

Design of Distraction:
Distraction and Environmental Design
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Abstract

This review investigates a variety of sources regarding distraction and its role in environmental design. Environmental design dictates how humans interact with the spaces around them. It is essential to analyze these spaces and the role that distraction plays for the future design of buildings and physical environments to make them better for human interaction. The role of distraction was analyzed through the lens of three realms: education, medical, and transportation hubs. Studies suggest that distraction in environmental design has mostly negative effects on users of the space such as in airport traffic control. However, it is vital to note that environmental design and distraction is not always negative. In some cases, distraction in a space has been proven to lead to positive outcomes for humans in the physical environment such as in the case of pain mitigation. These contradicting effects show that environmental design involves tradeoffs and must be tailored to the end user. Future research in emotional design could behoove the field as findings show that distraction and emotion play a pivotal role in how people inhabit spaces. These findings could lead to better design and thus better human experiences and interactions.

Keywords: distraction, environmental design, outcomes

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Humans interact with their built environment everyday. Some spaces are sought out, while others are neglected. Why do people treat Piazza San Marco in Venice differently than Tiananmen Square in Beijing? The human experience is molded by the spaces people dwell and exist in. Thus it is essential to learn more about how the design of the spaces affects the interaction with an environment. An architect, planner, or designer's decision can drastically alter the inhabitants of a building or space and how they interact with it. More specifically, distraction can be a limiting factor in the efficacy of a space.

Research in grade school classrooms in proximity to airports suggests that ambient noise can alter students' learning experiences regardless of instruction. Students in close proximity to an airport and the sounds of planes had different learning outcomes even though the instruction was controlled (Ahrentzen & Evans, 2016). Distraction also plays a role in air traffic control situations. A study researching the effects of mental load on traffic controllers showed a correlation between traffic and distraction (Loft, Sanderson, Neal, & Mooij, 2007).

However, distraction and design can be used in positive ways to enhance the efficacy of a space for the individual. Hospitals show a unique example of how these positive distraction design interventions can be made. Research suggests that the presence of windows in a hospital room for recovering surgery patients led to faster recovery times (Choudhary, Joseph, Quan, Ulrich, & Zimring, 2004). This positive distraction from the pain the patient was enduring shows the direct effects of environmental design's impact on an individual.

In the present article, environmental design and distraction was explored in three key areas. First, the role of distraction in the design of schools was investigated. Then hospital design

in relation to patient care was examined, followed by airport environments. Distraction and the potential consequences of each space were inspected and analyzed.

Schools

The process of learning can be significantly impacted by distraction. Diversions from course material or physical interferences can lead to students missing vital information. This article is concerned with primary and secondary school classrooms and how distractions in the physical space influence students.

Ambient noise has been touted as a significant distraction in the classroom. Research shows that there is a relationship between aircraft noise and negative performance. In areas of high ambient noise, research suggests that agitation and blood pressure levels increased (Cohen, Evans, Krantz, & Stokols, 1980). In these areas, students showed decreased performance on memory tasks (Matsui, Stansfeld, Haines, & Head, 2004). However, in a different study of primary schools, students in high noise areas were compared to students in classrooms with low ambient noise levels and no significant difference in general learning differences was found (Haines, Stansfeld, Brentnall, Head, Berry, Jiggins, & Hygge, 2001). However, children in the noisier classroom environment did have more significant cognitive impairments (Haines, et al., 2001). Though some of the research around ambient noise as distraction in the classroom is uncertain about all of the ways it can affect students, it is obvious that noise must be accounted for in the design of primary school classrooms.

Another area of focus for distraction in the design of classrooms is the presence of technology. Classrooms are trying to keep up with the rapid evolution of technology to educate students in engaging and effective ways. However, technological resources can be counteracting what they were deployed to accomplish. Researchers used eye-tracking software to test the

differences between student's interaction with a classroom with highly visual learning aids and classrooms with minimal stimulus. The research concluded that students in the high stimulus condition did not pay attention to their teacher as much as in the low stimulus condition (Hanley, Khairat, Taylor, Wilson, Cole-Fletcher, & Riby, 2017). These findings are relevant to conclusions about all children, but are particularly relevant to children with conditions such as autism and attention deficit hyperactivity disorder as distractions might more easily lead to negative outcomes. Classrooms should minimize the distraction caused by visual learning aids and technological aids in the design of the learning environment.

