THE DEVELOPMENT OF CHILDREN'S IDEAS ABOUT THE CONTENT AND FUNCTION OF THEIR BODIES: A METHODOLOGICAL STUDY

by

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DEDICATION

TO MY PARENTS

LOYD AND RUTH HEWITT

Who have unselfishly given a lifetime of
support
and
encouragement
to their children

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CHAPTER I

OVERVIEW

Young children's conceptions of internal body organs and their function is an area of interest to researchers from a number of disciplines. Specialists from psychology, psychiatry, medicine and cultural anthropology recognize the influence of conceptions about the body upon many aspects of human attitude and behavior, in both the physiological as well as emotional arena. It has been observed that people's beliefs about the working of their bodies may affect the response made to illness and to public health measures (Mead, 1955).

It is often assumed that the older a child becomes the more he knows about his body. How a child developmentally arrives at his ideas and perceptions may differ considerably from the adult perspective (Grillot, 1979). As the child develops, his understanding and knowledge undergoes qualitative as well as quantitative change. He begins to see more of the whole, developing ideas and interrelationships (Piaget, 1969).

A few studies have been done on what children know about their bodies (Brumbeck, 1977; Crider, 1981; Denehy, 1984; Gellert, 1962; Nagy, 1953; Porter, 1974; Schilder & Weschler, 1935; Tait & Ascher, 1955). A number of these studies focus on anatomical rather than physiological aspects of the body (Brumback, 1977; Porter, 1974; Schilder & Weschler, 1935; Tait & Ascher, 1977) containing questions relating primarily to the knowledge about certain organs rather than the "how" of the bodies functioning. In addition to seeking anatomical information, Crider (1981), Denehy (1984), Gellert (1962), Nagy (1953), and Williams (1979),

pursue the idea of body function. Crider (1981 and Nagy (1953) look at the physiological processes associated with breathing, digestion, and brain function.

Methodology used to elicit knowledge about the body from children vary with the researcher and the population under consideration. Individual interviews (Crider, 1981; Denehy, 1984; Gellert, 1962; Nagy, 1953; Schilder & Weschler, 1953) and body outline drawings (Brumback, 1977; Gellert, 1962; Goodenough, 1926; Porter, 1974; and Tait & Ascher, 1955) are the two most utilized methods noted in the literature. A written essay and objective testing was implemented by Nagy (1953).

The Goodenough draw-a-person test (Goodenough, 1926) focused on the concept of the individual's physical exterior as a method of determining personality adjustment and intelligence. Tait and Ascher (1955) proposed the Inside-of-the-Body test for evaluating distorted perceptions of the interior of one's body and Brumback (1977) using the same tool, looked at normal elementary school children. Hospitalized children were studied by Gellert (1962) and Williams (1979) while normal non-clinical children were tested by Brumback (1977), Crider (1981), Denehy (1984), Gellert (1962), Nagy (1953), Porter (1974), and Schilder & Weschler (1935). Non-American children were studied in Hungary (Nagy, 1953) and the Phillipines (Williams, 1979).

In general these studies tend to support a general progression of body knowledge and awareness that proceeds from the outside in. The most commonly identified body parts are the bones, heart, and brain (Brumback, 1977; Crider, 1981; Gellert, 1962; and Porter, 1974). Children identify the cardiovascular, musculoskeletal, and gastrointestinal systems most frequently according to Gellert (1962) and

Porter (1974). Williams (1979) identified the lungs as being least known while Gellert (1962) found little knowledge of the bladder and ribs among young children. The least represented systems include reticuloendothelial, integumentary, and reproductive (Gellert, 1962; Porter, 1974). According to all investigators, the number of body parts named by children increases with age. Young children have a tendency to conceive of contents of the body in terms of what they observe being put in or coming out of it (Gellert, 1962; Williams, 1979) and are unable to readily explain organ function in terms of transformation until early adolescence (Crider, 1981; Nagy, 1953).

Gellert's (1962) work has shown that the child proceeds to learn about the surface characteristics of the body followed by more concrete body parts such as muscles and bones. The child in the pre-operational stage learns primarily from concrete experiences and can feel a bone or muscle through the skin. The child's acquisition of knowledge about body parts show a steady rise according to Gellert, except for a sharp rise which occurs around the age of 9. This dramatic increase in information about the body at this age might be expected, based on current knowledge of children's interest during this period of their lives. Gessel and Ilg (1946) observed that this is usually a time of considerable curiosity about nature studies in general, and about the workings of the body in particular. In concurrence with this finding, Blos (1956) states that it corresponds to the spurt in intellectual facility seen by teachers at this age.

In later American studies the progression of body knowledge is seen to proceed much more quickly, and children today appear to be more knowledgeable about their bodies than in the 1940's when Gellert did her

work. Porter (1974) suggests that this increase may have been the result of a combination of several contributing factors which include the greater emphasis on health teaching in the school system and society in general. The influence of television, advertising, and the development of educational toys involving the body has also impacted on children's knowledge level.

Marie Scott Brown is currently investigating children's understanding of their bodies, their emotions and the relationship between the two. The purpose of Brown's study is to develop three tools for the investigation of the normal growth and development of children's concepts in these areas and to begin to study the normal development of these concepts in the 2 1/2 - 12 year-old-child. Anticipated contributions from the study are: 1) an increase in knowledge about the development of children's knowledge in the areas of their bodies, emotions, and the relationship between the two; 2) the provision of beginning baseline data for health education; 3) the development of clinical assessment tools based on the refinement of the tools used in the research; and 4) provision of interventions to provide children with knowledge and skills to help them maintain a healthful relationship between their bodies and emotions.

An assumption basic to Brown's study is that before devising or selecting any method of teaching children about the relationship of their bodies to their emotions, the normal development of these concepts must be charted.

The purpose of this study is to investigate methodologically the "Inventory of Body Knowledge" questionnaire developed by Brown (1976, Appendix A). This tool, originally developed in exploratory work

with 146 preschool children, is based on Gellert's (1940) tool but modified in several ways. Gellert's tool seemed to be conceptually mixed in terms of anatomical versus physiological questions asked. Brown changed all of Gellert's basic questions into a physiological format and added a number of systems, such as skin and sensory organs not included in the original tool. The language was also updated. In the initial investigation, test-retest reliability, interrater reliability, and content and face validity were attempted. Results were unsatisfactory because of problems with the scoring mechanism.

It is the purpose of this investigator to conduct a study that looks at the reliability and validity of Brown's Inventory of Body Knowledge instrument and, in so doing, add to the knowledge base of how children learn about the content and function of their bodies. Another purpose is to begin to investigate children's knowledge about health and illness related to their body parts and function. First through fourth grade subjects, age 6-10 years, will be individually interviewed and tape recorded using this tool. Content analysis will then be done on the tape recorded information and statistically analyzed.

In the review of the literature the following areas will be examined: 1) children's conceptual development of body knowledge; 2) principles of interviewing relative to the young child; 3) use of psychometric theory in the establishment of the reliability and validity of a measuring instrument; and 4)content analysis.

Review of the Literature

Development of Body Knowledge

The typical school age child, when asked about contents of the body is likely to identify brain, bones, heart, blood, and blood vessels

(Gellert 1962; Porter, 1974; Schilder & Weschler, 1935 and Tait & Ascher, 1955). By age 10 to 11 the stomach will be identified, and as the child grows older, lungs, muscles, nerves, kidneys, intestines and other major organs will be added to the list (Gellert, 1962; Porter, 1974). Interrelationships between organs, systems, and physiological body processes can be conceptualized by the adolescent (Crider, 1981).

Schilder and Weschler (1935) interviewed 40 non-hospitalized subjects ages 4 to 13 in their study, "What do Children Know about the Interior of Their Body?" Their findings suggested that young children believe the whole inside of the human body to be filled with food. Over age 11, the emphasis is no longer on ingestion and egestion but on structural elements and vital organs. These findings concur with Tait & Ascher (1955) who administered the Inside-of-the-Body Test to both adults and children to evaluate distorted perceptions of the body interior. As part of this study, 22 sixth graders were allowed three minutes to draw the inside of the body including all the organs; they were then to draw a line from each organ to the outside and label accordingly. Among the younger children was the tendency to conceive of contents of the body in terms of what is observed "being put in and coming out of it". Items listed included food, beverages, feces, blood, and urine.

Organs most frequently drawn in Tait's study with the 22 sixth grade children were the heart, stomach, intestines, brain, and ribs. Frequent musculoskeletal responses were noted and systems most often noted were the cardiovascular and gastrointestinal.

Nagy (1953) summarized general characteristics of young children's notions of organ function in her study of 650 normal, 4 - 12-year-old,

Hungarian subjects. The three functioning areas of brain, respiration, and digestion were dealt with methodologically by individual interviews, essay performance, and timed testing in her study entitled "Children's Conceptions of some Bodily Functions".

It was concluded by Nagy that children have a single operating scheme with regard to the body. Body organs are represented as nonspecific, with the lungs and stomach all said to be made of bones, skin, blood, flesh and food. The young child under 11 does not distinguish internal from external function and each orgán is given a single specific function. A one-to-one correspondence exists as with the notion that lungs are for breathing and the brain for thinking. Further, the child is not able to explain function in terms of transformation such as in gas exchange. Complementary functions such as assimilation of food and elimination of waste are not recognized by the child.

The developmental progression in children's knowledge of interior body content and body functions or processes has been systematically studied by Gellert (1962). Individual interviews, using the "Index of Body Knowledge" questionnaire developed by Gellert and the drawing by subjects of the size and location of body organs on a body outline, were used with 96 children ages 4 years 9 months to 16 years 11 months. All but 4 subjects were hospitalized. The questionnaire with three parts has, as a focus, the vital body processes of respiration, circulation, digestion, and locomotion. Part one asks generally "What do you have inside you"; part two looks at identification of body part, size, location, and function; and part three asks "What parts are the most or least important part of you?" Gellert categorized children's ideas about body functions and arranged the categories in sequence from those

expressed most frequently by younger children to those expressed most often by older children.

Gellert inferred from the children's drawings that awareness of the various body regions proceed from head to legs to arms and then to the trunk. The number of items cited spontaneously as being inside increased with age, with most children able to list 1 to 2 items even at the preschool age. A sharp increase in information about the body occurs between 8 to 10 years and at no age level is there significant difference between boys and girls, either in quantity or kinds of items listed.

Items most frequently mentioned are bones, blood vessels, heart, blood, and the brain. Those least mentioned include the gallbladder, bladder, and ribs. One-fourth mentioned the stomach spontaneously; systems mentioned most were musculoskeletal and circulatory; least mentioned were reproductive, reticuloendothelial, and integumentary. As age increases the proportion of children identifying the digestive, urinary, nervous, and respiratory system steadily rose. The heart is considered to be the most important part of the body and by age 7 the child views the heart as "necessary for living". The majority of 9 to 10 year olds associated heart activity with breathing.

Gellert found few children under nine able to explain the relationship of the lungs to vital body processes. "Although most subjects...aware air is required for maintenance of life, it was not until 15 years that the majority stated the lungs essential to life" (p. 343).

Many children view the skin as a boundary between the internal and external aspects of the body. The young child perceives the skin as

"holding the body together" and beyond nine years protection is mentioned as a function. Bones are most frequently mentioned as being inside the body. Gellert attributes this finding to the child being able to feel hardness and angularity. All ages give some account of bone function but the "relationship of the skeletal system to mobility received increasing emphasis with age" (p. 351). Children also appear to learn about ribs later than the heart, lungs, bone, and skin. Although children know little about the nervous system before the age of nine, there is some conception of relating nerves to nervousness.

Children under 9 did not mention stomach in Gellert's study. The term stomach, when identified, is referred to as the entire abdomen and contrary to Nagy's (1953) findings, is located below the correct anatomical position. Until age 13 most children exaggerate the size of the stomach, probably due to reference of the "stomach" as the entire abdominal area. Digestion as a function of the stomach is not mentioned prior to age 11. The 4 to 7 year old sees all food as going to the abdominal region and never leaving the body. Gellert states "From the data it appears the possibility of transforming one kind of matter into another generally becomes conceivable at about age eight; the notion of turning matter into energy may require a higher level of abstract thinking not prevalent until adolescence" (p. 373).

To the very young child "elimination (defecation) is a social requirement rather than a mechanical necessity". By nine the majority of Gellert's children identified feces in connection with food. The urinary bladder, rarely identified, is often confused with the gall-bladder. Gellert found that it was not until adolescence that the child associates the bladder with the elimination of fluids. Tait (1955)

mentions that the "popular idea of body interior just doesn't include a bladder".

Gellert proposes several hypothesis regarding the way children may have arrived at their conceptions about the body: 1) Body parts emanating little or no sensation are thought to be smaller than body parts which can be felt frequently and/or intensely, 2) organs whose functions are well known are thought to be larger than organs whose functions are not known and 3) the lesser the sensations emanating from a body part, the poorer is the child's information about its functioning (1962, p. 392).

Utilizing a body outline drawing, Porter (1974) tested 144 elementary school children in the first, third, and fifth grades to ascertain their perceptions of internal body content. The students were given 15 minutes to draw everything "inside the body" and to label the parts identified. The purpose of her study was to determine: 1) the accuracy of children's drawings, 2) organs drawn most frequently, 3) the differences in perceptions between the sexes, 4) how perceptions change with age, 5) parts rarely drawn and named, and 6) the body systems most familiar to children. From the results of her study, Porter concluded that children knew considerably more about their internal body parts than previous studies had indicated. The parts most frequently named were the heart, brain, and bones; the three body systems most frequently represented were the cardiovascular, gastrointestinal, and musculoskeletal, and boys named more parts than girls. Four out of 144 subjects in Porter's study mentioned the reproductive system. The number of parts identified as well as the frequency of reference to all systems, showed a gradual increase with age.

Brumback (1977) used the Inside-of-the-Body Test to study 150 normal, upper class, elementary school children, grades 1-6. In contrast to Porter's study there was no time limit for drawing and labeling all the parts possible on a body outline. The complexity of the drawing and the number of identified parts increased with age with the heart being the most commonly identified organ. The brain was mentioned by all grades and the only reference to gender or perineal structure was the penis noted in 40% (8) drawings by the sixth grade males. Brumback concluded that young children initially perceive the inside of the body as the heart and bones and, as they get older, begin to view the body as having internal organs. The older child also has a better perception of the correct anatomical relationship of body organs.

Both hospitalized and well chidren from grades one, three, and five were randomly selected by Williams (1979) in a study carried out in the Philippines. Three hundred fifty-nine children were tested by drawing and identifying body parts drawn on a human figure outline and stating the function of the parts named. The most frequently named body part was bones (81%) with lungs (28%) the least frequently mentioned. Again the number of correct responses increased with grade level. Miscellaneous items such as food, water, air, feces, and urine were mentioned less frequently as age increased. The reproductive organs such as ovary, womb, and testicle, were identified by fifth graders. This finding is thought to be related to the sex education and family planning curriculum taught in grade schools in the Philippines.

A convenience sample of 140 second, fourth, and sixth grade children were individually interviewed by Denehy (1984) regarding the function of 5 body organs, the heart, lungs, stomach, kidneys, and

bladder. In contrast to earlier studies (Gellert, 1962; Nagy, 1953) that indicated children had little knowledge about the function of the human body until age 9-10, this study noted that even at the second grade level, children had some understanding of the function of the heart, lungs, and stomach. Most fourth graders had a good understanding of these organs; sixth graders were able to relate the organ to the appropriate system and other related body systems. Few of Denehy's subjects had a good understanding of the function of the kidneys or bladder. Overall knowledge showed a gradual increase with each grade level.

A theoretical interpretation of data about what children think about their body interior is attempted by Crider (1981). Using the developmental theories of Werner (1947) and Piaget (1929, 1958) as a conceptual base, Crider interviewed 21 children, ages 6 to 12. The interview included answering questions about what is inside the body, drawing the body parts, and locating organs on a schematic drawing. The child was then asked to answer a series of questions about the constitution and function of body parts as well as what happens to "food we eat" and "air we breathe".

Crider conceptually develops an abstract outline of the progression that might be anticipated in children's increased understanding about the body interior and function. She bases this progress upon Werner's developmental theory that says "Whenever development occurs, it proceeds from a state of relative globality and lack of differentiation to a state of increasing differentiation and heirarchic integration" (1947, p. 126), and Piaget's stages of operational thinking.

There is a heirarchial arrangement of concepts as children develop. Crider postulates that children's ideas, although limited, are not erroneous. What the adult perceives to be misconceptions are not simply replaced with adult accuracy; rather children's limited knowledge proceeds by a gradual increased specificity and elaboration of their ideas. The trends noted in the studies looking at how children developmentally learn about the body interior correspond to the cognitive characteristics described by Piaget (Crider, 1981; Gellert, 1962) and are discussed further in the conceptual framework.

Crider (1981) clarifies the notion that knowing a child's age does not mean one can predict how he or she will think about the body. There is not a one-to-one correspondence of age to developmental stage but there are age related trends in conceptualization well documented by Brumback (1977), Gellert (1962), Nagy (1953) and Porter (1974).

In summary the literature suggests that, as children develop they learn about their bodies in a progressive, predictable way. The studies overall support a general progression of body knowledge and awareness that proceeds from outside in, with surface characteristics the first to be identified. The number of body parts increase with age as does the knowledge of body function and the interrelationship between body systems. Health and illness aspects are not specifically addressed in the literature reviewed.

Principles of Interviewing

In the research process there is a good deal of information that can only be gathered from a certain specified population by direct, systematic questioning and face-to-face verbal exchange. Young children comprise such a population. If carefully developed and implemented, the

personal interview with the chid is powerful in that it can get at a depth and quality of information unattainable by other methods.

Underlying interviewing as a method of data collection are basic principles applicable to all age levels. Of particular concern to the researcher who interviews children is the normal physiological, social, and emotional processes of development. These factors impact upon the approach to the interview procedure as well as the methodology used. Analysis of the data is not exempt from consideration of the child's age and level of development.

In the next sections the basic principles of interviewing and interviewing techniques discussed in the literature are reviewed. Developmental concepts relevant to data collection from the young child by interview are explored.

Interview: Definition

The interview, as defined by Molyneaux (1982) is "conversation with a purpose" (p. 1); and more specifically by De Schvewnitz (1962), as "Verbal interaction that is purposeful and directed in which one person takes responsibility for the development of conversation" (p. 9).

Kahn and Cannell (1967) elaborate upon the basic concepts of interviewing by defining the process as a "specialized pattern of verbal interaction, initiated for a specific purpose, and focused in some specific content area, with a consequent elimination of extraneous material. Moreover the interview is a pattern of interaction in which the role relationship of interviewer and respondent is highly specialized, its specific characteristics depending somewhat on the purpose and character of the interview" (p. 16).

From these definitions one deduces that an interview is an interactional process in which both the interviewer and respondent, have a part in an interpersonal process. The directional responsibility rests with one person, the interviewer; the focus of conversation is for a specific reason and associated with a particular subject matter.

Interview: Purpose

The interview may serve a number of purposes. Molyneaux (1982) identifies five goals of interviews as: Information getting, information giving, expression and exploration of feelings, problem solving and planning for future action (p. 3).

The basic purpose for the interview from a research perspective, is to collect information. If certain, factual information from the respondent is essential to the purpose of the study, the information getting interview becomes the most appropriate choice.

Attitudes and feelings as well as factual data may be obtained in an information getting interview. However, this interview style is not designed to penetrate deeply into the personality structure or unconscious mind; nor is its intended purpose to change the individual. It is the absence of interest to change the respondent which most sharply differentiates the information getting interview from other interview strategies (Kahn, 1979, p. 19).

Components of the Interview

Benjamen (1974) discusses three stages, indicating movement, in the interview. Not always well defined, these stages sometimes fuse into each other and include: The initiation or statement of the matter, development or exploration, and the closing (p. 18). Molyneaux (1982)

identifies these three divisions in a time frame: The "first minutes", the "body", and the "closing minutes".

Objectives appropriate in the opening stage include: Making the respondent feel at ease by creating an atmosphere of acceptance, identification of the interview purpose, discussion of the time frame, and interview protocols and procedure. The confidentiality of materials, their potential use, and permission to record the data, must also be discussed in the opening moments.

