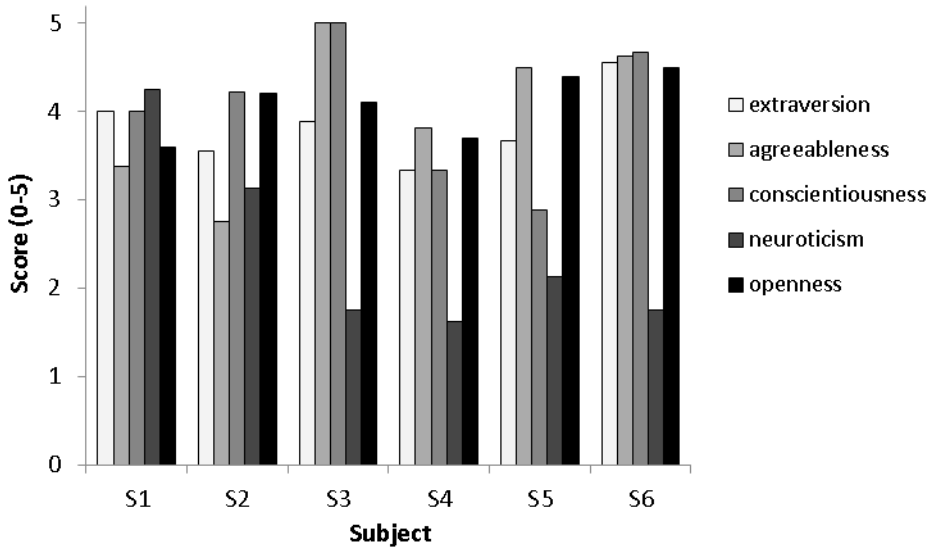


Figure 1: Personality scores of volunteers using the Big Five axes of extraversion, agreeableness, conscientiousness, neuroticism, and openness. All subjects displayed characteristics consistent with the ability to work in a collaborative manner.

Participants were divided into two groups of three, and assigned a task to solve together. The problem, construction of a 3D puzzle, was challenging but no formal instructions were given as a way to maximize casual collaboration. Participants spoke in a conversational manner, often in tandem. It was rare for more than three participants to speak at once. Following each problem solving period, one subject was swapped between groups to randomize the group dynamics. Four conditions were tested as shown in Table 1; allowing the investigation of open vs semi- shielded environments, whispering versus normal communication, and close versus separated groups.

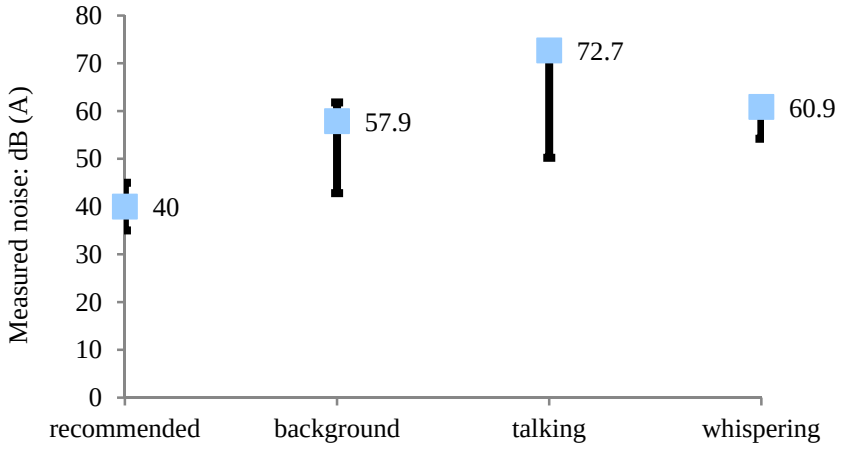
3 Results

The values obtained from the acoustics measurements are shown in Figure 2. Whispering between subjects raised the noise levels above 60 dB(A). The talking condition produced levels above 70 dB(A). A reading of 15 dB(A) over the background noise level would likely disturb nearby workers according to ANSI/ASA standards. The difference between the talking and background conditions is 14.8 dB(A). Thus, the talking condition (two conversations per 1,300 square feet) represents the limit for disturbance of nearby workers. Note that these results were achieved with higher background noise levels than are recommended by ASHRAE and from six subjects in a room designed for 100 people.

