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Pain in its Environmental Context: Implications for Designing Environments to Enhance Pain Control

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There has recently been heightened recognition that environmental factors can influence pain. Clinicians involved in delivering multidisciplinary pain programs often structure the social environment of their treatment settings to help promote adaptive responses to pain. Recent theories of pain (e.g. Craig, 2003, Melzack, 1999, Fields & Basbaum, 1999) highlight the role that sensory stimuli from the environment can play in influencing the pain experience.

Despite the awareness if the environment's influence on pain, patients with pain continue to be treated in settings that are devoid of distracting stimuli. The typical treatment room is painted white, lacking decoration, sparsely furnished, and windowless. Patient's auditory stimuli may range from the noise generated by overhead lighting to urgent, loud paging requests, to sounds of other patients suffering. The visual and sensory settings in which we usually treat pain patients probably do little to relieve pain and may exacerbate pain.

This paper considers the influence of environmental stimuli including light, nature scenes and sounds, and video and virtual reality (VR) stimuli on pain and examines the implications for designing pain treatment environments to enhance pain control.

Literature Review

Light

Light is an integral part of any building and can vary according to time of day, location of the structure, window number and style, and numerous other structural and environmental elements. Light influences people in the building and available evidence suggests that exposure to light has implications for pain experiences.

Walch et al. (2005) recently conducted a prospective study testing the effects of exposure to sunlight on pain medication in 89 patients who had undergone spine surgery. Patients were randomly assigned to a bright or dim room in the hospital. Bright rooms were exposed to 46% more natural light than dim rooms. Patients in the bright rooms required 22% less opioid-equivalent analgesic medications which resulted in 21% decrease in medication costs. Bright room patients reported significantly greater decreases in stress and marginally significant decreases in pain. The fact that recovering in a room with more natural light lowered medication intake is noteworthy, particularly since lower medication intake is associated with fewer side effects and lower costs.

Exposure to light may enhance recovery from painful medical conditions. Beauchemin and Hays (1998) conducted a retrospective study that examined the impact of natural light exposure

on length of hospitalization and mortality in myocardial infarction patients. Study results found that individuals in bright rooms had significantly shorter hospital stays. Specifically, women spent only 2.3 days when in a bright room compared to 3.3 days when in a dark room. There was also a strong statistical trend for more deaths in the dark rooms as compared to the bright rooms.

Nature

In 1984, Wilson (1984) suggested the "biophilia" hypothesis which claimed that human beings have an inherent bond with the natural world, and that contact with nature could benefit an individual's health. Given a connection between health and nature, it is logical that nature could be useful in healthcare facility design, and could have implications for the reduction of pain.

Ulrich (1984) conducted an early study comparing recovery from cholecystectomy surgery in patients whose hospital room windows provided a view of natural landscape versus a view of a brick wall. Patients with the view of a natural landscape had shorter stays, took less pain medication, and had fewer negative-toned notes in their hospital charts.

Natural views of landscape are not always available to hospitalized patients and Ulrich, Lundén and Eltinge (1993) examined whether providing images of nature might enhance recovery from heart surgery. In this study, patients were randomly assigned to rooms providing exposure to images of nature, abstract art, a control blank panel, or nothing at all. Patients exposed to nature images were significantly more likely to switch from strong analgesics to weaker painkillers during their recovery than patients in the other conditions—indicating that the nature images influenced patients' postoperative pain. Patients exposed to the nature images reported significantly less anxiety than the other groups; patients who looked at abstract art had the highest level of anxiety.

Diette et al. (2003) tested the effect of combining nature images and sounds to reduce pain in a randomized clinical trial of patients undergoing flexible bronschopies. During the procedure patients were exposed to nature scenes and sounds or received treatment as usual. Patients who were exposed to nature views and sounds reported significantly higher levels of perceived control over pain. In an experimental pain study, Tse, Ng, Chung, and Wong (2002) induced pain (e.g., modified tourniquet technique) in healthy participants when exposed to a video of natural scenery or to a static blank screen. Participants exposed to the natural scenery reported increased pain threshold and tolerance.

Video and Virtual Reality Environments

Video and VR methods expose persons to interesting and distracting environments. Miller, Hickman, and Lemasters (1992) tested the effects of video visual and music presentation on pain and anxiety in burn patients. Seventeen patients were randomly assigned to videos of scenic imagery and music during dressing changes or to a usual care control group. Patients exposed to the video reported significant reductions in ratings of pain intensity, pain quality, and anxiety during dressing changes.

A recent study examined the differential impact of visual distraction (e.g., headset that screened out external simuli and provided visual stimuli), audiovisual distraction (e.g., visual distraction accompanied by classical music), and no distraction on the use of patient controlled sedation medication and pain during elective colonoscopy (Lee et al., 2004). Patients who received audiovisual distraction used less sedative medication and reported less pain than individuals who received only video distraction or no distraction. Environments that combine visual and audio stimuli may be more effective in decreasing pain.

Hoffman, Patterson, and Carrougher (2000) conducted one of the first controlled investigations testing the efficacy of VR as a method of pain relief in burn patients undergoing physical therapy. VR produced significant decreases in pain intensity, pain unpleasantness, and time spent thinking about pain. Patients who reported high levels of feeling as though they were actually in the VR environment showed the greatest decreases in pain and anxiety.

