Fundamentally Misunderstanding Visual Perception

Adults' Belief in Visual Emissions

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The authors reviewed research about a profound misconception that is present among college students, namely, the belief that the process of vision includes emanations from the eyes, an idea that is consistent with the extramission theory of perception, *which was originally professed by early Greek philosophers and which persisted in scholarly circles for centuries. The authors document the strength and breadth of this phenomenon and the abject failure of traditional educational techniques to overcome this belief, and they reveal that students are leaving psychology courses with a flawed understanding of one of the most studied processes in the history of psychology—visual perception. Some suggestions are offered for overcoming this misconception in traditional college classroom settings.*

How much of people's thinking is based on false ideas? Research on scientific misconceptions was stimulated by investigators who showed that people typically cannot solve problems that involve an understanding of simple physics.[1] For example, in what are now classic studies, McCloskey and others (e.g., Kaiser, McCloskey, & Proffitt, 1986; Kaiser, Proffitt, & McCloskey, 1985; McCloskey, Caramazza, & Green, 1980; McCloskey, Washburn, & Felch, 1983) showed that adults and children often cannot predict the correct trajectory of moving objects. Participants believed, for example, that objects projected from a curved tube or pipe would continue to follow a curved path (e.g., Kaiser et al., 1986; McCloskey et al., 1980). These researchers also showed that people do not realize that an object dropped from a moving carrier, such as an airplane, will follow a curved path in falling (Kaiser et al., 1985; McCloskey et al., 1983).

Since these early findings, research in the area of misconceptions in science has virtually exploded. Countless studies (see Novak, 1987, for a compendium of early research) have demonstrated a variety of scientific misunderstandings, with many studies revealing how difficult it is to overcome erroneous beliefs through traditional forms of education (Chinn & Brewer, 1993; Guzzetti, Snyder, Glass, & Gamas, 1993; Sandoval, 1995). Most of these studies, however, have involved misconceptions about the physical sciences, whereas others have dealt with geographical and biological phenomena.

Researchers in the scientific misconceptions field have relatively ignored the understanding of psychological processes, at least in older children and adults. The study of the understanding of light and vision, however, is one area of research that has examined people's understanding of psychological as well as physical functioning. For example, several investigators have shown that children have a poor understanding of the nature of light (Anderson & Smith, 1986; Eaton, Anderson, & Smith, 1984; Guesne, 1984, 1985; Kärrqvist & Andersson, 1983). Children also often do not understand the connection between light and vision (Guesne, 1984, 1985; Kärrqvist & Andersson, 1983) and sometimes believe that the eye is an active agent and not simply a receptor that detects light (see Guesne, 1985).

Piaget (1929/1967), however, was perhaps the first to note an odd type of misunderstanding that children have about vision. He commented on a report of a child who stated that looks can mix when they meet, and, along with other observations, Piaget suggested that children believe in emissions from the eyes during vision. In an apparently unpublished work, Piaget (referenced in Piaget, 1971/1974) claimed to have found strong evidence of extramission beliefs in children.

When Piaget (1929/1967) made his observation, he also noted that the child's misunderstanding corresponded to the theory of the ancient Greek philosopher Empedocles, a theory often referred to by current historians of science as the extramission theory of visual perception. Other ancient philosophers, such as Plato, Euclid, and Ptolemy, shared the same idea. (For reviews documenting the presence of extramission beliefs among ancient philosophers, see Gross, 1999; Lindberg, 1976; Meyering, 1989). In 1490, Leonardo da Vinci included extramissionist statements in his notebooks (Ackerman, 1978, pp. 126–128), and it is

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[1] Currently, it is fashionable among some writers to argue that what were termed *scientific misconceptions* are merely misunderstandings, perhaps not indistinguishable from other failures to understand.

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Gerald A. Winer

possible that such beliefs existed in some scientific circles until Kepler's work on the retinal image early in the 17th century (see Lindberg, 1976, for a discussion of Kepler's work).