A similar sized room in an office building might hold 40 to 50 people. Still, this number of people could possibly produce more than two conversations at a time.

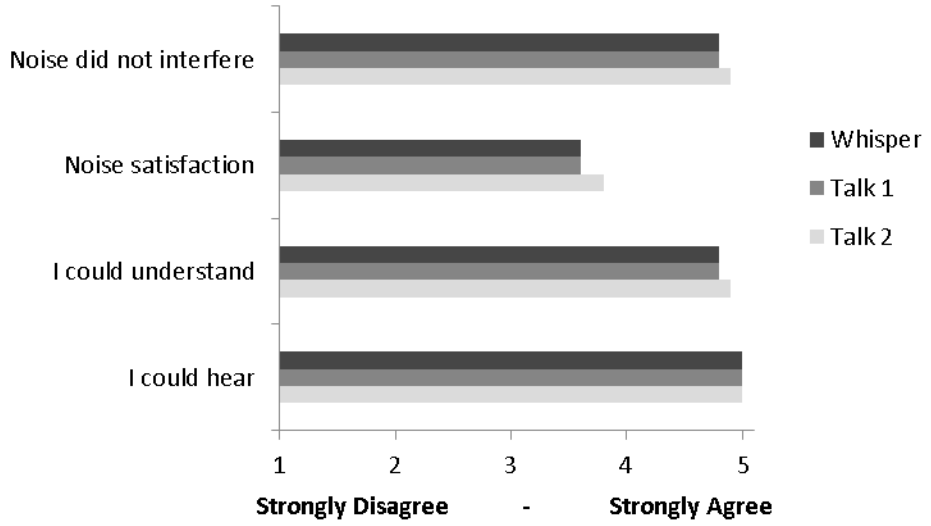
After all conditions had been tested, the volunteers were surveyed to determine their impressions of each condition, focusing predominantly on the ease of collaborative problem solving, and the level of distraction afforded by each condition (Fig 3). Noise levels did not appear to interfere with the functional aspects of collaboration, such as understanding other group members; however, overall satisfaction with noise levels was ambivalent. This suggests that noise was less problematic when directly engaged on a task, although it should be kept in mind that satisfaction would likely decrease in the presence of larger numbers of co-workers.

Figure 2: Noise levels measured during problem solving attempts. The plot indicates the 95 percentile, max and minimum encountered during 30 seconds of measurement. 'Recommended' levels are the preferred background levels for open offices without sound masking according to the ANSI/ASA standards. The sound levels within the grey region would likely not disturb nearby workers.



As well as measuring their agreement with set statements, subjects were asked for commentary on their ability to perform the task; selected comments are included in Table 2. Interestingly, while the requirement to whisper did not appear to change subjects' impressions of noise levels or understanding very much, their comments suggested other concerns. Subjects felt that the requirement to be quiet held them back from conversation that was not immediately necessary in an effort to minimize the amount of noise produced. This may have had the unintended consequence of hampering effective collaboration, with consequences for a more fully occupied space.

Figure 3: Results from subject impressions on noise levels. Agreement with the statements indicated was rated on a scale from 1 (strongly disagree) to 5 (strongly agree). Bars indicate average response for three different situations.



'I thought I was open to anything until I couldn't talk'
Concern about 'being loud' hampered creativity.
'I was interested in what others were saying, which was distracting'
'I didn't need to talk to my teammates much'

Table 2: Selected commentary from subjects completing puzzles under various conditions.

4 Analysis

The noise levels produced from more than two normal collaborative conversations would likely bother nearby workers in an open office. Note that the space where the study took place was designed for 100 people. Current open-plan offices are designed for tens to hundreds of people as well, and this corresponding increase in noise can quickly overwhelm worker concentration and hamper the effectiveness of collaborative interactions. Indeed, a study by the Center for the Built Environment indicated that over 50% of cubicle dwellers believed that acoustics negatively affected their productivity (Jensen, Arens et al. 2005).