Most of the interview will be spent in development of the main body or exploration stage. Major responsibility of the interviewer is to maintain effective interaction while working toward the interview goal.

Summarizing what has happened in the interview is a helpful way to bring closure to the "information getting" interview. Certain information might need to be repeated or clarified. The respondent needs to be given the opportunity to evaluate what has transpired and, in the leave taking process, the interviewer needs to express appreciation to the interviewee for his/her cooperation.

Interview Schedule

A formal instrument such as a questionnaire, is generally used in the direct questioning of subjects in a research project. Identified as an interview schedule, the development of such an instrument involves extensive planning and consultation, pretesting, and revision (Polit & Hungler, 1982).

The purpose for the questions within the interview schedule is to translate the researcher's specific objectives into a form in which they can be communicated to the respondent with maximum effectiveness. They

also assist the interviewer in the task of motivating the respondent to communicate freely (Kahn & Cannell, 1965).

In planning a research interview there is a choice between a standardized or tightly structured interview schedule and an unstructured or free schedule. The questions in a structured interview are completely formulated prior to the interview session and are presented to each subject in exactly the same way without variation in language or sequence. The purpose of such structure is to ensure comparability of responses. In a totally unstructured or free interview, the researcher does not specify in advance the questions or the alternative responses, but interviews from an outline of suggested topics. The majority of interviews and questionnaires fall somewhere between the two extremes (Polit & Hungler, 1982; Yarrow, 1960).

Interview: The Question

The form of the question, either open or closed, is part of the overall structure of the interview/questionnaire. Open ended items allow subjects to respond to questions in their own words while closed end or fixed alternative questions offer the respondent a number of alternative replies from which he/she must choose the "right" answer.

The use of open or closed items depends on a number of factors, including the objectives of the interviewer, the respondents level of knowledge about a topic, the extent to which the respondent is motivated to communicate on a topic, and his verbal ability.

Open questions, although time consuming and difficult to analyze, are more appropriate when the objective is to learn about a subjects level of information. The difficulty lies in developing appropriate

categories and then transferering the open response to a fixed category so tabulation can be made.

Closed items are difficult to construct but easy to analyze and according to Kahn (1965) should be used when the researcher's objective is limited to classification of the respondent with respect to attitude or perception. Sometimes considered superficial, a major drawback to the use of closed items is the possibility of the researcher overlooking some potentially important response.

Yarrow (1960) discusses three major types of interview questions in terms of directness: direct, indirect and projective. The direct, straight forward question is most commonly used for obtaining factual information or for identification of a respondents level of knowledge. Indirect questions are used to explore feelings or attitudes; they inquire without seeming to do so, and usually have no question mark at the end. In a projective question the purpose is disguised in that the respondent is asked to interpret or predict actions in a hypothetical situation. Doll play or pictures are frequently used in this method of questioning.

Interview Question: Principles of Development

Wording of questions for an interview schedule is a complex task. The choice of language and the framework of the question should be such that the respondent understands what the researcher wants him to understand. Questions should be precise and unambiguous; long sentences and overuse of technical and/or complicated terms should be avoided. Questions should be stated positively, with negative words deleted.

Two other types of questions that cause difficulty in the interview are the double question and use of bombardment. The double question

gives the respondent one choice out of two; the second choice may be identical to the first, dissimilar to the first, or incomplete. Bombardment is a statement containing three or more questions of any type (Benjamen, 1974). Double questions and bombardment lead to confusion and breakdown in rapport in the interview process.

Leading questions suggesting a particular answer, should be avoided. The aim in phrasing the question should be either to give no indication of possible response or, to indicate possible responses in such a way that alternatives are balanced (Kahn, 1965).

The ability of the respondent to give information must be considered. The language of the questions must conform to the shared vocabulary of the interviewer and respondent; there must be a common basis of understanding and the language must be simple enough for the least educated respondent in the sample (Polit & Hungler, 1982).

The researcher should not make assumptions about the information level of the respondent. Face saving methods such as "I'm going to ask you a question lots of people don't know," is valuable in making the respondents lack of knowledge seem acceptable. The researcher must not assume the subject is able to remember events or taught knowledge with a high degree of accuracy.

Questions should be phrased in the least objectionable way possible. Consideration of how objectional wording in a question might be to the respondent, as well as provision of a permissive, non-judgemental atmosphere is useful in minimizing anxiety and embarrassment.

Interview: Question Sequence

The opening questions in an interview are of particular importance. The tone of the relationship is set, rapport established and the expectations of the interview identified by both interviewer and interviewee. Personal and/or threatening information should be placed later in the interview after maximum rapport has been established. Demographic information should be placed near the end of the interview (Polit & Hungler, 1982).

Open ended questions that arouse interest should be asked first. This gives the respondent an opportunity to conceptualize the area of inquiry in his/her own words. To minimize confusion with content, questions should be arranged so all items in a category are in relative close proximity. The wording of the questionnaire should be followed precisely in a natural conversational tone. Reading of questions is unacceptable; the interviewee should be familiar enough with the questions so this is unnecessary.

Sequencing of questions with the most general asked first, is recommended. The funnel sequence (Kahn, 1965; Yarrow, 1960) is the procedure whereby the most unrestricted questions are asked first, followed by successively more specific questions. In this manner the content is narrowed to precise objectives; the respondent is also allowed to state his own frame of reference without being influenced by specific questions that define that of the intervewers (Yarrow, 1960).

Questions may be repeated but spontaneous explanation of what the questions mean is to be avoided. Often there is a need to clarify or elaborate on a response to a question. If the response is irrelevant or partial such as "I don't know", probing may be used to stimulate additional or a more useful response.

The Interview: Probing for Response

According to Polit and Hungler (1982), the ability to probe well is the greatest skill of the interviewer. Forms of probing include repetition of the original question, a long pause, or a nondirective probe in the form of a restatement of content ending in a questioning tone, eg., "How is that?". The interviewer's biases may be communicated in his probes, endangering the validity of the interview (Yarrow, 1960).

Response to the answers given by the respondent need to be encouraging and positive in the information getting interview. When the interviewer responds, he speaks in terms of what the interviewee has expressed. A "mm hm" response is a verbal utterance that indicates the listener is "tuned in" and usually indicates approval, as well as permission for the interview to continue (Benjamen, 1974).

The interviewer must respond to silence appropriately. Silence may occur because the respondent needs time to process the question and/or organize thoughts for a response. If the question touches a sensitive area, the interviewee may need time to decide whether or not to answer.

Interviewing Children

The interview is particularly well adapted to assessing a child's perceptions and to study how he/she conceptualizes life experiences, including learned knowledge. The direct relationship established between child and interviewer reduces misunderstandings in the data collection process by providing the opportunity for clarification of unclear questions.

A major problem arises from the child's limitations in language facility and comprehension; there may even be differing stages of language maturity in children of about the same age. The role

relationship between children and adults and the facilitation of adequate rapport with the child are other areas of consideration to the investigator.

Developmental Aspects

Yarrow (1960) identifies four developmental factors to be considered when entering into the interview relationship with children. These are: comprehension of language, language facility, affective and role relationships between children and adults, and the normative, motivational characteristics of children at different age levels such as negativism and independence (p. 563).

The conventional interview, because of its dependence on language, is not appropriate at a preverbal stage. Neither is it useful for children with auditory and language handicaps, including those of emotional origin.

Children between 2 and 3 years of age use words in a limited way to exchange information and concepts. Language is used to express needs and to some extent, control others behavior. Between 4 and 5 years of age children become more interested in exchanging information, in describing events and in directing activities of others. Complex and subtle concepts, however, are often expressed in symbolic language; the grammar of thought and syntax of word meaning differ from the conventional speech of adults.

Jean Piaget's theory of cognitive development identifies the age of 2 to 7 years as the preoperational period. One of the central themes in describing this stage is the egocentric (self-centered) quality of the preschool child's thought and behavior. The child cannot understand the point of view of another person, or even that they may have a point of

view different from his/hers (Ambron, 1979). The egocentric child often uses language just for practice or for communication with her/himself.

Egocentrism does not begin to decline until increased social interaction with other children force the child to acknowledge her mutually dependent relationship with other thinking beings (Ambron, 1979).

Yarrow (1960) believes the direct interview can be used effectively with four year olds and, under this age, productive interviewing can occur if special adaptation to children's linguistic and motivational characteristics are considered. The picture choice and doll-play techniques are useful methods (p. 564).

The motivational characteristics of the preschooler may affect the validity of the interview. Persistent testing, such as refusal to respond or playful teasing behavior may result in response distortion. The skillful interviewer may overcome some of this behavior by establishing rapport with the child prior to the interview.

The young child is very suggestible and the interviewer must make a special effort to avoid influencing the child to give a response he thinks will gain adult approval. Wording the questions so as to suggest several acceptable alternatives eg., "Some children think that ..." is helpful. Counter suggestion or the presentation of the same question in several forms, will also help reduce this problem.

Children's language ability and conceptual development increase rapidly in middle childhood. Language is socially directed and used primarily to communicate ideas.

Piaget's period of concrete operations, age 7 to 11 years, follows the pre-operational period. In this stage the child can use symbols

constructively to perform acts of cognition that are abstracted and free from sensory stimuli. He/she is able to focus attention on more than one aspect of a situation at a time (decentration) and consistently conserves qualities such as length, quantity and weight. Thinking becomes reversible and the child begins to grasp changes in objects or situations throughout an entire dynamic sequence (Ambron, 1979).

In this middle childhood period the child may be hesitant to reveal his/her concerns, feeling and attitudes to adults. Game playing or strategies to make the interview "fun" may enhance rapport and facilitate verbal expression.

Effective motivation to involve the child in the interview will vary with age. The young child must have immediate gratification such as a sticker, while all age children may find the interview experience itself gratifying (Yarrow, 1960). Receiving the full attention of an interested adult who accepts answers to questions without judging them to be right or wrong, enhances a child's feeling of status.

Principles and Methodology for Interviewing Children

Some of the basic principles relative to the interpersonal relationship useful in the therapeutic interview with children, are applicable also to the research interview.

The interviewer must convey to the child a sense of genuine interest and appreciation for child's cooperation. The purpose of the interview, the expected participation from the child, and the interviewer's role must be clearly defined. There should be room for spontaneity that will facilitate the child's response; the interviewer should take care not to become overly anxious in demanding a response from the child.

The environment should be comfortable and familiar. A quiet, private area free from distraction will facilitate the interview process as will a non-threatening seating arrangement. Side by side at the same level is recommended (Yarrow, 1960).

Interviews can be structured (standardized) or free (non-structured). Advantage of using the standardized interview is that it assures response from all subjects to the same questions. The free interview allows for greater flexibility in the form and sequence of question, an advantage with children whose comprehension of language may vary.

Approach to the interview may be directive or non-directive. The directive approach in which the interviewer establishes direction and maintains control of the content area, is more useful for obtaining factual information from the child. The degree of structure refers to the characteristics of the questions and the degree of specificity. Highly structured questions usually go along with the directive approach and are useful when the researcher wishes to focus on a specific topic or obtain factual data (Yarrow, 1960).

A young child needs some framework within which he can focus and direct his thinking and language and may have difficulty with an unstructured approach. The interviewer may alter technique and question form at various points, such as beginning with an open question and moving in a more directive role to more structured questions as the interview proceeds.

When developing questions, several areas should be considered. The question should be readily understood by the child, the language should

be age and culturally appropriate, and the form of the question should not lead the child to a given response.

Pretesting on a population chosen for its comparability to the experimental population is useful in helping to eliminate unclear, inappropriate, or anxiety arousing question. The most effective motivational techniques can also be identified in this process.

Use of the interview as a research approach with children has a number of advantages. The interviewer is able to identify and clarify the child's misunderstanding or lack of comprehension regarding a question. Control of the question sequence and context of questions is possible, and the depth of data obtained is likely to be greater than other forms of approaches.

Yarrow (1960) states "The ultimate value of the interview as a research tool is dependent on the interviewer's knowledge of developmental psychology and his ability to apply this knowledge sensitively in relating to children." (p. 599).

Tool Development: Measurement

Measurement is central to the research process if scientific advances are to be made. This is true in nursing research yet many of the concepts of interest in nursing are difficult to measure accurately. To critically evaluate a measurement tool prior to use, scientists have developed a number of techniques for evaluating the quality of an instrument. Central to this process are measures designed to establish the reliability and validity of a measuring tool.

Reliability

Reliability as a concept of measurement, refers to the degree of consistency with which an instrument accurately measures the attribute

it is designed to measure (Polit & Hungler, 1983). The knowledge of the reliability of an instrument is important to the researcher, not only for interpretation of results, but to make the determination of whether the instrument requires modification for further use. Synonyms used in the literature for reliability include dependability, stability, consistency, predictability, repeatability, and accuracy.

In looking at the accuracy of precision of a measuring instrument, the reliability is defined as the relative absence of error of measurement in that instrument (Kerlinger, 1973). An instrument is said to be reliable to the extent that measurement error is slight. In defining reliability through error, the more error, the greater the unreliability; the less error, the greater the reliability. Reliability maximizes the true score and minimizes the error component (Kerlinger, 1973; Polit & Hungler, 1983).

The consistency of an instrument helps establish its reliability. The extent to which measurements are repeatable and stable over time, under a variety of conditions that could produce measurement error, helps with this determination. The less variation produced with repeated measurement of the attribute in question, the higher the reliability (Aiken, 1979; Nunnally, 1978; Polit & Hungler, 1983).

Two equivalent statistical definitions of reliability stated by Kerlinger (1973) are:

1. Reliability is the proportion of the "true" variance to the total obtained variance of the data yielded by a measuring instrument.
2. Reliability is the proportion of error variance to the total obtained variance yielded by a measuring instrument subtracted

from 1.00, the index 1.00 indicating perfect reliability (p. 446).

According to Polit & Hungler (1983) and Kerlinger (1973), the reliability of an instrument is not the property of the instrument itself but of the instrument when administered to a specified group under certain conditions.

The reliability of a measuring tool can be assessed in several different ways with the method chosen dependent to a certain degree, upon the aspect of reliability the researcher wishes to investigate. The literature looks primarily at three basic approaches: stability, internal consistency and equivalence. The reliability coefficients computed using these approaches can be an important indication of the quality of the instrument. The standard for what a reliability coefficient should be varies with groups and individual comparisons, but any instrument with a reliability of .60 or less is considered unwise to use (Polit & Hungler, 1983).

Reliability: Stability

Stability is the consistency of measurement scores over some given period of time; it is the extent to which the same results are obtained on repeated administration of the instrument and is sometimes referred to as test-retest reliability. The same test is administered to the same group within a predetermined time interval. The two scores are compared and a reliability coefficient (coefficient of stability) is computed to quantitatively describe the magnitude and direction of the relationship. The higher the coefficient, the more stable the measure (King, 1979; Polit, 1983).

Weaknesses exist in the use of stability procedures. Test-retest results do not provide adequate assessment of the instruments susceptibility to extraneous factors. This may result in error. Systematic changes occur in people, traits of interest change over time; intervening experiences and education modify response. The major defect as discussed by Nunnally (1978) is that experience of the first testing will influence response on the second (p. 233). Remembered responses on the first test will tend to be repeated as well as similar guesses on the unsure items.

Reliability: Internal Consistency

The internal consistency of an instrument refers to the correlation among items within the tool itself. An instrument that has internal consistently is homogenous to the extent that all its subparts are measuring the same characteristic (Nunnally, 1978; Polit, 1983). If all the test items are presumed to assess a common, unitary trait, all the items should assess the trait in a similar way (Chase, 1974).

This approach to looking at an instrument's reliability is used by researchers because it is economical, requiring only one test administration. It is also the best way to assess the major source of measurement error, the sampling of content.

The two most widely used methods for determining the reliability based on internal consistency, are the coefficient alpha (Cronbach's alpha) and the Kudar-Richardson Formula 20 (KR 20). Coefficient alpha is felt to be the most useful index of reliability available and, according to Nunnally (1978) should be applied first to all new measurement methods. KR 20, a special version of coefficient alpha, is applicable to dichotomous items.

Coefficient alpha and KR 20 both produce a reliability coefficient that has a normal range of value between 0.0 and +1.00 with the higher value reflecting a higher degree of internal consistency. If the value is too low, either the test is too short or the instrument items have very little in common (Nunnally, 1978).

Reliability: Equivalence

With most measures, in addition to computing a coefficient alpha, it is also useful to estimate the reliability of a measure by the equivalence approach. Two methods utilized are interrater reliability or the use of alternative (parallel) forms of a single instrument.

Interrater reliability is done by having two or more equally trained observers use the same instrument to measure the trait under question at a given point in time. Independently the observers record the relevant variables according to a predetermined coding system and then use the results to compute an index of agreement (Polit, 1983, p. 392). A correlation coefficient may be computed to demonstrate the strength of the relationship between the observers ratings.

In the alternative forms method, two forms constructed to cover the same content area, are administered in succession to a sample of individuals. Correlation between the two sets or scores give an index of reliability of equivalence.

There are exceptions, but reliability estimated from internal consistency usually is very close to the reliability estimated from correlation between alternative forms (Nunnally, 1978, p. 230). If the correlation between alternative forms is markedly lower than the coefficient alpha, measurement error is present. Sources of error described by Nunnally (1978), include differences in content,

subjectivity in scoring, or large variations in people over short periods of time.

Validity

Experts in the field of tool development identify the establishment of validity to be complex and controversial, yet a process which is extremely important, particularly in the area of behavioral research where the nature of reality is questioned (Kerlinger, 1973).

Validity is the degree to which an instrument actually measures what it is designed to measure (Aiken, 1979; Chase, 1974; Polit & Hungler, 1983). It is the extent to which the tool measures the hypothesized, underlying trait, construct, or factor (Brown, 1970).

A measuring instrument by itself is considered to be neither valid nor invalid; a judgment of validity refers to the degree to which the instrument provides information relevant to the decision to be made and to some use to which the instrument is put (Chase, 1974; Nunnally, 1978 & Thorndike, 1977). A test of an instrument's validity is not "proved", "established" or "verified" but is supported to a greater or lesser degree by evidence (Polit, 1983, p. 411).

Nunnally (1978) states that there is no way to prove the validity of an instrument by appeal to authority, deduction from psychological or mathematical computation. Although a never-ending process, Nunnally believes empirical investigation leading to evidence from the real world crucial to the establishment of validity (p. 87).

Authors agree that both judgment and empirical investigation are necessary in the validation enterprise. The more evidence gathered that an instrument is measuring what it is supposed to be measuring, the more

confidence researchers have in its validity (Polit, 1983; Thorndike, 1977).

A tool has many different validities depending on the specific purpose for which it is used, the population for whom it is designed, and the circumstances in which it is to be utilized (Aiken, 1979; Ebel, 1974).

In 1966 a joint committee of the American Psychological Association, the American Education Research Association and the National Council on Measurements used in Education, classified and discussed three types of validity: content, criterion related and construct. They identified construct validity as the most important form of validity from a scientific research perspective (Kerlinger, 1973, p. 457).

In discussing the functions of psychological measures, Nunnally (1978) identifies Predictive or Criterion-Related validity as establishing a statistical relationship with a variable. Content Validity represents a specified universe of content and Construct Validity, as measuring psychological traits.

Content Validity

Content validity refers to the degree or adequacy to which a sample of subject matter is representative of the operationally defined body of knowledge under investigation (Brown, 1970; Chase, 1974; Kerlinger, 1973; Polit & Hungler, 1983). Is the sample evaluated measuring knowledge of a specific, predetermined content area and are the items composing the instrument representative of this content? Content validity becomes a "measure" of the adequacy of sampling (Brown, 1970);

the validity for some instruments depends primarily upon the adequacy with which a specified domain of content is sampled (Nunnally, 1978).

Kerlinger (1973) believes that it is not possible to draw random samples of items from a universe of content and that such a universe exists only theoretically (p. 458). According to Polit and Hungler (1983) there are no objective methods available that assure adequate content coverage of an instrument. To assess a measuring instrument for content validity is not only a rational process but judgmental as well. An instrument must stand by itself as an adequate measure of what it is supposed to measure.