The distraction within the layout of classrooms can also significantly impact learning outcomes for students. This topic can be split into two categories: open and private classrooms. Open classrooms are layouts in which all students are grouped together in tables and there is minimal privacy. Private classrooms allow for silent areas for students to work independently and have pupils in a sparser configuration. Research suggests that some aspects of private classrooms such as natural light, air quality, flexibility and complexity are all correlated with student progress (Barrett, Davies, Zhang, & Barrett, 2015). Flexibility allows for the change of the layout of the classroom to fit different activities. This is an example of when distraction would be a positive factor in a student's learning. By switching the layout, students stay engaged and can interact with the material more fully. Complexity is the measure of how the elements in the classroom fit together. With increased complexity and thus increased distraction, student performance tends to decrease (Barret, et al., 2015). It can be concluded that distraction in the design of the layout of the classroom involves tradeoffs and should maximize outcomes for students.

Distraction in the classroom environment is largely a negative force in student learning and outcomes. Tradeoffs exist and the student benefits must be maximized. Some exceptions exist such as the flexibility of a classroom in which distraction can play a positive role in helping pupils engage with the material. Further research into how distraction in design affects students with special needs or learning disabilities is necessary. Specific strategies for maximizing positive distraction and minimizing negative distraction include creating consistent sound environments with limited technical distractions in a flexible and moderately complex classroom.

Hospitals

The hospital environment is full of distracting stimuli and efforts to reduce its effects have been successful such as the Tallman method, which involves highlighting differences in similarly named medications. Yet there is much to be done. One side of hospital design involves designing for medical professionals in spaces such as operating rooms. The second is design for patient care. This section focuses on the side of patient care and the role distraction plays.

Dr. Roger Ulrich is the internationally leading researcher in the field of evidence-based healthcare design. His findings have largely shaped research discussed in this section. One such study delved into Ulrich's Theory of Supportive Design and confirmed its role in positive distractions in the design of the hospital environment (Andrade & Devlin, 2015). The theory posits that the hospital environment will reduce stress if the patient feels in control, has social support and positive distraction. The experimental findings showed that cancer patients given control over their lights reported higher levels of comfort than those without. Additionally, active stimuli like music that patients can control also led to positive health outcomes (Andrade & Devlin, 2015).

Other positive distractions such as plants and window views in patient rooms led to positive results too. Having a private room with views of nature is associated with shorter hospital stays (Malenbaum, Keefe, Williams, Ulrich, & Somers, 2008). In one study, patients recovering from appendectomies, thyroidectomies and hemorrhoidectomies were assigned to having plants in their room while recovering or not (Park & Mattson, 2008). Park and Mattson's study found that in the condition with plants, patients used less pain medication and had a shorter average hospital stay than those in the condition without plants (2008).

Another salient opportunity for positive distraction in the design of the hospital environment lies in birthing rooms. One study compared births in standard birthing rooms to rooms that felt less institutional including items that may be found in a home such as flowers and photos (Hodnett, Stremler, Weston, & McKeever, 2009). In the standard hospital room, women giving birth were in labor for longer and used more pain medication than those in the experimental condition. Though promising, the conclusions are limited as this was a pilot study. Thus more research is required to reach bona fide conclusions.

Furthermore, positive distraction can be also be utilized in the hospital environment through the emergency waiting room. Virtual reality (VR) can be used to improve the waiting experience of people suffering from migraines (de Tommaso, Ricci, Laneve, Savino, Antonaci, & Livrea, 2013). Participant's perception of the migraine pain in the positive VR environment was significantly changed in comparison with the control (de Tommaso, et al., 2013). This suggests that VR can potentially be used in other hospital situations to mitigate pain through positive distraction.

One area in patient-side hospital design that does not benefit from distraction is the nursing station. Nurses work long shifts, thus inviting fatigue and distraction to influence their

work. This affects the patients they care for. Medication errors cost the medical industry \$16.4 billion yearly and account for 7,000 deaths per year (Institute of Medicine (US) Committee on Quality of Health Care in America, 2000). Much of this is caused by distraction. A limitation regarding the role of distraction in this realm is that there has been limited research. Possible effective designs include designing wards in a radial way with the nursing station in the center (Choudhary, Joseph, Quan, Ulrich & Zimring, 2004). This study also suggested to minimize distraction by reducing staff fatigue and stress, and to more closely examine the staff activities when designing a building such as minimizing the amount of walking for nurses (Choudhary, et al., 2004).

In a hospital setting, distraction can prove helpful in most situations of patient care but in others it can lead to costly mistakes. It is essential to include positive distraction techniques into the design of hospitals, some of which require little capital investment. In addition, reducing the negative distraction in the design of patient care environments will lead to a decrease in error rates. Implementing these changes will lead to shorter hospital stays, which are beneficial, both from an operations and economics perspective as well as from the patient and pain viewpoint.

