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The development of theories of visual perception: Implicit and explicit extramission beliefs

Cottrell, Jane Eleanor, Ph.D.

The Ohio State University, 1992

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THE DEVELOPMENT OF THEORIES OF VISUAL PERCEPTION: IMPLICIT AND EXPLICIT EXTRAMISSION BELIEFS

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree Doctor of Philosophy in the Graduate School of The Ohio State University

By
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* * * * *

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CHAPTER I
INTRODUCTION

One of the enduring questions in the history of science and of psychology has been that of the nature of vision. Beginning with the inquiries of ancient Greek philosophers, attempts to understand how our eyes function in perceiving the world have been conducted through two quite different channels of cognition: (1) formal investigations into the nature of visual processes and how these relate to psychological and cognitive processes; (2) informal observations of the effects of vision interpreted through implicitly held notions about the power of the human eye and its gaze. So important was the knowledge gained through the first channel of inquiry that a philosopher of science, T. S. Meyering (1989), has suggested that the cognitive revolution in psychology as we know it would not have been possible without breakthroughs in the understanding of visual processes. So compelling have been the observations conducted through the second channel that personal beliefs about the power of our eyes to affect the objects of our gaze seem to have changed little since ancient times.

This dissertation is a study of both kinds of understanding in children and adults. The primary focus of interest is on the explicit theories people hold regarding the functioning of visual processing, for these theories
constitute a main component of our knowledge of human perceptual processes in general and of our theory of mind in particular, i.e. the system of inferences that allows us to impute perceptual and cognitive processes, as well as mental states to ourselves and to others (Premack & Woodruff, 1978). The second area of investigation involves our personal notions of visual processes, and our beliefs about the effects of our gaze upon the objects of our vision. These beliefs constitute our implicit, personal theory of visual perception. Although personal, and constructed from individual experiences, these implicit theories of visual perception also have historical roots in a long tradition of cross-cultural superstitions involving emissions from the eyes, which are with us still today, known as the evil eye.

Explicit Theories of Visual Processing

Throughout most of recorded human history two opposing theories of visual processing existed side by side, each supported by eminent philosophers, scientists, and artists: the intromission theory, which proposed that rays enter the eyes and produce some kind of change in them that causes us to see; and the extramission theory, according to which rays are emitted from the eyes and strike an object, which then sends back its image along the rays. The two theories continued to be pitted against each other in active philosophical debate until the discovery of the retina in the seventeenth century when the issue could finally be settled with indisputable scientific evidence in support of the intromission theory. (For a history of the theories of vision and a discussion of the role of
Kepler and Descartes in the understanding of visual processing see Meyering, 1989, ch. 6, and Arnauld, 1990, Intro. pp. 4-17).

Beliefs about visual perception have been traditionally associated with the quality and accuracy of our knowledge about the world. Whether, for example, our eyes see reality in an undistorted enough manner so that we can act on the information they provide has been a matter of philosophical debate since Descartes. According to historians of science, it was only after optics advanced enough through understanding of the basic functioning of the retina that cognition could begin to be separated from vision (Lindberg, 1976; Meyering, 1989).

Quite apart from scientific discoveries in optics and anatomy, vision has, throughout history, retained its position as the prime instrument of understanding, knowledge acquisition, and knowledge verification. A number of expressions in English and in the other languages of western Europe relate to notions of visual processing that were formulated in the ancient world: *I see* meaning *I understand* is probably the most common; *see for yourself*, *seeing is believing*, *the eyes are the windows of the soul* are examples of other expressions that have persisted in our language for centuries.

Although the issue of rays entering the eyes or emanating from them has been settled for almost 400 years, is it possible that people might still, on some level, believe in the extramission theory, even if they do not explicitly admit to it? Is there, furthermore, a developmental change in extramission perception beliefs, with young children holding such beliefs most frequently and adults less frequently? Piaget (1929) reported
observing three children who believed that their looks would "mix or meet" when they viewed the same object, an example of an implicit extramission belief. No specific follow-up research on this issue has been found in developmental literature.

Personal Beliefs About Visual Functioning

Our personal notions of visual processes exert extensive influence on our theory of mind, ranging from inferences we make about the behavior of other people based on our assessment of what they have or have not seen, to superstitions about the evil eye. Between these two extremes we regularly engage in assessments about people who do or do not make eye contact with us and note when we feel we are being stared at by other people, often speculating about the reasons we may be an object of their attention. Such attention is often unwanted, especially from strangers whose motives we cannot easily determine, but even from people with whom we have close relationships. We quickly become aware of someone staring at us, especially if we interpret their look as searching, penetrating, cutting, withering, or if they "look daggers at us"—all of which, of course, suggest that something emanates from the eyes.

Thus, the topic of the nature of vision has its roots in the philosophical schools of the ancient world, especially those of Aristotle and of Plato. The subject of visual perception has, however, continued to be a relevant area of inquiry in every succeeding century, including our own, mainly because it has been so closely associated with theories of cognition. Although subject to illusion and prone to error, visual perception more than any other
sensory activity has, since the time of recorded history, been considered a major source of human knowledge (see Meyering, 1989).

**Purpose and Goals**

The overall purpose of this research was to investigate the two channels of cognition about visual processing. More specifically, it was: to determine whether children and adults in significant numbers subscribe to extramission theories of perception; and to investigate the possibility of developmental trends in implicit and explicit intromission/extramission beliefs by questioning children beginning at about the age of 6 years (first grade) as well as adults (college students) about their experiences and beliefs regarding visual perception.

Major goals were: to replicate in face-to-face interviews the findings from paper-and-pencil questionnaires used in pilot and other preliminary research, which had revealed that surprisingly large numbers of subjects of all ages, but especially children, subscribed to extramission beliefs (Winer & Cottrell, 1991); and to investigate how people who subscribe to an extramission theory of perception (implicit or explicit) while having knowledge of the scientifically correct intromission theory can explain the disparity inherent in holding both theories simultaneously.

Another set of goals was related to the second channel of cognition, involving the effects of our visual processes and the beliefs people hold about visual perception in interpersonal relations. These goals were addressed in a series of questions we called "feeling-the-eyes-of-the-other." The pilot research conducted by Winer and Cottrell (1990-1991)
found that almost all college students said they had had the experience of feeling that someone was staring at them without actually seeing the other person's eyes. Furthermore, virtually all of them said that they believed other people had had the same type of experience in feeling someone staring at them. Ninth- and tenth-graders, and even sixth-graders also responded overwhelmingly that they and other people had had feeling-the-eyes-of-the-other experiences. Given these responses from older children and college students, an important question underlying the dissertation research in this area of investigation was: What about younger children? Have early elementary school children also experienced someone staring at them, and did they think other people might have had the same kind of experience?

The responses to the feeling the eyes of the other questions might, it was hoped, provide another measure of children's awareness of visual processes. In addition, it was thought that they might also provide an indication of levels of egocentrism and perspective-taking if significant differences in answers to this set of questions were found between age groups.

The Winer and Cottrell pilot research also questioned subjects about feeling-the-eyes-of-the-other experiences between humans and animals. Results indicated that more subjects believed an animal could feel them staring but that they probably could not feel an animal staring at them without seeing its eyes. Might there be age differences here too, and perhaps indications of a development in differentiating the effects of human eyes and animal eyes?
Ultimately, of course, the two channels of cognition are related in that both provide a measure of belief in theories of perception, a belief that is explicit in the case of the scientific or theory based channel and implicit in the case of the personal or experientially based channel. Since the personal channel is the source of virtually all our early information on visual processing and since so many of our early interpersonal relations involve shared visual experiences, it may be that our first theories of vision are implicit extramission beliefs. Although this dissertation will not answer that question directly, it is hoped that it will provide enough information on the frequency and types of extramission responses by children and college students to support the possibility of a developmental trend that begins in the young child with a strong tendency to subscribe to extramission beliefs and a denial of pure intromission theory, to an almost total adherence on the part of college students to intromission theories. Intriguingly, however, according to the data to be reported in this study, fewer than half of the college students declared themselves to be pure intromissionists. A majority seem not to have given up all former extramission beliefs but merely to have combined them with some knowledge they acquired over the years about intromission perception, or perhaps to have compartmentalized intuitive and scientific belief systems.
CHAPTER II
REVIEW OF THE LITERATURE

No specific research on this topic has been found in a search through the literature on visual perception, except for recent pilot studies by Winer and Cottrell (see below). There is, however, a large body of historical and philosophical literature on the topic of visual perception, and more especially on the intromission and extramission theories of perception. I will first examine some of the historical precedents, showing how theories of visual perception have evolved since the 5th century B.C. I will then turn to more current research on children's understanding of perception, including the 1990-91 Winer & Cottrell studies on 6th grade, high school and college students.

Historical precedents

The ancient philosophers grappled mainly with the problem of whether the eye was active in sending out rays or some invisible force either to contact objects or cause the air in the intervening space to be conductive of object images, or whether it was passive and merely received rays or emanations that were cast off by objects. The three main currents of the optical tradition thus began with the investigations and treatises of philosophers and scientists in the ancient world: (1) The
optical-mathematical; (2) The Aristotelian and intromissionist; (3) The
Galenic-Stoic. These three schools of thought remained, almost in
unchanged form, the major source of beliefs about visual perceptual
processes until the end of the Renaissance (see especially Lindberg, 1976
and Meyering, 1989 for a history of these schools of thought).

**Optical-Mathematical theories.**

The primary exponent of the optical-mathematical school was Plato
(427?-327 B.C.). All members of the Platonic school shared the belief in
extramission visual perception. The idea of a fiery emanation from the
eyes that they subscribed to was probably a Pythagorean notion
articulated early in the fifth century B.C. by Alcmaeon, and later in the
century by Democritus (Lindberg, 1976).

Plato is thought to have drawn on these earlier sources to formulate
his theory which he presents in its most complete form in the *Timaeus.*
Plato’s theory, which is more fully developed than that of others before him,
is that visual perception occurs when a current of fire or light issues forth
from the eyes and coalesces with daylight to form a single homogeneous
body in a direct line with the eyes that stretches from the eyes to the object
of vision. Thus rays from the eyes and sunlight join to form a “body” which
serves as a material mediator between the eye and the perceived object.
When this coalesced current-light strikes an object, it transmits to the soul
the motions of anything it has contacted and produces in us the sensation
of seeing (Lindberg, 1976, pp. 5-6 provides a more complete discussion of
this theory).
The best-known followers of the Platonic tradition were Euclid (fl. 300 B.C.), Hero of Alexandria (fl.62 A.D.), and Ptolemy (fl. second century A.D.) who mathematicized Plato's theory of vision, operationalizing visual rays for purposes of measurement as actual substances that diverge from the eye and form a cone, the base of which is located on a perceived object. The ninth-century mathematician, Al-Kindi, is the best known medieval exponent of the extramission theory.

**Aristotle and intromission theorists.**

Aristotle (384-322 B.C.) rejected the notions of fire, light and vision, and firmly denied the idea of rays issuing from a perceiver's eyes. He proposed instead the intromission theory of perception (much of the information on Aristotle's theory of visual perception comes from his *De Anima*). He did not, however, give up the idea of a physical intermediary between perceiver and object. In fact he devoted considerable attention to describing the medium of vision which he called the “transparent”, which comes into existence from fire, and becomes actualized as light. Through the medium of light we perceive color as a “special sensible” directly. When we perceive color, the transparent is stimulated and acts on the eye instantaneously so that the watery substance in it immediately takes on the color of the object perceived. Thus the water in the eye quite literally becomes red when a red object is viewed. Shape and “common sensibles” are perceived only through the special sensible. A red apple, for example, is perceived instantly as red, with the apple shape mapped subsequently onto redness. (See Gaukroger's introduction to Arnauld, 1990, pp. 4-10 for a discussion and summary of Aristotle's main ideas on visual perception.)
Lucretius (ca. 99-95 B.C.) postulated a somewhat different, intromission theory in his *De rerum natura* (1982, 4. 26-468). An atomist, Lucretius held that the objects of our world continuously and rapidly cast off their images (simulacra), which are like thin films, in particles that travel through light and enter into our eyes to excite vision. Lucretius believed that our senses themselves are credible and project an image that is identical to what exists in the world. It is our mind, with the opinions and the false reasoning it brings to sensory information that can deceive us into thinking that we have seen things which in fact we have not seen with our senses. So certain of the credibility of the senses was this follower of Epicurus that he proclaimed them irrefutable. Furthermore, the concept of truth, he believed, can come in its first instance only through the senses.

Alhazen (ca. 1000), the greatest medieval scholar of optics, was the primary exponent of the intromission theory after Aristotle and Lucretius. Although a prolific writer and the most influential theorist in the history of optics until the end of the Renaissance (Meyering, 1989, ch. 3, and Lindberg, 1976, ch. 4), his theory never replaced that of Plato. However, his refutation of extramission perception was persuasive enough to cast doubt in the minds of many Platonists of the middle ages, and to engender various degrees of compromise between extramission and intromission beliefs.

**The Galenic-Stoic theory.**

Galen and the Stoics focused on the physical, anatomical, and physiological elements of visual perception (Meyering, 1989, ch. 3, and Lindberg, 1976, ch. 1 provide good accounts of this theory). Galen (ca.
adopted the Stoic idea of *pneuma*, which is present in the *Hegemonikon* (source of consciousness), and flows through the hollow *nervus opticus* to the eye. *Pneuma* issues from the eyes and unites immediately with the air around it transforming the air into an instrument of perception. Since the air becomes itself a sensory power, vision can extend all the way to a visible object. *Pneuma*, for Galen, thus actually existed in two forms: the "visual spirit" that functioned only within the eye, passing from brain to the sensitive crystalline surface where it could pick up images; and the "shining pneuma", which is emitted from the eye to transform the air around it in order to contact objects.

