0196-206X/85/0603-0118$02.00/0
DEVELOPMENTAL AND BEHAVIORAL PEDIATRICS

Vol. 6, No. 3, June 1985
Printed in U.S.A.

Looking Out from the Isolator: David's Perception of the World

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ABSTRACT. David, who from September 1971 to February 1984 actively lived his life in a sterile isolator, was severely deprived of experience of the physical world. His difficulty with the concepts of space, depth, and size related clearly to his limited experience rather than to cognitive or visual-motor-perceptual deficits.

To write an article about David,* who from September 1971 to February 1984 actively lived his life in a sterile isolator, is painful. Although it has proved to be therapeutic in our mourning process, it is by no means the closure of our sadness. David described the authors as "best friends, Mary number one, Jackie number two." Our relationship spanned the greatest part of his life; we were with him when he left the isolator and at the time of his death. The very personal and private nature of our involvement allowed us unprecedented opportunity to observe a child develop in an environment so different and unusual that it is virtually impossible to comprehend.

David's unique perceptual development intrigued us from the beginning and seemed worthy of description. We are not offering a systematic case history, let alone a conceptual model. To have placed this child into a situation of experimental study would have destroyed our ability to support him emotionally. Our intimacy with David and the tragic circumstances of his life obviously preclude our ever being able to present him as a research subject. If our observations about David stimulate interest or even controversy about the way in which children in limiting environments grow and develop, then a closer look at these children would be a most fitting tribute to a very special and much-loved child.

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David's gnotobiotic care was funded, in part, by USPH grant RR-00188, from the General Clinical Research Centers Branch, National Institutes of Health.

Developmental support for David was provided formally from age 3 years until his death by a multidisciplinary team based in the Meyer Center for Developmental Pediatrics and headed by Murdina M. Desmond, M.D.

* David was placed in a sterile isolator moments from birth because of severe combined immune deficiency. His care alternated between identical isolator systems at Texas Children's Hospital and at the home of his parents. Until age 8, 50% of his time was spent at the hospital in periods of 4 to 6 weeks. Then for 3½ years his time at home increased, varying from 6 weeks to 5 months; his last 9 months were spent mostly at the hospital. The space suit was used six times: four times within the hospital and twice for a brief trip to his home.

HIS PHYSICAL WORLD

To understand the limits of David's knowledge of the world, his environment must be described. The isolator in which he lived consisted of a 6 × 8 × 6 ft high plexiglass room and three rectangular flexible plastic "bubbles." The largest bubble, 6 × 2 × 4½ ft, and the small supply bubble, 4 × 2 × 3 ft, were on a table; a 4 × 2 × 4 ft transport bubble was on a wagon. All of these were housed in a room on the third floor of the Texas Children's Hospital. Windows all along one side faced West. The opposite side had two doors opening into a hall. From the windows, David saw the doctor's parking lot, a two-story hospital annex, a traffic artery and, across the street, a variety of buildings. Directly opposite was a one-story bank, to his left a 14-story Holiday Inn, and to the right a five-story medical clinic. He could see the front as well as the roof of the bank and two sides of both the clinic and the Holiday Inn. To his left he could see the Holcomb-Fannin and Interfirst Bank buildings and the front of the more distant Shamrock-Hilton Hotel.

David's isolator system in his parents' home was identical to the one at the hospital, but his view of the world was from ground level. The playroom was parallel to and inches away from a large picture window. He could, in essence, sit or stand at the edge of the front yard.

OBSERVATIONS

The first author's (M.A.M.) involvement with David began during a visit to his home in September 1974,

the month of his third birthday. Already, he had an excellent vocabulary and could identify virtually any geometric figure. He defined many objects or pictures by shape and described a tree as a brown rectangle and a green circle. He refused to believe that the green was given its color by leaves and was only convinced when he watched from the window as a branch with leaves was broken off and brought to him. He asked that a leaf be put beneath the clear plastic bottom of his isolator so that he could examine it.