Reports on children's understanding of light and vision have provided data supporting Piaget's (1929/1967) observation that children hold extramission beliefs (e.g., Guesne, 1984, 1985; Kärrqvist & Andersson, 1983). However, evidence for this misconception has sometimes been ignored by writers or perhaps considered peripheral to other misunderstandings regarding light. Thus, Guesne (1985) reported findings for what seemed to be extramission beliefs, but she also seemed to deny that her data provided evidence for extramission conceptions, at least of the type resembling those described by ancient philosophers:

> For children the movement that goes from the eyes to the object remains abstract. It is thus clearly differentiated from the "visual fire" of early theories, from the "fluid" emitted by the eyes of witches in fairy tales or from the red rays that are beamed from Superman's eyes. Only the idea that the subject is at the origin of a process, instead of being at the receiving end, is common to these various ways of portraying sight. (Guesne, 1985, p. 26)

Guesne (1985) also mentioned that evidence for the existence of these beliefs in children was scanty and admonished the reader not to give the idea undue importance, despite its appeal.

Following Piaget's (1929/1967, 1974) lead, we examined the responses of children and adults to questions asking whether there was visual input and/or output during the act of perception (e.g., Cottrell & Winer, 1994; see Winer & Cottrell, 1996a, for a review of several studies). This research revealed widespread evidence of extramission beliefs among children, with a decline in such beliefs over age. We were, however, startled to find that, despite consistent developmental trends toward decreasing extramission beliefs with age, large numbers of adults also affirmed a belief in visual extramissions. Apparently some college students were behaving like prescientific ancient philosophers in affirming an extramission understanding of vision that is entirely at odds with the theories of modern science.

Perhaps even more disturbing to us was the strong likelihood that this misconception existed despite our participants' having received formal education on the topics of sensation and perception. For example, we typically found extramission beliefs among college students who were tested after they had received instruction on sensation and perception in introductory psychology classes, thus suggesting not only that adults were affirming extramission beliefs but that such beliefs were resistant to education. We were confronted, then, with the likelihood that students were emerging from basic-level psychology courses without an understanding of one of the most important psychological processes, namely, visual perception. In fact, Meyering (1989), in emphasizing the constructive nature of vision, claimed that it was the understanding of vision in the history of science that provided the groundwork for the emergence of cognitive science.

In this article, we review evidence for the presence of extramission beliefs in adults. We demonstrate that such beliefs occur across a wide variety of measures, that they are supported by participants' responses to follow-up questions to our tests, that they are highly resistant to common educational classroom experiences, and that college students are leaving basic psychology courses with a profound misconception about the nature of the visual system.

Breadth of the Misconception: Evidence That Extramission Beliefs Exist Across a Wide Range of Questions Given Under a Variety of Conditions

The test most recently used to examine extramission beliefs involves computer representations of vision (see Gregg, Winer, Cottrell, Hedman, & Fournier, 2001; Winer, Cottrell, Karefilaki, & Gregg, 1996). We typically instructed participants that we were interested in how vision occurs, sometimes adding that we were specifically concerned with whether anything, like rays or waves, comes into or goes out of the eyes when people see. We then presented a series of trials in which we simultaneously displayed on a computer screen various representations of vision that involved different combinations of input and output. The participants then indicated which representation they thought depicted how or why people see.

Each graphic representation showed a profile of a face on one side of the screen. The face was staring at a green rectangle (identified as a block), which was on the other side of the screen, diametrically opposite the eye of the profile. Dots were shown moving in lines between the eye of the profile and the rectangle in one of five possible ways:

Jane E. Cottrell

(a) from the rectangle toward the eye (demonstrating pure visual input, the only technically correct interpretation); (b) from the eye toward the rectangle (representing pure extramission); (c) from the rectangle toward the eye and then back toward the rectangle (representing input followed by output); (d) from the eye toward the rectangle and then returning to the eye (indicating output followed by input); and (e) simultaneously toward and away from the eye (demonstrating simultaneous input and output).

In our most frequently used test, the correct representation, visual input, was presented on the screen with one, two, or three alternative representations of vision. For example, on a trial involving a choice among three alternatives (input, output, and input followed by output), the participant saw three profiles vertically aligned on the left side of the screen, each staring at one of three green blocks presented on the right side of the screen. To demonstrate visual input, several dotted lines emerged from different points on the block, traveled across the screen, and converged as they entered the eye. To demonstrate visual output, dotted lines moved in the opposite direction, emerging from the eye and fanning out to reach several points on the block on the opposite side of the screen. The input–output choice was a combination of the prior representations, with dotted lines first converging on the eye from the block and then fanning out from the eye back to the block.