Airports

Airports differ from schools and hospitals because users are more active in the environment and the experience is transient. Additionally, an airport is a hub for exchange and a midpoint between destinations. The design of the environment has to be universal, but not vague in order to meet the time and conceptual constraints of the inhabitants.

One pivotal aspect of airport design in which distraction plays a role is in wayfinding. Signage and layout allow people to navigate in an unfamiliar place when stress and mental load are high. As a result signage can be helpful to travelers or a hindrance. One study that delves into

this topic reported that standardization of signage across airports globally would minimize distraction and allow travelers to absorb the necessary information more quickly (Fuller, 2002). In addition, when the layout mimics preexisting mental models, passengers tend to be less distracted and navigate with minimal distraction (Fuller, 2002). This was supported especially when mimicking cities including radial and grid designs that urban planners do in cities such as Paris (Lloyd, 2003).

With a large number of planes, a limited number of runways and high stakes, air traffic control (ATC) is another area in which distraction and environmental design play a role. Within ATC duties, the layout of controls and distraction of the control room environment can have disastrous results. Research suggests that the role of operator distraction and cognitive load did not have a conclusive relationship (Loft, Sanderson, Neal, & Mooij, 2007). However, in another study, distraction was linked to memory errors when completing air traffic control tasks (Shorrock, 2005). There is still a great deal of research being done about this topic and more needs to be completed. Yet, it can be concluded that distraction has only negative consequences in the realm of ATC.

In a commercial travel setting, distraction generally plays a negative role. Whether it is in the wayfinding process of an individual trying to interpret signage to make their connection or an ATC officer managing the skies, distraction in the design of the environment is usually harmful for safety and efficiency purposes. Distraction may have positive applications in the case of long layovers or flights, however additional research is required to make this claim.

Conclusions

Distraction in the design of the environment leads to negative effects in most cases. However, in some situations, distraction can be harnessed to create positive outcomes for users.

There are tradeoffs by including distraction in design. Thus the specific needs of a space must be fully researched and considered in the planning and design stages. It is important to delve into the relationship between distraction and environmental design because humans spend the majority of their time within designed structures or areas. Rare is it that a person finds himself or herself in a completely undefined space. It is vital we learn from these findings and apply them to future planning.

The findings of this article show the need for further research on the design of patient care spaces including nursing homes and people living with chronic pain. As shown in this article, research exists but further research into the effects of new technologies and practices such as virtual reality experiences is necessary. These could drastically improve patient experience and recovery, thus saving hospitals and insurance companies time and resources and patients from pain. Furthermore, additional research for the efficiency of people navigating unknown spaces is required. Of the three realms studied, the airport and transportation hubs had a limited amount of research in the field of distraction and design. Expanding this research base will lead to a better understanding of mapping and signifiers within spaces, which could be applied to airports as well as other large buildings and could potentially help in emergency situations as well such as fire or in the case of evacuations.

Recommended Reading

Ahrentzen, S. & Evans, G. (2016). Distraction, privacy, and classroom design.

Environment and Behavior, 16(4), 437 – 454. doi: 10.1177/0013916584164002

Examines environmental distractions in the classroom space for both teachers and students.

Choudhary, R., Joseph, A., Quan, X., Ulrich, R., & Zimring, C. (2004). The role of the physical environment in the hospital of the 21st century: A once-in-a-lifetime opportunity. *The Center for Health Design*. Sept. 2004.

Reviews how hospital design choices impact patient recovery and medical outcomes.

Cole-Fletcher, R., Hanley, M., Khairat, M., Riby, D. M., Taylor, K., & Wilson, R.

(2017). Classroom displays—attraction or distraction? Evidence of impact on attention and learning from children with and without autism. *Developmental Psychology*, 53(7), 1265-1275. doi: 10.1037/dev0000271

Investigates implications of classroom displays in student learning outcomes.

Loft, S., Mooij, M., Neal, A., & Sanderson, P. (2016). Modeling and predicting mental

workload in en route air traffic control: Critical review and broader

implications. *Human Factors Vol* 49(3), 376 – 399. doi: 10.1518/001872007X197017

Detailed review of air traffic control operations in relation to mental load and distraction manifested in a model of operator behavior.

Malenbaum, S., Keefe, F. J., Williams, A., Ulrich, R., & Somers, T. J. (2008). Pain in its

environmental context: Implications for designing environments to enhance pain control.

Pain, 134(3), 241–244. doi: 10.1016/j.pain.2007.12.002

Examines varied modes of design to influence pain and further explores effects of different hospital design choices.

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