Research Note

The 16 Cubes Game for Children Who Are Visually Impaired

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Children who are visually impaired (those who are blind or have low vision) can perform just as well as do sighted children on spatial tasks, as long as they use strategies for coding spatial information that are appropriate for the task at hand. Although they cannot obtain cues as to distance, depth, and perspective, they can imagine spatial layouts and the relationships of objects in a space with the representation system that they develop (Barber & Lederman, 1988; Millar, 1994; Warren, 1994). Play is a way for children who are visually impaired to rehearse future encounters with the physical and social environment; play introduces them to the physical properties of the surrounding space and helps them develop spatial awareness and body awareness by challenging and thus improving their sensory modalities, motor skills, and cognitive skills (Chin, 1988; O'Donnell & Livingston, 1991; Palazesi, 1986; Pogrund, Fazzi, & Lampert, 1992). Play can help visually impaired children to integrate the information they keep in different frames of reference, and contributes to the establishment of the concrete operational stage, in which they develop notions of scale, dimensions, volume, weight, mass, classification, seriation, space, and time (Piaget & Inhelder, 1969).

The 16 cubes game

The 16 cubes game is composed of 16 cubes and 4 cardboard stands into which the cubes are distributed (see Figure 1). The stands are 70 cm (about 27 in.) high, which is an appropriate height for children as young as 7–8 years to perform a task in a standing position (Pheasant, 1986), and white, to provide a light background. The stands are placed in front of, behind, and at each side of a child. The surface of each stand is 40 x 26 cm (16 x 10 in.), and there is a protective border around the surface to prevent objects placed on the stand from falling because of accidental gestures.

The 16 cubes, 5 cm (1.9 in.) at each side, are also made of cardboard, but each cube in a group of 4 is covered with a different material—felt, corrugated cardboard, dense sponge, or a self-adhesive plastic sheet—that serves as a cue for the children to group it with the 3 other like cubes into a group of 4. Each group has one of four bright colors, red, yellow, green, and blue, as a source of visual stimulation for children with low vision. In addition, each of the group of 4 cubes is filled with a different sound-making material, so the cubes make noise when they are shaken.

Since the task of the game is to group the cubes according to their textures, four textural plates are placed on each stand as keys that indicate which textural group the stand belongs to. The textural plates are black, with white material framing the hole to provide contrast. After a child groups the cubes according to their texture, he or she places them in the 6 x 6 cm (2.3 x 2.3 in.) holes on the surface of the stands, where they fall into mesh bags from which they can be collected. The holes are slightly wider than the face of the cubes, so that the child uses his or her manual skills to place the cubes correctly in the square holes.

The sample

The participants were 30 students (16 boys and 14 girls), who were chosen randomly from students aged 7–11 who were born with blindness or low vision. The children all attended a school in Turkey for children who are visually impaired, were in grades 1–5, and had received training for 1–5 years. The children had been given courses for independent mobility, music, arts and crafts, modeling, and self-care skills in addition to the curriculum. They were classified into three groups according to their visual status: (1) children who were totally blind (no light perception); (2) those who perceived light and could see as far as 2 m (about 6.5 ft), but could not perceive such details as grain and color; and those with low vision, who could see up to 6 m (about 20 ft) and could follow moving objects and people with their eyes.

The experiment

One objective was for the child to be moving throughout the game and to use his or her body independently in space. With the continuous interaction of the child and the observer, the child was alert to the observer's voice, which could come from any side, and was expected to locate the observer from the observer's voice, accompanied by the sound made by the cube the observer was shaking, and accordingly to orient himself or herself to take the cube from the observer. This step was repeated with each cube.

Each child's performance in orienting himself or herself to the observer's voice and shaken cube and in grouping the cubes correctly, as well as the time he or she took to complete the game of all 16 cubes, was recorded on an observation sheet. To measure the effects of the game and accompa-

