

These same critics also claim that many articles are reporting on case studies demonstrating strong environmental influences on twins that Bouchard and Lykken fail to consider.

In addition, some researchers have voiced a major criticism of one aspect of twin research in general, referred to as the “equal environment assumption” (e.g., Joseph, 2002). This argument maintains that many of the conclusions drawn by Bouchard and Lykken about genetic influence assume that monozygotic and dizygotic twins raised together develop in identical environments. These critics maintain that such an assumption is not valid and that fraternal twins are treated far more differently than are identical twins. This, they contend, draws the entire method of twin research as a determinant of genetic influences into question. However, several other articles have refuted this criticism and supported the “equal environment assumption” (e.g., Kendler et al., 1993).

RECENT APPLICATIONS

In 1999, Bouchard reviewed the nature-nurture evidence from the Minnesota twin registries (Bouchard, 1999). He concluded that, overall, 40% of the variability in personality and 50% of the variability in intelligence appears to be genetically based. He also reiterated his position, discussed previously, that your genes drive your selection of environments and your selection or avoidance of specific personality-molding environments and behaviors.

Research at the Minnesota Center for Twin and Adoption Research continues to be very active. Some fascinating research has examined very complex human characteristics and behaviors that few would have even guessed to be genetically driven, such as love, divorce, and even death (see Minnesota Twin Family Study, 2007). These researchers have studied people’s selection of a mate to see if “falling in love” with Mr. or Ms. Right is genetically predisposed. It turns out that it is not. However, the researchers have found a genetic link to the likelihood of divorce, eating disorders, and age at the time of death.

Bouchard and Lykken’s research has been applied to the larger philosophical discussion of human cloning (see Agar, 2003). If a human being is ever successfully cloned, the question is, as you are probably thinking, to what extent will a person’s essence—an individual’s *personality*—be transferred to

immoral but were more concerned about the ethics underlying the *reasons* for human cloning. Of course, this is a philosophical discussion so far, but as the prospect of human cloning looms ever closer, it becomes increasingly important and interesting food for thought.

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Reading 4: WATCH OUT FOR THE VISUAL CLIFF!

Gibson, E. J., & Walk, R. D. (1960). The "visual cliff." *Scientific American*, 202(4), 67-71.

One of the most often told anecdotes in psychology concerns a man called S. B. (initials used to protect his privacy). S. B. had been blind his entire life until the age of 52, when he underwent a newly developed operation (the now-common corneal transplant) and his sight was restored. However, S. B.’s new ability to see did not mean that he automatically perceived what he saw the way the rest of us do. One important example of this became evident soon after the operation, before his vision had cleared completely. S. B. looked out his hospital window and was curious about the small objects he could see

depth. We might have run headlong into things, been unable to judge how far away a predator was, or stepped right off cliffs. Therefore, it might be logical to assume that depth perception is an inborn survival mechanism that does not require experience to develop. However, as Eleanor Gibson and Richard Walk point out in their article,

Human infants at the creeping and toddling stage are notoriously prone to falls from more or less high places. They must be kept from going over the brink by side panels on their cribs, gates on stairways, and the vigilance of adults. As their muscular coordination matures, they begin to avoid such accidents on their own. Common sense might suggest that the child learns to recognize falling-off places by experience—that is, by falling and hurting himself, (p. 64)

These researchers wanted to study this visual ability of depth perception scientifically in the laboratory. To do this, they conceived of and developed a remarkable research tool they called the *visual cliff*.

THEORETICAL PROPOSITIONS

If you wanted to find out at what point in the early developmental process animals or people are able to perceive depth, one way to do this would be to put them on the edge of a cliff and see if they are able to avoid falling off. This is a ridiculous suggestion because of the ethical considerations of the potential injury to participants who were unable to perceive depth (or, more specifically, height). The *visual cliff* avoids this problem because it presents the participant with what appears to be a drop-off, when no drop-off actually exists. Exactly how this is done will be explained shortly, but it is important first to recognize that the importance of this apparatus lies in the fact that human or animal infants can be placed on the visual cliff to see if they are able to perceive the drop-off and avoid it. If they are unable to do this and step off the “cliff,” there is no danger of falling.

Gibson and Walk took a “nativist” position on this topic: They believed that depth perception and the avoidance of a drop-off appear automatically as part of our original biological equipment and are not, therefore, products of experience. The opposing view, held by empiricists, contends that such abilities

checked pattern. Under the other half is the same pattern, but it is down at the level of the floor underneath the table (the deep side). At the edge of the shallow side, then, is the appearance of a sudden drop-off to the floor, although, in reality, the glass extends all the way across. Between the shallow and the deep sides is a center board about a foot wide. The process of testing infants using this device was extremely simple.