On the second author's (J.B.V.) first visit, the 16th of July 1976, David's parting request was that she write the exact date and time of her return on his calendar. Since he functioned by clock and calendar, his mastery of time concepts was precocious. Even before he could actually tell time he used the clock. Probably few, if any, children have ever gazed at a clock so much. He was dependent upon people and things coming into his world, and lateness or changes in routine were stressful for him. He never seemed to lose his orientation to time. At 9:30 p.m., the night before he died, as weak and ill as he was, he had both of us scrambling to repair the television because *Star Trek* would be on at 10 p.m.

David's difficulty with space, depth, and size related clearly to his drastically limited and confined physical experience rather than to cognitive or visual-motor-perceptual deficits. He consistently performed in the superior range (age 8; WISC-R Performance IQ 126) on intelligence tests, and his school achievement test scores were always above his grade placement. Eye-hand coordination and dexterity skills were always excellent. At age 4 he had a sight vocabulary of at least 50 words.

At 5, he said, "Nothing in the whole world is as big as the hospital parking lot." He insisted that the buildings across the street had no backs. The two visible sides of the Holiday Inn and of the medical clinic he described as "flat," and the edge of a building was merely a line. The same was true of the bank roof and front. Neither drawings nor explanations convinced him that the buildings actually had four sides. Construction paper silhouettes pasted on a blue poster board were to David no different than his percept of the buildings and sky. To teach him the concept that the building has a front and back, M.A.M. built models. The first step was to draw each side that he could see. He described the window positions and determined when the drawings were correct. Then with sticks for reinforcement the sides were pasted together, duplicating the buildings. Finally, at age 6 he conceded that the buildings did have four sides. However, he still insisted they only had windows on one side. He asked someone to check for windows on the other side of the medical clinic, and, unfortunately for the teaching sessions, this building does have windows on one side only.

From age 5 on David frequently requested sketches of what could be seen from our windows at home: backyards, courtyards, streets. Attempts at a more complex drawing which showed a floor plan with front, back, and side yards frustrated him. "Don't bother about that, Jackie," he would say, "just draw what you can see from one window."

At 6 a "space suit" designed by NASA allowed David a limited opportunity to walk outdoors on two occasions. After he was outfitted, he was taken by a van to his home and enjoyed playing with a hose and water in his backyard. When a second excursion was planned, he again wanted to go into the backyard and sprinkle. When M.A.M. discussed this excursion with him beforehand, it became evident that he did not realize that his family's house had four walls. Its structure remained obscure to him even after detailed descriptions. For this reason, it was planned that he be allowed to walk completely around the house. Others involved in the excursion thought this ridiculous, since this very bright boy, of course, knew that houses had four sides.

David was familiar with the front yard because of his view of it from the window. When the van parked in front of his house, he got out and, surprisingly, started to walk across the street away from his front yard, saying, "I want to go in the backyard." When attempts were made to redirect him, he asserted adamantly, "No, no, I want to sprinkle in the back." Finally, on faith alone, he agreed to cross the front lawn to the backyard. After going completely around the house, his comment was, "Gee, Mary, you're right, the house is a box, and the backyard is where you said it was. You know everything!"

Similarly, he was confused and unsure about the different floors in the hospital itself. He understood that the rows of windows in the buildings across the street each represented a story, but he did not relate this knowledge to the hospital. He knew that M.A.M.'s office was on the first floor directly under him (he was on the third), because he had visited it, but until age 7 he was certain that no story existed between. Only an elevator stop on the second floor convinced him. As far as he was concerned, there were only three floors in the hospital: First, Third, and Seventh (J.B.V.'s office).

The Interfirst Bank and the Shamrock-Hilton Hotel are similar in height, both being approximately 16 stories high. The Shamrock-Hilton, however, is a much larger building in terms of cubic feet. Because David viewed it at a greater distance, it was impossible to convince him that the hotel was really the larger of the two structures and only appeared smaller due to the effect of distance. After counting the stories in the building he reluctantly agreed that they were the same height, but he could not comprehend the more complex issue of square footage or the amount of ground covered by the building. The linear perspective in his sketch (see Fig. 1) is correct, yet at 12 he firmly believed that the Shamrock-Hilton was the smallest building, when in reality it was the largest. He held to his trust in appearance.