**Pliny the Elder and the evil eye.**

The Roman scholar, Pliny the Elder (Gaius Plinius Secundus, 23/24-79 A.D.), was the author of a 36-volume encyclopedia called the *Natural History* that remained popular for centuries as a source of general knowledge and scientific authority. Still used today as a compendium of information about customs, attitudes, and beliefs of the ancient world, Pliny provides information on evil eye beliefs in several pages of his text.

In his volume on humans, for example, Pliny tells us: "There are people...among the Triballi and the Illyrians who also bewitch with a glance and who kill those they stare at for a longer time, especially with a look of anger, and their evil eye is most felt by adults...what is more remarkable is that they have two pupils in each eye." He goes on to mention women of Scythia called the Bitiae, and people of many other tribes who have the same kind of double pupil and evil eye powers (VII, II, 16-17). The volume on animals provides information on the beliefs in the
power of the eyes of wolves, hyenas, and goats in particular. The eyes of wolves are harmful to people, we are told, and if "they look at a man before he sees them, it temporarily deprives him of utterance" (VIII, XXXIV, 80-81). The hyena is credited with having "certain magic arts by which it causes every animal at which it gazes three times to stand rooted to the spot" (VIII, XLIV, 106). We also find the following piece of information in a later volume on comparative anatomy: "The eyes of night-roaming animals like cats shine and flash in the dark so that one cannot look at them, and those of the wild-goat and the wolf gleam and shoot out light" (XI, LV, 151).

In his various references to the powers of the eye Pliny does not provide the kind of disclaimer he includes when reporting beliefs that he and his Roman readers could not accept as truths. Rather, "persons who have the evil eye" (XI, LIV, 142) seem to have been accepted as a fact of life, along with certain animals whose eyes have magical or transfixing powers.

Pliny's exposition of his own beliefs regarding visual perception is also worth noting. In the section of his Volume XI that he devotes to animal and human physiology he tells us: "It is the mind that is the real instrument of sight and of observation; the eyes act as a sort of vessel receiving and transmitting the visible portion of the consciousness..." (Xi, LIV, 146). He goes on to explain the various structures of the eye: "The horny skin in the center of the eye nature has furnished with the pupil as a window, the narrow opening of which does not allow the gaze to roam uncertain, but so to speak canalizes its direction, and easily averts objects that encounter it on the way; the pupil is surrounded with circles which with some people
are coloured black, with others grey and with others blue, so that the light from the surrounding radiance both may be received in a suitable blend and having its reflexion moderated may not be jarring" (XI, LV, 148). Later in this section, Pliny also attributes reflectiveness to the pupil, which he likens to a mirror that can reflect the entire image of a human being.

Pliny thus appears to have been largely an extramissionist and partly an intromissionist in that he conceived of the pupil as a kind of transmitter of the mind and the iris as an absorber of the light of the environment. Given the immense popularity of the *Natural History* and Pliny's reputation as a scientific authority we may probably consider what he wrote about visual perception to be an accurate synopsis of the beliefs of people of his time. These beliefs ranged from the magical powers of the eyes of certain animals and the evil powers of the eyes of certain humans to a blend of explicit extramission and intromission theories about the functions of some of the anatomical parts of the human eye. (For more historical information on evil eye beliefs see especially Gifford, 1958, and Elworthy, 1895/1989).

**St. Augustine and Christian alterations.**

A last major figure in the group of early influences on theories of visual perception was Saint Augustine, Bishop of Hippo (354-430). The first, and the most influential of the synthesizers of visual theories, Augustine explicitly espoused Plato's extramission theory of vision but added Christian elements to it. He also believed that nerves contain soul pneumonia as did the followers of the Galenic-Stoic tradition. Furthermore, like Aristotle he suggested that the sensation is higher than the sensed, with perception being passive on the part of the body and active on the part
of the soul. Augustine's *De Genesi ad litteram* and *De Trinitate* are two of the main sources of information on his perceptual notions. (See O'Daly, 1987, pp. 86-87 for a more complete explanation of Augustine's physiological theory of visual perception.)

For the Bishop of Hippo, sight was an activity of the spirit, which was not simply born of fire, but was a part of a higher light. Thus, vision meant the emission of a spiritual light into physical light, and represented the judgment of the soul issuing forth into the light of the world (see Summers, 1987, pp. 116-117 for a discussion of sight and judgment in Augustine). According to this theory, rays (*radii*), which are a faculty of the soul, burst out of the pupil of the eye and travel at great speed to contact an object. Although Augustine was clearly a Platonist who believed that sight was a product of emissions from the eyes, his fusion of the notions of physical and spiritual vision clouded discussions of visual perception well into the Renaissance.

The Middle Ages and the Renaissance.

By the thirteenth century, the intromission theory of Aristotle, which had become better known through the work of Alhazen, was gaining ground. Still, it was not yet possible for most thinkers to give up the extramission notion entirely. Roger Bacon (b. ca. 1214) was a major promoter of Alhazen's and Aristotle's theories, but he realized the need for reconciling other theories of vision, and most especially the Augustinian-Platonic notions (Lindberg, ch. 6). He managed to combine, in his *Opus maius*, opposing views of radiation by affirming that the different concepts
expounded by various authors were really synonyms for one and the same thing. He even managed to prove the correctness of both Aristotle and Plato by affirming that although Aristotle was right in his intromission theory, it was not a sufficient explanation. The eye must also have its own visual power, he argued, because it can see itself in a mirror. A species (or ray) therefore must be emitted from and returned to the eye. Visual power is thus both a recipient and an agent.

Bacon's ideas were influential throughout the remainder of the Middle Ages, and they gained even greater currency through the work of John Pecham and Witelo who wrote texts on optics later in the thirteenth century (Lindberg, 1970). Bruyne (1946) explains that the importance of light as a philosophical concept in the thirteenth century also helps to explain the unabatedly strong dominance of Augustiniansim and Neo-Platonism. Light in the thirteenth century was universally accepted to be the source of all beauty, all goodness, and all energy in the world.

Many combinations of the intromission and extramission theories can be found in the art and literature of the Middle Ages and Renaissance. For example, the vision of God that Dante Alighieri (1265-1321) provides in his Divina Commedia, Canto 33 of II Paradiso is constructed through the visual experience of the author who endures the "living ray" until his gaze is strong enough to arrive at the source of Infinite Goodness. Dante's sight is gradually strengthened by gazing at the eternal light, he becomes changed in the process and is finally, suddenly, and completely overcome by the force of the light entering him, so that his will and desire (the quintessential human characteristics that motivate us to gain knowledge
and understanding) move out to join the revolving wheel of "L'Amor che move il sole e l'altre stelle," (Love that moves the sun and the other stars, Grandgent, 1933, l. 145— the famous last line of Dante's *Divina Commedia*). The changes that have occurred within Dante through the light entering his eyes (Aristotelian notion) permit him to join the will of God (Augustinian idea).

Leon Battista Alberti (1401-1472) in his influential treatise on art, *Della pittura*, accepts that rays emanate from as well as enter the eyes (Alberti, 1950, pp. 58-59). Later in the same century Leonardo da Vinci (1452-1519) in his notebooks of 1490 explicitly espouses the extramission theory, only to devote his attention almost exclusively two years later to the intromission theory (Ackerman, 1978, pp. 126-128). Such ambivalence on the part of a genius is an indication of the continued strength of the various fifth-century B.C. theories of visual perception.

Along with these philosophically-oriented extramission notions, the influence of another ancient-world tradition, the image of the eye as an arrow-shooter of love, rapidly gained ascendancy in the literature of the middle ages. The eye as transmitter and receiver of arrows, daggers, swords, and fiery beams can be traced back at least as far as Aeschylus. (Donaldson-Evans, 1980, Chapter 1, provides an excellent, concise history of this "aggressive eye topos" with literary examples of it from the earliest Greek literature through the French Renaissance.) Although the motif had remained a constant theme in Arabic erotic literature, it was not until the Provençal troubadour poets of the twelfth century came into contact with Arabic poetry that this view of love began to make its way into European
literature. In this tradition love is portrayed as a painful malady in the form of a substance transmitted from the eyes of the Beloved to the victim. The origin of this idea has been traced to the myth of Cupid, who was conceived of as actually lodging in the pupil of the eye through which he shot his arrows of love.

It was, however, the Italian lyric poet, Francesco Petrarch (1304-1374), who was responsible for establishing the eyes as agents of love in European literature. In seeking to describe his life-long love for a married woman named Laura, Petrarch revolutionized literary techniques and provided a view of love that came to be accepted universally from the 14th through the 16th centuries. The Petrarchan notion is, simply stated, that a fine substance of some type enters the eyes of the lover from the eyes of the Beloved and travels immediately into the heart, as is illustrated in Sonnet 3 (Lind, 1954, p. 186): “Trovommi Amor del tutto disarmato/E t aperta la via per gli occhi al core” (Love found me completely disarmed/And the path through my eyes to my heart wide open).

Throughout the next two centuries, Petrarch's followers debated the physical, physiological and psychological manner of innamoramento. A kind of consensus developed around the notion that love was transmitted in some form of refined blood, mingled with emanations from the eyes. As the sixteenth-century French poet, Louise Labé described it: “C'est la force de l'œil de la chose aymee, et que de là sort une suture evaporacion, ou sang, que nos yeux recoivent, et entre jusques au coeur” (It's the power of the eye of the Beloved that a fine evaporation, or blood, emerges from it and is taken in by our eyes and enters into our heart,1555/1986, p. 92).
The Seventeenth Century to the Present.

Despite the efforts of Leonardo and the attempts of many other thinkers to solve the mystery of visual perception, and most especially the inverted image of the camera obscura, it wasn’t until Johannes Kepler (b. 1571) discovered the retinal image that understanding of visual perception was able to advance beyond the theories of the ancient world. However, it took Descartes, writing some 33 years later in *La dioptrique*, to provide the final arguments against the theories of the ancient world through his linking of the retinal image to a number of seventeenth-century mechanist assumptions (Lindberg, 1976, ch. 9 provides an extensive discussion of the Kepler-Descartes achievement).

Although the extramission theories and the Aristotelian account of visual perception were put to rest in scientific circles after the discovery of the retinal image, folk beliefs about the power of the eye, emissions from the eye, and more specifically the evil eye, have persisted (Gifford, 1958). Furthermore, the many expressions and metaphors in English and the other languages of Western Europe linking physical effects from the eye’s gaze suggest a continuing belief in emanations from the eyes. This is not so surprising if we form extramission theories through an intuitive channel of cognition early in our lives, based on personal experience and then must erase these beliefs much later after we have learned the correct intromission theory of vision based on knowledge of the anatomy of the eye and an understanding of the physics of light its relation to visual perception. In fact, the early scientific extramission theories may themselves have been based on information provided by the personal,
intuitive channel that continues today to provide the extramission beliefs that bear such an uncanny resemblance to the theories of the philosophers of antiquity.

Human visual perception has been invested with new power during the course of the Twentieth Century. Philosophers have had to account for the relativism of information we gain through all our senses. It is, however, vision that has received the greatest attention, and especially the problem of the "gaze" or "eyes of the other" upon us which leads to our oppression by others for whom we are "objects" of vision (this is the main thrust of M. Merleau-Ponty's 1962 *Phenomenology of vision*, and of virtually all of Jean-Paul Sartre's writings, especially his 1943 *Being and Nothingness*, and his 1944 *No Exit*). The feeling of anguished disconnectedness in much of twentieth-century art and literature has often been traced to the problem of our "objectification" in the eyes of other people. Whatever new powers may have accrued to our eyes in the course of the Twentieth Century, it is possible that the ancient powers whose traces remain in our language are still present in the ideas and valuations of our visual processes by children and adults.

**Current Research on Children's and Adult's Understanding of Perception**

**Gaze interactions.**

One of the earliest forms of infant socialization, the mutual gaze of infant and mother or caretaker, has received considerable attention from researchers. One of the illustrations of the importance of dyadic interactions according to Papousek and Papousek (1987) is the early
social training parents give to newborns in their attempts to achieve eye-
contact with their offspring, no matter how much they may believe that
newborns cannot see. "They seek a vertically parallel, face-to-face
position toward the infant and use various forms of stimulation in order to
increase the probability of visual contact" (p. 692). The authors further
explain the careful regulation of eye-to-eye distance parents maintain
between themselves and infants, and the type of greeting behavior virtually
all parents engage in when their young infants show signs of willingness to
communicate. This all leads to a carefully coordinated intercommunication
system between a young infant and a parent or caregiver involving rhythms
of gaze and gaze away.

Brazelton and associates (1974) have noted that mothers adjust to
infants' arousal patterns in 3 ways: (1) with increased and decreased
stimulation following the infant's gaze and gaze away cues; (2) by not
following their infants' cues and continuing stimulation thus reinforcing the
gaze away behavior; (3) by attempting to establish a rhythmic pattern of
their own. Field (1987) affirms the importance of gaze interactions by
demonstrating how non synchrony of maternal-infant gaze patterns are
related to affective and physical disturbances in the infant. Therefore, it
would appear that visual contact is one of the earliest, most elemental and
most influential regulators of the human physiological system as well as of
behavior and socialization.

Infants' ability to follow the gaze of their mother has also been studied
extensively (see Butterworth & Glover, 1988, for a review of this topic and
others relating to early person knowledge). According to Scaife and
Bruner (1975), infants as young as 4 months indicate an awareness of the
direction of the gaze of their mother, with continuing improvement in
following the direction of gaze through 11 months of age. According to
more recent studies (Butterworth & Glover, 1988) infants appear to follow a
series of steps in identification of the object of the gaze of another from 6
months of age when they can look to the side to follow a gaze, to 12
months when they can cue on head movements and gaze to differentiate
the exact object of a gaze to 18 month when they can turn to follow a gaze
directed behind them. These research findings may, as Winer (1991) has
pointed out, indicate an early awareness of visual perception as a process
that is shared by other people. In any case, awareness of the gaze of
others, a physiological and even an affective reaction to being the object of
the gaze of another, and use of the gaze of another for information about
the object of attention of the other all seem to be patterns that become
established in early infancy.