The participants for this study were 36 infants between the ages of 6 months and 14 months. The mothers of the infants also participated. Each infant was placed on the center board of the visual cliff and was then called by the mother, first from the deep side and then from the shallow side.

To compare the development of depth perception in humans with that in other baby animals, the visual cliff allowed for similar tests with other



FIGURE 4-1 Gibson and Walk's visual cliff.



FIGURE 4-2 The visual cliff in a testing situation. (Mark Richards/PhotoEdit, Inc.)

species (without a mother's beckoning, however). The baby animals were placed on the center board and observed to see if they could discriminate between the shallow and deep sides and avoid stepping off "the cliff." You can imagine the rather unique situation in the psychology labs at Cornell University when the various baby animals were brought in for testing. They included chicks, turtles, rats, lambs, kids (baby goats, that is), pigs, kittens, and puppies. One has to wonder if they were all tested on the same day!

Remember that the goal of this research was to examine whether depth perception is learned or innate. What makes this method so ingenious is that it allowed that question to at least begin to be answered. Infants, whether human or animal, cannot be *asked* if they perceive depth, and, as mentioned, human infants cannot be tested on real cliffs. In psychology, answers to perplexing questions are often found through the development of new methods for studying the questions. The results of Gibson and Walk's early study provide an excellent example of this.

RESULTS AND DISCUSSION

Nine children in the study refused to move at all off the center board. This was not explained by the researchers, but perhaps it was just infant stubbornness. When the mothers of the other 27 called to them from the shallow side, all the infants crawled off the board and crossed the glass. Only three of them, however, crept, with great hesitation, off the brink of the visual cliff when called by their mothers from the deep side. When called from the "cliff" side, most of the children either crawled away from the mother on the shallow side or cried in frustration at being unable to reach the mother

comparison. As you know, most nonhuman animals gain the ability to move about much sooner than humans. The results of the animal tests were extremely interesting in that the ability of the various animals to perceive depth developed in relation to when the species needed such a skill for survival.

For example, baby chickens must begin to scratch for their own food soon after hatching. When they were tested on the visual cliff at less than 24 hours of age, they never made the mistake of stepping off onto the deep side.

Kids and lambs are able to stand and walk very soon after birth. From the moment they first stood up, their response on the visual cliff was as accurate and predictable as that of the chicks. Not one error was made. When one of the researchers placed a one-day-old baby goat on the deep side of the glass, the goat became frightened and froze in a defensive posture. If it was then pushed over the shallow side, it would relax and jump forward onto the seemingly solid surface. This indicated that the visual sense was in complete control and that the animals' ability to feel the solidity of the glass on the deep side had no effect on the response.

For the rats, it was a different story. They did not appear to show any significant preference for the shallow side of the table. Why do you suppose this difference was found? Before you conclude that rats are just stupid, consider Gibson and Walk's much more likely explanation: A rat does not depend very much on vision to survive. Because it is nocturnal, a rat locates food by smell and moves around in the dark using cues from the stiff whiskers on its nose. So when a rat was placed on the center board, it was not fooled by the visual cliff because it was not using vision to decide which way to go. To the rat's whiskers, the glass on the deep side felt the same as the glass on the shallow side and, thus, the rat was just as likely to move off the center board to the deep side as to the shallow side.

You might expect the same results from kittens. They are basically nocturnal and have sensitive whiskers. However, cats are predators, not scavengers like rats. Therefore, they depend more on vision. And, accordingly, kittens were found to have excellent depth perception as soon as they were able to move on their own: at about 4 weeks.

Although at times this research article, and this discussion, risk sounding like a children's animal story, it has to be reported that the species with the

need to develop the ability to perceive depth by the time they achieve independent movement. For humans, this does not occur until around 6 months of age; for chickens and goats it is nearly immediate (by 1 day old); and for rats, cats, and dogs, it is about 4 weeks of age. The authors conclude, therefore, that this capacity is inborn because to learn it through trial and error would cause too many potentially fatal accidents.

If we are so well prepared biologically, why do children take so many falls? Gibson and Walk explained that human infants' perception of depth had matured sooner than had their skill in movement. During testing, many of the infants supported themselves on the deep side of the glass as they turned on the center board, and some even backed up onto the deep side as they began to crawl toward the mother across the shallow side. If the glass had not been there, some of the children would have fallen off the "cliff"!