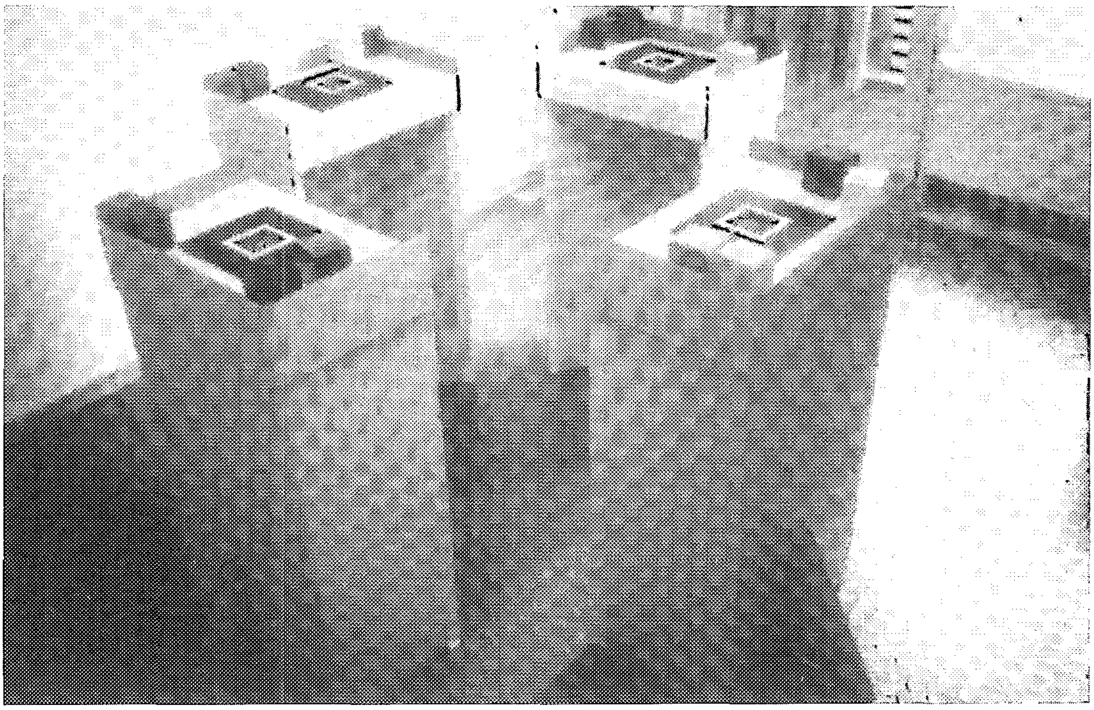

Figure 1. The 16 cubes game.

nying cubes on learning, a pretest and posttest were conduced a week apart.

Results

The findings revealed that the posttest scores were not independent of the degree of visual impairment (χ^2 (1) = 5.00, α = .10) and sex differences (χ^2 (1) = 2.92, α = .10). The chi-square test also revealed that the duration of the pre- and posttests was not independent of grade (χ^2 (2) = 11.47, α = .05; χ^2(2) = 8.34, α = .05). In addition, the duration of the pretest was not independent of the number of years in school (χ^2 (2) = 7.21, α = .05). Thus, the older children who had more years of education obtained higher scores in less time. The girls had higher scores and completed the game in less time than the boys.

In addition, the children who were totally blind and those who could perceive light had higher scores than did the children with low vision, which indicates that they were faster and more accurate in tactile discrimination, orienting to sound, and placing the cubes correctly because of their skills in manipulating objects. These children were also adept in locating the stand that a given cube belonged to, regardless of which side of the cube was given to them.

Furthermore, the scores on the posttests were higher than those on the pretests, and the times it took the children to complete the task on the posttests were much shorter. The average score for the pretest was 14.6, and the average time to complete the game of all 16 cubes was 4.4 minutes, whereas the average score for the posttest was 15.76, and the average time was 2.05 minutes. A paired-comparison of the scores indicated that the number of correct answers increased at the posttest (t (30) = 3.75, p = .0004). A two-way analysis of variance on the duration of the tests revealed that there was a significant difference between the pre- and posttests (F (1,29) = 36.65, p < .005).

Conclusion

This game and the cubes developed for it can be used in educational programs to stimulate children to use all their senses and to move about the environment. It is suggested that further opportunities should be provided for designers in this area to collaborate with teachers of children with visual impairments to develop more such educational toys and games. Furthermore, given the beneficial effects of play, teachers of children with visual impairments need to emphasize play to a greater extent (apart from the children's participation in physical education classes). Designers of environments may contribute by developing not only accessible environments, but additional games and toys that stimulate children to use all their senses and expand their body and spatial awareness so they can use these environments independently.

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Practice Note

The Effects of Blue Light on Ocular Health

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For years, professionals in the fields of light energy and vision have known that ultraviolet (UV) light presents hazards to ocular health. People are gradually being exposed to near UV, or "blue light" (light with wavelengths in the 500nm to 381nm range), for longer durations and at more intense levels. Not only is much of the world of commercial display and industry lit with cool white fluorescent tubes that emit a strong spike of light in the blue range, but many homes and offices are lit with cool white fluorescent tubes and, in some cases, daylight-simulation tubes, and more people are spending time in front of video display terminals (VDTs) (computer screens) that produce blue light. Although some people find that blue light causes eye pain, tearing, or headaches, most people do not suffer noticeable discomfort from blue light. Scientists have only recently begun to investigate the long-term effects of blue light and to offer some solutions for maintaining ocular health in its presence.

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Experts differ as to the exact wavelength of UV light waves, but generally, UV light is defined as that part of the invisible spectrum that ranges from 380nm to 200nm. This part of the spectrum is divided into UV-A (380nm to 315nm), UV-B (314nm to 280nm), and UV-C (279 to 200nm).

UV-C is virtually absent from ordinary lamps, black light, and sunlight within the earth's atmosphere. It is largely germicidal and is used by dentists and in industry for sterilization purposes. One of the primary benefits of the ozone layer is that it filters out virtually all UV-C, but UV-B and UV-A manage to enter the atmosphere. UV-B and, to some degree, UV-A have been implicated in the formation of skin cancers and cataracts and in the degeneration of retinal tissue (Van der Leun & Gruijl, 1993). UV-A is particularly plentiful in the light emitted from black-light bulbs, which are popular in "sensory stimulation" activities. However, until recently, little was said about blue light and its effects on the eye. Both blue light and UV-A are sometimes referred to as near UV, but for the purposes of this article, near UV refers to blue light.

Of special concern is the blue light given off by black-light tubes—glass tubes whose