Language acquisition and visual perception.
Many types of visual perception studies have been published,
including research on language acquisition that documents the
appearance of demonstrated comprehension and the use of words
referring to perception. Findings from a studies by Bretherton and her
associates indicate that the words *look* and *see* may enter the infant’s
vocabulary around the age of 11 months (Bretherton, McNew, & Beeghly-
Smith, 1981), and negative expressions referring to sight such as, *I don’t
want to see it*, *Don’t watch me* (Bretherton & Beeghly, 1982) are used by a
majority of infants before their 28th month. In fact, half the mothers in the
1982 study (above) reported having been admonished by their infants either not to look at or not to watch them.

Attempts of infants in their second year of life to control what they see and whether others can see them are generally nonverbal and may include covering their eyes with their hands, covering their head with clothing, blankets, etc., or hiding. (It is perhaps not surprising, in this context, that peek-a-boo is a universally favorite game of infants). Ways to hide may become quite elaborate by the age of 28 months. Bretherton and Beeghly report the following utterance by a 28-month-old in their study (1982): “I’m going to be a cloud in the sky so you can’t see me.” Clearly, being the object of the gaze of other persons is something even young infants experience as unpleasant and intrusive at times.

**Ocular orientation and visual obstacles.**

Studies on older children have also demonstrated the importance of orientation of the eyes for vision. Masangkay, et al. (1974) reported that about half the children they tested between the ages of 2 and 3 years could correctly identify which of 4 objects an experimented looked at, and that virtually all children between 3 and 3 1/2 years could accurately indicate the object of gaze.

A number of other visual perception topics have been investigated, such as near and far studies, closed vs. open eyes, a straight vs. a bent line of sight (see Lempers, Flavel, & Flavel, 1977). Although these studies show that children seem to know, in general, that the eyes are needed for visual perception and that where the eyes are directed is important for what can be seen, various tasks have sometimes held some surprises. For
example, in the Lempers, et al. (1977) studies, children under the age of 2 1/2 - 3 years did not consistently remove a cover from or open the eyes of a doll who was supposed to be viewing an object. Furthermore, while children were shown to improve between the ages of 1 and 3 in their ability to remove an obstacle to permit an observer to see, Flavell, Green, and Herrera (1990) reported that more than half the 5-year-olds they tested thought they would be able to see an object at the end of a bent tube. They, however, were able to improve their performance with feedback while the 3- and 4-year-olds were not.

**Perspective taking.**

Perspective taking has also been extensively researched, with a major focus of attention on egocentrism as defined by Piaget in studies using stimuli such as the three-mountain task. In order to test development in the area of perspective taking in a more systematic manner, Flavell proposed a distinctions between two levels of processing: Level 1, in which the viewer is able to understand when another person can or cannot see the same object (e.g. because of something that blocks that person’s vision); and Level 2, in which the viewer understands that the other person is seeing a different view of the same object, and therefore that the object looks different to the other person. Level 2 is presumed to be more difficult for the child to grasp, and many studies have supported the claim that while 3-year-olds can generally perform Level 1 tasks with ease, it is not until the age of 4 years that children can reliably perform Level 2 tasks, even with training (Flavell, Everett, Croft, & Flavell, 1981: see also Flavell, 1988 for an analysis of the Level 1-Level 2 distinction).
According to Winer (1991) finer gradations of behavior between the two levels indicating continuous development rather than stage-level type changes would seem to be possible if gradations of perspective-taking task difficulty are taken into account as we can see in a study by Yaniv and Shatz (1990). Recently, perspective-taking has also been investigated in connection with the development of a theory of mind in young children (see especially Flavell, 1988 for a discussion of this topic).

**Appearance and reality.**

Development of the ability to distinguish appearance from reality has also been an area of considerable research, in which it has been generally demonstrated that between the ages of 3 and 5 years children learn that appearances do not always reflect the reality of the object the child is viewing (Flavell, Flavell, & Green, 1983; Flavell, Zhang, Zou, Dong, & Qi, 1983). Flavell and associates have identified two types of errors children regularly commit: phenomenism, when the child reports appearance when asked about reality; and realism, when the child reports reality when asked about the appearance of an object. Children’s ability to distinguish between appearance and reality is of critical importance in their acquisition of a level of understanding of perception sophisticated enough to permit them to realize that what they see at a given moment may not faithfully reflect the reality of the world around them. Whether the tasks used in the studies of this topic actually test children’s awareness of perception and understanding of perceptual errors is not clear (see Winer, 1991, for a discussion of this problem).
Perceptual adaptation.

A final area of inquiry related to children's understanding of perceptual processes involves research on perceptual adaptation and what children understand of common illusions, for example involving temperature (see Arnold, Winer, & Wickins, 1982; Arnold, Moye, & Winer, 1986) and weight (Shing & Winer, 1990) that we experience in our daily life. An important issue in this research has been the role of integration of knowledge from other phases of an ongoing experience or from experiences in other domains in the understanding of a perceptual adaptation illusion (Winer, 1989).

The literature on these topics documents differences in age of the development of various levels and types of perceptual understanding beginning with consideration of gaze patterns between caretaker and young infant. As we have seen, "it appears that young children know the importance of the eyes and the orientation of the eyes for perception" at an early age (Winer, 1991). However, consistently correct performance on tasks involving perceptual processes may not be found until a year or two after an ability can be first demonstrated. Children continue to develop increasing understanding with age, and the developmental literature on perceptual understanding in the main supports Piaget's theory that substantial changes occur during the period of concrete operations. It is not until about the age of six, for example, that children have been shown to begin to realize differences in knowledge based on what persons have seen or not seen. Nevertheless, despite massive amounts of research in the above-mentioned areas, there has been very little research on the
child's knowledge of visual perceptual processes, and the kinds of theories children may hold of visual perception (Winer, 1991).

**Children's theories of visual perception.**

Piaget (1929), however, mentions two different sources who found that children believed in an extramission theory of perception. Piaget quotes G. Stanley Hall and a colleague who in questioning children discovered they believed that when two people looked at the same object their looks would "mix or meet" (Piaget, 1929, p. 48). Piaget's own questioning of three children (aged 6, 6 1/2 and 10 years) revealed that they tended to believe that seeing is "due to the light given out by the object meeting the light that emanates from the eye" (Piaget, 1929, p. 49). Although the similarity of these children's theory of visual perception to that of the ancient Greeks is remarkable, no follow-up studies on the Hall and Piaget reports have been found in the literature.

Chandler and Boyes (1982), reviewing literature on cognitive-social development, mention the possibility that preschoolers might be using a "ballistics" approach in order to understand how knowledge is acquired by them and by other people. This would mean that preoperational children would conceive of objects firing information about themselves with the result that a faint copy of an object would impress itself upon the bombarded individual who was in a direct line-of-sight. This "copy theory" of visual perception which has its origins in the thing known and not in the perceiver, would, according to Piaget's development theory, gradually give way to an understanding of the more subjective origins of perception. Chandler and Boyes (1982, pp. 391-393) cite several researchers whose
work (mainly on visual perspective-taking and Piaget's three mountains task) would seem to support the ballistics approach to knowledge acquisition on the part of preschoolers. This preoperational "theory of mind" described by Chandler and Boyes has remarkable similarities to Aristotle's intromission theory.

Pilot studies and unpublished research.

Preliminary pilot studies on developmental changes in the belief in extramission visual perception were conducted by Winer and Cottrell (1990, 1991). Questionnaires were administered to 57 sixth-graders, 90 ninth-graders, 60 tenth-graders, two groups of OSU students (sample sizes of 48 and 115), and in a separate study a group of 77 students from a college of art and design. Two groups of subjects (the 57 sixth-graders and the group of 48 OSU students), answered a short-form questionnaire, while all the other subjects were given a longer form that included the questions on the short form. Both forms questioned subjects in two main areas: (1) extramission and intromission theories of perception; (2) their beliefs about human ability to sense or feel the eyes of other people staring at them without actually seeing the other person look. More specifically, subjects were asked: (1) if they believed that when people look at something rays, energy,- or something else enters the eyes (the intromission theory of perception) or emanates from the eyes (the extramission theory); (2) if they had had the experience (and how frequently) of having felt someone staring at them without actually seeing the other person's eyes, and if they believed that other people can feel it (without seeing the other person's eyes) when someone is looking at them.
Winer and Cottrell hypothesized that some high school and college students might admit to explicit extramission beliefs, but that the younger subjects would be more likely to believe in an extramission theory, possibly because of not having had the opportunity to acquire much scientific knowledge about visual perception. Winer and Cottrell also hypothesized that many subjects, college students, high school students, and children alike, would have had the feeling-the-eyes-of-the-other experience. Furthermore, when asked about this type of experience, some of these subjects might give evidence of holding an implicit extramission theory of perception, whatever their responses to the direct intromission/extramission questions, because of its intuitive appeal in a situation for which there was no readily available scientific explanation. The idea that subjects might rely on an intuitive type of understanding was based on Werner's (1948) theory which allows for regressions in modes of thought in situations of uncertainty.

The data from the questionnaires generally supported the above hypotheses. A surprisingly large number of subjects gave affirmative answers to both the intromission and the extramission questions, indicating belief in both theories of visual perception. An even larger number gave evidence of an implicit belief in extramission perception by giving affirmative replies to questions concerning their own, other people's, and even animals' experiences in feeling staring without seeing the other look, even though they might have denied believing in the extramission theory when asked about it directly. In fact, most subjects in both age groups reported they had had the experience of feeling another person staring at
them, and almost all claimed to believe that other people could feel it when someone stared at them.

A developmental trend was also evident, with a majority of 6th-graders admitting to belief in extramission perception in significantly greater numbers than the college students, and 9th-graders giving significantly more affirmations to the extramission question than tenth-graders or college students. Although several orders of questions were tested, no order effects were found.

In his book, *The evil eye*, Gifford (1958) mentions in passing a study on people's beliefs in their ability to feel unseen eyes staring at them, which he identifies only through the following description.

The principles of fascination are implicit in the belief firmly held by many educated people, clearly not idiots, that they can feel the stare of a person not visible to them. Of 1,300 college students questioned at Stanford University 84 percent of the women and 72 percent of the men believed this possible, but when 1,000 tests were made of these students' ability to sense whether or not invisible eyes were upon them there were 502 correct answers and 498 false. The investigators concluded that the answers were no better than guesses and did not demonstrate the reception of a visual impact or mental telepathy (p. 95).

In trying to suggest explanations for the universal human fear of being stared at as a remnant of belief in the evil eye, Cook (1977) also mentions what seems to be the same study that Gifford describes (neither author provides identifying information about it):

The belief is also related to the idea that vision works by rays that emanate from the eyes; it has been supposed, for example, that when a witch looks at a mirror she leaves a thin, poisonous film on it. This death-ray view of gaze lingers on in the belief, held by three-quarters of an American college sample, that you can definitely tell when someone behind your back is looking at you" (p. 331.).
These references, although sketchy, would seem to be in line with the findings of the Winer and Cottrell (1990-91) studies showing that many college students appear to hold beliefs about extramission perception.

Summary and Statement of the Research Goals

The developmental research on children’s understanding of their visual perceptual processes would thus seem to indicate that children might hold theories that bear close resemblance to the main extramission historical visual theories (the Platonic and the Galenic-Stoic). If research has also shown that children seem to subscribe to a ballistics (i.e., intromission) theory, this may be only part of what they believe occurs during visual perception. They may also hold beliefs closer to the Augustinian model in which rays both enter into and emanate from the eyes in order to contact objects so that we may gain knowledge of them through the “light” of our understanding. Whether such theories are actually abandoned when other more scientific ones are learned was one of the questions that this study was designed to investigate.

The previous research by Winer and Cottrell consisted of paper-and-pencil questionnaires administered to groups of students in classroom settings. Although there was no reason to doubt those results, it was important to attempt to replicate in one-on-one testing the results found in the paper-and-pencil questionnaires, which have the disadvantage of allowing for unknown levels of inattention, acquiescence, and misunderstandings that can be more easily controlled in interviews.
The current study expands on the pilot studies of Winer and Cottrell in several ways, some of the most important of which are the following. (1) Subjects were questioned individually in face-to-face interviews with various types of questions designed to control for the above-mentioned potential problems; (2) In order to investigate the possibility of a developmental trend from early childhood to adulthood, first-, third-, and fifth-graders were tested as well as college students, whereas sixth-graders were the youngest subjects tested previously; (3) Subjects were asked for explanations of their responses, and to identify what they thought it was that entered or was emitted from the eyes; (4) Drawings were presented to subjects with arrows depicting rays or other entering, exiting, and both entering and exiting the eyes so as to present subjects with a nonverbal stimulus that would provide a behavioral measure of their beliefs; (5) Questions about extramissions during hearing and smelling were added to test for possible differences in beliefs regarding visual versus non-visual perception; (6) Subjects were made aware of dissonant responses after they had responded to the main sets of questions and were asked to explain their answers so as to provide more information about their possible implicit extramission beliefs and the relationship of such beliefs to scientifically-based knowledge of visual functioning.

Hypotheses

The ideas behind the questionnaire (see Appendix 1) to be used in this were based largely on results from the pilot research of Winer and Cottrell (1990, 1991). All subjects were to be queried on their personal
experiences in feeling-the-eyes-of-the-other, and their beliefs about the abilities of animals to feel or to project feelings through their eyes to humans (see Table 1 for a list of the main questions used in this study). These questions were designed to tap implicit extramission beliefs. Explicit questions about intromission and extramission visual perception were also to be asked of all subjects. In addition subjects were to receive questions about hearing and smelling, and looks “mixing or meeting at an object.” When subjects answered “no” to explicit extramission questions but said “yes” to feeling-the-eyes--of-the-other questions, they were to be made aware of a possibility of disparity in their answers in Probe questions. The order of the Feeling questions and the Intromission/Extramission questions was to be varied to test for condition effects.