Nunnally (1978) suggests that rather than testing the validity of measures after they are constructed, one should ensure validity by the plan and procedure of construction (p. 92). A collection of items should be formulated that broadly represent the unit of content; a detailed outline or blueprint of the kinds of questions to be included should be prepared. The quality of the outline then may be judged as part of the assessment of content validity. In content valid instruments there should be a representative collection of items and "sensible" methods of tool construction.

It is expected that there should be at least a moderate level of internal consistency among items on a tool in that the items should measure something in common. Comparing change in performance on a test/tool before and after a period of education, as well as identification of a high correlation of scores on different tests purporting to measure the same thing, are two types of evidence supporting the content validity of a measuring instrument (Nunnally, 1978).

Face validity concerns judgment about an instrument after it is constructed and can be considered as one aspect of content validity. It refers to the extent to which an instrument "looks like" it measures what it appears, on subjective evaluation, to measure (Nunnally, 197, p. 111).

Although an inadequate indication of validity by itself, the appearance of reasonableness of what a tool "looks like" may be of importance in determining its acceptability to those who will be tested (Thorndike, 1977). Face validity is also an important consideration in marketing a test/instrument (Aiken, 1979; Chase, 1974).

Criterion Related Validity

The criterion related validity of an instrument is established by the process in which an investigator attempts to demonstrate a relationship between the instrument in question and some other criterion. An instrument is considered valid if the abstract attribute one is measuring correlates highly with this criteria; criterion related validity is determined only by the degree of correspondence between the two measures involved. If the correlation is high, no other standards are necessary (Nunnally, 1978).

Authors vary as to the terminology used to describe criterion related validity. Nunnally (1978) uses the term predictive validity in a general sense that is inclusive of the functional relationship between an instrument and events occurring before (postdiction), during (concurrent), and after (predictive) the instrument is applied. Chase (1974) calls criterion related validity empirical validation in that it is the process of comparing, by statistical procedure, test score rankings with scores based on actual performance of a criterion task.

Polit and Hungler (1983) and Thorndike (1977) use the term "criterion related validity" but identify the subdivisions of concurrent and predictive validity in differentiating the time dimension for obtaining measurement of a criterion.

Predictive validity assesses as to whether an instrument is adequate to differentiate between performance and/or behavior of an individual on future criteria while concurrent validity is the ability of the instrument to distinguish individuals who presently differ on some criterion (Polit, 1983, p. 397). The test is given and the criterion data collected at essentially the same point in time. Brown's (1970) basic paradigm for investigating criterion related validity is: test $\frac{\text{measure of relation}}{}$ criterion (p. 102).

The single greatest difficulty with criterion related validation is obtaining a good criterion. One must have available a reasonable reliable and valid criterion with which the measures on the target instrument can be compared.

Brown (1970) distinguishes between a criterion and a criterion measure. The criterion is the more global concept which must be operationally defined in measurable terms if it is to be useful in determining the validity of an instrument. The criterion measure becomes the operational definition for the conceptual criterion (p. 106).

Four qualities desirable for a criterion measure are discussed by Thorndike (1977) and Brown (1970) and include relevance, freedom from bias or contamination, reliability or consistency of measurement, and availability and practicality.

The ultimate criterion is believed to be "inaccessable"; a researcher must usually be content with a "less than perfect" criterion and choose the most satisfactory measure or combination of measures from those that appear most feasible for his particular study (Polit, 1983; Thorndike, 1977).

Once the criterion is established, the scores of the predictor instrument and the scores on the criterion variable are statistically correlated. A predictor instrument cannot be valid unless it has a significant correlation with the criterion. The magnitude of the correlation coefficient is a direct indication of how valid the instrument is; the higher the correlation, the better. The correlation between the predictor instrument and the criterion variable is important in determining the extent to which one can specify the degree of validity for generalization to a given population.

Construct Validity

One of the most challenging and difficult tasks facing a researcher is validation of an instrument for construct validity. Unlike criterion related valdity, construct validity is concerned with the underlying abstract concept under investigation rather than the scores the instrument produces. Unlike content validity, the logical operations required by construct validation are related to a theoretical base (Polit & Hungler, 1983, p. 401).

Construct validity is considered to be the most general type of validity in that it does use evidence from studies of the content and criterion related validity of an instrument (Aiken, 1979). Like content validity, construct validity requires a judgment pertaining to what the instrument is measuring; it shares an empirical component with criterion

related validity, although there is usually an objective criterion with which to compare a measure in criterion related validity (Polit, 1983).

Construct validity is believed to be particularly relevant to measurement problems in basic research in the behavioral sciences (Nunnally, 1979) in that the process of construct validation incorporates both logical and empirical procedures. It is set apart from the other types of validity by linking psychometric theory with theoretical conceptualization (Kerlinger, 1973; Polit, 1983).

The term construct validity was introduced into the literature by Cronbach and Meechl in 1955 when they defined a construct as a "postulated (assumed or hypothetical) attribute of people that underlies and determines their overt behavior". If that behavior cannot be directly observed, it is not a construct in this sense (Ebel, 1979, p. 306). Brown (1970) describes construct as a "defining term in an interlocking (nomological) network of constructs and laws that constitute a psychological theory (p. 156)".

A construct is evidenced in characteristics of a basic trait or organizer, for example, intelligence, that tells us something meaningful about people. It is not observable, but is literally "constructed" by the investigator to summarize or account for the regularities or relationships one observes in behavior (Aiken, 1979; Chase, 1974; Thorndike, 1977). The construct acts as though it exists because one can see its manifestations; if one can identify a group of behaviors that characterize the construct, one can also rank people on the extent to which they demonstrate the behavior typical of the construct (Chase, 1974).

Summarizing these ideas, Nunnally (1978) states that a construct represents a hypothesis that a variety of behaviors will correlate with one another in studies of individual differences and/or will be similarly affected by experimental treatment (p. 96).

The scientific approach to the establishment of construct validation includes building and supporting with controlled observation, a theory about the trait the researcher wishes to assess. The theory of the construct in hypotheses form, will allow the researcher to make some predictions about what will happen when the varying conditions that influence the construct, are manipulated (Chase, 1974).

Three major aspects of construct validity are discussed by Nunnally (1978). First the domain of observables related to the construct must be specified. From empirical research and statistical analysis the researcher must then determine the extent to which observables tend to measure the same or different phenomena. Studies must then be performed to determine whether a supposed measure of a construct correlates in expected ways with measures of other constructs or is affected in expected ways by a particular experimental treatment (p. 98).

There are several approaches to construct validation. One needs to be cognizant of the fact that there is always an emphasis on logical analysis as well as the testing of relationships based on theoretical consideration.

In the known groups technique the expectation is that groups will differ on the critical attribute because of some known characteristic such as age, developmental level, educational preparation, or particular skill ability. Group differences reflected on the scores are anticipated and support the instruments construct validity.

Campbell and Fiske (1959) developed a procedure for construct validation known as the multitrait-multimethod matrix method in which the concepts of convergence and discriminability are used. Convergence means that evidence from different sources gathered in different ways all indicate the same or similar meaning of the construct. Different methods of measurement should converge on the construct (Kerlinger, 1973). Discriminability means that one can empirically differentiate the construct from other constructs that may be similar and can identify that which is unrelated to the construct (p. 462).

In a multitrait-multimethod matrix method, analysis of more than one attribute and more than one method are used in the validation process. The researcher measures the critical concept by two or more methods; constructs from which one wishes to differentiate the main construct are also measured, employing the same methods. The scores on the different measures are then correlated statistically.

Different aspects of the multitrait-multimethod matrix procedure identify varying evidence of construct validity. The most direct evidence (convergence) comes from the correlations between two different methods for measuring the same trait. Convergent validity entries should be higher in terms of absolute magnitude than those correlations between measures with neither method nor trait in common. The validity of the measure should be questioned if this requirement fails. In addition, convergent validity coefficients should be greater than the coefficients between measures of different traits by a single method. This requirement provides some evidence for discriminant validity (Polit & Hungler, 1983).

A look at relationships based on theoretical predictions is another method for looking at construct validity. This process is one of logical analysis and although important in providing a type of evidence, it is fallible and does not provide proof of construct validity.

Factor analysis is the fourth and perhaps most powerful approach to the measurement of psychological constructs and construct validation (Kerlinger, 1973; Nunnally, 1978). It consists of methods for identifying cluster of related variables. Each cluster or factor is denoted by a group of variables whose members correlate more highly among themselves than they do with variables not included in the cluster. Each factor is thought of as a unitary attribute (Polit, 1983).

At the heart of the measurement of psychological constructs, factor analysis is used directly to determine the internal statistical structure of a set of variables said to measure a construct and the statistical cross structures between the different measures of one construct and those of other constructs (Nunnally, 1978, p. 112).

According to Nunnally (1978), scientists can never be sure a construct has been measured or that a theory regarding that construct has been tested. The evidence obtained is not so much proof of the truth of the theories as it is proof of their usefulness as guides to empirical reality. At best, the construct validity of a measurement method provides circumstantial evidence for its use and should not be trusted until used many times. If, over time a measuring instrument produces interesting findings and tends to fit the construct name applied to the instrument, then its continued use can be encouraged (p. 109).

Content Analysis

Much of the research in the social sciences depends in some way upon the careful reading of written materials and/or interpretation of verbal exchange. Content Analysis is a basic research technique/tool whereby the content of communication can be scientifically analyzed. Potentially one of the most important research tehcniques in the social sciences, content analysis seeks to understand data, not just as a collection of physical events, but as symbolic phenomena (Krippendorff, 1980, p. 7).

History

Inquiry into the content of communication dates back to the 1600's when the church worried about the spread of non-religious information through newspapers and hymns. With the increase in mass production of newsprint in the early 1900's, journalism developed the notion of quantitative newspaper analysis in determining the "truth" of newspaper articles. Traditionally, mass communication became the domain of content analysis. Social and political problems as well as the influx of the powerful electronic media of communication and the emergence of empirical methods of inquiry led to the intellectual growth of content analysis as a method of scientific research.

The first large scale practical application of content analysis occurred during World War II when propaganda analysis became part of the war effort. After the war, and following publication of texts written by Berelson and Lazarsfeld (1952), content analysis as an investigative tool in the research process, spread to other disciplines including Psychology, Anthropology, Political Science, and Linguistics. Historians and educators found the technique of content analysis

amenable to the analysis of large amounts of data, such as documents and textbooks.

In 1955 in response to increased interest in the process of content analysis by a multitude of disciplines, the Social Science Research Council's Committee on Linguistics and Psychology sponsored a conference on content analysis. Trends in content analysis, edited by Pool (1959), was a compilation of contributions from this conference.

Computer use came into focus in the early sixties, revolutionizing much of the tedious work previously associated with content analysis. In 1967 papers presented at the National Conference on Content Analysis focused attention on methodological problems including the role of theories and analytical constructs, the need for standardized categories and the problem of drawing inferences in analysis. Holsti and Gerbner summarized and published these contributions (1969).

Content Analysis: Definition

Content Analysis is a method to objectively, systematically, and quantitatively study, describe and analyze communications and documentary evidence (Berelson, 1952; Kerlinger, 1965; Polit & Hungler, 1983). A definition by Paisley in Holsti (1969) states that "Content analysis is a phase of information processing in which communication content is transformed, through objective and systematic application of categorization rules, into data that can be summarized and compared " (p. 3).

Krippendorff (1980) defines content analysis as "A research technique for making replicable and valid inferences from data to their content" (p. 21). He views content analysis as a method of inquiry into the symbolic and multiple meaning of messages and suggests that

communication is generally about phenomena other than that which is directly observed. He suggests that any content analysis must be performed relative to, and justified in, terms of the context of the data (p. 23).

Content Analysis: Conceptual Basis

Conceptually, Krippendorff (1980) offers a framework within which the investigator can define his role in the use of content analysis as a research method. Concepts include: the data as communicated to the analyst, the context of the data, the analyst's interest and knowledge of the data, the target of the analysis, the basic intellectual task of making inferences from the data and the evidence of validity as the ultimate criteria of success (p. 26).

The data and the population from which drawn, must be clearly defined; boundaries of the context must be made explicit and the target of inferences or what the analyst wants to know, must be clearly stated. The analyst's knowledge and interest help determine the construction of the context within which the inferences are realized; his task is to make and justify inferences from data to certain aspects of their context. To validate the results of content analysis, the kind of evidence needed must be specified in advance.

Krippendorff (1980) intended this framework to be prescriptive, analytical, and methodological. It is prescriptive in that it should guide the conceptualization and design of practical content analysis for any circumstance; analytical in that it should facilitate the critical examination of content analysis results obtained by others, and methodological in directing growth and improvement of content analysis methods (p. 26).

Holsti (1969) identifies similar concepts in his discussion of the defining characteristics of content analysis generally agreed upon among researchers: objectivity, generality and a systematic approach. The characteristics of quantification and the manifest/latent meaning of content have been questioned by modern investigators.

Criticism of content analysis as a research method is related to the "mechanical" characteristic of quantification in which numerical data takes on meaning about phenomena or variables of interest. Although quantification allows precise conclusions and lends itself well to statistical interpretation, researchers view the qualitative or insightful aspect of content analysis as more meaningful. Holsti (1969) believes both methods are useful and rather than being dichotomous attributes, fall along a continuum in gaining insight into data.

The manifest/latent issue has to do with the superficial, as opposed to, inferred meaning of content. Krippendorff (1980) conceptually provides the framework for making inferences from data to draw meaningful conclusions. The area of research determines, in part, the type of interpretation to be coded and analyzed.

Usefulness of Content Analysis

Content analysis as a research method is indicated when other methods of measuring the same variables are inappropriate or impossible. There is difficulty with data accessibility in some research problems and the study of values and attitudes with ordinary methods of measurement may be difficult. Data may be limited to documentary evidence such as in the study of trends, propaganda, and historical events.

Content analysis becomes necessary when given certain theoretical components for which the subjects own language is crucial to the investigation. Children can produce verbal materials on specified topics which can be content analyzed for expressed knowledge and values (Holsti, 1969; Kerlinger, 1965).

As a research technique, content analysis is unobtrusive, it accepts unstructured material, is able to cope with large volumes of data, and is context sensitive in being able to process symbolic forms (Krippendorff, 1980).

The disadvantage of using content analysis is that it is laborious, time consuming and expensive. There is a risk of subjectivity and the content analysis becomes useful only when the nature of the research problem requires it. Berelson (1952) states "Unless there is a sensible, or clever or sound, or revealing, or unusual, or important notion underlying the analysis, it is not worth going through the rigor of the procedure, especially when it is so arduous and so costly" (p. 518).

Content Analysis and the Research Design

The research design is the plan for collecting and analyzing data in order to answer the investigator's question. A good design ensures that theory, data gathering, analysis and interpretation are integrated (Holsti, 1969). Krippendorff (1980) emphasizes that the research design must be "context sensitive and must be appropriate to the context from which the data stem or relative to which data are analyzed (p. 49)".

Prior to development of a research design the investigator must look at the communication process. Holsti (1969) identifies six elements of communication: a source or sender; an encoding process

resulting in a message, a transmitting channel, a detector or recipient of the message and a decoding process. According to Holsti (1969), the object of content analysis is the message, although analysis can be used to answer questions about the other five elements (p. 24).

Messages may be analyzed to make inferences about the characteristics of the text, the cause or antecedents of messages, or the effecs of communication. Intermessage analysis is the comparison of messages from a single source over time, in differing situations, or across audiences. Contingency analysis is the comparison of messages from two or more different sources (Holsti, 1969). Clearly, the type of research design selected will depend upon the question which the investigator seeks to answer.

Datum

When developing the research design the investigator must determine what is to be observed, recorded, and considered a datum. A datum is a unit of information that is recorded in a durable medium, distinguishable from other data, analyzable by explicit techniques and representative of the phenomena in question (Krippendorff, 1980, p. 53). To be content analyzed, human speech must be written down or at least tape recorded.

Coding

Coding is the process whereby raw data is systematically transformed and aggregated into units which permit precise description of relevant content characteristics (Holsti, 1969, p. 94). Coding rules, a central part of the research design, are identified as the operational link between the investigator's data, theory, and his

hypotheses. Holsti (1969) considers coding under three interrelated headings: categories, units of content and a system of enumeration.

A category system, a method for classifying units of content, makes the analysis operation more objective and systematic. Unfortunately, there is an absence of useful or agreed upon classification systems for categorizing diverse materials; the investigator often must develop his own scheme.

Holsti (1969) identifies five general principles of category construction: categories should reflect the purpose of the research, be exhaustive, mutually exclusive, independent, and derived from a single classification principle (p. 95).

Categories should conceptually reflect the purpose of the research and operationally define the indicators which specify what data falls within the category. All categories should be exhaustive and mutually exclusive in that all relevant items in the sample must be capable of being put in a category; no content data should be placed in more than a single cell.

A non-exhaustive set of categories can be made exhaustive by the addition of another category that represents all units not represented in the initial set, eg. "non-applicable", "none of the above", and "other". Krippendorff (1980) suggests little contribution to research findings are made by this method and should be avoided.

The assignment of any data into a category must not affect classification of other data. Different levels of analysis must be kept separate as well.

Recording Unit

The specific unit of content to be classified in a given category is the recording unit. The smallest and least useful is the letter, phoneme and individual word. A theme, such as in a phrase, a sentence or paragraph, makes a single assertion about a subject and, although most useful, is time consuming to analyze. An item is the entire message such as an article, film, or book and is too gross for most research. Berelson (1952) discusses the space/time unit or the actual physical measurement of content.

The contextual unit refers to the context within which a recording unit appears. It sets limits to the contextual information that may enter the description of a recording unit and may contain many recording units (Holsti, 1969; Krippendorff, 1980).

System of Enumeration

The system or unit of enumeration is related to the early definitional requirement of content to be quantitative and numerically accountable such as: frequency of occurrence, space and time, the binary index of yes/no, and ranking and rating scales. The most common form of quantification is enumeration of recorded occurrences in each category.

Although in agreement with quantification, Krippendorff (1980) emphasizes a contextual focus. He believes a system of enumeration of little significance.

Sampling Plan

A sampling plan is often used in content analysis. The plan selected will depend upon the extensiveness of the universe of content and the unit of analysis being used. Since the aim of content analysis is to present a systematic and objective description of some attribute or phemomena, the findings, to be valid, should be generalizable and

relevant to a larger audience than those being coded. The source or universe of relevant information must be identified and a representative sample that is manageable, selected for analysis.

The split-half technique in which a sample is randomly divided into equal parts for analysis, is a method that assists the researcher in identifying an appropriate sample size. If either part supports the same statistical conclusions within the same level of confidence, the whole can be accepted as an adequately sized sample (Krippendorff, 1980, p. 69).

Recording

Recording is a necessary result of the fact that content analysis accepts unstructured materials for analysis. One cannot analyze what is not adequately and accurately recorded.

In a study where content analysis is the methodology, explicit recording instructions should be defined. The characteristics and qualifications of the observers (coders) and the training they undergo to qualify for the task, should be identified; training of obsevers should be standardized so as to be replicable. Coders often become instrumental in the preparatory phase of content analysis when categories are being refined, processes altered, and data sheets revised.

Those who take part in the development of suitable recording instructions should not be involved in recording the data. Independent reliability checks are prevented when the same investigator develops recording instructions and applies them all by himself. Krippendorff (1980) identifies this as the worst practice in content analysis (p. 74).

Recording is more reliable and more efficient, the more familiar the concepts, the simpler the cognitive operations, the fewer the categories and the less training coders require (Krippendorff, p. 81).

Content is recorded on data sheets which contain information in its primary and most explicit form. The information to be recorded must be easily entered, easily read by those who process it, and not easily altered by wear or dishonesty.

The semantics and syntax of data language and the analytical techniques for computation are discussed in depth by Krippendorff (1980). An overview of the techniques of computer based content analysis are provided by both Holsti(1969) and Krippendorff (1980).

Content Analysis: Reliability and Validity

As with any research methodology, the reliability and validity of a content analysis must be established.