CRITICISMS AND SUBSEQUENT RESEARCH

The most common criticism of the researchers' conclusions revolves around the question of whether they really proved that depth perception is innate in humans. As mentioned, by the time infants were tested on the visual cliff, they had already learned to avoid such situations. A later study placed younger infants, ages 2 to 5 months, on the glass over the deep side of the visual cliff. Unless this happened, all the babies showed a decrease in heart rate. Such a decrease is thought to be a sign of interest, not fear, which is accompanied by heart rate increases (Campos et al., 1978). This indicates that these younger infants had not yet learned to fear the drop-off and would learn the avoidance behavior somewhat later. These findings argued against Gibson and Walk's position.

It is important to notice, however, that although there was and still is controversy over just when we are able to perceive depth (the nativists vs. the empiricists), much of the research that is done to find the answer incorporates the visual cliff apparatus developed by Gibson and Walk. In addition, other related research using the visual cliff has turned up some fascinating findings.

One example is the work of Sorce et al. (1985), who put 1-year-old infants on a visual cliff for which the drop-off was neither shallow nor deep

Gibson and Walk's groundbreaking invention of the visual cliff still exerts a major influence on current studies of human development, perception, emotion, and even mental health. The following is a brief sample.

A study by Berger and Adolph (2003) cited Gibson and Walk's early study in their research on how toddlers analyze the characteristics of tasks involving heights, specifically crossing over a bridge. The researchers coaxed very young toddlers (16 months) to cross bridges of various widths, some with handrails, some without. They found that the children were significantly more likely to cross wider bridges than narrower ones (pretty smart for 16 months!). More interesting, however, was the finding that the toddlers were more likely to attempt the narrow bridge if it had handrails: "Infants who explored the bridge and handrail before stepping onto the bridge and devised alternative bridge-crossing strategies were more likely to cross successfully. [These] results challenge traditional conceptualizations of tools: babies used the handrail as a means for augmenting balance and for carrying out an otherwise impossible goal-directed task" (p. 594).

How about using the concept of a *technological* visual cliff to help people with severe *acrophobia* (an irrational fear of heights)? This is a very common phobia affecting about 1 in 20 people. If you are a therapist and would like to have your acrophobic clients "face their fear of heights," you will not have very many customers. Why? Because they are too scared! When someone has a true phobia he or she will do *anything* to avoid the feared object or situation. One study incorporating Gibson and Walk's study found that the therapeutic effectiveness of a *virtual drop*, while still eliciting fear in the acrophobe, found it was less threatening for the client, which allowed for more effective therapy to reduce the irrational fear without ever leaving the therapist's office (Coelho et al., 2009).

CONCLUSION

Through the inventiveness of Gibson and Walk, behavioral scientists have been able to study depth perception in a clear and systematic way. Behavioral scientists continue to debate the question of whether this and other perceptual

- Coelho, C., Waters, A., Hine, T., & Wallis, G. (2009). The use of virtual reality in acrophobia research and treatment. *Journal of Anxiety Disorders*, 23, 563-574.
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The study of perception and consciousness is of great interest to psychologists because these activities define and reveal much of your psychological interaction with your environment. Think for a moment about how your senses are bombarded constantly by millions of pieces of information from the combined stimuli that surround you at any given moment. It is impossible for your brain to process all of it, so your brain organizes this barrage of sensory data into sets of information that yield form and meaning. That's what psychologists refer to as *perception*.

Clearly, your level of *consciousness*, also commonly referred to as your *state of awareness*, governs to a large extent what you perceive and how your brain organizes it. As you go through your day, night, week, year, and life, you experience many and varied states of awareness: You concentrate (or not), daydream, fantasize, sleep, dream; maybe you've been hypnotized at some point or used psychoactive drugs (even caffeine and nicotine are psychoactive drugs!). These varying mental conditions are all altered states of consciousness that produce changes in your perceptions of the world that, in turn, influence your behavior.

Within the research areas of perception and consciousness, some of the most influential and interesting studies have focused on perceptual abilities in early childhood, sleep, dreams, and hypnosis. This section begins with a famous and influential study that contributed a brilliant and remarkable method that allows researchers to study the thinking processes, the *perceptions*, of preverbal infants as young as a few days old. This method, called *preference looking*, provides insights into the functioning of infants' brains and how they conceptualize the world. The second reading contains two articles that changed psychology because they (1) discovered rapid eye movement (REM) sleep and (2) revealed the relationship between REM and dreaming. Third is an influential and controversial study proposing that dreams are not mysterious messages from your unconscious, as Freud and others suggested (and as you probably believe), but rather that dreams are the result of purely random, electrochemical impulses firing off in your brain while you sleep. Fourth is