The formal hypotheses that guided the study were as follows:

(1) Young children, 5th-grade and below, would subscribe in significantly greater numbers than college students to an explicit extramission theory of visual perception.

(2) Virtually all subjects would answer questions about hearing and smelling correctly by denying the need for emissions from the ears or nose for hearing and smelling. Belief in an extramission theory of perception would be more evident in responses to questions on visual perception than in responses to questions on auditory or olfactory perception.

(3) Most older children and college students would answer affirmatively to intromission questions, and would know that (light) rays enter the eyes during visual perception. However, some might have forgotten, and thus asking the same question in different ways (i.e., as
questions request a simple "yes" or "no" response, as forced-choice items, and in pictorial form with choices) might induce subjects to reconsider whether their first answer was correct and give an opportunity for self correction.

(4) Almost all subjects would have had feeling-the-eyes-of-the-other experiences.

(5) The college students, and possibly the 5th-graders would make a distinction between the power of the eyes of humans and those of animals, showing a belief in human superiority. The 1st- and 3rd-graders, however, would make less of a distinction, attributing the same kinds of powers to the eyes of animals and to humans.

(6) There would be condition effects from varying the order of Feeling-the-eyes-of-the-other and Intromission/Extramission questions. Subjects would be more likely to answer affirmatively to extramission questions if these are presented after the feeling questions, being led by implicit extramission responses in the first set of questions to an admission of explicit extramission beliefs in the second set.

(7) Some subjects would give indications of holding a possible implicit extramission theory by answering affirmatively to feeling-the-eyes-of-the-other questions while denying belief in an explicit extramission theory. When asked about the disparity in their answers, some subjects might agree to holding, in effect, an explicit intromission theory about visual perception at the same time as an implicit extramission belief, while others might seek to reduce their cognitive dissonance in a manner suggested by Festinger (1957) by making adjustments in their previous answers.
CHAPTER III

METHODOLOGY

Subjects

Elementary school students from a working class, mostly white school district located in a suburb of Columbus, Ohio, and Ohio State University students who volunteered for the experiment in order to fulfill a basic psychology course requirement were tested individually. The elementary school students were: 41 first graders (mean age = 7 yrs, 4 mos, range = 6 yrs, 8 mos - 8 yrs); 40 third graders (mean age = 9 yrs, 4 mos, range = 8 yrs, 8 mos - 10 yrs, 6 mos); 49 fifth graders (mean age = 11 yrs, 6 mos, range = 10 yrs, 8 mos - 12 yrs, 11 mos), and 58 college students (mean age = 19 yrs, 9 mos, range = 18 yrs 7 mos - 26 yrs, 10 mos). Subjects were relatively equally divided by sex within grades and conditions.

Procedure and Measures

Four sets of questions were administered verbally to subjects in one-on-one interviews and answers were recorded. The college students were tested individually in a university room used as a psychology laboratory; the elementary students were withdrawn from their classrooms and tested individually in rooms and areas that were not being used for other purposes at that time.
Set A Warm-Up questions.

A set of five general perception Warm-Up Questions on seeing, hearing and smelling which had obviously correct answers was presented to all subjects at the outset (see Table 1 for a list of the main questions used in this study, and Appendix for the complete Questionnaire). These questions included: Do you touch with your fingers, hear with your eyes, smell with your nose, see with your ears, taste with your tongue? Although the answers to these questions was obvious, correction was provided for the rare subject who answered one of them incorrectly. The rationale behind these Warm-Up Questions was that they would introduce the subject to the topic area, provide some practice in answering this type of test question, and would help offset tendencies toward automatic acquiescence by including questions that required a negative answer. Two other questions with obvious “no” answers (within Set B #8, “Can people see well in the dark without any light, or can’t they?” and within Set C #13, “Can most people see through thick, solid walls or can’t they?”) were included as an additional check on possible automatic acquiescence. A wrong answer to these questions was also immediately corrected, although once again very few subjects answered them incorrectly.

Set B Feeling-the-eyes-of-the-other questions.

Following the Warm-Up (Set A) Questions, subjects were next asked either five Set B Feeling-the-eyes-of-the-other Questions or nine Set C Intromission/Extramission Questions, depending on the condition to which they had been randomly assigned. The Set B Feeling Questions queried subjects on: whether they thought that they and other people could feel
Table 1. List of Main Questions Used in the Study

Set A: Initial Perception questions with immediate corrections
1. Do you touch with your fingers?
2. Do you hear with your ears?
3. Do you smell with your nose?
4. Do you see with your eyes?
5. Do you taste with your tongue?

Set B: Feeling-the-eyes-of-the-other
6a. Do you ever feel that someone is staring at you without actually seeing them look at you? For example, in class (school) on a bus, in a restaurant or a store, etc?
b. If yes, Does this happen to you (1) often or almost every day, (2) about once a week, (3) every so often, (4) only once in a while.
7. Do you think that other people can feel it, without seeing, when someone is looking at them, or that they can’t?
8. Can people see well in the dark without any light, or can’t they?
9. Can you feel it when an animal like a dog or a cat is staring at you if you aren’t looking at it?
10. Do you think an animal like a dog or cat could feel you staring at it without seeing your eyes, or that it couldn’t?

Set C: Intromission/Extramission
11. When people look at something or someone, do you think rays, or maybe energy, or mindwaves or something else goes out of their eyes? (If yes, What?)
12. When people look at something or someone, do you think rays, or energy or something else goes into their eyes? (If yes, What?)
13. Can most people see through thick, solid walls or can’t they?
14. When people look at something or someone do you think that rays or energy or something else first goes out of their eyes and then comes back in?
15. When two people look at the same thing at the same time, do you think their looks mix or meet?
16. When people hear something do you think that invisible rays, or energy, or maybe something else goes out of their ears or not? (If yes, What?)
17. When people smell something, do you think the invisible rays, or energy or maybe something else goes out of their nose or not?
18. When people look at someone or something, do you think that rays go into their eyes, or go out of their eyes, or both?
19. Please look at these 3 drawings. Here is one with rays or energy going out; here is one with rays or energy going in; and here is one with rays or energy going out and then coming back in. Point to or tell me the one that shows best what happens when we look at something or someone.

Probe questions depended on responses a subject had given to Sets A, B, C questions

Set D: General Wrap-Up questions (all subjects were asked)
7. Do you believe there is some way that people might communicate without using words. Like a message that might get sent from mind to mind, heart to heart, etc.?
8. How do you think this might happen?
9. Have you ever thought about questions like these before? If yes, Which ones? When/Why did you think about them?
10. So, finally, when we look at someone or something, do you think that rays go into our eyes, or go out of our eyes, or both?
someone staring at them without actually seeing their eyes; and whether they thought that an animal like a dog or cat could feel people staring without seeing them look, or if they believed they could feel a dog or cat staring at them without seeing its eyes.

**Set C Intromission/Extramission questions**

The eight explicit Intromission/Extramission (I/E) Questions of Set C asked subjects whether they believed that when people look at something or someone, rays, energy, mindwaves or something goes out of their eyes, or goes into their eyes, or whether rays, energy or something else first goes out of their eyes and then comes back in, as well as the Piaget question of whether subjects thought that when two or more people look at something at the same time their looks somehow mix or meet.

Two questions on hearing and smelling were included in this section with the original intent of giving subjects an opportunity to say "no" to the necessity of extramissions from the ears or nose for hearing and smelling (see Hypothesis 2, p. 33). Another important reasons for their inclusion was also, however, to learn if subjects tended to think of the eyes as having special powers for contacting people and objects not provided to the ears or nose. In these questions subjects were asked if they believed that when people hear something, invisible rays, energy, waves or something else goes out of their ears, and when they smell something, invisible rays, energy or something else goes out of their nose.

The last of the Set C Intromission/Extramission questions was based on an array of three drawings depicting: (a) rays entering the eyes, (b) rays emanating from the eyes, and (c) rays exiting from and entering into the
eyes. These drawings were actually copies of the same line drawing of a 3/4 profile of a unisex head, with lines and arrows used to indicate the directions of rays or other intromissions/extramissions (see Figure 1). The three drawings were glued onto 5" by 7" index cards which were shuffled before being placed in a row in front of each subject. The subject was then asked to choose the drawing that best represented what he/she thought happened when we look at someone or something.

Conditions.

Two orders of questions, representing two conditions, were given to subjects to test for order effects. The only difference in the two conditions was whether the Intromission/Extramission questions (Set C) preceded or followed the Feeling-eyes-of-the-other questions (Set B). One of the hypotheses of this study was that subjects may be more likely to answer affirmatively to the extramission questions (Set C) if these are presented after the Feeling-eyes-of-the-other questions (Set B), since the Feeling questions themselves actually tap extramission beliefs also, albeit in an indirect manner. Thus, Condition A contained questions in the sequence presented in Appendix 1, while in Condition B, the Set C (I/E) questions were presented after Set A but before Set B (the Feeling questions). In both conditions Set A questions were administered before any others.

Probe questions.

In both conditions, a series of Probe questions followed the administration of Sets A, B, and C questions. Here the questions asked depended on the type of answers subjects had given to the previous questions. If subjects had admitted to beliefs that they or other people
Figure 1. The 3 drawings (reduced from the 5" by 7" originals) used in Question 19. These drawings, which were glued onto 5"x7" index cards, were shuffled before being placed in front of a subject. The above array depicts rays A) going into the eyes, (B) out of the eyes, and (C) both into and out of the eyes.
could feel others staring without seeing them look, or could feel animals
stare, or thought that animals could feel them stare without seeing their
eyes, but they had denied belief in emissions from the eyes, the
contradiction in their answers was pointed out and they were asked to
explain. For example, if subjects admitted to extramission beliefs, they
were asked to explain what they thought comes out of our eyes when we
look, and what effect this has on perceived objects (i.e., if our perception of
the objects changes them in any way).

Set D Final questions.

All subjects were administered a final series of questions (Set D),
following the Probe Questions. In this final series, subjects were first asked
if they thought there was some nonverbal way people can communicate,
for example from mind to mind, heart to heart, or other. If subjects
answered affirmatively, they were further queried on how they thought this
might occur. Next they were asked whether they had ever thought about
questions like these before.

As a final question, all subjects were asked to answer once again a
critical question they had already responded to in Question #18 Set C
(intromission/Extramission questions) before having been presented with
the drawings (Question #19) or the probe questions. This last question
(#10 Set D) was: “So, finally, when we look at someone or something, do
you think that rays go into our eyes, or go out of our eyes, or both?” The
rationale behind repeating Question #18 at the end of the test was that it
would provide subjects with an opportunity to think about the responses
they had given to other questions, and to correct or change a previous
answer at this point if they wished. Some subjects did indeed change their answers, but not in the direction predicted.
CHAPTER 1V
RESULTS

   a. Analysis of Combined Responses to 6 Critical I/E Questions.

   A 2 x 2 x 4 (condition = I/E first vs. Feeling first x sex x grade) analysis of variance was used to analyze the data from six critical intromission/extramission questions. Three of the six questions queried subjects on whether rays, energy or something else exits the eyes (Question #11), enters the eyes (#12), or both exits from and enters the eyes (#13). The last three were forced-choice questions requiring subjects to select one of the above possible responses. These last three questions were: #18, "When people look at someone or something, do you think that rays go into their eyes, or go out of their eyes, or both?"; Drawing #19, which asked the same kind of question but provided illustrations of something going into, out of, and both into and out of the eyes; and the last question #D10, which was a repeat of question #18. Answers were scored as correct only if the subject responded that rays or waves or something enters the eyes; all other responses were scored as incorrect.

   The results of the analysis of variance of correct responses to the six questions are summarized in Table 2. No condition effects, sex differences, or interactions were found. There was, however, a large,
Table 2: ANOVA of Combined Results of Correct Responses to 6 Critical Questions Relating to Visual Perception.

(Questions were: #11 rays, energy enter eyes; #12 rays, energy exit from eyes; #14 rays, energy exit then re-enter; #18 choice of rays into eyes, rays out of eyes, rays both in and out; #19 choice of drawing showing rays entering eyes, rays exiting eyes, rays going in and out; # D10 =Last Q, a repeat of choice of rays into, rays out of, or rays both into and out of the eyes.)

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<th>MS</th>
<th>F</th>
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<td>33.43 ***</td>
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\[ N = 184 \quad ***p < .001 \]

Student-Newman-Keuls Test: Means for Grade:

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<tr>
<td>College</td>
<td>3.9474*</td>
</tr>
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</table>

* \[ p < .05 \] (df = 169)
significant main effect for grade (F (3, 188) = 32.84, p < .001. The Student-
Newman-Keuls Test of mean differences between grades indicated that
although 5th-graders performed somewhat better than 3rd- or 1st-graders,
the differences between these grades were not significant. The only
significant difference was between College students and the three other
grades (Table 2).

b. Analysis of Responses to the First Three vs. the Last three I/E
Questions.
Separate ANOVAs, summarized in Table 3, were performed on the
first three and the last three critical I/E Questions. (Please note that
differences in Ns in the analyses throughout this study are due to subjects' failure to respond to some of the questions.) Since the first three of these questions all require only a "yes" or "no" answer to queries involving beliefs about intromission or extramission perception (#11 asked whether rays or other are emitted from the eyes, #12 asked whether rays or other enter the eyes, and #14 asked whether rays or other first exit then re-enter the eyes), subjects might be able to answer more of these correctly than the last three critical I/E Questions which required choosing an answer from three possibilities (Do rays enter the eyes, exit the eyes, or both exit and enter). Once again, significant differences were found between college students and the elementary school children. Note, however, that the means for correct responses are considerably lower for the last three I/E (forced-choice) questions at all grade levels, indicating that the forced-choice questions were more difficult for all subjects to answer correctly. Interestingly, 1st-graders gave more correct responses than 5th-graders to
Table 3: ANOVAS of Combined Results of Correct Responses to the First 3 vs. the Last 3 I/E Questions

<table>
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***p < .001

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***p < .001

Student-Newman-Keuls Test: Means for Grade (out of a possible score of 2):

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* p < .05 (df = 172)

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<td>Grade 5</td>
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<tr>
<td>College</td>
<td>1.6491*</td>
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* p < .05 (df = 169)
both types of questions, and all groups performed better than 5th graders on the forced-choice questions.