In content analysis, repeated measures with the same instrument on a given sample of data should yield similar results. Reliability is a function of the coders skill, insight and experience, the clarity of categories and coding rules guiding use, and the degree of ambiguity in the data (Holsti, 1969).

Training prior to coding can significantly increase the level of intercoder agreement. Formulation of categories empirically identified as being appropriate by agreement among judges, will also increase category reliability.

Problems of reliability attributable to categories, may be resolved by defining the categories rigidly to the point of reducing the coding from a judgmental to clerical task. Computer analysis is useful if using words or symbols as units. If fine discrimination is not of major

theoretical significance, aggregating subcategories is acceptable (Holsti, 1969). More judges can be added to broaden the base of consensus.

Intercoder agreement can be computed by use of Scott's (1955) index of reliability. This formula corrects for the number of categories in the category set and for the probable frequency with which each is used (Holsti, p. 140).

$$pi = \frac{\text{observed agreement} - \%\ \text{expected agreement}}{1 - \%\ \text{expected agreement}}$$

Reliability is a necessary condition for valid inquiry but steps to increase reliability may result in a reduction in validity. As categories and units of analysis become more complex, the results yielded may be more useful but less reliable. In formulating the research design, the investigator cannot use the reliability coefficient as the only criterion between reliability and the relevance of categories and units (Holsti, 1969, p. 142).

Validity is the extent to which an instrument is measuring what it is intended to measure. Choice of categories and content units enhance or reduce the likelihood of valid inferences. Content analysis is considered to be valid to the extent its inferences are upheld in the face of independently obtained evidence (Krippendorff, 1980, p. 155).

The validity of the study is also interrelated with its sampling design and reliability. Valid inference is the goal of all inquiry but does not exist independently of other aspects of the research process (Holsti, 1969).

Purpose of the Study

The purpose of this methodological study is to evaluate the reliability and validity of "Brown's Inventory of Body Knowledge" questionnaire (Appendix A). The research will be conducted as part of a pilot study to preliminarily determine the normal development of the child's concept of body knowledge. This knowledge will be specifically related to the major physiological systems of skin, respiration, digestion, circulation, excretion, and sensory and neurological response and innervation.

Polit and Hungler (1982) present methodological research as "research in which the investigator is concerned with the development, validation, and assessment of methodological tools or strategies (p. 218). The goal of the researcher is to "develop an effective, serviceable, and trustworthy instrument that can be used by other researchers and to evaluate his or her success in accomplishing this goal" (p. 215). It is the aim of this researcher to refine the measuring instrument, Inventory of Body Knowledge, so as to make it useful for further research and clinical use.

Operational Definitions

The following operational definitions are offered for clarification and summary of the subject under investigation.

Reliability is the degree of consistency with which an instrument measures the attribute it is designed to measure and is investigated by looking at the three aspects of stability, internal consistency, and equivalence. Stability is the consistency of measurement scores over a given period of time measured by a coefficient of stability. Internal consistency refers to the correlation among items within the tool as determined by the

Cronbach's alpha or Kuder-Richardson 20. Equivalence is demonstrated by use of a correlation coefficient to determine interrater reliability as well as the correlation between two sets of scores on parallel forms.

Validity is the degree to which an instrument actually measures what it is designed to measure. It is the extent to which the tool measures the hypothesized, underlying trait, construct, or factor. Content validity refers to the adequacy with which a sample of subject matter is representative of the operationally defined body of knowledge under investigation and can be judged by use of a table of specifications. Face validity is the extent to which an instrument "looks like" it measures, on subjective evaluation, to measure and is determined by the objective evaluation of experts in the area of investigation. Criterion Related validity refers to the degree of correspondence between an instrument and some other criterion as determined by a correlation coefficient. Construct validity has to do with the underlying abstract concept under investigation and may be measured by the multitrait, multimethod matrix, factor analysis and/or differences reflected in the known group technique.

The child's knowledge of his/her body will be defined as the child's ability to articulate a reasonable facsimile to the current understanding of these physiological processes by adult standards.

CONCEPTUAL FRAMEWORK

The theoretical basis upon which this study is conceptualized has to do with the underlying assmption that children develomentally learn about their body structure and function in an orderly, predictive manner. The Piagetian theory of cognitive development as well as

Development of Body Knowledge theory, provide the basis for this assumption. These two theories underlie Brown's overall research study.

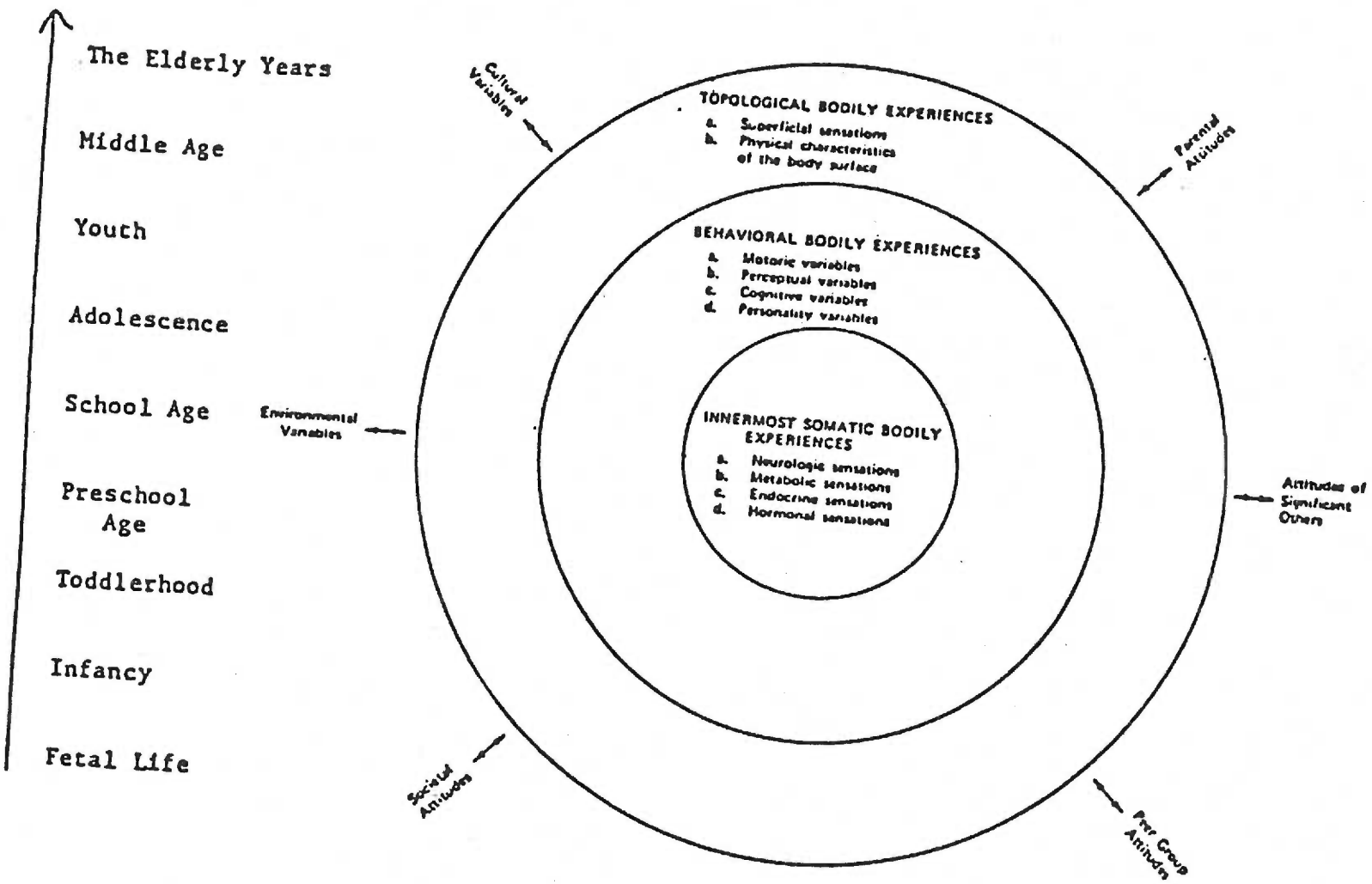
Although the focus of this particular study is methodological, the specific theory of Development of Body Knowledge is the basis for Brown's "Inventory of Children's Knowledge about their Bodies" questionnaire. All methodology implemented in establishment of the reliability and validity of this instrument is based upon both Piagetian and Body Knowledge theory.

Body Knowledge Theory

Brown's larger study which looks at children's concepts of their bodies, their emotions, and the relationship between the two, is structured theoretically upon the general theory of Body Image and the more specific theories of Emotional Development and Development of Body Knowledge.

The conceptual model used to clarify the concept of Body Image as used in the study, was formualted by Brown in 1977. She defines body image as "the internal image of the body formed through the interaction of bodily experiences with influential factors in the environment at a particular stage in the life span. It is a dynamic and growing experience heavily influenced by current as well as preceding developmental stages". The model constructed to correspond to this definition is depicted graphically (Page 55).

The symbolic model of body image includes three levels of bodily experience and six interactions of these bodily experiences with influential environmental factors. This interaction takes places over a time span shown by the headings at the left of the model, indicating


The Elderly Years
Middle Age
Youth
Adolescence
School Age
Preschool Age
Toddlerhood
Infancy
Fetal Life
Cultural Variables
Parental Attitudes
Environmental Variables
Attitudes of Significant Others
Societal Attitudes
Peer Group Attitudes
TOPOLOGICAL BODILY EXPERIENCES
a. Superficial sensations
b. Physical characteristics of the body surface
BEHAVIORAL BODILY EXPERIENCES
a. Motoric variables
b. Perceptual variables
c. Cognitive variables
d. Personality variables
INNERMOST SOMATIC BODILY EXPERIENCES
a. Neurologic sensations
b. Metabolic sensations
c. Endocrine sensations
d. Hormonal sensations

that these interactions and their results differ according to the stage in the life span during which they occur (Brown, 1977).

The innermost somatic experiences are bodily experiences derived from deep or systemic physiologic causes. These bodily experiences are basic and form the core of the body image.

Although somewhat less basic than the somatic experiences, behavioral experiences, including motoric, perceptual, cognitive, and personality factors are very important and differ over the life span.

Topological characteristics, the last category of bodily experiences, refer to those experiences emanating from the surface characteristics of the body. Some of these such as the capacity for pain, pressure sensations, hearing, vision and taste, are similar in all people. Body Boundry is also an important concept related to the topological level of bodily experience.

Six interacting factors are indicated by the two way arrows on the model. It is the interaction between all three levels of bodily experience as well as those factors occurring at a given time in the life span, that constitute the person's body image. Some of these factors are more relevant at certain points in a person's life. The theory concerning the development of children's knowledge about their bodies can be viewed logically within the Body Image model, specifically the outer circle of the model relative to topological bodily experiences. Gellert's (1940) studies have documented that children learn about their bodies from the outside in. The model depicts how body boundries are defined throughout the life span as interactions with external sources increase. Studies (Gellert, 1940, Nagy, 1953; Crider, 1981) have also shown that children first learn

about the surface characteristics of their body followed by other more concrete body parts.

Piaget's Theory of Cognitive Development

In Piaget's pre-operational stage of cognitive development the child 2 to 7 years focuses attention on one aspect of a situation and disregards the rest (centration), he focuses on static aspects of reality, and his thoughts are irreversible. He has an inadequate understanding of time, space, quantity, and relation. The child's thinking is egocentric in that he cannot understand the point of view of another or even that they may have one different from their own.

The pre-operational conception of body function deals with the global state of the whole body as immediately perceived; there is no differentiation between internal and external, and functions are conceived of in terms of purposes or final causes. Relationships are perceived in terms of spatial and temporary contiguity (Crider, 1981). The pre-operational child deals with observable activity such as breathing without the awareness of the lungs or respiratory process. Body parts such as bones and muscles are recognized by spatial location; there is no concern about how these parts work. At 6 to 7, organs are defined as the origin of a global function such as needing a heart for "love" and a brain for "thinking".

The child age 7 to 11 in Piaget's period of concrete operations, classifies concrete objects by category and begins to understand the relationship among categories. He becomes able to focus attention on more than one aspect of a situation at a time (decentration), consistently conserves such qualities as length, quantity, and weight, and begins to grasp changes in objects or situations throughout an

entire sequence. Thinking becomes reversible and he is able to conceive that the effects of some action or transformation may be reversed by a subsequent action.

Body function and structure are conceptualized more specifically by the child in the period of concrete operations. The perceptual attributes, shape, motion, and substance of organs are noticed and identified, i.e., "the heart pumps". Structure and function are differentiated and relate to one another by reference to body substances. The "stomach holds food", "lungs are tubes you breathe with", the organ as the locus of function, is described as a spatial container, and causes displacement of body substances, eg., "the heart pumps blood". The movement of organs are seen as coordinated or reversible such as "breathing air in and out". Toward the end of this period the child is able to conceive of transformation of body substances that can be reversed by a subsequent action such as "you breathe in good air and breathe out bad air".

The adolescent in the period of formal operation is able to think abstractly and can conceptualize several alternative explanations for the same phenomena. He is able to postulate hypothetical transformations that account for perceived function of the body. Functions become heirarchically organized in terms of organs, systems, and interdependencies of systems (Crider,1981). Body processes can be explained in terms of physiological processes such as chemical reactions at the cell level. The adolescent, although certainly not knowledgeable about all aspects of body process, possesses a conceptual framework of body structure and function that will enable him to further expand physiological knowledge through the education process.

Summary

Conceptually both Piagetian theory and Body Knowledge theory are congruent with the hypotheses proposed for this methodological study: 1) Chidren developmentally learn about their body parts and functions in a predictable, progressive manner and 2) Children of the same age/grade level will possess a similar cognitive awareness of body parts, location of parts, their function, and the relationship between body systems.

CHAPTER II

METHODS

Overview

This methodological study was designed to refine and establish the validity and reliability of one specific instrument, "Brown's Inventory of Children's Knowledge About Their Bodies" questionnaire. This instrument was constructed as a means of eliciting specific information from children concerning the anatomical and physiological processes of their bodies. It is a structured, open-ended instrument to be used with children 2 1/2 to 12 years of age. The study used Brown's instrument to interview 40 children. The results of these interviews were coded and these data used to investigate the reliability and validity of the instrument.

The specific type of reliability investigated was interrater reliability of the coders. The study did not investigate stability, internal consistency, nor equivalence. Measures of stability were not possible because repeated administration of the instrument would result in variation based upon developmental changes occurring in the subject over time. Measures of internal consistency were not obtained at this time because of the need to limit the project. Measures of equivalence were not investigated because only one instrument is designed to cover the area of content under investigation.

Content, face, and construct validity were investigated. Content validity was evaluated using a table of specifications representing the body of knowledge under investigation on both the questionnaire and the coding mechanism (Table 1). Face validity, one type of content validity, was investigated by 15 specialists in the field of child

TABLE I

TABLE OF SPECIFICATION FOR BROWN'S INSTRUMENT

AND CODING MECHANISM FOR 7 CONTEXTUAL UNITS

	Identify Parts		Locate Parts		Function Parts		Purpose Systems		Identify System		Locate System		Inter-Relationship Systems	
CATEGORY	Tool	Code	Tool	Code	Tool	Code	Tool	Code	Tool	Code	Tool	Code	Tool	Code
Smell	1	3	1	3	4	3	1	3	1	1	1	1	0	2
Touch	2	4	1	4	3	4	1	3	1	1	1	1	0	2
Taste	3	8	1	8	2	8	1	2	1	1	1	1	0	2
Sweat	1	4	2	4	3	4	0	3	0	1	1	1	0	3
Bones	5	40	1	40	7	40	1	4	1	1	1	1	0	3
Neurological	2	7	2	7	5	7	2	5	1	1	1	1	0	13
Respiratory	7	16	1	16	4	16	2	5	1	1	1	1	0	2
Cardiac	5	20	7	20	7	20	2	5	1	1	1	1	0	6
Vision	3	12	1	12	2	12	1	3	1	1	1	1	0	2
Tears	3	7	2	7	3	7	0	3	0	1	1	1	0	2
Digestive	9	31	2	31	13	31	2	6	1	1	1	1	0	4
Hearing	4	14	1	14	4	14	1	3	1	1	1	1	0	1
Muscles	7	20	2	20	5	20	1	5	1	1	1	1	0	6
Urinary	6	6	2	6	5	6	2	3	1	1	1	1	0	2
Skin	3	14	0	14	2	14	0	3	0	1	1	1	0	3

development. Construct validity was investigated by determining whether results of the interview corresponded with hypothesized developmental changes. The underlying construct, children's knowledge about their bodies was statistically analyzed using Analysis of variance, and the Pearsons product-moment-correlations. A new approach to validity was also included, i.e., instrument validity. This was done by use of an interview analysis form utilized by two raters.

Historical Origin

The purpose of this study was to assess the validity and reliability of "Brown's Inventory of Children's Knowledge About Their Bodies" questionnaire and, by so doing, refine it for use in a descriptive study on a larger scale. Developed by Marie Scott Brown, Ph.D., during a two year postdoctoral fellowship in exploratory work with 146 preschool children, this instrument is an attempt to investigate how children develop ideas about their body parts, the location of parts, and function of parts, and the purpose of systems. Health and illness aspects of each body system were also addressed. "Brown's Inventory of Children's Knowledge about Their Bodies" questionnatire, is based upon Elizabeth Gellert's (1962) early "Index of Body Knowledge" instrument. Gellert's tool was initially modified by Brown in several ways. Gellert's instrument seemed to Brown to be conceptually mixed in that some body systems were asked about physiologically and some anatomically. For example, Gellert asks "when you swallow a piece of food where does it go? What happens to it there? Where does it go then?, but when asking about the respiratory system, she simply asks "Where are your lungs". All basic questions were changed into a physiological format by Brown, who also updated

some of the language and added the systems of integumentary and sensory function, not included in Gellert's original instrument. Since these original modifications, "Brown's Inventory of Children's Knowledge About Their Bodies" questionnaire has been in the process of refinement and has undergone several revisions based upon feedback by parents, teachers, and interviewers and upon responses from children. Analysis of 24 interviews with preschool children also resulted in some refinement. (Appendix A)

Procedure

The procedure for this study consisted of two stages. Stage one involved 1) revision of the questionnaire based on the problem areas previously identified, 2) establishing face validity of the questionnaire, 3) constructing a tool for standardizing interview quality, and 4) revision of the coding form. Stage two involved establishing construct validity by relating results of the tool with grade level of the children interviewd. Interrater reliability was also explored in Stage two.

Stage 1

The introductory statement explains the purpose of the interview and the childrens' anticipated participation. This statement is designed not only to explain the purpose of the interview (i.e., to learn about children's ideas about their bodies), but to emphasize that whatever the child "thinks" about the body is ok, whether it is correct or not.

Following the introductory statement, the content of the questions progress from those systems and body parts involving things that go into the body, digestion of food and liquid and respiration, to those

physiological processes in which something comes out of the body; excretion of urine and bowel movements, sweat, and tears. The circulatory system is introduced with the idea of blood coming "out" of the body when one is cut. The questioning leads into the idea of blood vessels and their function. Following the in/out emphasis, the area of focus moves to the body parts involved with movement, structure, and protection including muscles, bones, and skin. After the musculo-skeletal section, the interview focuses on neurological parts and function, including the brain and nervous system. The sensory aspect of the neurological system is developed with questions about hearing and vision. Smell, taste, and touch are listed, but no questions are asked.

In Stage 1 "Brown's Inventory of Children's Knowledge About Their Bodies" questionnaire follows a narrative format. Two sections, A and B, are identified. Section A is composed of open-ended questions. Section B is composed of questions which ask the child directly to identify specific body parts which may not have been volunteered by the child in Section A. The narrative, open-ended format allows the interviewer to explore the child's knowledge of body parts and function until the child gives some kind of closure to the sequence. For example, "When you eat an apple, where does it go?" "Where does it go next?" "Does it ever come out?" The open-ended questions are asked in a developmentally appropriate way such as "Let's pretend you breathe air into your nose" or "Have you ever cut yourself and seen some of your blood come out?". Part B is designed to elicit specific information about body parts and functions as yet unmentioned by the

subject in Section A. Following identification of such a part, the subject is then asked "Where is the part?" and What is it for?"