At age 11 two weather circumstances, fog and rain as the sun set, did help to give David a vague percept of distance. On a foggy night when the Holiday Inn lights were brighter than the Interfirst Bank and the more distant Shamrock-Hilton Hotel lights were barely

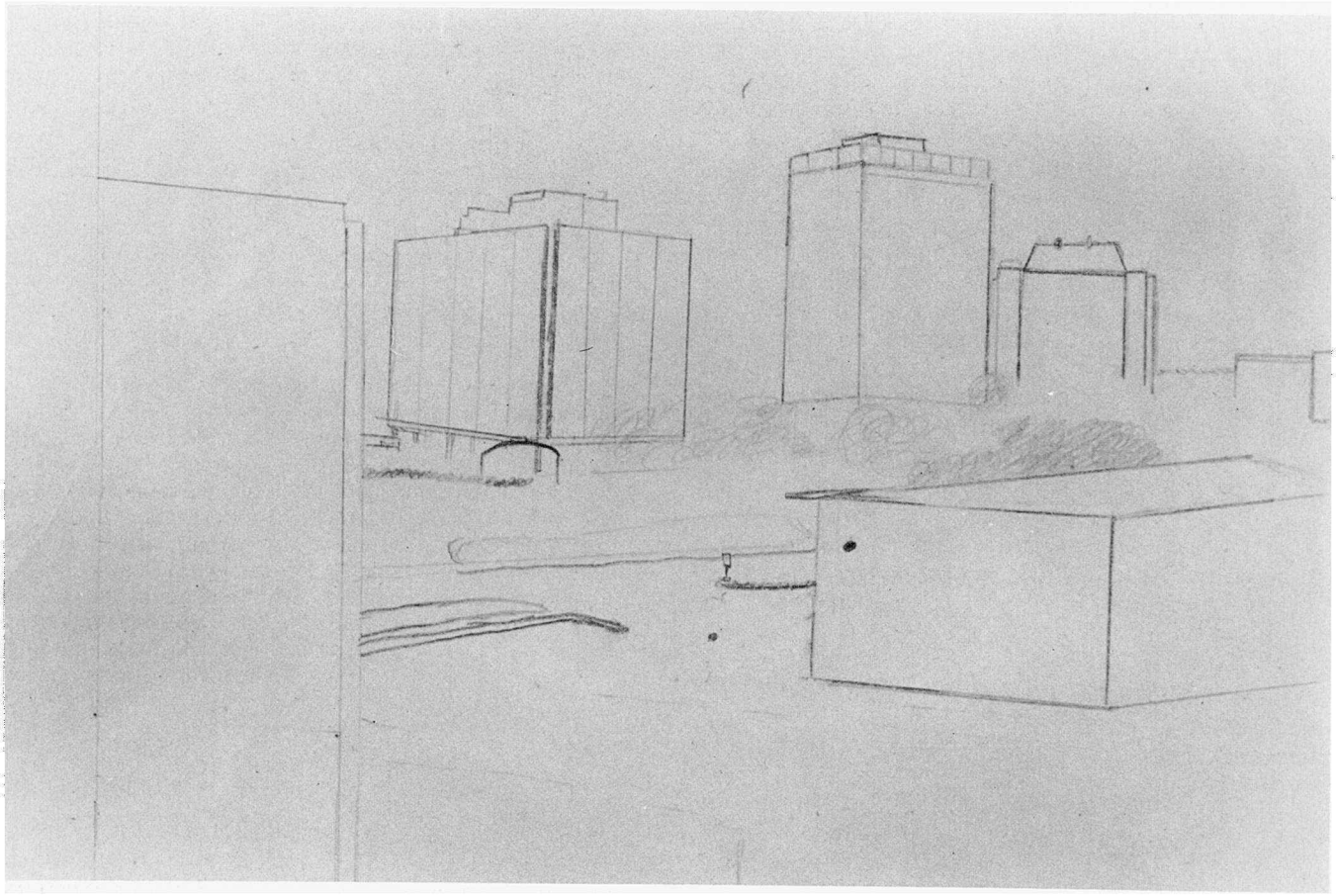

FIGURE 1. Sketched by David in December 1983. From left to right: Three-story Texas Children's Hospital wing, 10-story Holcomb-Fannin Building, 16-story Interfirst Bank, 16-story Shamrock-Hilton, top of Houston-Place. Right front: two-story hospital annex and the doctors' parking lot.

visible he said, "I think I understand what you were trying to get at with the little flashlight." One evening he related how he had watched rain approach the hospital, "I could see the parking lot get wet; as the rain came closer the sun moved back."

David knew at age 4 that it took 1 hour to drive from the hospital to his home, and he knew that it took 5 minutes for M.A.M. to drive from the hospital to her home. However, he could not relate distance to time. At age 7 he outlined a route on a road map from St. Louis to Houston and then to an address on a city map. But seeing locations of homes on a map did not help him to comprehend distance. M.A.M.'s attempts to construct a "map" with boxes for buildings and string for the road to his home were met with "No, no, that's not right. We can never do it as long as I'm in here and you're out there."

The vast expanse of the oceans eluded him, as became evident when M.A.M. told him when he was 11 of her plans to fly to Singapore. He located Singapore on the globe, and stated that it certainly was far away, about halfway around the earth. To her lament at having to fly 28 hours, his comment was, "Well, if you don't like flying that long, why don't you just drive over?" His advice after listening to explanations that driving across the States took days and that one cannot drive on oceans was, "take a ship." Cognitively, he was aware that Houston and Singapore were far apart and he reluctantly conceded, "You should probably just go ahead and fly." Clearly, the relationship of time and distance continued to remain a mystery to him.

The concept of bodies of water, lakes and rivers and pools, was virtually impossible for David to understand. Even more basic than David's problem with water was his belief that the ground's surface was like a sheet of paper. Trees had no roots, and, certainly, holes did not exist. J.B.V. undertook to explain trees and roots by bringing a plant in a pot of soil. He was allowed to pull up the plant and see the roots.