On each trial, participants were told, depending on the choices presented, something like the following: This shows rays, waves, or energy coming into the eye, going out of the eye, first coming into the eye and then going back out, first going out of the eye and then coming back in, or coming into the eye and going out at the same time. Which one shows how or why we see? (Gregg et al., 2001, pp. 622–623; Winer, Cottrell, Karefilaki, & Gregg, 1996, pp. 505, 509). In addition, we almost always included a purely verbal item (i.e., without computer graphics) at the end of the testing session. This item required participants to choose the correct option given all five options (input, output, input followed by output, output followed by input, and simultaneous input and output).

On such intromission–extramission (i-e) tests, large numbers of adults gave extramission responses, with the percentages varying depending on the particular representations of vision shown on the screen. For example, in one study (Winer, Cottrell, Karefilaki, & Gregg, 1996), when given a simple choice between input versus output, approximately 13% of the adults selected output only. When available, however, the favored extramission choices were representations that showed (a) simultaneous input and output and (b) input followed by output. On trials that included these favorite choices, the percentage of extramission responses ranged from 41% to 67% (the greater the number of preferred choices offered, the greater the frequency of extramission responses). Data presented later in this article (Gregg et al., 2001) likewise show more than 50% of adults giving extramission responses. It is interesting that the favored representations (input followed by output or simultaneous input and output) do not match what some of the early philosophers claimed about vision. For example, Plato believed in a fiery essence coming from the eye and coalescing with the object of visual regard, after which there was apparently some input. That is, he apparently believed that visual output was followed by input.

Extramission interpretations among adults are not limited to tests involving computer representations. We have asked i-e questions in a purely verbal fashion, using items of different types, such as yes–no and forced-choice questions (Cottrell & Winer, 1994). We have also asked questions that made reference to drawings, with input and output represented by arrowheads on lines extending between a profile of a face and an object of visual regard (Winer & Cottrell, 1996b). Participants were expected to choose the representation indicating vision. We have also presented a pictorial representation of a profile of a face apparently looking at an object directly ahead, with lines extending between the eye of the face and the visual referent; participants were required to draw arrowheads to indicate the process of vision (Winer & Cottrell, 1996b). In other cases, participants saw just a profile of a face staring at an object and were required to draw lines, with the direction of the movement of the pencil (i.e., toward or away from the eye) serving as the dependent variable (Winer & Cottrell, 1996b). In all of these cases, we found convincing evidence for extramission beliefs. For example, when students were asked to draw and number arrows to show how a person sees a balloon, 86% showed some evidence of extramission (i.e., outward arrows), whereas when adults were repeatedly asked specifically to draw whether something comes into or goes out of the eyes when a person sees a balloon, 69% placed outward-pointing arrows in their drawings.

The medium of a test does make a difference, however. Drawing items seemed to yield the highest frequency

Virginia Gregg

of extramission responses (see Winer & Cottrell, 1996b), and computer items sometimes yielded more extramission responses than purely verbal items (Winer, Cottrell, Karefilaki, & Gregg, 1996). Whatever the test, we have consistently found substantial numbers of college students reporting extramission beliefs.

We have also varied the visual referent in our questions, with disturbing findings. In one noncomputer test, we asked students about vision when presenting them with different visual referents, namely a shining light bulb, the same bulb unlit, and a white Styrofoam ball approximately the same size as the unlit bulb (Winer, Cottrell, Karefilaki, & Chronister, 1996). We expected that referring to the lit bulb would diminish extramission responses—indeed, that it would be nearly impossible to maintain extramission beliefs in reference to light shining in one's face. We also assumed that initial intromission responses, encouraged by reference to the shining light bulb, would generalize. That is, we expected positive transfer from questions about the shining light bulb to subsequent questions about the nonluminous objects.

The results supported the idea that asking i-e questions about a shining light would cause a decrease in extramission responses. But asking about the lit bulb did not even come close to eliminating extramission beliefs: 33% of the adults tested affirmed extramission in reference to viewing the lit bulb. Moreover, there was no sign of positive transfer from questions about the lit bulb to questions about the nonluminous objects. In fact, the opposite occurred. When we switched from the lit bulb to the nonluminous objects, there was an increase in extramission responses, as if turning off the light signaled that there were no more incoming rays.