Interestingly the results above demonstrated that some noise is not necessarily a distraction when working on set problems; subjects were able to problem solve even when challenged with extra noise sources. Studies have shown that low noise levels can be tolerated in offices; rather that the problem is a lack of acoustic privacy (Sundstrom, Town et al. 1994). This is the degree to which intermittent noises (phone calls, conversations, etc.) are able to pass between working zones. This lies behind the development of electronic sound masking systems, which provide a steady background sound level to help mask the otherwise much more distracting transmission of speech (Evans and Johnson 2000). Clearly then, controlling the noise produced by

each worker, and the transmission of this noise between zones, is important to the harmony of the group. This of course, becomes more difficult as office occupancies become denser.

Enforced quietness however, is likely not a good solution since it hampers collaboration. Subject responses indicated that a requirement to remain quiet hampered their creativity, more specifically that they held back from mentioning ideas that were not directly relevant to the task at hand. Unwritten social mores often develop around shared space which, while preventing excessive noise-related distractions, can have a similar detrimental effect on collaboration. An example of this was given in an interview with an academic, who indicated that a specially built collaborative wall (a combination of whiteboard and digital projector) had never actually been used due to fears that this would create too much noise (Pinder, Parkin et al. 2009).

It should be pointed out that increased collaboration does not necessarily have to result in increased noise levels, as subjects in our groups were rapidly able to solve problems using non-verbal communication skills. It is thus important that organizational and office design processes train and equip workers to collaborate in many ways. The simplest form of non-verbal communication is via office email or instant-message (IM) chat programs, allowing the transmission of text messages between employees within the same group or department. Corporate intranet systems are increasingly incorporating more complex collaborative tools, such as personal employee homepages, group wikis, and live news feeds modeled on the highly successful Facebook. These are highly informal tools that allow for spontaneous problem solving without the problems of increased office noise.

Further developments of chat software that incorporate non-spoken gestures are underway, where each user controls a virtual avatar (a representation of themselves) (Guye-Vuillème, Capin et al. 2014). Non-verbal cues are vital to effective communication and are currently often expressed in text communication through emoticons (Fahlman 1982). By allowing more extensive non-verbal communication, avatar systems are able to further improve communication between distant users (Dodds, Mohler et al. 2011).

Intermediate working environments can retain the benefits of both collaborative open spaces and motivational private areas. Several successful buildings designed for academics, which require both collaborative and individual problem solving skills, combine small private offices for pairs of workers as well as comfortable spontaneous meeting areas for larger discussions (Pinder, Parkin et al. 2009). This set up is often known as a ‘combi-office’ and provides greater privacy than the ‘mobile office’ setup which has also been proposed.

An alternative paradigm is that of the ‘mobile office’. In this system, the workplace is divided into a number of zones, ranging from fully open, collaborative areas to conference rooms and quiet regions for individual work. All workers have laptops and wireless access to the internal network, allowing them to shift between zones depending on their requirements at the time, while still remaining in easy non-verbal contact. Studies of pilot implementations of this system have shown that they tend to reduce time wasted by waiting for responses or meeting attendees, while also increasing employee engagement, knowledge of each other’s work, and ability to

work together (Craig 2010). This kind of workplace spatial / collaborative design can provide multiple benefits without pressuring individual workers.

5 Conclusion

The results presented here indicate that collaborative work by even a small group of people in a large space can rapidly increase noise levels. Larger groups talking would certainly exceed the levels seen here. Additionally, subject responses indicate that while collaboration can be achieved in a quiet or non-verbal manner, these restrictions had the result of hampering non-essential but potentially important communication. As such, it is important that the design of open-plan offices include support for impromptu collaboration, but also prevents it from becoming a hindrance to collaborators or those workers needing quiet. Advances in technological collaboration tools, such as instant messaging and others, may help accomplish this balance. In this way organizations can achieve the benefits of both collaborative and individual work.

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