Questionnaire Revision

A content analysis of previous interviews revealed nine problem areas with this questionnaire.

1) Complete coverage of each content area was not assured by the format of the questionnaire.
2) A section of demographic data was not included.
3) The sensory areas of taste, smell, and touch were not included.
4) There were no questions directed at the location of body parts in any section except skeletal.
5) Questions about the function of body parts in the categories of digestion, respiration, and tears were not included.
6) The sequencing appeared to create difficulty in the subject's ability to identify a relationship between body parts and systems.
7) All subjects already knew the terms in Section B: nose, mouth, eyes, and ears, and their inclusion lengthened the interview unnecessarily.
8) Terms in Section B which were familiar to some subjects (eg., joints, ligaments, tendon, esophagus, spleen, blood cell, red blood cells, white blood cells, platelets, plasma, bronchioles trachea, bronchii, and alveoli) had not been included.
9) In Section B, although the location and function of each word is identified by "Where is the ...? What is it for?", the idea of importance to the body was not addressed.

Face Validity

After revisions were made based on the nine problem areas mentioned previously, the questionnaire was evaluated for Face Validity. The instrument and a checklist (Appendix B) were given to 15 experts in the field: 5 mothers, 5 preschool teachers, and 5 pediatric specialists. The checklist required the experts to rate four general areas: 1) The developmental appropriateness of the questions on the instrument, 2) the semantics and syntax of the questions, 3) the overall adequacy of the format of the instrument, and 4) the completeness of the anatomical and physiological information asked. Results from the face validity process were reviewed and tabulated (Appendix B).

Results from the Face Validity survey indicated an overall general approval of content areas and the appropriateness of format, syntax and semantics. Several questioned the length of the instrument for the very young (3 to 4 year old) child. The term "worry" in the opening phrase might be bothersome to some subjects, according to one rater. The terms "container" and "material" were identified as being conceptually difficult for the young child to grasp. Suggested material to include in Section A of Brown's instrument were "sleep", "reproductive process", "genitals", "hair and nails", and in Section B, "bones". Absence of a question relative to "expiration of air" was identified. Interviewing suggestions included the idea of using visual and tactile cues. A young child could swallow a piece of food while feeling his throat or observe pictures of varying body processes such as eating, running, or listening. Suggestions regarding the content area addressing elimination include the use of privacy for the

interview, continued use of familiar terms for urinary and bowel function, anticipation of "giggles", and a "matter of fact" approach to the whole subject. Several raters indicated they felt teaching in the home regarding privacy might interfere with the depth of response in this area of questioning.

Standardizing Interview Quality

In order to standardize quality for all interviews, an interview analysis form was developed (Appendix C). This form was developed using expert authority in the literature (Benjamen, 1974; Molyneaux, 1982; and Yarrow, 1960), as well as by experienced interviewers critiquing several tapes and citing common errors. It incorporated basic interviewing techniques and developmental appropriateness into a checklist which could be used to evaluate all interviews.

Using this form, two raters independently rated the interviewer's technique and style by each reviewing three tapes of pilot interviews done by the investigator. Results from this analysis consistently identified two problem areas. The interviewer persisted in asking double and leading questions in each interview. Another weakness noted less frequently, was incompleteness of questions covered. This particular area of inconsistency was felt to be directly related to the Stage 1 format of Brown's instrument. It was recommended that the interviewer attempt to reduce the incidence of double and leading questions and to use particular care with completeness of categories. The revised format of the instrument facilitated this process.

Revision of Coding Form

Following analysis of six pilot interviews by two independent investigators, the coding mechanism was revised to make it compatible with the revised questionnaire.

Stage 2

Stage 2 of this project attempted to establish construct validity by information obtained from first through fourth grade subjects interviewed using "Brown's Inventory of Body Knowledge Questionnaire".

Sample: Subjects and Setting

Howard Eccles Grade School in Canby, Oregon provided a convenience sample of 40 subjects for the study. Located in the mid-Willamette valley, Canby, with a population of approximately 8,000, is 30 miles south of Portland. Although in a rural setting, a large number of families commute for daily employment to the metropolitan Portland area. Two grade schools with approximately 450 students each, serve the community on a year-round school system. The school district determines in part the student population, with one grade school servicing a larger rural area. The grade school selected for this study serves primarily in-town children. The population of subjects selected for this study began the new school year in July. Predominantly caucasian, the majority of children are from lower to upper-middle socioeconomic class. A small percentage of 2-3 students per class, are of low income and there are a few students of other racial origin, primarily Hispanic. Permission from the school principal was obtained. An explanation of the study and informed consent forms (Appendix E) was distributed to 8 classes (approximately 175 students). Two classes from each grade, one through four, with 20 to 22 students per class,

were selected for the target population. A convenience sample of 10 subjects from each grade (a total of 40) was selected. The children whose parents gave permission for participation were tested, with grade level and age the only criteria.

Data Collection

Each child was interviewed individually by the investigator; each interview was tape recorded. Institutional permission to remove the child from the classroom setting during the school day was obtained. Teacher concurrence with the study was elicited. Permission to remove the child from the classroom at a time convenient for the teacher/student during the morning hours when the child was less fatigued, was obtained. Teachers were made aware of the purpose and procedure of the study in a formal inservice meeting prior to distribution of parental permission forms. At this time they were given an opportunity to meet the interviewer/investigator and ask questions. At the conclusion of the study results will be shared in another inservice setting.

At a designated time the investigator removed the subject from the classroom and escorted him/her to a private, non-stimulating, environment, usually an unused classroom. The subject was seated at eye level facing the interviewer, with the recording device situated in close proximity to both the subject and the interviewer. Following introductions, explanation of the purpose of the study and the procedural aspects was discussed with the subject. The investigator elicited the subject's cooperation by encouraging him/her to assist with the tape recorder. Personal data were recorded and then played back so the subject could hear himself on the recording device. The

actual tape recorded interview began following this interaction.

In the opening statement by the investigator, the purpose of the study ("I'm trying to learn more about kids and what kinds of things kids know about how their bodies work"), the subject's part in the study ("I'm going to ask you some questions about your body and what it can do"), and reassurance as to the acceptability of the subject's knowledge level (Don't worry if the answers are right or wrong..I want to know what you think.."), were addressed. The investigator began the interview (Section A) by asking open-ended questions about digestion such as "Pretend you ate an apple...where does it go?", "Where does it go next?" As each body part was mentioned the subject was asked, "where is that located?" and "What happens to it there?" Sequential questioning to these three aspects of knowledge were directed by the investigator until the subject brought some kind of closure to the sequence. Each of the 15 anatomical categories followed a similar format. The investigator also picked up on cues given in one category that reflected knowledge about another category. By sequential questioning, information not elicited in the original questioning was identified, providing an avenue to document the child's knowledge about interrelationships between systems.

The approach in Section B required a direct response from the subject. Body parts not previously mentioned in the interview (Section A) were identified by the investigator. In a positively structured format the investigator identified the change of approach in this section by stating: "Now I am going to ask you some words many kids don't know". "Tell me what ...means", "where is the ...?", "What is it for...?", and "Why is it important for your body?" Because of the

direct approach, Section B facilitated a review of the previously gleaned information by the investigator. Closure was brought to the interview by allowing the subject to assist with rewinding the tape, after which he/she was given opportunity to listen to the beginning phrases of the document. The subject was thanked and escorted back to the classroom.

All subjects completed the interview which lasted from 30-40 minutes. None became upset, nervous, or unwilling to participate at any time during the interview; no one returned to the classroom prior to completion of the interview. To prevent interviewer fatigue, no more than three interviews were conducted in a given block of time; the interviews were conducted over a calendar month.

Following the interview session with each child, a thank you note was sent to the child at his home in appreciation for his assistance. Upon completion of the interviewing, each teacher, as well as the office personnel who assisted with room assignments, etc., were personally thanked with a letter. At the completion of the study, a time will be established with the staff and school administration, for a review of results.

During data collection the need for further revision prior to coding, became apparent. Previously unlisted terms spontaneously identified and located, as well as additional functions of systems mentioned by grade school subjects, were added to the coding form. Total enumeration of each category was determined based upon these additions. The word list (Part B) was expanded to include lymph nodes, appendix, and voice box (Appendix D).

Coding done by this investigator took from 1-2 hours per

interviews were coded at one sitting. In an attempt to validate the subject's comments, as well as facilitate cross referencing of knowledge to the appropriate category, Part B (word list) was coded twice.

Data Coding

The data coding for "Brown's Inventory of Children's Knowledge About Their Bodies" was carried out in the following manner. The subjects' name, sex, age, the date of the interview, special circumstances (grade level), and the interviewer and coder were coded. The 15 categories of digestion, elimination, respiration, cardiovascular, tears, sweat, skin, skeletal, muscular, neurological, hearing, vision, smell, taste, and touch were coded. Totals were tabulated for the following component of knowledge for each category.

1) Accurately identified body parts
2) Inaccurately identified body parts
3) Accurately identified location of body parts
4) Inaccurately identified location of body parts
5) Accurately identified function of body parts
6) Inaccurately identified fuction of body parts
7) Accurately identified interrelationships with other systems
8) Inaccurately identified interrelationships with other systems
9) Accurately identified purpose of the entire system
10) Inaccurately identified purpose of the entire system

Contextual units used to analyze the study in a quantitative manner include: 1) accurately identified body parts, 3) accurately identified location of body parts, 5) accurately identified function of body parts, and 9) accurately identified purpose of the entire system.

Interrelationships between systems and the health and illness aspects of each system were identified and tabulated by the analysis of childrens' comments in the qualitative results.

Interrater Reliability

An attempt at interrater reliability was made. Four tapes randomly chosen, were recoded by coder number 2. Based on differences between coder number 1 and coder number 2, recommendations for the next phase of development of the coding were identified.

Disagreements in coding appeared to relate to the lack of clear, concise criteria and training of coders. To correct for this problem, a coding manual needs to be devised in which all coders base the evaluation of children's knowledge on predetermined criteria. Coder training needs to occur, with a level of interrater reliability achieved prior to further investigative effort.

Validity

Construct Validity

To establish construct validity the investigator attempted to identify the underlying abstract concept of children's knowledge of their body parts, location, function, and the purpose/function of body systems. Observation of the construct "Body Knowledge of Children" was attempted by tape recorded interviews with a sample of 40 subjects, grades 1 through 4 (ages 6-10). To validate the construct, children's knowledge of their bodies Analysis of Variance and Pearsons

correlations were done to address a series of research questions and related hypotheses. These are presented in Chapter III.

CHAPTER III

QUANTITATIVE RESULTS AND DISCUSSION

Overview

Theoretically, it is predicted that children's knowledge about their bodies increases as they grow older. This construct, children's knowledge of their bodies, is divided into four categories: 1) knowledge of body parts, 2) knowledge of the location of parts, 3) knowledge of the function of the body parts, and 4) knowledge of the body systems.

Subjects were categorized by grade level rather than age, since it was assumed that children were placed in the grade appropriate to the level of their cognitive development. Data were obtained from 10 subjects from each grade, one through four (total N=40).

Nine research questions, six of which incorporate directional hypotheses, were addressed statistically using the analysis of variance (ANOVA) and Pearson product-moment correlation procedures. The difference among the means of four groups, grades one through four, were evaluated using analysis of variance (research questions 4 through 7). Separate F tests for linearity and nonlinearity were computed (research questions 4, 5, and 6). The ANOVAs were followed by planned comparisons regarding the four grades (research question 7). Pearson product-moment correlations were performed to detect whether there was a correlation between children's knowledge within a system and between systems (research question 8 and 9).

Offered below are the nine research questions and, where appropriate, the six hypotheses regarding the direction of the findings.

1) Approximately how much do children in grades one through four know about each of the 15 systems investigated?
   It is hypothesized that children will demonstrate a general awareness of the overall purpose of a body system prior to specific knowledge of the body parts, location of parts, and function of parts within a given system.
2) Is there a developmental sequence with which knowledge of parts, location of parts, function of parts, and purpose of system is acquired? It is hypothesized that children's knowledge of body systems will progress from identification of parts to location of parts to function of parts.
3) Is the developmental sequence the same across the 15 systems?
4) Is there an increase in children's knowledge about their bodies across grade levels?
5) Is the increase in knowledge linearly related to grade level? It is hypothesized that children, developmentally learn about their body parts, location of parts, function of parts, and the purpose of body systems in a predictable, progressive manner.
6) Is the increase in knowledge related to grade level in a non-linear fashion, i.e., does knowledge increase suddenly at a particular grade level? It is hypothesized that children will

demonstrate a larger increase in the knowledge of their bodies between the second and the third grade (9 year old) than between either first and second grade or third and fourth grade.

7) Which pairs of grade levels differ from one another on each of the 15 anatomical categories?

8) Within a system, is knowledge regarding each component (parts, location, function, system) related to knowledge on each of the other components? It is hypothesized that children who identify parts of a body system will be more likely to know the location and function of those parts as well as the overall purpose of that system.

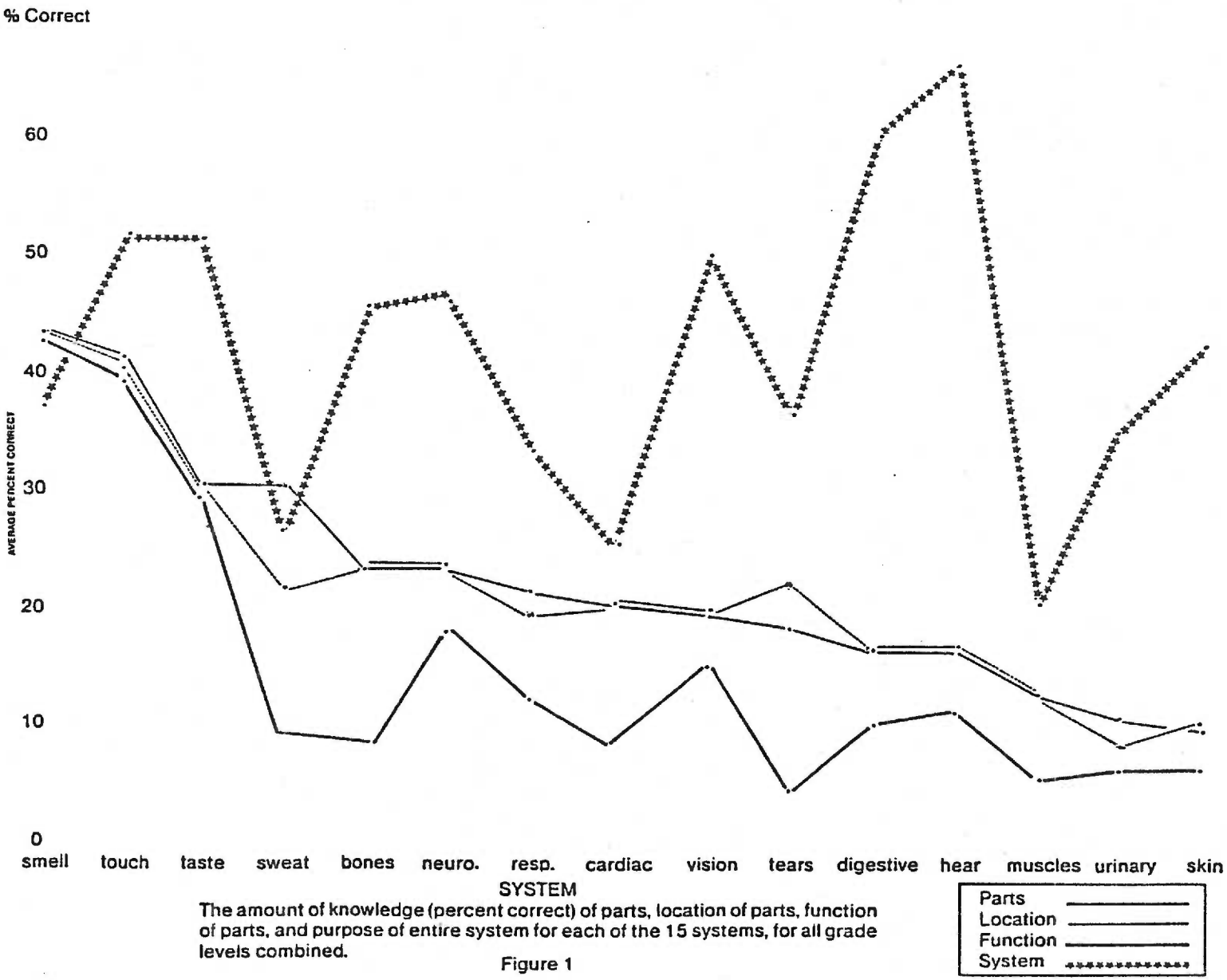
9) Is knowledge of parts related across systems?
Is knowledge of location related across systems?
Is knowledge of function related across systems?
Is knowledge of system purpose related across systems?
It is hypothesized that a positive relationship will exist between corresponding areas of children's knowledge across systems.

The results and discussion addressing the above nine questions and corresponding hypotheses, are presented in three general areas of consideration. An overview of the level of knowledge of all 40 children and the develomental sequence of acquisition of the differrent areas of knowledge (body parts, location of parts, function of parts, and purpose of systems) is addressed with questions 1, 2, and 3. The

differences in grade level as compared to children's increase in knowledge of body parts, location of parts, function of parts, and purpose of systems across grades is addressed in questions 4, 5, 6, and 7. The relationship of children's knowledge of body parts, location of parts, function of parts, and the function of systems within systems and across systems is discussed in questions 8 and 9. Results regarding each of these three areas under consideration contribute to construct validity of the Brown instrument.

Results

The overall level of children's knowledge and the developmental sequence for acquiring knowledge about body parts, location of parts, function of parts, and the purpose of 15 systems is presented in Table 2 and Figure 1. Figure 1 portrays the average percent correct (vertical axis) for knowledge of parts, for knowledge of location, for knowledge of function, and for knowledge of the purpose of the entire system for each of the 15 systems for all 4 grade levels combined. Along the horizontal (X axis) of that figure, the 15 systems are ordered left to right. The system on the far left is smell for which, on knowledge of parts, there is the highest percent correct score, and on the far right, skin for which there is the lowest percent correct for all 40 children combined. Forty-four percent of the possible parts for smell were correctly identified whereas for skin, the system for which the lowest percent of correct parts were identified by all the children, only ten percent of the parts were correctly identified. It



The amount of knowledge (percent correct) of parts, location of parts, function of parts, and purpose of entire system for each of the 15 systems, for all grade levels combined.

Figure 1

TABLE 2

THE AMOUNT OF KNOWLEDGE (PERCENT CORRECT) OF PARTS, LOCATION OF PARTS, FUNCTION OF PARTS, AND PURPOSE OF ENTIRE SYSTEM FOR EACH OF THE 15 SYSTEMS FOR ALL GRADE LEVELS COMBINED.