Although extramission beliefs have been demonstrated across a wide variety of tests, one might still argue that the impact of these beliefs is highly specific and not of major significance to psychology in general. How do we know that we are not dealing with students who are basically missing a single item on an exam? There is evidence that extramission beliefs are not limited to visual perception. In some of our early work (Cottrell & Winer, 1994), we asked simple i-e questions about hearing and olfaction, as well as vision, and we found that participants also gave extramission responses on nonvision items.

Responses to questions about olfaction are difficult to interpret because there are naturally occurring emissions from the nose during the course of smelling. And, in the case of audition, there actually are auditory outputs, a phenomenon known as otoacoustic emissions (Yost, 1994). In fact, Norwich (1993), theorizing on the basis of touch and feeling, has proposed that there might be emissions in vision, although he admitted that visual extramission has not been experimentally demonstrated.[2] However, we can reasonably assume that participants in our studies—and indeed most psychologists—are unaware of otoacoustic emissions and Norwich's theorizing. In any event, college students also affirmed auditory and olfactory extramissions.

The Validity of Extramission Questions: Are Extramission Interpretations an Artifact of the Question Asked?

Initially it seemed possible that extramission beliefs were an artifact and an epiphenomenon. For example, when people affirmed the presence of rays or the like leaving the eye, they might have meant output that is essentially nonfunctional when it comes to vision. Such rays might represent random reflections or perhaps something akin to the photographic phenomenon of red eye, which is caused by the reflection of light off the retina and which is indeed an extramission. Or perhaps participants assumed that when we asked about emissions from the eye, we were referring to messages sent from the eye, say, to the brain.

Considerable evidence has indicated, however, that the extramission questions were tapping extramission beliefs. The items presented on the computer screen would be difficult to misinterpret as referring to merely a random emission or to only something that leaves the eye and travels to the brain. In fact, we resorted to using animated computer graphics precisely to prevent such misinterpretations.

Moreover, several types of data allow us to argue against the idea that extramission responses represent beliefs in random reflections or other kinds of nonfunctional emissions. First, we have routinely asked questions about the necessity of extramissions for vision. For example, we have asked whether a person can see if nothing leaves the eye and whether what exits the eye helps people see. In one study, at least 70% of adult participants who reported

[2] We thank Lester Krueger for this reference.

Jody S. Fournier

extramission beliefs on the last question of the test stated on one of the probe questions that they believed visual extramissions were functional in vision. Second, we have directly tested for the possibility that extramission interpretations were due to participants misinterpreting i-e questions. In his master's thesis, Rader (1996) gave college students intensive training on the concept of necessity, before asking them specifically whether it was necessary that something leave the eye during the act of vision. The training had no effect on responses to i-e questions. In fact, many participants who affirmed on a pretest question that something exiting the nose was not necessary for olfaction went on to claim that visual extramissions were necessary for seeing.

The Impact of Educational Experiences

In a series of experiments (Gregg et al., 2001), we investigated the impact on vision knowledge of traditional classroom and course experiences, along with focused readings containing pertinent information about visual perception. A pilot study showed no difference between college students tested before and after course work on vision (defined as reading assignments, lectures, and a midterm test). We (Gregg et al., 2001) then turned to a design in which we presented readings on vision immediately before extramission tests for students who either had or had not yet learned about visual perception in their introductory psychology courses. Experimental students received a reading on vision immediately prior to the i-e tests; control participants received a reading unrelated to vision. We assumed that extramission responses were not resulting from a failure to understand facts about vision but rather that they occurred because people did not access previously acquired information and instead responded intuitively. More specifically, we hypothesized that people entertain both scientifically correct and incorrect or intuitive theories about vision. When asked i-e questions in the absence of a technical context, people might be expected to reason on the basis of intuition. However, if asked the same questions in the context of a scientifically acceptable account of vision, participants should reject the extramission notion. We predicted that having the students read an account of vision from an introductory psychology text would provide such a context.

One study using this design (Gregg et al., 2001) compared a group of college students who were given a reading on visual processing immediately prior to receiving the i-e tests with two control groups: one that received a reading on audition and one that received no reading before being given the i-e tests. A second study using this design (Gregg et al., 2001) compared control participants who received a reading on John Watson prior to i-e tests with two experimental groups that received initial readings on vision. In one experimental group, participants merely received the reading followed by the i-e computer and single verbal test trials, as was the case in the first study. In the other experimental group, participants were told, prior to receiving the reading, that they were going to be tested on what they were about to read (i.e., the subsequent test was presented as a test on the reading). The readings in the two experiments came from different well-known college introductory psychology textbooks, and they clearly described the projection of light on the retina, the parts of the eye, and communication between the eye and the brain. As indicated, students received the experimental or control reading conditions before or after their introductory psychology courses covered sensation and perception.