The frequencies of correct and incorrect responses to the six individual Intromission/Extramission questions are reported in Table 4, for first three critical questions (#11, 12, 14) and Table 5 for the last three (#18, 19, and D10 = Last Q). Chi-square tests were used to examine the independence between grade and subjects' responses to each of the six questions. The overall chi-square value for each of the six questions indicated significant differences in responses by grade. Specific comparisons were also made using chi-square tests. In most cases significant differences were found only between the college students and the children, with college students giving more correct responses.

An examination of the frequencies of responses to the three initial I/E questions (Table 4) reveals that approximately half of the 1st- and 5th-graders, and about two-thirds of the 3rd-graders, believed that rays (or other) go out from our eyes when we look at someone or something (Ques. 11). Surprisingly, one-third of the college students answered this question incorrectly. The only specific significant difference in performance on #11 was between 3rd-graders and college students, $X^2 (1, N = 98) = 13.16$, $p < .001$ although other differences approached the level of significance, e.g. between college students and 5th-graders $X^2 (1, N = 107) = 3.67$, $p < .056$, and between 1st-graders who answered more correctly than 3rd-graders $X^2 (1, N = 81) = 3.78$, $p < .052$.

When asked next if rays (or other) enter our eyes when we look at someone or something (Ques. 12), almost 90% of college students
Table 4: Frequency of Correct and Incorrect Responses to the 3 Initial Individual Intromission/Extramission Questions

<table>
<thead>
<tr>
<th>Ques 11</th>
<th>Ques 12</th>
<th>Ques 14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rays go out from our eyes</td>
<td>Rays enter our eyes</td>
<td>Rays go out from then come back into our eyes</td>
</tr>
<tr>
<td>Correct Answer</td>
<td>Incorrect Answer</td>
<td>Correct Answer</td>
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<tr>
<th>Grade 1</th>
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<tbody>
<tr>
<td>21</td>
<td>20</td>
<td>22</td>
<td>19</td>
</tr>
<tr>
<td>51%</td>
<td>49%</td>
<td>54%</td>
<td>46%</td>
</tr>
<tr>
<td>n=41</td>
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<tbody>
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<td>16</td>
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<td>30%</td>
<td>70%</td>
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<td>49%</td>
<td>51%</td>
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<td>69%</td>
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<table>
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<td>12%</td>
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<tr>
<td>n=58</td>
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</tbody>
</table>

\[ X^2 (3, N = 188) = 13.26 \]
\[ p < .004 \]

\[ X^2 (3, N = 188) = 36.04 \]
\[ p < .001 \]

\[ X^2 (3, N = 188) = 13.92 \]
\[ p < .002 \]
Table 5: Frequency of Correct and Incorrect Responses to the last 3 Intromission/Extramission Questions

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<th>Ques 18</th>
<th>Drawing 19</th>
<th>Last Ques</th>
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</thead>
<tbody>
<tr>
<td>Rays go into, out from, or both into &amp; out from our eyes</td>
<td>Rays go into, out from, or both into &amp; out from our eyes</td>
<td>Rays go into, out from, or both into &amp; out from our eyes</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 1</th>
<th>Correct Answer</th>
<th>Incorrect Answer</th>
<th>Grade 3</th>
<th>Correct Answer</th>
<th>Incorrect Answer</th>
<th>Grade 5</th>
<th>Correct Answer</th>
<th>Incorrect Answer</th>
<th>College</th>
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<th>Incorrect Answer</th>
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<td>n=41</td>
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<td>49</td>
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<td>15%</td>
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<td>24%</td>
<td>41%</td>
<td>45%</td>
<td>45%</td>
<td>55%</td>
<td>55%</td>
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</tbody>
</table>

$X^2 \ (3, N = 186) = 53.82$  \hspace{1cm} $X^2 \ (3, N = 187) = 56.18$  \hspace{1cm} $X^2 \ (3, N = 188) = 49.84$

$p < .001$  \hspace{1cm} $p < .001$  \hspace{1cm} $p < .001$

*All differences in Ns due to missing responses
correctly answered affirmatively. Responses from the other grades were quite mixed, with 54% of the 1st-graders, 60% of the 3rd-graders and only 31% of the 5th-graders answering correctly. Specific differences were found between college students and all other grades, the largest difference of which was between college students and 5th-graders, $X^2 (1, N = 107) = 36.92, p < .001$. Fifth-graders in fact, also gave significantly fewer correct intromission responses than the younger children in this sample, as indicated by the following comparative tests: $X^2 (1, N = 89) = 7.73, p < .005$ for 3rd- and 5th-graders; and $X^2 (1, N = 90) = 4.9, p < .027$ for 1st- and 5th-graders.

Question 14 asked if subjects believed that rays go out from our eyes and then come back in when we look at someone or something. Three-quarters of the college students answered correctly in saying "no", while 63% of 5th-graders, 59% of 1st-graders, and only 39% of 3rd-graders were correct. The specific significant grade differences here were between the 3rd-graders and both the college students and 5th-graders who gave more correct responses: $X^2 (1, N = 98) = 14.39, p < .001$ (college and 3rd grade), $X^2 (1, N = 89) = 5.79, p < .001$ (5th grade and 3rd grade).

The last three items were forced-choice questions. In these, subjects of all ages gave incorrect answers more frequently than in the initial three questions. Each of these last questions asked subjects to choose among three responses to the question of what happens when people look at someone or something: either that rays go into the eyes, or rays go out of the eyes, or both. Figures 2, 3, and 4 illustrate the percentage of subjects choosing each category of response at the four grade levels.
Figure 2: Question 18. Graph of Percentage of Subjects Who Chose Rays Go Into the Eyes, Rays Go Out from the Eyes, Rays Go Both Out From and Into the Eyes, or None of the Above.

Percent of subjects in each grade

Grades

1st 3rd 5th Coll

IN OUT BOTH NONE

15 15 61 4
18 23 58 4
21 30 52 5
10 5 21 5

N = 185
Figure 3: Drawing - Question 19. Graph of Percentage of Subjects Who Chose Rays Go Into the Eyes, Rays Go Out from the Eyes, or Rays Go Both Out From and Into the Eyes.
Figure 4: Last Question (D9). Graph of Percentage of Subjects Who Chose Rays Go Into the Eyes, Rays Go Out from the Eyes, Rays Go Both Out From and Into the Eyes, or None of the Above.
A comparison of Figures 2, 3, and 4 permits us to see the most frequent specific response in each grade level to the last three questions, i.e., #18, #19 and the last question (#D10). These questions are important because they forced subjects to make a choice for the first time among in, out, and both. To Question 18, the modal response for 1st-, 3rd-, and 5th-graders was rays go both out from and into the eyes, whereas for college students it was the correct into only response. To the drawing (Question 19), it was both out from and into the eyes only for 3rd-graders, while 1st- and 5th-graders chose the pure extramission response out from the eyes, and college students continued to select the correct intromission answer. However, on the last question the most frequent answer in all grades was both out from and into the eyes. In these last three questions the only specific significant differences were between college students and all the other grades, and these differences were very large. For example, the differences between college students and 5th-graders were: #18, \(X^2 (1, N = 105) = 37.41, p < .001\); #19 \(X^2 (1, N = 107) = 32.36, p < .001\); Last Question \(X (1, N = 1078) = 29.01, p < .001\).

In response to Question 18, the first verbal question forcing a choice among the three alternatives, 61% of college students, 15% of 1st- and 3rd-graders, and only 4% of 5th-graders correctly stated that rays go into our eyes during visual perception. Responses to the drawing (Question 19), were similar to those of Question 18, with 59% of college students, 15% of 1st-graders, and 5% to 6% of 3rd- and 5th-graders choosing the correct drawing. By the time subjects answered the last question, however, even fewer thought that rays only enter our eyes during perception: only 45% of
college students, 7% of 1st-graders, 5% of 3rd-graders, and no 5th-graders answered correctly. The decrease in number of correct responses for college students appeared to be a result of presenting subjects with evidence of apparent inconsistencies in their previous answers in the Probe questions (see Appendix, and also discussion of Probe questions, pp. 39-41).

An examination of the graphs in Figures 2 and 4 shows that most of the college students who changed from a correct (intromission) answer on Question 18 to an incorrect (extramission) answer on the last question chose Both Out From and Into the Eyes as their final response— an increase of some 18%. The category Rays go out from the eyes increased by only 3%. The correct intromission response lost 16% between Question 18 and the last question in the college sample. The Both category was also the major gainer in the younger elementary grades with 17% more 1st-graders and and 27% more 3rd-graders choosing it as the correct response to the last question. The number of 5th-graders changing response category was divided almost evenly between gains for out from (11%) and both out from and into (9%).

2. The Piaget Extramission Question (#15)

Responses to this question of whether the looks of two people viewing the same thing at the same time mix or meet were inconclusive, at least for college students who were often puzzled by the question. Later in answering the Probe Questions, some of the college students indicated that they had understood this question differently than intended. That is,
they understood "looks meet" to mean people looking at each other at the same time, despite the fact that testers used gestures to indicate a point where two people might look at the same time. Whenever subjects indicated a misunderstanding of this question, their response was changed. The younger subjects did not, however, show puzzlement over this question, nor did they indicate later that they had misunderstood it. In fact, most 1st-, 3rd-, and even 5th-graders answered the question unhesitatingly. From the data gathered (and corrected as indicated above), 63% of 1st-graders, 72% of 3rd-graders, 51% of 5th-graders and 40% of college students said they believed that people's looks can mix together or meet at the same object. An overall chi-square test of independence of grade and response was significant: $X^2 (3, N = 185) = 10.58, p < .014$. Specific comparisons using chi-square statistics revealed that there were no differences between the responses of 1st- and 3rd-graders, or between 5th-graders and college students. The significant differences were between 3rd- and 5th-graders $X^2 (1, N = 89) = 7.41, p < .007$. Perhaps the most interesting factor about question 15 for testers was the alacrity and apparent assuredness with which the 1st- and 3rd-graders answered this question compared to other questions in the test. The youngest subjects seemed to testers to find this item easier to answer than most of the others.

3. The Hearing and Smelling Questions (#16 and #17)

Table 6 shows the frequencies of correct/incorrect responses to Question 16 (hearing) and Question 17 (smelling). There were fewer correct responses overall to the question of whether invisible rays, waves,
Table 6: Frequency of Correct and Incorrect Responses to the Hearing and Smelling Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Frequency of Responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ques 16</td>
<td>Invisible rays/waves go out of our ears when we hear something</td>
</tr>
<tr>
<td></td>
<td>Correct Answer</td>
</tr>
<tr>
<td>Grade 1</td>
<td>24 (59%)</td>
</tr>
<tr>
<td>Grade 3</td>
<td>17 (42.5%)</td>
</tr>
<tr>
<td>Grade 5</td>
<td>38 (78%)</td>
</tr>
<tr>
<td>College</td>
<td>49 (86%)</td>
</tr>
<tr>
<td></td>
<td>27 (67.5%)</td>
</tr>
<tr>
<td></td>
<td>24 (60%)</td>
</tr>
<tr>
<td></td>
<td>38 (78%)</td>
</tr>
<tr>
<td></td>
<td>52 (90%)</td>
</tr>
</tbody>
</table>

| Ques 17  | Invisible rays/energy go out of our nose when we smell something |
|          | Correct Answer | Incorrect Answer |
| Grade 1  | 24 (59%)       | 17 (41%)         |
| Grade 3  | 17 (42.5%)     | 23 (57.5%)       |
| Grade 5  | 38 (78%)       | 11 (22%)         |
| College  | 49 (86%)       | 8 (14%)          |
|          | 27 (67.5%)     | 13 (32.5%)       |
|          | 24 (60%)       | 16 (40%)         |
|          | 38 (78%)       | 11 (22%)         |
|          | 52 (90%)       | 6 (10%)          |

$X^2$ (3, $N = 187$) = 24.31

$p < .001$

$X^2$ (3, $N = 187$) = 12.94

$p < .005$
or other go out of our ears when we hear something than to the same type of question about smelling. Although most college students said they did not believe in emanations from the ears or nose, it was surprising to find that 14% did say “yes” to emissions from the ears and 10% to emissions from the nose. Twenty-two percent of 5th-graders said “yes” to both hearing and smelling emissions, while in the case of 1st-graders, 41% said “yes” to emanations for hearing and 32.5% for smelling, and at the 3rd-grade level 56% said “yes” to hearing, and 38% said “yes” to smelling emanations. A chi-square test of independence of grades was highly significant for both questions: $X^2(3, N = 187) = 24.31, p < .001$ for Question 16, and $X^2(3, N = 187) = 12.94, p < .005$ for Question 17. Specific chi-square comparison tests for Question 16 showed that once again there were no significant differences between the responses of 1st- and 3rd-graders, or between 5th-graders and college students, and that the significant differences were between the 3rd- and 5th-grade samples, $X^2(1, N = 89) = 11.46, p < .001$. The only significant difference revealed by specific chi-square tests on responses to Question 17 was between the college sample and the children, $X^2(1, N = 187) = 10.23, p < .001$.