Wolitzky et al. (2005) conducted a study of VR in pediatric oncology patients undergoing a port access procedure. The VR intervention consisted of a scene from a zoo that children could view, hear, interact with, and travel through. Children receiving the intervention showed significant reductions in pain and pulse before and after the procedure.

Implications

Findings that light, nature, and video or VR can benefit in pain control provide significant implications for designing environments. Environmental factors that can be easily manipulated appear to decrease the use of analgesic medication which can eliminate troublesome side effects from medications, decrease medication costs, and enhance quality of care and outcomes.

Patients treated in rooms with brighter natural lighting experience less pain and take fewer pain medications (Walch et al, 2005). Exposure to both natural and artificial light may have positive effects on mood in healthy and depressed individuals (Beauchemin et al., 1990; Partonen et al., 2000; Yamada et al., 1995) and has been associated with reduced mortality in cardiovascular and cancer patients (Beauchemin et al., 1998; Lefkowitz et al., 1994; Freedman et al., 2002). Light exposure may impact pain by increasing serotonin levels in the body (Ernberg et al., 1999).

Vitamin D deficiency appears to be associated with musculoskeletal pain (Shinchuk & Holik, 2007). Patients who are exposed to environmental light sources may obtain more cutaneous vitamin D synthesis, thus decreasing their pain. Light also has positive effects on mood. A recent meta-analysis of randomized controlled studies concluded that light treatment for depression is efficacious with effect sizes equivalent to those in pharmacotherapy trials (Golden et al., 2005).

Designing treatment environments to make better use of natural light by incorporating more lighting into the design of a treatment facility may produce long-term benefits that can decrease health care costs. Healthcare facilities should use the rooms with the most windows for patients experiencing pain. The benefits of exposure to natural light could also be enhanced by incorporating other structural elements such as using skylights, larger windows, or light tubes that bring natural light inside.

Further research should examine whether there are certain pain levels or pain conditions for which exposure to light would be most helpful. Studies could examine what parts of the patient's body need to be exposed to light for it to be beneficial (e.g., only eyes verses body surface).

Viewing nature scenes may decrease pain perceptions by eliciting positive emotional responses and decreasing stress. Prospective environmental studies suggest that briefly viewing nature can produce rapid and significant recovery from stress. Blood pressure typically declines within three minutes of viewing unspectacular nature. Fredrickson and Levenson (1998) showed participants a scary, stressful film and reported that persons assigned to view a nature video evidenced recovery from cardiovascular stress in about 20 seconds.

It would be advantageous to increase the number of views of nature in new treatment structures by maximizing the surface area available for windows. Designers should consider what is viewed through windows, as views of natural scenery may promote pain control. Treatment

facilities could also be constructed such that there is a courtyard with a central garden which many of the room and hallway windows overlook.

Hospital beds should be arranged to give everyone a direct window view. Exposure to natural scenes could be enhanced by using nature inspired curtains and art and incorporating atypical natural elements such as pet therapy, nature based arts and crafts, or freestanding kiosks and art exhibits displaying scenes of nature.

Even though the home environment is potentially a rich one environmentally, patients with pain often tend to withdraw from visual stimulation and isolate themselves. A patient with pain might be encouraged to place their bed or chair near a window and take advantage of nature views and sounds by spending time outside.

Future research needs to examine the particular design elements that contribute to the effects that viewing natural scenes have on pain (e.g. types of scenes, relative benefit of real vs. created scenes). Future research needs to identify the characteristics of those patients who are most likely to benefit from exposure to nature scenes. Finally, studies could examine the advantages of patient choice of nature scenes (e.g., beach vs. mountain).

Video or VR presentations provide a relatively inexpensive strategy for pain relief. When designing treatment facilities, portable video or VR kiosks could made available throughout facilities to provide environments that can aid in the control of pain.

Past work has provided information on how to most effectively implement video and VR presentation. First, many patients undergo several treatment procedures that increase pain and repeated viewing of material decreases the positive effects (Miller et al., 1992). Alternative video material (e.g., sports, comedy) should be available to decrease habituation effects. Next, evidence suggests that video and VR presentations for pain should fully engage the patient by stimulating visual, auditory and tactical senses (Hoffman et al., 2000). Presentations should be designed based on patient characteristics such as age, gender, and ethnicity. Future research should assess the effects of different environments created with VR, and whether it is beneficial in terms of pain control for patients to choose what they view.

Interventions involving light, nature, and video and VR presentations appear to provide benefit for patients experiencing pain. The synergistic applications of these factors should be examined. Would greater pain reductions result if a patient could view an outdoor landscape from his hospital bed, while listening to his favorite music? Medical environments might involve computer generated nature scenes or art images projected on the walls of patients' hospital rooms, perhaps combined with background music of the patient's choice. Patient-generated decorations would make for environments that are more engaging than average hospital rooms. Research should attempt to determine the most effective environment for a person's pain reduction, and then find a way to program it. There is great promise for increased pain control and decreased patient suffering by combining conventional pain management with environmental alterations.

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