These experiments showed virtually no evidence of learning. The first study showed no effects from either classroom experiences or specific readings. The second study showed some possible effects for women tested before their classroom work on vision, but that outcome appeared to have been due to an unusually low performance by women in the control group, rather than to the effects of the readings. In any case, all of the women's scores were extremely low. Of a possible total of 8 correct, the highest average score shown by any group of women was 4.8. In fact, all the scores were low, irrespective of sex: 54% of control students versus 60% of experimental students in the total sample answered 4 or more of 8 questions incorrectly. In subsequent unpublished studies, we tried a number of variations on the readings (e.g., simplifying them), but to no avail. In summary, we found no evidence that traditional readings presented immediately before the test, formal classroom experiences, or the combination of both improved performance on i-e tests.

Two training procedures, however, have led to statistically significant decreases in the number of extramission interpretations, although large numbers of participants often remained unaffected. Gregg et al. (2001) compared the effects of three conditions on the responses of fifth and eighth graders, as well as college students, to i-e questions.

Lori A. Bica

In one condition, experimental participants were shown a videotaped lecture that contained a simplified explanation of vision, so simple in fact that it was understandable to fifth graders. In a second condition, we added to the same videotaped lecture explicit statements explaining that during the act of vision nothing leaves the eye. These refutational statements occurred at both the beginning and the end of the video lecture, and in one instance, involved reference to fictional characters (i.e., Superman and the X-Men), stressing that although these characters produce emissions from their eyes, in reality nothing has to leave the eyes for seeing to occur. Previous research on scientific misconceptions has shown that refutational messages in reading content can overcome some scientific misconceptions (see Guzzetti et al., 1993). In a third (control) condition, participants were instructed on a topic irrelevant to vision, namely, weight conservation. Seven computer-based i-e questions and an eighth purely verbal item were administered at two times: immediately after the lecture and three to five months later.

The results showed condition effects. For the fifth graders, both experimental groups had higher scores than the control group, with no difference between the immediate and delayed tests. However, for the eighth graders, only the immediate test was affected, with only the refutational condition producing higher scores than the control condition. The college students' scores likewise showed evidence of only short-term effects. However, in the college sample, all three groups were different: The refutational group had the highest number of pure intromission answers, and the control group had the lowest number. Thus, we were able to demonstrate some learning effects.

The fact that the learning effects for both college students and eighth graders disappeared was striking. Consider, for example, the performance of the college students, who were presumably the most cognitively advanced. On the first posttest, 100% of the students in the refutational group had five or more of eight items correct, compared with 54% in the simplified-explanation group and 29% in the control group. On the delayed test, 7 of the 17 college students who returned for testing in the refutational-teaching group had fewer than five of the eight items correct. Recall that no student in this group had fewer than five items correct at Time 1. Moreover, of the 7 whose performance declined, 6 had had perfect scores at Time 1. The long-term ineffectiveness of the training for the college students is further revealed by the fact that 53% of the participants in the two experimental groups at that grade level had four or fewer correct responses.

The finding that the simplified-explanation condition produced short-term effects for college students warrants a comment. We had never before found a consistent effect from providing readings from college texts on vision or from examining the impact of introductory psychology course units. What then accounted for the effect of the simplified-explanation condition?

Subsequent research ruled out the medium of presentation as a variable that could explain the enhanced performance shown by the simplified-explanation condition. When we presented the same videotaped script in the form of a reading passage, we found the same type of effect on immediate posttests (Gregg et al., 2001). Delayed posttests were not used in the reading studies. The short-term effect appeared, then, to have been a function of the message and could be attributed to either of two variables: (a) the simplicity of the message—the message was obviously much less complex than the college-level reading material previously used; or (b) the frequency with which visual input was mentioned—about 20 times in the short video message and the corresponding reading. Because any attempts before, and indeed all attempts after, that experiment did not show that simplification of college-level textbook passages on vision had an impact on i-e responses, it seems likely that repetition of the visual input message accounted for the decline in extramission responses. However, we should also point out that in reducing the level of difficulty of readings based on college texts, we had never before simplified them to a fifth-grade level.