Subjects’ scores were also entered into a 2 X 2 contingency table relating responses on Questions 16 and 17 (See Table 7). Although the greatest number of subjects at each grade level chose the correct response to both questions (last column), more than 80% of college students were right in both answers, while for 5th-graders it was 59%, 3rd-graders 31%, and 1st-graders 45%. Thus, the data indicated a decreasing tendency with age to attribute extramissions to either the ears or the nose,
Table 7: Contingency Table Representing a Summary of 2 X 2 Tables Relating Responses to Questions on Whether There Are Emissions From the Ears During Hearing (#16) and Emissions From the Nose During Smelling (#17)

<table>
<thead>
<tr>
<th></th>
<th>Both Emissions from the Ears and Emissions from the Nose</th>
<th>Emissions from the Ears but no Emissions from the Nose</th>
<th>Emissions from the Nose but no Emissions from the Ears</th>
<th>No Emissions from the Nose and no Emissions from the Ears</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grade 1</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n= 40</td>
<td>7</td>
<td>6</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>17.5%</td>
<td>15%</td>
<td>22.5%</td>
<td>45%</td>
</tr>
<tr>
<td><strong>Grade 3</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n=39</td>
<td>11</td>
<td>5</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>27.5%</td>
<td>12.5%</td>
<td>31%</td>
<td>31%</td>
</tr>
<tr>
<td><strong>Grade 5</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n= 49</td>
<td>2</td>
<td>9</td>
<td>9</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td>18%</td>
<td>18%</td>
<td>59%</td>
</tr>
<tr>
<td><strong>College</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n= 57</td>
<td>4</td>
<td>2</td>
<td>4</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>7%</td>
<td>4%</td>
<td>7%</td>
<td>82%</td>
</tr>
</tbody>
</table>
although the number of subjects who revealed extramission beliefs for these senses at all age levels was, nevertheless, surprising.

A comparison of responses to questions about emissions from the eyes (#11) and from the ears (#16) or nose (#17) during perception revealed that many subjects professed a belief in extramissions for visual perception, but not for auditory or olfactory perception (see Tables 8 and 9), even though there was a general developmental trend toward more correct responses on all three senses. The data on emissions from the nose and eyes, for example, show that at all ages the two most frequent categories of response were either “no” to both emissions from the nose and eyes, or “yes” to emissions from the eyes (#11), but “no” to emissions from the nose (#17). The data on the ears were more mixed for 1st- and 3rd-graders, with a greater tendency for them either to accept or reject emissions from both eyes and ears. However, the greater number of 5th graders and college students once again either rejected emissions entirely, or accepted emissions from the eyes but not emissions from the ears or nose.

Note that very few subjects of any age who did not believe in emissions from the eyes ever attributed emissions to the ears (only about 8% of the children, and 2% of the college students). The somewhat higher figures for belief in emissions from the nose but no emissions from the eyes on the part of the children (between 10% and 18%) may represent merely the understanding they all expressed that air goes out of the nose as you breathe. The frequency of incorrect olfactory responses for college students, however, was about the same as for emissions from the ears (3% compared to 2%).
Table 8: Contingency Table Representing a Summary of 2 X 2 Tables Relating Responses to Questions on Whether There Are Emissions From the Eyes During Visual Perception (#11) and Emissions From The Ears During Hearing (#16)

<table>
<thead>
<tr>
<th></th>
<th>Both Emissions from the Eyes and Emissions from the Ears</th>
<th>Emissions from the Eyes but no Emissions from the Ears</th>
<th>Emissions from the Ears but no Emissions from the Eyes</th>
<th>No Emissions from the Eyes and no Emissions from the Ears</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>14</td>
<td>6</td>
<td>3</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>34%</td>
<td>15%</td>
<td>7%</td>
<td>43%</td>
</tr>
<tr>
<td>Grade 3</td>
<td>20</td>
<td>8</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>50%</td>
<td>20%</td>
<td>7.5%</td>
<td>22.5%</td>
</tr>
<tr>
<td>Grade 5</td>
<td>7</td>
<td>18</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>14%</td>
<td>37%</td>
<td>8%</td>
<td>26%</td>
</tr>
<tr>
<td>College</td>
<td>7</td>
<td>12</td>
<td>1</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>12%</td>
<td>21%</td>
<td>2%</td>
<td>65%</td>
</tr>
</tbody>
</table>

Table 9: Contingency Table Representing a Summary of 2 X 2 Tables Relating Responses to Questions on Whether There Are Emissions From the Eyes During Visual Perception (#11) and Emissions From The Nose During Smelling (#17)

<table>
<thead>
<tr>
<th></th>
<th>Both Emissions from the Eyes and Emissions from the Nose</th>
<th>Emissions from the Eyes but no Emissions from the Nose</th>
<th>Emissions from the Nose but no Emissions from the Eyes</th>
<th>No Emissions from the Eyes and no Emissions from the Nose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 1</td>
<td>8</td>
<td>11</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>20%</td>
<td>27%</td>
<td>12.5%</td>
<td>40%</td>
</tr>
<tr>
<td>Grade 3</td>
<td>12</td>
<td>16</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>30%</td>
<td>40%</td>
<td>10%</td>
<td>20%</td>
</tr>
<tr>
<td>Grade 5</td>
<td>2</td>
<td>23</td>
<td>9</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>4%</td>
<td>48%</td>
<td>18%</td>
<td>31%</td>
</tr>
<tr>
<td>College</td>
<td>4</td>
<td>15</td>
<td>2</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>7%</td>
<td>26%</td>
<td>3%</td>
<td>64%</td>
</tr>
</tbody>
</table>
4. The Feeling-the-Eyes-of-the-Other Questions (Set B).

Responses to the first two Feeling questions were considered critical measures in this study: Question 6 (Have you ever felt staring?) and Question 7 (Can other people feel staring?). A chi-square analysis of responses by grade (Table 10) revealed significant differences for both questions, with a clear developmental trend in the direction of an increase with age in the experience of having felt the stare of another (68% to 93%), and in attributions of the same experience to other people (51% to 93%).

Specific chi-square comparison tests showed that the only significant difference in responses to Question 6 (feeling the eyes of another) was between college students and the children, $X^2 (1, N = 188) = 6.84, p < .009$. Since on Question 7 differences between 1st- and 3rd-graders and 5th-graders and college students were not found to be significant, the responses for these pairs of grades were pooled. The chi-square test for the two sets of pooled responses (1st + 3rd grade and 5th grade + college) was significant, $X^2 (1, N = 188) = 28.42, p < .001$, supporting the above-mentioned age trend apparent in the data of increasing social awareness and attributions of shared experiences to other people.

Some of the most startling information, however, was revealed through a 2 x 2 analysis of the two questions (Table 11). Not only did the younger children indicate they had experienced feeling-the-eyes-of-others less frequently than older children and college students, but some 32% of 1st-graders and 3rd-graders who said they had had such experiences themselves did not believe that other people had felt the staring of another person. Note that a major shift had occurred by 5th grade where only 8%
Table 10: Frequency of Subjects’ Responses to the 4 Feeling-the-Eyes-of-Other-People-and-Animals (Set B) Questions By Grade

<table>
<thead>
<tr>
<th>Ques 6</th>
<th>Ques 7</th>
<th>Ques 9</th>
<th>Ques 10</th>
</tr>
</thead>
<tbody>
<tr>
<td>I feel the stare of other people</td>
<td>Other people can feel staring</td>
<td>I can feel an animal stare</td>
<td>An animal can feel me stare</td>
</tr>
<tr>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Grade 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>13</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>68%</td>
<td>32%</td>
<td>51%</td>
<td>49%</td>
</tr>
<tr>
<td>n=41</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>30</td>
<td>10</td>
<td>24</td>
<td>16</td>
</tr>
<tr>
<td>75%</td>
<td>25%</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>n=40</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade 5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>39</td>
<td>10</td>
<td>41</td>
<td>8</td>
</tr>
<tr>
<td>79.5%</td>
<td>20.5%</td>
<td>84%</td>
<td>16%</td>
</tr>
<tr>
<td>n=49</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>4</td>
<td>54</td>
<td>4</td>
</tr>
<tr>
<td>93%</td>
<td>7%</td>
<td>93%</td>
<td>7%</td>
</tr>
<tr>
<td>n=58</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$X^2$  
(3, N=188)=10.48  
(3, N=188)=30.96  
(3, N=186)=1.51  
(3, N=187)=15.83  
$p < .015$  
$p < .001$  
$p < .67$  
$p < .001$
Table 11: Contingency Table Representing a Summary of 2 X 2 Tables Relating Responses to Both Feeling-the-Eyes-of-Other-People Questions (# 6 and #7)

<table>
<thead>
<tr>
<th>Grade 1</th>
<th>I feel and other people can also feel staring</th>
<th>I feel but other people cannot feel staring</th>
<th>I do not feel but other people can feel staring</th>
<th>I do not feel and other people cannot feel staring either</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=41</td>
<td>15</td>
<td>13</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>37%</td>
<td>32%</td>
<td>12%</td>
<td>19%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 3</th>
<th>I feel and other people can also feel staring</th>
<th>I feel but other people cannot feel staring</th>
<th>I do not feel but other people can feel staring</th>
<th>I do not feel and other people cannot feel staring either</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=40</td>
<td>17</td>
<td>13</td>
<td>7</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>42.5%</td>
<td>32.5%</td>
<td>17.5</td>
<td>7.5%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade 5</th>
<th>I feel and other people can also feel staring</th>
<th>I feel but other people cannot feel staring</th>
<th>I do not feel but other people can feel staring</th>
<th>I do not feel and other people cannot feel staring either</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=49</td>
<td>35</td>
<td>4</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>71%</td>
<td>8%</td>
<td>12%</td>
<td>8%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>College</th>
<th>I feel and other people can also feel staring</th>
<th>I feel but other people cannot feel staring</th>
<th>I do not feel but other people can feel staring</th>
<th>I do not feel and other people cannot feel staring either</th>
</tr>
</thead>
<tbody>
<tr>
<td>n=58</td>
<td>52</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>90%</td>
<td>3%</td>
<td>3%</td>
<td>3%</td>
</tr>
</tbody>
</table>
of subjects responded affirmatively for self and negatively for others. At
the college level students responded, almost unanimously, that they had
experienced feeling-the-eyes-of-others and that other people had the
same experiences as they (90%) and only 3% of the sample thought that
they could feeling staring but that other people could not. Thus, 1st- and
3rd-graders appeared to be considerably more egocentric in believing in
the uniqueness of their experiences in feeling the eyes of others than were
5th-graders or college students.

Responses to Questions #9 (Can you feel an animal staring?) and
#10 (Can an animal feel you staring?) were also analyzed through chi-
square procedures (Table 10). Surprisingly, no significant differences
among grades were found in responses to #9 (whether subjects could feel
an animal staring), nor was there any indication of a developmental trend.
Some 55%-66% of subjects of all ages said they thought they could feel an
animal looking at them.

Results did, however, indicate differences between grades for
Question 10, in which wide shifts occurred between 1st-grade and college
in whether subjects believed that an animal could feel them staring at it,
from 34% of 1st-graders to about 50% of 3rd-graders and college students,
with as many as 75% of 5th-graders answering affirmatively. Specific
significant differences in answers assessing the power of human eyes to
contact animals were found in chi-square tests between 5th-graders and
all other subjects: 3rd- and 5th graders showed the following difference,
$X^2(1, N = 89) = 7.41, p < .007$, and the difference between 5th-graders and
college students was almost identical, $X^2(1, N = 107) = 7.31, p < .007$. 
Interestingly, 1st- and 5th-graders were almost opposite in their responses to whether an animal could feel them staring at it (66% of 1st-graders saying “no” and 75% of 5th-graders saying “yes”), $X^2(1, N = 90) = 15.55, p < .001$. Third-graders and college students, on the other hand, were more alike in their responses to this question.

Once again, differences within grades in answers to this pair of questions were also revealing. First-graders answered that they could feel the staring of an animal about as often as an animal could feel them staring (37.5% vs. 34% respectively) and 3rd-graders differed only slightly in their frequencies (37.5% vs. 47.5%). More 5th-graders and college students, however, believed that an animal could feel them stare, but they were relatively less inclined to believe that they could feel the stare of an animal (5th grade = 46% vs. 75%, college = 34% vs. 50%) perhaps giving evidence of a belief in a human superiority over animals in older subjects not present in the younger children.
CHAPTER V
DISCUSSION

The overall purpose of this research was to investigate two types of understanding of visual perception in children and adults: explicit theories of visual functioning, and implicit theories or personal beliefs about the effects of our gaze upon the objects of our vision. The responses to all the main questions in this study, the Feeling-the-Eyes-of-the-Other and the Intromission/Extramission questions, except for one, resulted in age differences in that children gave more extramission answers than college students, and pointed to a clear developmental trend. (The only question that did not elicit such differences was #9—whether subjects thought they could feel an animal staring at them—which yielded a 35%-45% affirmative response rate over all ages.) Thus, five of the seven hypotheses in this study were supported by the results. However, the data also held a number of surprises, not the least of which was the number of believers in extramission perception that were found among college students.