		IDENTIFICATION OF PARTS				LOCATION OF PARTS				FUNCTION OF PARTS					PURPOSE OF SYSTEM			
SYSTEM	No. of Items	M	M%	SD	SD%	M	M%	SD	SD%	M	M%	SD	SD%	No. of Items	M	M%	SD	SD%
SMELL	3	1.33	44.33	0.53	17.67	1.33	44.33	0.53	17.67	1.33	44.33	0.57	19.0	3	1.13	37.67	0.33	11.0
TOUCH	4	1.68	42.0	0.76	19.0	1.65	41.25	0.74	18.5	1.65	41.25	0.80	20.0	3	1.55	51.67	0.55	18.3
TASTE	8	2.5	31.25	0.99	12.38	2.48	31.0	1.06	13.25	2.43	30.38	1.06	13.25	2	1.03	51.5	0.16	8.0
SWEAT	4	1.23	30.75	0.58	14.5	0.88	22.0	0.52	13.0	0.4	10.0	0.59	14.75	3	0.8	26.67	0.52	17.33
BONES	40	9.43	23.58	3.2	8.0	9.6	24.0	3.01	7.53	3.68	9.2	2.63	6.58	4	1.83	45.75	0.90	22.5
NEUROLOGICAL	7	1.65	23.57	0.86	12.29	1.65	23.57	0.89	12.71	1.35	19.29	0.58	8.29	5	2.33	46.6	1.02	20.4
RESPIRATORY	16	3.58	22.38	1.3	8.13	3.13	19.56	1.22	7.63	2.13	13.31	0.91	5.69	5	1.68	33.6	0.86	17.2
CARDIAC	20	4.25	21.25	1.78	8.9	4.13	20.65	1.92	9.6	1.73	8.65	1.36	6.8	5	1.28	25.6	0.85	17.0
VISION	12	2.35	19.58	1.0	8.3	2.35	19.58	1.03	8.25	1.95	16.25	0.78	6.5	3	1.53	51.0	0.6	20.0
TEARS	7	1.33	19.0	0.62	8.86	1.58	22.57	1.24	17.71	0.33	4.71	0.53	7.57	3	1.10	36.67	0.38	12.67
DIGESTION	31	5.38	17.35	1.94	6.26	5.13	16.55	1.77	5.71	3.55	11.45	1.41	4.55	6	3.68	61.33	1.14	19.0
HEARING	14	2.35	16.79	0.95	6.79	2.38	17.0	1.05	7.5	1.73	12.35	0.75	5.38	3	2.0	66.67	0.93	31.0
MUSCLES	20	2.55	12.75	1.18	5.9	2.63	13.15	1.15	5.75	1.18	5.9	0.84	4.2	5	1.05	21.0	0.45	9.0
URINARY	6	.63	10.5	0.67	11.17	.53	8.83	0.51	8.5	0.40	6.67	0.55	9.17	3	1.08	36.0	0.47	15.67
SKIN	14	1.43	10.21	6.78	5.57	1.48	10.57	0.75	5.36	0.98	7.0	0.77	5.5	3	1.3	43.33	0.56	18.67

is the knowledge of parts that determined this ordering, and this ordering is then used for all tables and figures.

Knowledge of Parts

Children in grades 1 through 4 know the most about smelling, touching, tasting, and sweating in terms of the parts. The average score for these four systems ranges from 30 to 44% correct. Children know slightly less about the systems of bones, neurological, respiratory, cardiac and vision (20 to 30% correct), and are least knowlegeable about parts of tears, digestion, hearing, muscles, urinary, and least of all, skin (10 to 20% correct).

Location of Parts

An examination of Figure 1 reveals that the profile representing the percent correct for knowledge of location lines are nearly superimposed with four exceptions out of the 15 systems. The largest exception is sweat where knowledge of parts is 31%, but children's knowledge of location of parts is 22% and knowledge of location of parts, 20% whereas for urinary, the knowledge of parts is 11% versus a 9% knowledge of the location of parts having to do with this system. For tears, the knowledge of parts is 19% in contrast to a 23% knowledge of location. This unexpected reversal in level of knowledge of parts and location can be explained by several children who pointed to where tears came from but could not name the part.

Function of Parts

With regard to knowledge of function of parts, the ordering of systems is not quite the same as for knowledge of parts and location of

parts. Again for smell children know the function of 44% of the parts and for touch they know the function of 41% of the parts.

For taste, children know the correct function for 30% of the parts whereas children appear to know between 10 to 19% for the systems of neurological, vision, respiratory, hearing, digestion, bones, and sweat. Children appear to know the least about the function of the parts for the systems of cardiac, urinary, skin, muscles, and tears (5 to 9%).

Purpose of Systems

The fourth profile represented on Figure 1 for all groups combined, is knowledge of the purpose of the total system. Interestingly here, knowledge of the function of the entire system does not at all parallel knowledge of parts, location, and function of parts. In fact for the system of hearing the average percent correct out of the number of purposes identified, is 67% while the percent correct for knowledge of parts, is 17%. In terms of purpose of the overall system, mean scores for hearing, digestion, taste, vision, and touch are between 50 and 70% correct. The mean scores for neurological, bones, skin, smell, tears, urinary, and respiratory are between 30 and 49% correct. Only for sweat, cardiac, and muscles does the percent correct fall below the 30% mark, with all of these scores somewhere between 20 and 29%.

Discussion

To address research question 1, children in this study, when taken as a group, demonstrate to a varying degree knowledge of the parts,

location and function of parts, and the purpose of systems for all 15 systems investigated. The highest level of knowledge appears to be for the purpose of the system of hearing where the average percent correct is 67%. Children seem to know the least (5%) about the function of the parts having to do with tears.

The results suggest that children are the most knowledgeable about the sensory systems of smell, touch, and taste. Scores are highest for the identification of parts, location of parts, and function of parts of those systems. It appears likely that these areas are learned first.

An interesting issue has to do with the attainable level of knowledge that is possible for any system. It might be incorrectly assumed that one eventually will have a 100% knowledge level. Perhaps the highest score one might ever attain on tears will always be considerably lower than on another system such as digestion, which is of daily relevance and receives intensive media coverage. When we talk about percent correct and its relationship to age, there may be some systems for which the percent correct may not be very high, even for an adult.

The results suggest that there is a developmental sequence with which children's knowledge of body parts, location of parts, and function of parts, and the purpose of systems, is acquired (question 2). In general, in terms of the way we measured it, children seem to know more about the purpose of the overall system than about specific details of parts, location of parts, and function of parts. The level

of knowledge regarding the entire system does not parallel the level of knowledge about the specific aspects of that system. For example, children know a lot about the system of hearing but not about its specific components.

Correct identification of parts and location of parts almost goes hand in hand in terms of average scores and in general, both of these knowledge areas are higher than the function of parts. Only for the systems of smell and touch is the knowledge of the function of parts nearly the same as the knowledge of parts and the knowledge of location of parts. One might speculate that the identification and location of parts go together somehow and that people may learn a part because they know where it is. It appears that knowledge of the function of parts is not learned at the same time and may be learned later.

In general, it appears that, with the exception of sweat and smell, the knowledge of the entire system (percent correct) is always above the knowledge of identification of parts, location of parts, and function of parts. Part of the reason that knowledge of the entire system is higher may be because people have a notion of what the overall system does, not necessarily knowing individual parts, which is conceptually more detailed and more difficult to grasp. Perhaps the purpose of the entire system is easier to know and provides the context for more complex knowledge.

On the other hand, the discrepancy between the knowledge for the entire system and the knowledge regarding the details of the parts of the system may have to do with how the questions were asked during the

interview. Maybe the knowledge of the purpose of the entire system is more complicated than what is being asked. Perhaps what is asked is at a much simpler level than questions investigating more detailed parts.

With respect to the third research question which asks whether or not the developmental sequence of children's knowledge is the same across 15 systems, the results of the study seem to suggest this to be the case with a few exceptions. Children generally appear to have an awareness of the overall body system followed by knowledge of parts, location of parts, and lastly, the specific function of parts. Smell and sweat don't exhibit the same developmental sequence in that knowledge of the entire system falls below knowledge of body parts. Likewise, for smell and touch, the three aspects, knowledge of parts, location of parts, and function of parts, are almost identical.

Results: Question 4, 5, 6, and 7

The differences among grade levels in knowledge of body parts, location and function of parts, and the purpose of system is addressed by questions 4, 5, 6, and 7.

Question number 4, "Is there an increase in children's knowledge across grade levels?" is a general question for which the subsequent questions (5, 6, and 7) relate and support. The answer to the more general question rests on the evidence regarding its three supporting research questions:

. Is knowledge linearly related to grade level?

. Is knowledge curvilinearly related to grade level?

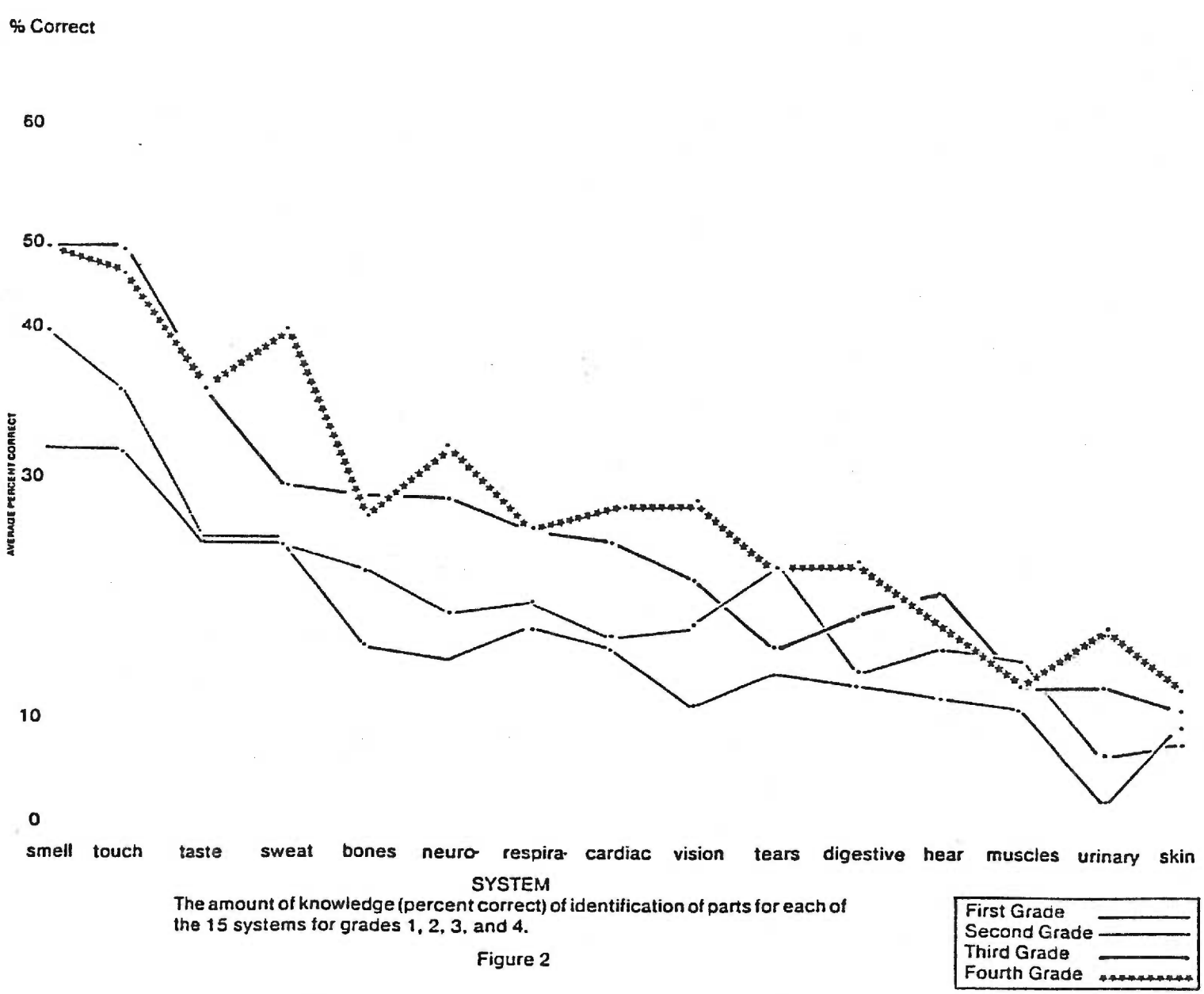
. Which pairs of grade levels differ from one another?

TABLE 3

THE AMOUNT OF KNOWLEDGE (PERCENT CORRECT) OF IDENTIFICATION OF PARTS

FOR EACH OF THE 15 SYSTEMS FOR GRADES 1, 2, 3, AND 4

		GRADE 1				GRADE 2				GRADE 3				GRADE 4			
SYSTEM	No. of Items	M	M%	SD	SD%	M	M%	SD	SD%	M	M%	SD	SD%	M	M%	SD	SD%
SMELL	3	1.0	33.3	0.00	0.00	1.3	43.3	0.48	16.0	1.5	50.0	0.71	23.67	1.5	50.0	0.53	17.67
TOUCH	4	1.3	32.5	0.67	16.75	1.5	37.5	0.71	17.75	2.0	50.0	0.82	20.5	1.9	47.5	0.74	18.5
TASTE	8	2.0	25.0	0.47	5.88	2.0	25.0	0.82	10.25	3.0	37.5	1.25	15.63	3.0	37.5	0.82	10.25
SWEAT	4	1.0	25.0	0.47	11.75	1.0	25.0	0.00	0.00	1.2	30.0	0.42	10.5	1.7	42.5	0.82	20.5
BONES	40	6.2	15.5	1.23	3.1	9.0	22.5	2.05	5.13	11.6	29.0	3.81	9.53	10.9	27.25	2.18	5.45
NEUROLOGICAL	7	1.0	14.29	0.00	0.00	1.3	18.57	0.67	9.57	2.0	28.57	0.94	13.43	2.3	32.86	0.82	11.71
RESPIRATORY	16	2.8	17.5	0.79	4.93	3.2	20.0	1.23	7.69	4.1	25.63	1.37	8.56	4.2	26.25	1.32	8.25
CARDIAC	20	3.2	16.0	0.79	3.95	3.3	16.5	0.82	4.1	5.0	25.0	2.0	10.0	5.5	27.5	1.96	9.8
VISION	12	1.3	10.83	0.48	4.0	2.1	17.5	0.74	6.17	2.6	21.67	0.84	7.0	3.4	28.33	0.52	4.33
TEARS	7	1.0	14.29	0.00	0.00	1.6	22.86	0.84	12.0	1.1	15.71	0.32	4.57	1.6	22.86	0.70	10.0
DIGESTION	31	4.1	13.2	0.57	1.84	4.4	14.19	1.08	3.23	6.0	19.35	1.56	5.03	7.0	22.58	22.49	8.03
HEARING	14	1.7	12.14	0.67	4.79	2.2	15.71	0.63	4.5	3.0	21.43	1.25	8.93	2.5	17.86	0.71	5.07
MUSCLES	20	2.1	10.5	1.10	5.5	3.0	15.0	0.67	3.35	2.6	13.0	0.84	4.2	2.5	12.5	1.78	8.9
URINARY	6	0.2	3.3	0.42	7.0	0.4	6.67	0.53	8.67	0.8	13.33	0.79	13.17	1.1	18.33	0.57	4.68
SKIN	14	1.2	8.57	0.42	3.0	1.1	7.86	0.57	4.07	1.6	11.43	0.84	6.0	1.8	12.86	1.03	7.36



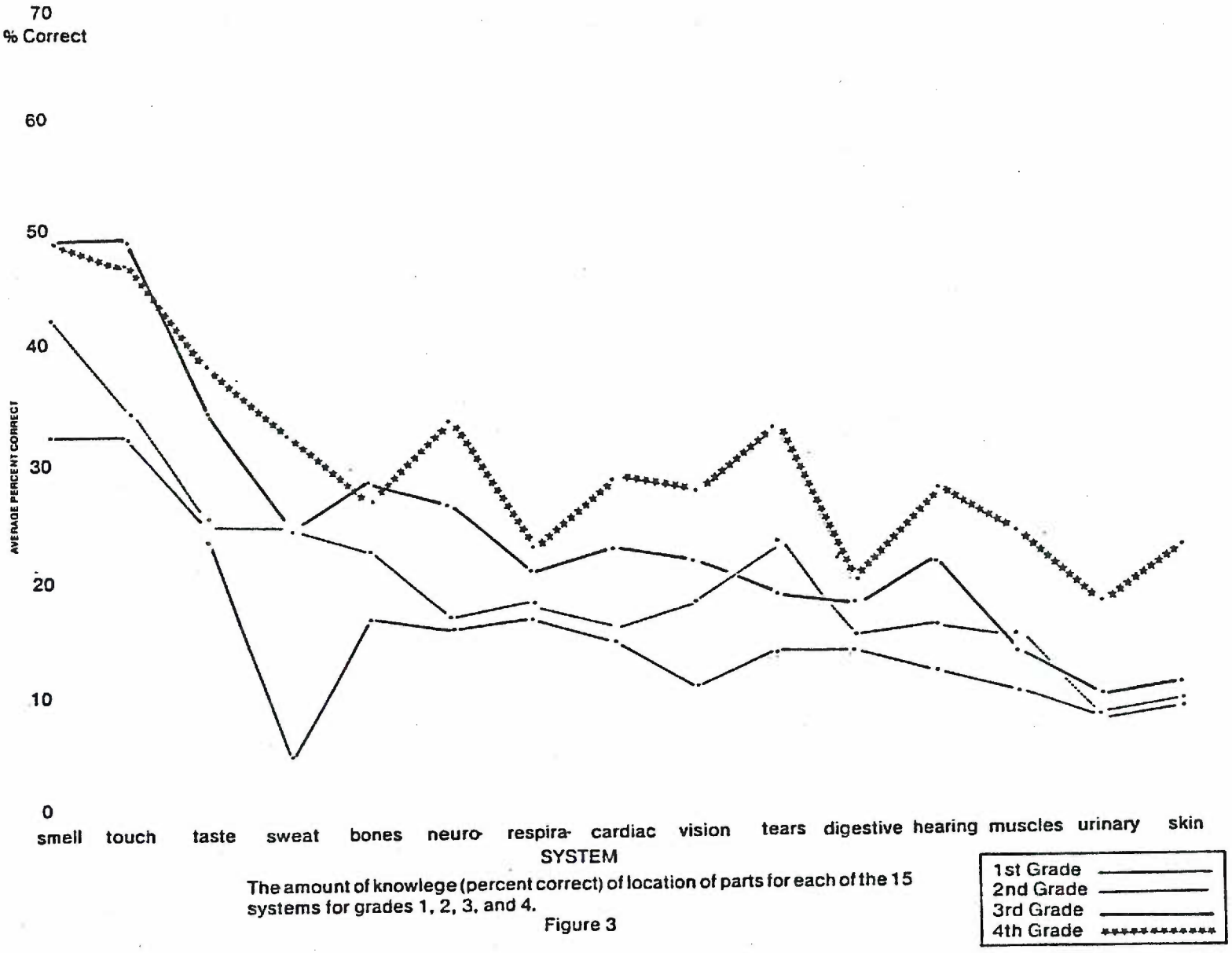
The amount of knowledge (percent correct) of identification of parts for each of the 15 systems for grades 1, 2, 3, and 4.