The underpass at Fannin and Holcombe Streets could not be explained to him despite many attempts. From his vantage point, he could only glimpse the top of the railing marking the beginning of the underpass. He would see cars on the one-lane frontage road continue at street level, while the cars in the center two lanes disappeared. Even photographs taken by J.B.V. from all sides of the underpass failed to clarify its structure or the practical function of an "underpass."

David showed little interest in photographs of landscapes but could analyze subtleties of abstract and surrealistic paintings for hours. Surprisingly, he inquired, "Why do you call those abstract? They are not

abstract, they are real. This is a peaceful forest, and that one is *Hawaii Five-0*. See the waves, the beach, and seashells." On many occasions, attempts were made to enlarge David's understanding of the natural world by way of nature documentaries on television. Despite repeated encouragement, however, his interest in these films was minimal.

David preferred the "soaps" and situation comedies on television. One common element in these programs was that the action is all in one room. He liked the characters in *Little House on the Prairie*, which has many outdoor scenes, but he needed an interpreter. For example, when the horse and wagon went over a hill and out of sight, he did not understand why it disappeared. Learning by television can distort perception; for example, at age 8 he believed the cart was what "made the horse go." When watching a film with action, especially a Western, he would ask, "What happened, where is he?" or state, "Look up and watch, so you can tell me what's going on." He had no problem following action in outer space films and cartoons.

In February 1984, 2 weeks before his death, he was removed from his isolator to a regular room across the hall. His view was restricted to the hospital's second-story roof and wings. Until then he had always watched for M.A.M. to park her car in front of the hospital. He asked, "Mary, where are you parking now?" To the reply, "The same place," he said, "Well, I guess you just can't break a habit." As to the garage where J.B.V. parked, he had only a vague idea, since he never saw it.