Discussion of the Hypotheses

Upholding the first hypothesis, children did subscribe in greater numbers than college students to an explicit extramission theory of perception. However the differences between the children and the college
students in correct vs. incorrect responses to the two individual extramission questions #11 (do rays or other go out from the eye) and #14 (do rays or other go out then come back into our eyes) were not as large as might have been expected (see Table 4 for frequencies of responses). A much larger difference was found in frequencies of correct responses to the initial intromission question (#12 = do rays or other enter the eyes). Eighty-eight percent of the college students correctly answered "yes" to intromission question #12, while far fewer of the children responded correctly—from 33% for 5th graders to 54% and 60% for 1st- and 3rd-graders respectively. The differences in frequencies of correct intromission responses between the college students and the children grew even larger in the three forced-choice items (#18, #19-drawing, and #D10-last question) which all asked essentially the same question, i.e., whether rays or other go into, out from, or both into and out from our eyes. The children gave a correct intromission response with a frequency ranging from 4%-15% (#18), 5%-15% (#19), and 0%-7% (#D10-last question), while college students' responses were 61%, 59%, and 45% for the same questions (Table 5).

Thus, although age differences had been expected, and they did prove to be significant, what was not expected was the finding that so many younger subjects would reject the intromission theory entirely. Equally unexpected, too, was the fact that so many college students would exhibit such uncertainty about their visual perceptual processes that only 45% (n=26) of the 58 college students would answer all three of the critical, forced-choice questions correctly. The 32 other college students in this sample
gave from 1-3 incorrect extramission responses, which fell into the following pattern: if only one response to the three forced-choice questions was incorrect, then it was (in all but two cases) the response to the last question (#D10); and if an incorrect extramission response was given to Question 18 and Drawing 19, then the last question was invariably answered erroneously also.

With regard to the hearing and smelling questions, younger children once again gave considerably more incorrect extramission responses to these questions, as was expected, ranging from as many as 58% endorsing emanations from the ears, to 40% stating they believed in emissions from the nose for smelling (Table 6). What was not expected was that as many as 14% of college students said “yes” to waves, rays or other being emitted from the ears during auditory perception, and 10% said they believed in such emissions from the nose for smelling.

Interestingly, erroneous beliefs about emissions from the eyes may have influenced some subjects to give more incorrect answers about hearing and smelling (although no significant effects were found), if we are to judge from comments made by some of the older subjects. One college student, for example engaged in the following spontaneous thinking aloud processes: “Well, I guess if something goes out of your eyes when you see, then something must go out of your ears when you hear... If something goes out when you hear, then I guess something has to go out when you smell too.”

The data did, in any case, confirm Hypothesis 2 in that many subjects made a clear distinction between emanations from the eyes and from the
other senses. Many who knew there were no emanations from the ears or nose believed, however, that rays, energy or something else goes out of the eyes when we look at someone or something.

It had been further expected (Hypothesis 3) that subjects who had given extramission answers might consider revising them after being given the opportunity to see drawings of intromission vs. extramission perceptual processes, to state exactly what they think comes out of the eyes, and to consider whether emissions from the eyes effect changes in the objects they contact. In other words, it was thought that the older subjects must know that intromission is the correct answer, but they might possibly have forgotten that visual perception involves only (light) rays entering the eyes, and thus that asking them questions about perception in several different ways could help them remember.

The results did not support these expectations. Not one subject in the college sample ever progressed from choosing an extramission response on Question 18 and Drawing 19 to a correct response on the last question. Fourteen subjects (24%), on the other hand, switched from having correctly responded to Question 18 and Drawing 19 to answering the last question incorrectly (see Table 5). Of the remaining subjects who answered erroneously, 14 stated the same incorrect response three times, while 4 switched between “out” and “both” as their answers. Most of the total of 32 college students who answered erroneously said they thought that energy, mindwaves, unidentifiable rays, some combination of the aforementioned, or “something else” emanated from and entered the eyes; only 2 who gave erroneous responses mentioned light. By contrast, of the
26 college students who answered all three forced-choice questions correctly all except 2 stated that light enters the eyes.

Thus, while asking the same question at different times or in different ways may be expected to yield a certain number of subjects who might randomly change their response, in this case there did not appear to be random answer switching since the only changes were from one incorrect response to another, or from a correct to an incorrect response. Furthermore, college students who knew that light rays entered the eyes and that nothing emanated from them during perception were not induced to give incorrect responses according to our data. On the other hand, while virtually all the other college students seemed to know that something entered the eyes, they also believed that something emanated from them, and their belief in extramission visual perception was not shaken by the questions.

The fourth hypothesis, that most subjects had felt the eyes of other people, was largely upheld, at least for the college students and older elementary students, with evidence of a developmental trend (Table 10): almost all college students (93%), about three-quarters of 3rd- and 5th-graders, and approximately two-thirds of 1st-graders stated that they had had "feeling-the-eyes-of-the-other" experiences (Question 6). A comparison of these and responses to Question 7 ("Do you think that other people can feel it, without seeing when someone is looking at them, or that they can't?") yielded the surprising findings that may be found in Table 11. Most college students and 5th graders answered appropriately that others could probably feel staring if they themselves could, while a few answered
that they thought other people had such experiences even if they themselves didn't. In contrast, only about half of the 1st- and 3rd-graders thought others could feel what they could feel, or believed that others might have had such experiences in feeling staring even if they themselves did not. Fully one-third of the two youngest age groups answered that they could feel staring but that other people could not.

The responses to these two questions also have implications beyond suggesting a developmental trend in awareness of or sensitivity to the “feeling-the-eyes-of-the-other” experience. The fact that only about two-thirds of the 1st-graders in this study had had feeling-the-eyes-of-the-other experiences compared to almost all of the college students would seem to point to differences in social awareness. And, the fact that so many young children did not believe that other people had experiences like theirs suggests the possibility of a greater level of egocentrism for 6- and 7-year-olds in this area of perspective-taking than has been found in many other perspective-taking studies. Flavell (1985), and many other researchers have shown that children are capable of understanding another's point of view at earlier ages, and that shifts in understanding for a number of types of perspective-taking may occur at about 18 months, 30 months, and 4 years. The present findings are, however, more in line with Piaget’s theory that children first become able to take the viewpoint of another person only around the age of 6 or 7 years. Carey (1985) also reported that important changes in children’s concepts of people and animals occur between the ages of 6 or 7 and 10 years, when children began to display the adult patterns of responses.
Answers to the two questions on animals (#9 and 10) in this study yielded fewer age differences overall than the other perception questions (Table 10). Only about 35-45% of subjects in all age groups thought they could feel an animal stare at them (#9). A clear developmental trend was evident, however, in the number of subjects who thought an animal could feel a person staring at it (#10). First-graders made no distinction between a person feeling an animal (37.5%) or an animal feeling a person (34%), while about one-half of 3rd-graders and college students, and as many as 75% of 5th-graders thought an animal could feel them staring at it although considerably fewer thought they themselves could feel an animal staring. Most children and older subjects thus appear to hold an implicit belief in a level of superiority of humans over animals in eye power. The gaze of an animal such as a dog or a cat is apparently not powerful enough to be felt by most humans. The majority of our subjects tended to believe, on the other hand, that a human gaze can be felt by such animals, a confirmation of Hypothesis 5.

All four of the "feeling" questions were considered indicators of a possible implicit extramission belief. Another such question was #15, the "Piaget" question that asked whether the looks of two people viewing the same thing at the same time might mix or meet. Despite the evidence of some confusion about the question on the part of college students (corrections were made for misunderstandings), it provided data that was in keeping with the other measures of extramission belief in this study. It was intriguing to note the children's general level of acceptance and apparent understanding of this question, and the quicker responses they
gave to it compared to most other questions in the study. Perhaps the fact that this was a more concrete question than those about explicit extramission beliefs made it easier for the children to answer, but it also may be that this question tapped into an area of beliefs that are more on a children's level rather than an adults' level of thinking.

Hypothesis 7 postulated that subjects confronted with a discrepancy between their feeling-the-eyes-of-the-other answers and their rejection of an explicit extramission statement would find themselves unable to explain their contradictory-appearing responses, and some would try to make adjustments in their answers. In fact, so few of the children proved to be in this situation because of their frequent extramission responses that this discrepancy occurred virtually only in the college sample.

Subjects from the college sample who answered the critical questions correctly and at the same time stated they had experienced feeling the eyes of another (and thought other people could also, questions #6 and 7) tended to react in one of two ways. Some shrugged their shoulders and said they did not know how it was that you could feel the eyes of others, but they still didn't think anything was emitted from the eyes because they knew from physics that it was light entering the eyes that permitted you to see. A number of this group decided on the spot that maybe you only thought you could feel eyes looking at you but that it might have happened by chance.

As mentioned above, however, 14 college students (26% of the sample), having given two correct intromission responses (to #18 and #19-Drawing), actually changed to an incorrect extramission response on the
last question (#D10) after being confronted with the disparity between their affirmative feeling-the-eyes-of-the-other answers (#6 and 7) and their denial of extramission in question #11 along with their intromission answers in the forced-choice questions (#12, 18, 19). Several of these subjects stated openly, when faced with the apparent discrepancy, that they guessed they'd have to change their answer because something obviously had to come out of the eyes since you could feel someone looking at you. These students then chose "both into and out from our eyes" as their final response, and sometimes mentioned that we should go back and alter their previous answers (in which case the subjects' request was recorded but their answers were analyzed as originally given). Thus, the need to resolve their feelings of cognitive dissonance—i.e., a strong implicit belief in the power of their eyes to have effects on the objects of their gaze, along with uncertainty about how our perceptual processes function—would seem to be what might have led these students to adopt an explicit extramission response to the last question. In any case, this would indicate, according to Festinger's hypotheses regarding dissonance reduction, that these subjects placed greater value on their feeling-the-eyes-of-the-other beliefs than on the scientific explanations of visual processing they had been taught. They therefore altered the beliefs in which they had less personal investment in order to make them consonant with their feeling beliefs (see Festinger, 1957).

Finally, contrary to the sixth hypothesis, no condition effects were found. Presenting Feeling-of-the-eyes-of-the-other questions before the explicit Intromission/Extramission questions (as in Condition A, see
Appendix) had no significant effect on extramission responses. That is, subjects were not influenced by their affirmative responses to the feeling-of-the-eyes questions (which in many cases seemed to indicate an implicit extramission belief), to give a greater number of affirmative responses to the explicit extramission questions.

This study did not test for the possibility of condition effects from or upon the ears and nose questions, nor did it even test a full range of beliefs about these senses since it was not expected that many subjects would respond incorrectly to questions about emissions from the ears and nose. While high frequencies of incorrect responses to questions on extramission for hearing and smelling were not obtained, more children and adults than expected did answer these questions erroneously. Subsequent unpublished research, however, which tested for order effects from and upon questions asking about intromissions and extramissions in these senses along with similar questions about the eyes has not revealed any significant condition effects. The measures used in these follow-up studies were paper-and-pencil tests that varied the position of hearing and smelling versus visual questions for 6th-graders and college students. Based on the results of the study reported here as well as the follow-up paper-and-pencil questionnaires, the belief in extramission visual perception appears to be relatively robust.

General Discussion

How might we explain the numbers of subjects in this research (as well as those in the study by Winer and Cottrell, 1991) who subscribe to
extramission perception beliefs? Virtually all children through the 5th-grade level in this study said they believed something goes out of our eyes when we look at something or someone (and one-third to one-half of them also believed that something goes out of the ears and nose in order to permit us to hear or smell something). Since no child in the study expressed consistent intromission beliefs we may conclude that the extramission beliefs are learned early in development. Such learning may begin in infancy with the rhythmic, mutual gaze-gaze away patterns that become established in the first weeks of life. By 1st grade children can begin to answer questions about how their perceptual processes function. Some of them in this study answered that something can go into their eyes when they look, because, as a couple of them mentioned spontaneously, "sunshine gets into your eyes and it hurts". However, these children thought that something also goes out of your eyes, so that you can see people and things. They apparently did not link sunshine or light going into the eyes with seeing. By 5th grade children no longer mentioned the sunshine problem, and significantly fewer answered "yes" to anything going into the eyes during perception. But at the same time there was no reduction in the number believing that something goes out of the eyes.

Fewer 5th-graders than younger children selected the intromission answer on the forced choice questions (#18, #19 and last question), and not one 5th-grader chose intromission as his or her final answer (not that the younger children performed significantly better, though, because only two 1st-graders and three 3rd-graders chose intromission as a final answer). In fact, when students were given feedback in their classrooms
about the research, the 5th-graders in particular appeared amazed, judging from their expressions and exclamations to each other, to hear that nothing emanates from the eyes during visual perception. Despite explanations that attempted to describe seeing as something like the action of a camera and the retina as a kind of permanent film from which information about what you see is sent to your brain, the students still seemed to find it hard to believe that visual perception involves only light waves entering the eyes. Superman movies and examples of x-ray vision from other movies were brought up in the question and answer period. Obviously, introversion explanations are not nearly so appealing as the images of eye power disseminated through our popular culture.

Although many more of the 5th-graders scored higher than younger children on questions that tapped social awareness ("feeling-the-eyes-of the-other" questions) it is intriguing that their scores were lower on some of the introversion/extraversion questions. The data would lead one to conclude that what develops between 1st and 5th grade might be a strengthening of personal, intuitive, extraversion beliefs. A partial explanation may be that such beliefs become strengthened through increased self-consciousness from more social awareness coupled with a lack of direct teaching about the anatomy and functioning of the eye.

One would expect that most college students had been taught something about visual perception during their many years of education, either through biology or physics classes, or even in general science courses in which light would have been studied. In fact, the college students in this sample had all completed a unit on sensory perception
within a week or two before participating in the experiment and had taken a midterm exam even more recently than that which included questions on how the eye processes light waves. All had been taught a model of the pathway of light through the structures of the eye to the optic nerve. Thus, it was not surprising to find that almost all the college students (compared to no more than half of the children) answered that something enters the eyes during perception (almost all said it was light).

Nevertheless, some two-thirds of the college students also believed that something goes out of the eyes, which was surprising. Clearly, these students must have learned how our visual processes work in order to answer the intromission question correctly in such great numbers. And yet, this did not prevent a majority of them from maintaining their old extramission theory too.