Figure 2

TABLE 4

THE AMOUNT OF KNOWLEDGE (PERCENT CORRECT) OF LOCATION OF PARTS FOR EACH OF THE 15 SYSTEMS FOR GRADES 1, 2, 3 AND 4

		GRADE 1				GRADE 2				GRADE 3				GRADE 4			
SYSTEM	No. of Items	M	M%	SD	SD%	M	M%	SD	SD%	M	M%	SD	SD%	M	M%	SD	SD%
SMELL	3	1.0	33.0	0.00	0.00	1.3	43.3	0.48	16.0	1.5	50.0	0.71	23.67	1.5	50.0	0.53	17.67
TOUCH	4	1.3	32.5	0.67	16.75	1.5	37.5	0.71	17.75	2.0	50.0	0.82	20.5	1.9	47.5	0.74	18.5
TASTE	8	2.0	25.0	0.47	5.88	2.0	25.0	0.82	10.25	3.0	37.5	1.25	15.63	3.0	37.5	0.82	10.25
SWEAT	4	1.0	25.0	0.47	11.75	1.0	25.0	0.00	0.00	1.2	30.0	0.42	10.5	1.7	42.5	0.82	20.5
BONES	40	6.2	15.5	1.23	3.1	9.0	22.5	2.05	5.13	11.6	29.0	3.81	9.53	10.9	27.25	2.18	5.45
NEUROLOGICAL	7	1.0	14.29	0.0	0.0	1.3	18.57	0.67	9.57	2.0	28.57	0.94	13.43	2.3	32.86	0.82	11.71
RESPIRATORY	16	2.8	17.5	0.79	4.93	3.2	20.0	1.23	7.69	4.1	25.63	1.37	8.56	4.2	26.25	1.32	8.25
CARDIAC	20	3.2	16.0	0.79	3.95	3.3	16.5	0.82	4.1	5.0	25.0	3.0	10.0	5.5	27.5	1.96	9.8
VISION	12	1.3	10.83	0.48	4.0	2.1	17.5	0.74	6.17	2.6	21.67	0.84	7.0	3.4	28.33	0.52	4.33
TEARS	7	1.0	14.29	0.0	0.0	1.6	22.86	0.84	12.0	1.1	15.71	0.32	4.57	1.6	22.86	0.70	10.0
DIGESTION	31	4.1	13.2	0.57	1.84	4.4	14.19	1.08	3.23	6.0	19.35	1.56	5.03	7.0	22.58	2.49	8.03
HEARING	14	1.7	12.14	0.67	4.79	2.2	15.71	0.63	4.5	3.0	21.43	1.25	8.93	2.5	17.86	0.71	5.07
MUSCLES	20	2.1	10.5	1.10	5.5	3.0	15.0	0.67	3.35	2.6	13.0	0.84	4.2	2.5	12.5	1.78	8.9
URINARY	6	0.2	3.3	0.42	7.0	0.4	6.67	0.52	8.67	0.8	13.33	0.79	13.17	1.1	18.33	0.57	9.5
SKIN	14	1.2	8.57	0.42	3.0	1.1	7.86	0.57	4.07	1.6	11.43	0.84	6.0	1.8	12.86	1.03	7.36



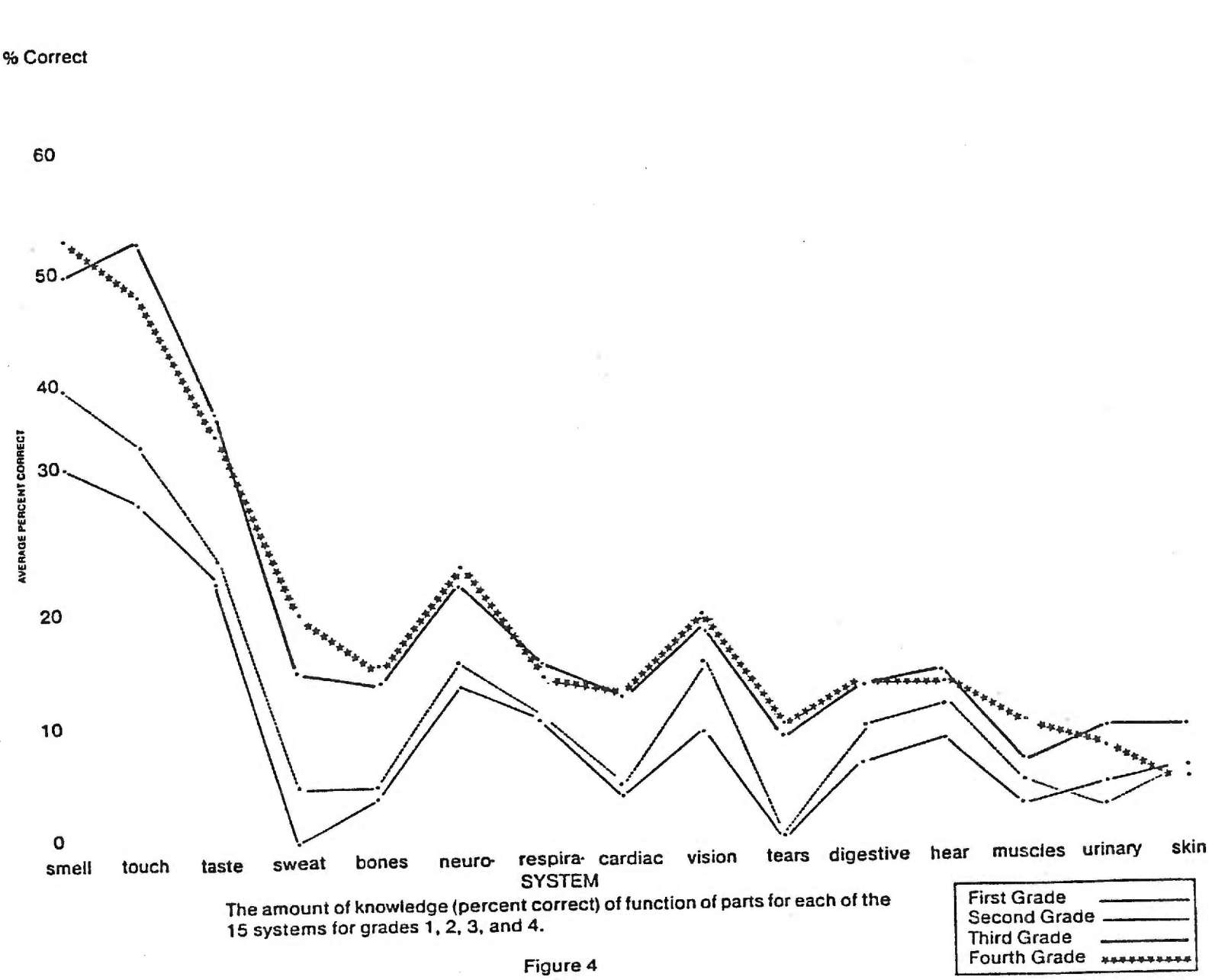
The amount of knowlege (percent correct) of location of parts for each of the 15 systems for grades 1, 2, 3, and 4.

Figure 3

TABLE 5

THE AMOUNT OF KNOWLEDGE (PERCENT CORRECT) OF FUNCTION OF PARTS FOR EACH OF THE 15 SYSTEMS FOR GRADES 1, 2, 3, AND 4

		GRADE 1				GRADE 2				GRADE 3				GRADE 4			
SYSTEM	No. of Items	M	M%	SD	SD%	M	M%	SD	SD%	M	M%	SD	SD%	M	M%	SD	SD%
SMELL	3	1.0	33.3	0.0	0.0	1.2	40	0.42	14.0	1.5	50.0	1.71	23.67	1.6	53.33	0.7	23.33
TOUCH	4	1.2	30.0	0.63	15.75	1.4	35	0.52	13.0	2.1	52.5	0.88	22.0	1.9	47.5	0.88	22.0
TASTE	8	1.8	22.5	0.42	5.25	2.0	25	0.82	10.25	3.0	37.5	1.33	16.63	2.9	36.25	0.99	12.38
SWEAT	4	0	0	0	0	0.2	5.0	0.42	10.5	0.6	15.0	0.7	17.5	0.8	20.0	0.63	15.75
BONES	40	1.4	3.5	1.08	2.7	2.1	5.25	0.99	2.48	5.4	13.5	2.9	7.25	5.8	14.5	1.62	4.05
NEUROLOGICAL	7	1.0	14.29	0	0	1.1	15.71	0.32	4.57	1.6	22.86	0.7	10.0	1.7	24.29	0.67	9.57
RESPIRATORY	16	1.7	10.63	0.82	5.13	1.8	11.25	0.63	3.94	2.5	15.63	1.08	6.75	2.5	15.63	0.85	5.31
CARDIAC	20	0.7	3.5	0.67	3.35	1.0	5.0	0.82	4.1	2.6	13.0	1.65	8.25	2.6	13.0	0.84	4.2
VISION	12	1.2	10	0.42	3.5	1.9	15.83	0.74	6.17	2.3	19.17	0.67	5.58	2.4	20.0	0.7	5.83
TEARS	7	0	0	0	0	0	0	0	0	0.6	8.57	0.7	10.0	0.7	10.0	0.48	6.86
DIGESTION	31	2.3	7.42	0.48	1.55	3.2	10.32	1.03	3.32	4.4	14.19	0.97	3.13	4.3	13.87	1.77	5.71
HEARING	14	1.2	8.57	0.63	4.5	1.7	12.14	0.48	3.43	2.1	15.0	1.1	7.86	1.9	13.57	0.32	2.29
MUSCLES	20	0.5	2.5	0.53	2.65	0.9	4.5	0.32	1.6	1.4	7.0	0.7	3.5	1.9	9.5	0.99	4.95
URINARY	6	0.3	5.0	0.48	8.0	0.2	3.33	0.42	7.0	0.6	10.0	0.7	11.67	0.5	8.33	0.53	8.83
SKIN	14	0.9	6.43	0.32	2.29	0.9	6.43	0.74	5.29	1.4	10.0	1.08	7.71	0.7	5.0	0.67	4.79



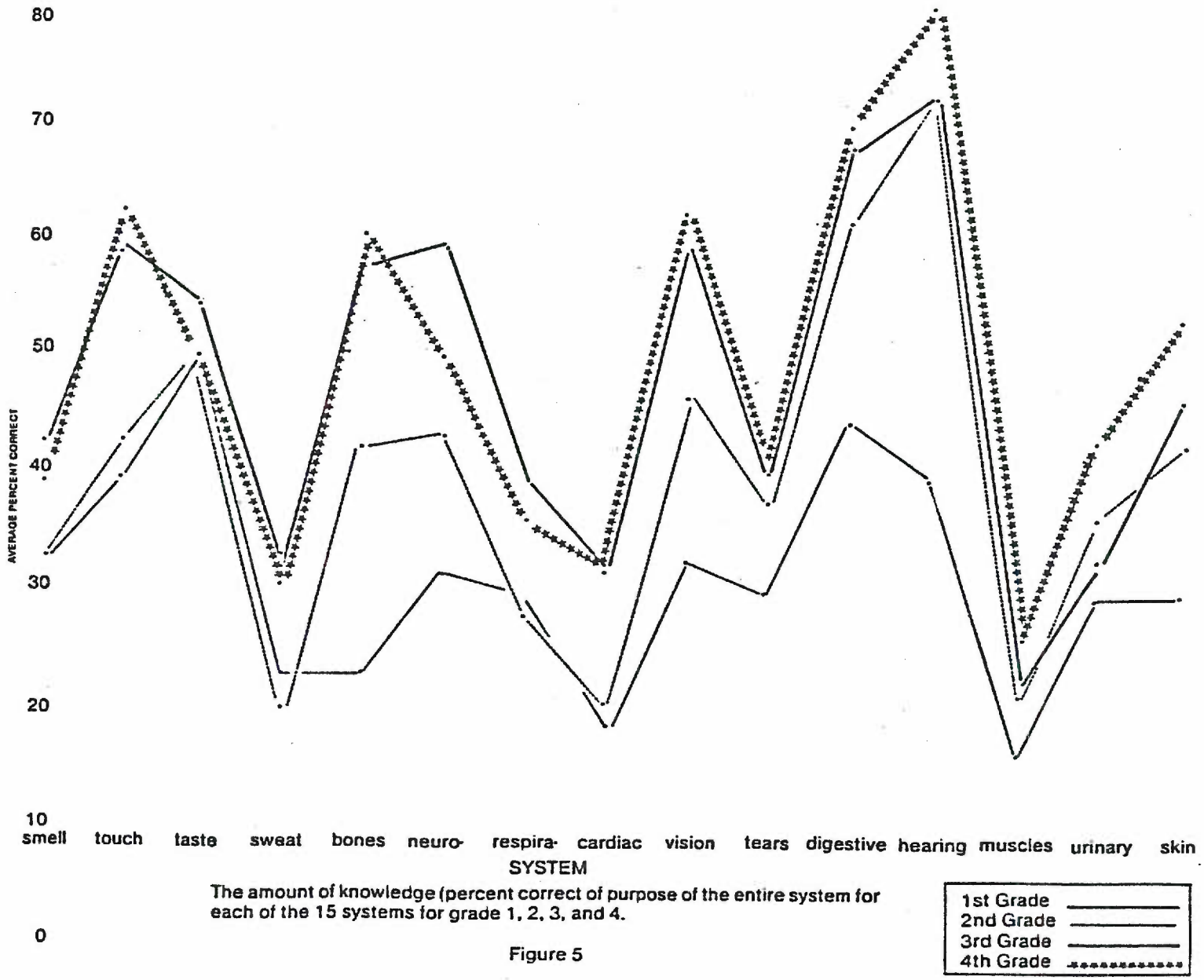
The amount of knowledge (percent correct) of function of parts for each of the 15 systems for grades 1, 2, 3, and 4.

Figure 4

TABLE 6

THE AMOUNT OF KNOWLEDGE (PERCENT CORRECT) OF PURPOSE OF THE ENTIRE SYSTEM FOR EACH OF THE 15 SYSTEMS FOR GRADES 1, 2, 3, AND 4

		GRADE 1				GRADE 2				GRADE 3				GRADE 4			
SYSTEM	No. of Items	M	M%	SD	SD%	M	M%	SD	SD%	M	M%	SD	SD%	M	M%	SD	SD%
SMELL	3	1.0	33.3	0	0	1.0	33.3	0	0	1.3	43.3	0.48	16.0	1.2	40.0	0.42	14.0
TOUCH	3	1.2	40.0	0.42	14.0	1.3	43.3	0.48	16.0	1.8	60.0	0.42	14.0	1.9	63.3	0.57	19.0
TASTE	2	1.0	50.0	0	0	1.0	50.0	0	0	1.1	55.0	0.32	16.0	1.0	50.0	0	0
SWEAT	3	0.7	23.33	0.48	16.0	0.6	20.0	0.52	17.33	1.0	33.3	0.47	15.67	0.9	30.0	0.57	19.0
BONES	4	0.9	22.5	0.32	8.0	1.7	42.5	0.67	16.75	2.3	57.5	0.82	20.5	2.4	60.0	0.84	21.0
NEUROLOGICAL	5	1.6	32.0	0.52	10.4	2.2	44.0	1.14	22.8	3.0	60.0	0.94	18.8	2.5	50.0	0.97	19.4
RESPIRATORY	5	1.5	30.0	0.71	14.2	1.4	28.0	0.52	10.4	2.0	40.0	1.15	23.0	1.8	36.0	0.92	18.4
CARDIAC	5	0.9	18.0	0.32	6.4	1.0	20.0	0	0	1.6	32.0	1.08	21.6	1.6	32.0	1.17	23.4
VISION	3	1.0	33.3	0	0	1.4	46.7	0.52	17.33	1.8	60.0	0.63	21.0	1.9	63.3	0.57	19.0
TEARS	3	0.9	30.0	0.32	10.67	1.1	36.67	0.32	10.67	1.2	40.0	0.42	14.0	1.2	40.0	0.42	14.0
DIGESTION	6	2.7	45.0	0.82	13.67	3.7	61.67	0.95	15.83	4.1	68.33	0.88	14.67	4.2	70.0	1.32	22.0
HEARING	3	1.2	40.0	0.63	21.0	2.2	73.3	0.79	26.33	2.2	73.3	0.92	30.67	2.4	80.0	0.97	30.33
MUSCLES	5	0.8	16.0	0.42	8.4	1.0	20.0	0.47	9.4	1.1	22.0	0.32	6.4	1.3	26.0	0.48	9.6
URINARY	3	0.9	30.0	0.32	10.67	1.1	36.67	0.32	10.67	1.0	33.33	0.47	15.67	1.3	43.33	0.67	27.33
SKIN	3	0.9	30.0	0.32	10.67	1.3	43.3	0.48	16.0	1.4	46.67	0.70	23.33	1.6	53.33	0.52	17.33



The amount of knowledge (percent correct of purpose of the entire system for each of the 15 systems for grade 1, 2, 3, and 4.

Figure 5

The raw score means and standard deviations for each of the four response areas of the 15 systems were calculated for each of the four grades and are presented in Tables 3 through 6. For ease of interpretation the raw score means and standard deviations were converted to percentages by dividing each mean and standard deviation by the corresponding number of items possible for the response area of each system. The total number of items possible differed from system to system due to the variation in the scope of knowledge identified as representative of each category. The amount of knowledge (mean percent correct) for identification of parts, location of parts, function of parts, and purpose of the entire system for each of the 15 systems is graphically displayed in Figures 2 through 5.

The vertical axis of the figures portrays the average percent correct according to the figure title: Figure 3, identification of parts; Figure 4, location of parts; Figure 5, function of parts; and Figure 6, purpose of systems. Along the horizontal axis of each figure, the 15 systems are ordered left to right with the system of smell on the far left and to the far right, that of skin. As previously noted, it is the knowledge of parts (percent correct) for the total sample that determines the ordering for these tables and figures.

Table 7 is a summary of the trend analysis (overall F value, F value for linearity, and F value for non-linearity) to examine the relationship between grade level and children's knowledge of the body. The significance level of the relationship of children's knowledge as

TABLE 7

SUMMARY OF TREND ANALYSIS TO EXAMINE THE RELATIONSHIP BETWEEN GRADE LEVEL AND CHILDREN'S KNOWLEDGE OF THE BODY

SYSTEM		OVERALL F	F FOR LINEARITY	F FOR NON-LINEARITY	r	r^2
		df=3,36	df=1,36	df=2,36		
SMELL						
	Identification Parts	2.21	5.7*	0.46	0.3662	0.1341
	Location of Parts	2.21	5.7*	0.46	0.3662	0.1341
	Function of Parts	2.6	7.6**	0.12	0.4155	0.1726
	Purpose of System	2.79	3.94*	1.31	0.3043	0.0926
TOUCH						
	Identification Parts	2.02	4.88*	0.58	0.3408	0.1161
	Location of Parts	2.55	5.96*	0.85	0.3694	0.1365
	Function of Parts	3.21*	7.13**	0.26	0.3952	0.1562
	Purpose of System	5.42**	14.84***	0.70	0.5329	0.2840
TASTE						
	Identification Parts	4.29**	10.29**	1.29	0.4588	0.2105
	Location of Parts	3.3*	8.8**	0.558	0.4372	0.1911
	Function of Parts	4.16**	10.24**	1.12	0.4596	0.2112
	Purpose of System	1.0	0.2	1.4	0.0716	0.0051
SWEAT						
	Identification Parts	4.05*	9.82**	1.17	0.4515	0.2039
	Location of Parts	21.65**	52.98***	5.98**	0.7244	0.5248
	Function of Parts	5.00**	14.72***	0.15	0.5369	0.2882
	Purpose of System	1.28	1.92	0.957	0.2193	0.0481
BONES						
	Identification Parts	9.33***	12.32***	2.84	0.5906	0.3488
	Location of Parts	7.1**	15.88***	2.71	0.5264	0.2771
	Function of Parts	15.24***	41.08***	2.32	0.7090	0.5027
	Purpose of System	9.79***	26.75***	1.31	0.6398	0.4093
NEUROLOGICAL						
	Identification Parts	7.19***	20.93***	0.316	0.6030	0.3636
	Location of Parts	6.85***	19.29***	0.655	0.5833	0.3402
	Function of Parts	4.72**	12.95***	0.61	0.5080	0.2580
	Purpose of System	4.043**	7.23**	2.45	0.3876	0.1502
RESPIRATORY						
	Identification Parts	3.27*	9.06**	0.37	0.4447	0.1977
	Location of Parts	1.50	4.25*	0.12	0.3239	0.1049
	Function of Parts	2.55	6.48**	0.59	0.3852	0.1484
	Purpose of System	1.03	1.53	0.78	0.1977	0.0391
CARDIAC						
	Identification Parts	6.03**	16.20***	0.946	0.5472	0.2994
	Location of Parts	7.06***	19.41***	.885	0.5826	0.3394
	Function of Parts	9.12***	23.45***	1.950	0.6084	0.3702
	Purpose of System	2.17	5.54*	0.48	0.3610	0.1303

*p <.05, **p <.01, ***p <.001

TABLE 7 (Cont'd)

SUMMARY OF TREND ANALYSIS TO EXAMINE THE RELATIONSHIP BETWEEN GRADE LEVEL AND CHILDREN'S KNOWLEDGE OF THE BODY

SYSTEM		OVERALL F	F FOR LINEARITY	F FOR NON-LINEARITY	r	r^2
		df=3,36	df=1,36	df=2,36		
VISION						
	Identification Parts	17.7***	52.68***	0.21	0.7690	0.5913
	Location of Part	15.71***	46.76***	0.18	0.7500	0.5625
	Function of Part	7.12***	19.2***	1.08	0.5786	0.3347
	Purpose of System	6.84***	19.44***	0.55	0.5864	0.3438
TEARS						
	Identification Parts	3.15*	2.6	3.43*	0.2391	0.0572
	Location of Part	2.67	5.6*	1.20	0.3567	0.1272
	Function of Part	7.89***	20.19***	1.75	0.5816	0.3383
	Purpose of System	1.4	3.6	0.36	0.2988	0.0893
DIGESTION						
	Identification Parts	7.37***	20.92***	.60	0.5999	0.3599
	Location of Part	3.28*	9.44**	.20	0.4538	0.2060
	Function of Part	7.39***	19.36***	1.41	0.5768	0.3327
	Purpose of System	4.6**	11.78**	1.02	0.4862	0.2364
HEARING						
	Identification Parts	4.08**	7.04**	2.6	0.3819	0.1459
	Location of Part	3.73*	5.92*	2.63	0.3543	0.1255
	Function of Part	3.07*	6.43*	1.39	0.3771	0.1422
	Purpose of System	4.19**	9.26**	1.66	0.4366	0.1906
MUSCLES						
	Identification Parts	0.99	0.23	1.37	0.0771	0.0059
	Location of Part	1.41	1.74	1.37	0.2072	0.0429
	Function of Part	7.96***	23.81***	0.032	0.6306	0.3977
	Purpose of System	2.36	6.98**	0.06	.4025	0.1620
URINARY						
	Identification Parts	4.68**	13.84***	.10	0.5259	0.2765
	Location of Part	.09	.02	.13	0.0224	0.0005
	Function of Part	1.13	1.70	.85	0.2076	0.0431
	Purpose of System	1.33	2.76	.62	0.2626	0.0689
SKIN						
	Identification Parts	1.92	4.65*	0.553	0.3335	0.1113
	Location of Part	1.39	4.03*	0.064	0.3165	0.1003
	Function of Part	1.58	0.009	2.367	0.0148	0.0002
	Purpose of System	3.18*	8.89**	0.33	0.4418	0.1952

compared to grade level for each of the 15 systems is indicated. The correlations (r) between grade level and knowledge and the variance in knowledge accounted for by grade level (r^2) is reported on this table.