It is interesting that only the fifth graders demonstrated learning effects that were not limited to the initial testing. One possible explanation for this outcome is that with increasing age, extramission responses become more firmly entrenched. Nevertheless, the interaction of age and condition warrants further investigation.

Why are extramission beliefs so difficult to overcome by training? One answer lies in the explanation of the origins of this misunderstanding. Our account is based on the contributions of diSessa (1993), who claimed that underlying scientific misconceptions are primitive, phenomenological experiences (termed *p-prims*), and on Werner's (1948, 1957) theory of development. One phenomenological experience, very much evident in vision, is an orienting response. Vision is generally thought of as directed out-

ward, away from the self, toward specific objects. This outer-oriented, dynamic quality of seeing might be at the heart of the extramission bias, because it may be that when asked about vision, people may syncretically fuse their phenomenological, outer-directed experience of vision with their beliefs about the nature of the act of seeing (Werner's, 1948, 1957, approach adds the notion of syncresis to diSessa's, 1993, approach). Presumably these erroneous notions also coexist with scientifically acceptable ones, without people seeing the inconsistency. Evidence consistent with our interpretation has shown that extramission beliefs increase in conditions that are designed to stress the outer-directed quality of visual experiences (see Winer & Cottrell, 1996b; Winer, Cottrell, Karefilaki, & Gregg, 1996).

Summary and Recommendations

We have shown that many college students believe in visual extramissions, as shown by a variety of measures and probes, and what we find most significant and surprising is that this belief is extremely resistant to standard educational experiences that seem as though they should counteract the misunderstanding. In fact, even when many college students showed evidence of overcoming the misconception because of a specific type of educational input, over time the gains proved to be transitory.

The results of these learning studies have several implications. They show that the belief in extramission is apparently deeply ingrained and that this misconception is like other misconceptions in science in its resistance to educational efforts. Our learning studies also point to the failure of traditional psychology instruction to convey a correct understanding of vision. Apparently, although acquiring information such as the names and functions of parts of the eye, many college students are not understanding the process of vision itself. The information they acquire is simply not sufficient to enable them to overcome the extramission notion. Correct ideas about the process of vision can seemingly coexist with incorrect ones, and the contradiction is not noticed.

It is clear that psychology instructors should counteract extramission ideas in teaching about visual perception. Our research by no means indicates that it is impossible to overcome extramission beliefs. The ineffective learning studies described in this article measured only the impact of short-term interventions and the impact of standard educational experiences that students received in their introductory psychology courses. We assume, for example, that if we were to spend more time giving several lessons on vision, we could make a sizeable dent in this misconception, although this does not seem to be very practical, given typical time constraints.

A number of programs and techniques designed to aid in the process of educating people to overcome scientific misconceptions might also be considered for classroom use. One relatively simple technique, termed *activation*, is to alert the participants to their mistaken beliefs, say by means of a pretest, before presenting instruction. The instruction then presumably clashes with the students' awareness of their beliefs. Augmented activation (Alvermann & Hynd, 1989; Dreyfus, Jungwirth, & Eliovitch, 1990; see Guzzetti et al., 1993, for a review of activation used in reading studies) forewarns the participant about the clash between the misconception and the learning content that is to follow.

A related strategy is to foster logical or cognitive dissonance. In one pilot study, for example, when we were trying to explore the breadth of the extramission misunderstanding, one participant tenaciously defended his extramission beliefs until we asked him whether someone would be able to see the image coming from his eyes, at which point he acknowledged, rather sheepishly, that nothing has to leave the eyes in order for people to see. Another strategy is to use analogies to overcome this misconception. Research has demonstrated that analogies (Dagher, 1994; Harrison & Treagust, 1993; Thagard, 1992) are sometimes useful in overcoming misconceptions, especially under certain conditions (Clement, 1993). Notice, though, that both of the aforementioned techniques involve directing the attention of students to the misconception.

One other possibility is to introduce the topic of scientific misconceptions in introductory psychology courses when presenting material that is subject to mistaken beliefs. Students would probably find many scientific misconceptions interesting, and extramission beliefs could then be identified as an instance of these apparent oddities of thought. This would have the advantage of providing not only cognitive dissonance but also another body of information to which intromission beliefs might be connected. Whatever the technique, there is no doubt that psychology educators need to counteract a misconception that deals with one of the most fundamental areas of their discipline.

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