Carey (1985, 1991) has theorized that children's theories undergo "strong" restructuring when scientific information is learned that conflicts with them. Such restructuring leads to a theory change that is like the paradigm shifts Kuhn (1962) referred to as scientific revolutions. However, not all changes are of the strong type. Carey also proposes a "weaker" type to represent the development of expertise of the kind that a player may gain in chess. This weaker type does not require a shift in core concepts; rather it involves an increase of knowledge that permits one to operate on a superordinate level as opposed to a basic level (Carey, 1985 pp. 4-7).

The data from the college students in this study would seem to argue against the idea of a theory change of either the stronger or weaker type in beliefs about extramission perception. Even with the scientific knowledge
of light waves entering the eyes all but a few college subjects maintained an implicit extramission belief in affirming that people can feel it when someone is looking at them without seeing that person's eyes, and more than half expressed an explicit belief in emanations from the eyes. This belief is astonishingly close to Plato's basic extramission theory—rays go out of the eyes to contact an object and come in with an image of the object, or to an Augustinian version of it—rays bring the image of an object in and then some force from the mind goes out through the eyes to the contact the object.

A possible explanation for such diverse modes of cognition within the same person may be found in Heinz Werner's theory which allows for the use of different forms of thought based on different systems of logic.

It is one of the most important tasks of developmental psychology to show that the advanced form of thinking characteristic of western civilization is only one form among many, and that more primitive forms are not so much lacking in logic as based on logic of a different kind (Werner, 1948, p. 18).

Werner also allows for regression to earlier forms of thought, which he calls "primitivation":

The normal adult, even at our own cultural level, does not always act on the higher levels of behavior. His mental structure is marked by not one but many functional patterns, one lying above the other. . . man possesses more than one level of behavior; and [. . .] at different moments one and the same man may belong to different genetic levels (Werner, 1948, pp. 38-39).

More recent studies of decision-making processes and irrational behavior in situations of uncertainty also point to the possibility of different types of conceptual systems existing side by side in the same individual.
Kahneman and Tversky (1982) have hypothesized that we assess external uncertainty in two ways:

(i) a distributional mode, where the case in question is seen as an instance of a class of similar cases, for which the relative frequencies of outcomes are known, or can be estimated; (ii) a singular mode, in which probabilities are assessed by the propensities of the particular case at hand (p. 152).

Based on a number of studies they conducted, the authors conclude that people generally prefer the singular mode, in which they take an 'inside view' of the causal system that most immediately produces the outcome, over an 'outside view'. . . [although] the distributional mode of judgment is more likely than the singular to view accurate estimates of values and reasonable assessments of probability (p. 153).

Although the subjects in the present research had obviously learned sometime between 5th grade and college that something enters the eyes during perception, this learning does not seem to have erased their extramission beliefs. Following the ideas of Kahneman and Tversky, the extramission theory may be part of a “singular mode” based on intuitive beliefs constructed over years of experience, the “inside view” of things that people generally prefer over the “outside view” which has been learned in a more or less formal manner. Judging from the fact that virtually all college students, but only about two-thirds of 1st-graders, had had “feeling-the-eyes-of-the-other” experiences, a further strengthening of intuitive beliefs may continually occur through that intuitive channel. There is also the strong increase with age in the belief that other people can feel staring, which may well contribute to the strength of a belief in emissions from the eyes. The scientific knowledge that light enters the eyes during visual perception does not provide an explanation for the “feeling-the-eyes-of-
the-other" that almost all college students have experienced. In fact, no subject in this study professed to have a sure or even satisfactory explanation for this almost universal feeling. No doubt the absence of a clear, satisfying explanation provides a kind of protected space for the growth of extramission theory.

It may also be helpful to consider in this context the points made in an earlier article by Tversky and Kahneman (1974) regarding the types of biases and memory search methods we use to assess occurrences. For example, the availability of instances that can be brought to mind, and the retrievability of instances because of familiarity or salience, as well as the ease with which relevant instances can be constructed may all lead us to judge an event as more frequent than it actually is, and to make illusory correlations about the frequency with which two events co-occur. Furthermore, as the authors point out, the illusory correlation effect is very resistant to contradictory data.

These hypotheses may thus help to explain the belief most subjects expressed that people could tell when someone was looking at them without seeing the other person's eyes. The startling, unexpected meeting of another person's eyes at an unguarded moment might well carry enough of an affective charge to create a strong memory trace and a category of salience for meeting-the-eyes-of-another-person. This type of category might, furthermore, lead us to believe that such a meeting-of-the-eyes was not just a chance occurrence of two person's eyes meeting as they randomly moved from one point of focus to another, but rather the result of the other person staring at us, and that we looked precisely in that
person's direction because we could feel his or her stare. And if we find ourselves staring at another person who suddenly looks up and catches our gaze, we might surely think that he or she could feel us staring. Never mind that we might often find ourselves staring at someone who doesn't look up. Such instances would be quickly forgotten, if noticed at all, because they would be merely one of hundreds of small experiences we have daily that have no emotional content, no affective charge, and thus no salience. The one of a dozen or more instances of our staring that involves a meeting of the eyes could well be enough to reinforce our belief as surely as any other variable ratio schedule of reinforcement, and produce a level of believing as difficult to extinguish as any other behavior learned under variable ratio reinforcement.

At the same time, our language also provides reinforcement for an extramission theory. According to Lakoff and Johnson (1980):

Our ordinary conceptual system, in terms of which we both think and act, is fundamentally metaphorical in nature. . . . The concepts that govern our thought . . . also govern our everyday functioning, down to the most mundane details. Our concepts structure what we perceive, how we get around in the world, and how we relate to other people. . . . If we are right in suggesting that our conceptual system is largely metaphorical, then the way we think, what we experience, and what we do every day is very much a matter of metaphor (p. 3).

The authors point out throughout the rest of the book the ways in which metaphors partially structure our concepts and how this structure is reflected in our literal language through various categories of metaphorical ideas. Two of the categories they mention by way of example are of particular interest here. They refer to one of them as the "seeing is touching; eyes are limbs" category. Examples of expressions in this
category include: "I can't take my eyes off her...Her eyes picked out every
detail...Everything within reach of his eyes" (p. 50). Another of their
common language categories is "understanding is seeing" in which ideas
are represented as light sources, and discourse is a light-medium, giving
rise to such expressions as: "I see what you are saying" (p. 48).

We can easily recognize that such categories are also representative
of ancient theories of perception, namely of Plato's extramission theory and
Augustine's Christian variant of that theory, with its emphasis on our gaze
reaching out to the light of understanding. Both of these ancient theorists
produced such compelling arguments for their ideas that their theories
guided scientific and popular thought about perceptual processes for
centuries. If Lakoff and Johnson are correct, then the influence of Plato
and Augustine continues still today through the metaphorical expressions
that reflect their theories.
CHAPTER VI
CONCLUSIONS

Extramission perception may have been doomed as a scientific theory more than 400 years ago when Johannes Kepler discovered the principle of the retinal image, however, it seems to have remained a compelling personal belief for virtually all children through the 5th-grade level, and for at least half the college students in the samples interviewed for this research. Judging from the fact that so few children agreed with the idea of something only entering the eyes, and all of them stated that something emanates from the eyes, we can only conclude that intromission ideas must be counter-intuitive, and extramission beliefs must be intuitive. The children who allowed for entry of something into the eyes when presented with forced-choice questions did so almost always only in combination with emanations from the eyes, i.e., intromission was acceptable to most younger children only when they could choose "both into and out of the eyes" as a response.

It may be that the act of visual perception appears to be too active a process to require only a receptive sensory organ that is pointed in the right direction and allowed to function somewhat like a camera, with the only other requirements being some light in the environment and some attentiveness on the part of the perceiver. It may also be that the almost
universal “feeling-the-eyes-of-the-other” experiences make it seem as if emissions from our eyes contact the objects of our vision, and that these emissions can be somehow felt by humans and animals when our gaze is directed to them. Given the fact that our language adds a substantive dimension when it describes our glances as cutting or piercing and our looks as hard—almost as if we threw knives or rocks with our eyes—it reinforces the intuitive extramission notions that personal experience has provided.

In any case, if our sample is at all representative, it takes years of education to instill the idea that perception involves light rays or waves entering the eyes. Our sample also shows, however, that learning about intromission does not necessarily mean that subjects reject extramission theories. On the contrary, fewer than half of our college subjects selected a pure intromission answer to the final question in this study; the other half chose a “both into and out of the eyes” response.

Thus, we may conclude that children might start out with strong, intuitive extramission beliefs that have been reinforced by language and common experiences of discomfort in feeling stared at and in meeting unexpectedly the eyes of another. At some point in their education most children learn that light and images enter the eyes during perception. This learning, however, does not always erase previous beliefs, and in many cases probably simply comes to exist alongside the intuitive beliefs as another category of information. To take another example, although all of us learn in school about the Copernican revolution, and are carefully instructed about how the earth travels around the sun and revolves in its
own orbit, I wonder how many of us are able to resist thinking that the sun rises in the morning and sets in the evening as we go about our daily lives, especially since this is certainly what appears to happen. When not required to think in a specific scientific mode, most people probably, especially at times of uncertainty, regress to a more primitive mode of thinking in Wernerian terms, and use a channel of intuitive, personal beliefs as Kahneman and Tversky's many studies have demonstrated.

The research reported here raises more questions than it answers. For example, it does not tell us what subjects believe in their own words occurs when they look at someone, or when someone looks at them, or when two people look at each other, or when people look at objects. It suggests the possibility of a U-shaped curve in development, with children becoming stronger extramissionists, at least through the 5th-grade level, before becoming at least partial intromissionists by the time they become college students, but it does not provide information about when or how the theory change may come about. And finally, it does not address the issue of what effects such erroneous ideas about an important basic perceptual process like vision may have on interpersonal relations and people's notions about the powers that humans can exercise over their environment, and over other people and animals through emanations from their eyes. In fact, the entire area of beliefs about communication of love through the eyes that was such an important theme in poetry and literature throughout the Medieval and Renaissance periods in western civilization was not investigated in this research, and remains uncharted territory for future exploration.
Thus, although this study has provided some answers to main questions represented by the hypotheses, many of the findings that point to solidly entrenched, intuitive extramission beliefs were unexpected, and merit further investigation. Extramission perception appears to be alive and functioning, albeit incognito, in virtually all children and in many adults.
APPENDIX

QUESTIONNAIRE USED IN THIS STUDY

(CONDITION A)
Test Questions  Condition A

Set A. Initial perception questions - with immediate corrections for wrong responses  (Circle yes or no, and the word correction if a wrong response is given and you had to correct)

1. Do you touch with your fingers? Yes  No correction?
2. Do you hear with your eyes? No  Yes correction?
3. Do you smell with your nose? Yes  No correction?
4. Do you see with your ears? No  Yes correction?
5. Do you taste with your tongue? Yes  No correction?

Set B. Feeling-eyes-of-the-other questions

6. a. Do you ever feel that someone is staring at you without actually seeing them look at you? For example, in class (school), on a bus, in a restaurant or a store, etc.?  
Yes  No________________________

b. (If Yes) Does this happen to you (1) often or almost every day  (2) about once a week  (3) every so often  (4) only once in a while

7. Do you think that other people can feel it, without seeing, when someone is looking at them, or that they can't?  
Yes  No________________________

8. Can people see well in the dark without any light, or can’t they? No  Yes Correction?

9. Can you feel it when an animal like a dog or a cat is staring at you if you aren't looking at it?  
Yes  No________________________

10. Do you think an animal like a dog or cat could feel you staring at it without seeing your eyes, or that it couldn't?  
Yes  No________________________

Set C. Intromission/Extramation questions

11. When people look at something or someone, do you think rays, or maybe energy, or mindwaves or something else goes out of their eyes? (if yes, What?)  
Yes  No________________________
12. When people look at something or someone, do you think rays or energy or something else goes into their eyes? (If yes, What?)
   Yes No

13. Can most people see through thick, solid walls or can't they? No Yes correction?

14. When people look at something or someone do you think that rays or energy or something else first goes out of their eyes and then comes back in? (If yes, What?)
   Yes No

15. When two people look at the same thing at the same time, do you think their looks mix or meet?
   Yes No

16. When people hear something do you think that invisible rays, or energy, or waves or maybe something else goes out of their ears. (If yes, What?)
   Yes No

17. When people smell something, do you think that invisible rays, or energy, or maybe something else goes out of their nose or not? (if yes, What?)
   Yes No

18. When people look at someone or something, do you think that rays go into their eyes, or go out of their eyes, or both?
   Into Out of Both Neither

19. Please look at these three drawings. Here is one with rays or energy going out; here is one with rays or energy going in; and here is one with rays or energy going out and then coming back in. Point to or tell me the one that shows best what happens when we look at something or someone.
   rays in rays out both rays in and rays out
   L R C L R C L R C
(5) Q 16
If S said yes to Q 16 (something out of ears) when we hear Yes No.
You said that comes out of our ears we hear something, does this have any
effect on the thing we are hearing? Does it change it in any way? Yes No
(If yes) How?

(6) Q 17
If S said Yes to Q 17 (something out of nose) when we smell Yes No:
You said that comes out of our nose we smell something, does this have any
effect on the thing we are smelling? Does it change it in any way? Yes No
(If yes) How?

Set D: General wrap up questions - ask at end.

(7) Do you believe there is some way that people might communicate without using words. Like
a message that might get sent from mind to mind, heart to heart, etc.
(Ans.) Yes No

(8) How do you think this might this happen?
(Ans.)

(9) Have you ever thought about questions like these before? Yes No
(If Yes) Which ones?
When / Why did you think about them?

(10) So, finally, when we look at someone or something, do you think that rays go into our eyes,
or go out of our eyes, or both? Into Out of Both
LIST OF REFERENCES