Few people were aware that David's percepts did not agree with objective reality. He understood this problem and in conversation was quick to cover errors. His relationship with both of us was such that he could discuss the discrepancy between his observations and assumptions and our descriptions of the physical world. Having lost trust in his own perception, he needed to check out reality with us.

LITERATURE AND COMMENTS

Our observations of David's perceptual development suggest that neither looking at buildings, photographs, and television nor the use of the power of cognition is a substitute for experience. Phenomena must be experienced to be learned.

In the 18th century British empiricist Bishop Berkeley argued that judgments made about depth, distance, and space were based entirely on memories of past experiences. We would agree. The literature on visual spatial perception, especially experimental studies, is voluminous, yet a survey produced only a few articles that had any relevance to David's case.[1-6]

Two dominant theorists, Gibson and Piaget, stress the importance of interaction with environment. We cannot fit our observations into Gibson's[7] framework: visual perception is direct and does not require interpretation or experience; the organism's locomotion and behavior are continually controlled by detecting information from the environment. David's description of his world as "flat" is the exact opposite of Gibson's (p 286) position:

> No one ever saw the world as flat patchwork of colors—no infant, no cataract patient, and not even Bishop Berkeley or Baron von Helmholtz, who believed firmly that the cues for depth were learned. The notion of a patchwork of colors comes from the art of painting, not from any unbiased description of visual experience.

Piaget's[8] theory that reality is constructed out of experience seems to hold the most promise in understanding David's perceptual development. Piaget's[9] passage could almost have been written by David:

> The sky seems to us a big spherical or elliptical cover on whose surface move images without depth which alternately interpenetrate and detach themselves: sun and moon, clouds, the stars as well as the blue, black, or gray spots which fill the interstices. It is only through patient observations relating the movements of these images and the way they mask each other, that we arrive at the kind of elaborating subjective groups. . . At first, with regard to immediate perception, there exist neither conscious groups nor permanent solids (the celestial bodies seem to be reabsorbed in each other and not to hide behind one another), nor even depth.

"If we passed our lives fixed to a solid object, as do oysters to a rock, and were deprived of movement and manipulations, our projective estimates would no doubt be excellent, but size constancy would probably not develop."[10] Piaget's oyster and rock can be seen as analogous to David and his bubble.

REFERENCES

1. Foley JM, Held R: Visually directed pointing as a function of target distance, direction, and available cues. Percept Psychophys 12:263–267, 1972
2. Fine BJ, Kobrick: Individual differences in distance estimation: Comparison of judgments in the field with those from projected slides of the same scene. Percept Mot Skills 57:3–14, 1983
3. Pick AD, Pick HL Jr: Culture and perception, in Carterette EC, Friedman MP (eds): Perceptual Ecology. Handbook of Perception, vol 10. New York, Academic Press, 1978
4. Deregowski JB: Pictorial perception and culture. Sci Am 227:82–88
5. Kennedy JM: Perception, pictures, and the etcetera principle, in Mac Leod RB, Pick HL Jr (eds): Perception: Essays in Honor of James J. Gibson. Ithaca, NY, Cornell University Press, 1974
6. Hochberg J, Brooks V: The perception of motion pictures, in Carterette EC, Friedman MP (eds): Perceptual Ecology. Handbook of Perception, vol 10. New York, Academic Press, 1978
7. Gibson JJ: The Ecological Approach to Visual Perception. Boston, Houghton Mifflin, 1979
8. Piaget J, Inhelder JL: The Child's Conception of Space (translated by FJ Langdon, JL Lunzer). London, Routledge & Kegan, 1956
9. Piaget J: The Construction of Reality in the Child (translated by M Cook). New York Basic Books, 1954, pp 144–145
10. Piaget J: The Mechanisms of Perception (translated by GN Seagrim). New York, Basic Books, 1969, p 228