A summary of probability levels for t-tests comparing pairs of grade levels, is presented in Table 8. The significance of these comparisons is indicated.

Linear and Nonlinear Progression of Knowledge by Grade Level

The F tests for linearity and nonlinearity were done for the four areas of knowledge, identification of parts, location of parts, function of parts, and purpose of the entire system for the 15 systems under investigation. The F tests for linearity tell us that there is a linear relationship between the grade a child is in and how much they know. When four significant F tests for linearity (parts, location, function, purpose of system) are obtained in a particular system, this clearly says that knowledge is related to grade level. If the F tests are not significant, then one cannot say there is a progression of knowledge across grade levels. The correlations give us a sense of the extent to which grade level is predictive of knowledge for a particular system. The r^2 values indicate the amount of variability in children's knowledge that can be predicted from the grade that child is in. For example, in digestion, function of parts, the r^2 is .3327, indicating that 33% of the variance in knowledge scores on function can be accounted for by, or predicted from, grade level. This r^2 also

TABLE 8

SUMMARY OF PROBABILITY LEVELS FOR t-TESTS

COMPARING PAIRS OF GRADE LEVELS

VARIABLE		2nd vs 1st	3rd vs 2nd	4th vs 3rd
SMELL				
	Parts			
	Location			
	Function			
	System		*	
TOUCH				
	Parts			
	Location		*	
	Function		*	
	System		*	
TASTE				
	Parts		**	
	Location		*	
	Function		*	
	System			
SWEAT				
	Parts		***	
	Location		*	***
	Function			
	System		***	
BONES				
	Parts	**	*	
	Location	*	*	
	Function		***	
	System	**	*	
NEUROLOGICAL				
	Parts		*	
	Location		*	
	Function		*	
	System		*	
RESPIRATORY				
	Parts		*	
	Location			
	Function		*	
	System			
CARDIAC				
	Parts		***	
	Location		***	
	Function		*	
	System		***	

* $p < .05$, ** $p < .01$, *** $p < .001$

TABLE 8 (Cont'd)

SUMMARY OF PROBABILITY LEVELS FOR t-TESTS

COMPARING PARTS OF GRADE LEVELS

VARIABLE		2nd vs 1st	3rd vs 2nd	4th vs 3rd
VISION				
	Parts	**	*	**
	Location	**		**
	Function	**		
	System	*	*	
TEARS				
	Parts			*
	Location			
	Function			
	System		***	
DIGESTION				
	Parts		*	
	Location			
	Function	*	**	
	System	*		
HEAR				
	Parts		*	
	Location		*	
	Function			
	System	**		
MUSCLES				
	Parts	*		
	Location	*		
	Function			
	System			
URINARY				
	Parts			
	Location		*	
	Function			
	System			
SKIN				
	Parts			
	Location			
	Function			*
	System	*		

indicates that about 67% of the variance in knowledge scores cannot be predicted by grade level.

Perfect prediction of knowledge from grade level would not be expected. Individual differences among children within grade levels in intelligence, knowledge, both experiential and learned, and maturation should result in correlations less than 1.00. As with other developmental milestones such as walking, children normally show some variability within each age group. The same thing applies to grade level in that one might predict fairly well what children know about their bodies on some of the areas investigated. Still, information on grade level does not result in perfect predictions.

Results of Trend Analysis by System

Results of the trend analysis (Table 7) is presented separately for each of the 15 systems. The systems are ordered and grouped by the number of areas (parts, location of parts, function of parts, and purpose of system) showing a significant linear relationship betwen grade level and knowledge.

Systems with Four Areas of Significance

Vision. For vision, the overall F and F for linearity are quite large and statistically significant for identification, location, and function of parts, and the purpose of system. This suggests that there is a linear relationship between a child's knowledge of this system and grade level. Correlations range from .77 for identification of parts with a variance accounted for by

grade level of 59%, to .58 for function of parts, with a variance accounted for of 33%.

Bones. A linear relationship between a child's knowledge of the skeletal system and grade level is seen with large overall F values and F values for linearity that are statistically significant. Correlations range from .71 (function of parts) to .53 (location of parts). Fifty percent of the variability for function of parts is accounted for by grade level.

Cardiac. For the cardiac system we see a linear progression of knowledge with accurately identified parts, location of parts, and function of parts, having large F values. The F test for linearity for purpose of the entire system, although not as large, is still significant. The variance accounted for ranges from 37% for function of parts to 13% for overall purpose of the system.

Digestion. Once again the overall F test and F test for linearity are quite large and significant in all four areas for the digestive system. Correlations range from .60 for identification of parts to .45 for location of parts. These correlations suggest a moderate relationship between grade level and knowledge.

Neurological. The variance in knowledge accounted for by grade level for the neurological system is in a moderate range (36% to 15% variance). The overall F tests and F tests for linearity are significant.

Touch. The F values for linearity for touch are also significant. Correlations are in a moderate range of .53 (purpose of system) to .34 (identification of parts); 28% of the variability for purpose of the system is accounted for by grade level, where for identification of parts, grade level accounts for only 12%.

Hearing. The overall F test and F test for linearity for hearing are significant in all four areas. Correlations are not large, however, with variance accounted for by grade level, ranging from 19% to 13%.

Smell. The overall F values for smell are low and not significant; however, the F tests for linearity are significant in all four areas. Correlations are low (.37 to .30) and the variance accounted for by grade level ranges from 17% (function of parts) to 9% (purpose of system).

Systems with Three Areas of Significance

Taste and Sweat. For both taste and sweat a linear relationship between a child's knowledge and grade level is seen in 3 out of the 4 areas: identification of parts, location of parts, and function of parts. Purpose of the entire system is not related to grade level. For taste, variance in knowledge accounted for by grade level ranges from 21% to 19%. For sweat the range of variance accounted for is from 52% (location of parts) to 5% (purpose of the system).

Skin. Overall F values for the system of skin are low. However, 3 of the 4 F tests for linearity are significant. The area of function of parts is not. Variability accounted for by grade level is 11% for identification of parts, 10% for location of parts, and 20% for purpose of the system.

Respiration. For the respiratory system only the overall F score for identification of parts is significant. The F for linearity is significant for parts, location of parts, and function of parts, indicating a linear relationship between grade level and knowledge in these areas. The correlations are moderate to low ranging from .44 (identification of parts) to .20 (system).

Systems with Two Areas of Significance

Muscles. The overall F tests for muscles are not significant with the exception of function of parts. The F tests for linearity show significance for purpose of system as well as for function of parts. The correlation for function of parts is .63 with a variance accounted for of 40%; for purpose of system, the variance accounted for is 16%.

Tears. The overall F test for tears is significant in two areas, identification of parts and function of parts. There is not a linear trend for identification of parts, however, but a significant deviation from linearity. When looking at the mean scores (Table 2), even though the deviation from linearity is statistically significant, the pattern of means across grade level is not what we would predict and may have occurred by chance. The

F test for linearity is significant for location and function of parts with a variance accounted for of 13% for location of parts and 34% for function of parts.

Systems with One Area of Significance

Urinary. A progression of knowledge across grades is seen for identification of parts. Non-significant F values are obtained for location and function of parts and for purpose of the entire system. The F test for linearity suggests that, for the urinary system, you do not see a linear progression in knowledge across grades. Looking at the average scores on that system (Tables 3 through 6) the means are extremely low, suggesting that the children investigated appear to have little knowledge of this system. The development of this knowledge may not even begin until a later grade.

Summary of Trend Analysis

The F tests for linearity indicate that for 8 out of the 15 systems (vision, bones, cardiac, digestion, neurological, touch, hear, and smell) all four areas, identification of parts, location and function of parts, and purpose of the entire system, are significant.

Those systems with three areas of significance include sweat, taste, skin, and respiration. For sweat, taste, and respiration, the areas that show significance are identification of parts, location of parts, and function of parts. For the system of skin, grade level is not significantly related to knowledge of function of parts.

Two areas of significance are seen with muscles and tears, whereas for urinary, only identification of parts show a significant relationship with grade level.

In terms of ordering systems by size of the Pearson r (correlation between grade level and knowledge of that system), systems such as vision have correlations between .58 and .77 whereas for urinary, correlations are from .02 to .53. Of the significant Pearson correlations, the variability accounted for by grade level ranges from a high of 59% for identification of parts for vision, to a low of less than 1% for location of parts for the urinary system.

Discussion

Question 4 states "Is there an increase in kowledge across grade levels?" and Question 5 asks, "Is this knowledge related to grade level in a linear fashion?" The F tests for linearity would suggest that for the four different areas of knowledge (parts, location of parts, function of parts, and purpose of the system), there is a strong relationship between knowledge and grade level. For the first three areas of knowledge significant F tests for linearity occurred for 13 of the 15 systems, and for knowledge of the purpose of the entire system, significant F values occurred for 10 of the 15 systems. Thus, strong evidence exists that for first to fourth graders, the older you are, the more you know about your body. It does appear that there is an increase in children's knowledge of their bodies across grade levels. Exceptions to this are seen in the systems of muscles, tears, urinary, skin, respiration, touch, taste and sweat for which not all four areas

are significantly related to grade level. For the systems where a progression across grade levels is not seen, the predominant reason may be that the scores are low. From a total of 60 F tests computed regarding the linear relationship between grade level and knowledge, only 10 areas were not statistically significant. In general, these non-significant tests occurred for the systems about which children did not know as much. Where a relationship between grade level and knowledge is not seen, knowledge scores are low and have a restricted range.

The results show that, for knowledge of the purpose of the entire system, there are not as many significant results as for the other three knowledge areas. The number of items measuring purpose of the entire system is very small, whereas for the other three areas of knowledge, the number of items is much larger. Whenever a measure does not have very many items, that measure is not as reliable or as sensitive, and a large sample is needed to pick up the pattern. The small sample size in this study, coupled with the fact that for the purpose of the entire system there are not as many items, make the results less sensitive and, therefore, less reliable.

Conceptually it makes sense that children do learn about their bodies in a progressive manner. Piagetian theory of cognitive development, as well as Brown's Development of Body Knowledge theory, provides the basis for this assumption. Less clear, however, is the idea that certain systems are developmentally integrated into a child's knowledge base prior to others. In this study the linear progression

of knowledge suggests that children first learn about the sensory systems, digestion, and bones. Children at a very young age have experience, as well as teaching, about the parts of the body having to do with seeing, hearing, touching, and smelling. The topological, surface characteristics of these systems is described in Brown's Body Knowledge theory, which postulates that children learn about their bodies from the outside in, learning first those parts that are hard, angular or prominent. The digestive process becomes relevant as children learn about food and eating and develop bowel control. Systems for which there appears to be less knowledge are those internal systems with complex processes such as cardiovascular, respiratory, and renal. These systems for which there appears to be little knowledge need to be investigated with an older population so that one can begin to see where this kind of knowledge begins to increase.

Question 6 asks "Is the increase in knowledge related to grade level in a nonlinear fashion? eg., Does knowledge increase at a particular grade level?" One way to pick this up might be the F test for nonlinearity. For instance, if the first and second grade means are similar and differ from third and fourth grade mean scores, a gap will show up between the second and third grade, resulting in a significant F test for nonlinearity.

Nearly all the F tests for nonlinearity are not significant. Two exceptions out of these 60 F tests are for location of parts having to do with sweat ($F(2,36)=5.98$, $p < .01$) and for parts of the system of tears ($F(2,36=3.43$, $p < .05$). The means associated with these F tests

do not differ in a predictable manner and may be a result of chance fluctuation. The issue of whether knowledge increases at a particular grade level is better evaluated by looking at the comparison of grades and the significant t-tests.

Question 7 addresses the issue of "Which pairs of grade levels differ from one another on each of the 15 anatomical systems?" Table 8 presents a summary of t-tests comparing grade levels. Results are for grade 2 versus grade 1, grade 3 versus grade 2, and grade 4 versus grade 3. Table 9 is a summary of the significant t-tests for these comparisons at the alpha level of .05, .01, and .001.

Using an alpha $p < .05$ level, we find second graders significantly different than first graders 13 of 60 times, third graders are significantly different than second graders in over 50% of the 60 t-tests (32/60), and fourth grade scores are significantly different than the third graders on 5 of the 60 t-tests. If we use a $p < .01$ alpha level, first versus second have significant t-tests 6 out of 60 times, second versus third, 8 out of 60 times, and third versus fourth 2 out of 60 times. At the .001 level, first and second graders show no difference. Second versus third graders are significantly different 7 out of 60 times and third versus fourth, 1 out of 60 times.

When doing a lot of t-tests, one is likely to get a number of them significant just by chance alone. Because using a multiple t-test procedure as above is a very liberal kind of procedure, rather than using an alpha level of .05, one may require differences to be significant at the .01 level. On the one hand it is important not to

miss any important differences; however, one must not dwell on findings that might be due to chance. Since this study is exploratory research we want to make certain that if something is there, we do detect it. The overall pattern of results needs to be evaluated at both the .05 and .01 levels to identify those systems where there is a difference between grade levels.

TABLE 9

SUMMARY OF SIGNIFICANT COMPARISONS (t-tests) FOR 1st vs 2nd, 2nd vs 3rd, and 3rd vs 4th GRADES AT THE .05, .01, and .001 ALPHA LEVEL

Alpha	1st vs 2nd	2nd vs 3rd	3rd vs 4th
.05	7/60	23/60	2/60
.01	6/60	2/60	2/60
.001	-	7/60	1/60
TOTAL:	13/60	32/60	5/60

It appears that third graders differ from second graders more often than first differ from second graders and third differ from fourth graders. Those systems for which these results suggest a leap in knowledge between the second and third grades include the cardiac, skeletal, and neurological with significant tests ($p < .05$) in all four areas, identification of parts, location of parts, function of parts, and purpose of the entire system. Sweat and taste have 3 out of 4 areas with significant differences whereas digestion, respiration, hearing, and vision each have two. Although these results give some suggestion that the second and third graders are different, the

evidence is not overwhelming and clear cut and merits further study to see if indeed there is some kind of leap or jump in knowledge between the second and third grade.

Conceptually, the seven year old child moves into Piaget's period of concrete operations. In this period the child begins to understand relationships, focus attention on more than one aspect of a situation, and begins to think in a reversible fashion. Body function and structure are conceptualized more specifically at this time; structure and function of body parts are differentiated and related to one another. Gellert (1962) identified the age of 8 to 10 as a time when a sharp increase in information about the body occurs.

At the time of interview, the majority (7) of second graders in this study were between 7 1/2 and 8 years of age, whereas the same number (7) of third graders ranged in age from 8 1/2 to 9 years. One child in the third grade, however, was particularly bright and, although not too much of an outlier, had a score large enough to pull the whole grade up. The sample size was small with only 10 children from each grade interviewed.

We do see an increase in knowledge over grade level, but the evidence regarding whether or not there is a jump between the second and third grade is not strong and further research is needed to clarify this area.

Question 8 asks "Within a system, is knowledge regarding each component (parts, location of parts, function of parts, and purpose of the entire system) related to knowledge on each of the other components?" In regard to this question, within a system each of the

four areas of knowledge was correlated (Pearson product-moment correlation) with the other three in the following format:

1. Identification of parts with their location.
2. Location of parts with their function.
3. Identification of parts with their function.
4. Identification of parts with the purpose of the entire system.
5. Location of parts with the purpose of the entire system.
6. Function of parts with the purpose of the entire system.

The first three areas address parts versus location versus function; the latter three, the relationship between the entire system and the component parts, location and function of parts. A median correlation for each comparison was determined. For this study any correlation above a .30 level was felt to be practically meaningful. A summary of correlations among the four areas of knowledge within systems is demonstrated in Table 10.

TABLE 10

SUMMARY OF CORRELATIONS AMONG THE 4 AREAS OF KNOWLEDGE WITHIN SYSTEMS

Comparison	Low	Median	High
Parts/Location	.42	.94	1.00
Location/Func.	.23	.72	.92
Parts/Function	.14	.76	.92
Parts/Purpose	-.03	.44	.72
Location/Purpose	-.07	.49	.75
Function/Purpose	.05	.35	.65

For construct validation it is hypothesized that if a child knows something about a body part, he/she will have some awareness of its location and function. For this study it is predicted that a knowledge of parts will correlate with a knowledge of location. It is further predicted that both identification of parts and location of parts will be positively correlated with function of those parts. These two latter correlations, however, are not expected to be as high as the correlation between identification of parts and location of parts because understanding the function of a part is a higher level of knowledge than the other two areas. Further we would expect that the correlations among the first three areas, "parts/location", "parts/function", and "location/function", would be higher than the correlations between the "knowledge of the entire system" and the parts, location, and function of individual parts.

As predicted, the correlation between identification of parts and location of parts tended to be the highest (Table 10). All Pearson r values were greater than the .30 level with a range of 1.00 (smell) to a low of .42 (tears), and a median correlation of .94. The correlations between location and function of parts ranged from .92 (tears) to .23 (muscles). All but two correlations fell above the level of .30, with a median correlation of .72. The correlations between identification of parts and their function ranged from .92

(smell) to .14 (tears). The median correlation was .76, with all but 3 of the 15 correlations above the .30 level.

Lower correlations are generally seen between knowing about the purpose of the entire system and knowing about its parts, location of parts, and function of parts. The range of correlations between identification of parts and the purpose of the system is from .72 (cardiac) to -.03 (tears). All but four of the 15 correlations were above the level of .30; the median correlation was .44. The median correlation between location of parts and the purpose of the system was 49. Correlations ranged from .75 (cardiac) to -.07 (tears). All but six correlations were greater than .30. The correlation between function of parts and the purpose of the system showed a range of .65 (digestion) to .05 (respiration). All but five correlations were above .30, with a median correlation of .35.

Discussion

These results give us sufficient evidence to say that the correlation between identification of parts and location of parts, is clearly higher than the correlation between location of parts and their function, and identification of parts with their function. The correlations of .96, .72, and .76, however, all appear related at a fairly high level, whereas the correlation between identification of parts, location of parts, and the function of parts, when compared with the purpose of the entire system, are much lower and less clearly related (Table 10).

A child's knowledge of parts appears highly related to location and also highly related to their function. Correlation of knowledge of the entire system, although much lower, may be due to restriction of range, that for the knowledge of the entire system there simply aren't as many items and that the scores can't have as big a range. Although these scores are much lower and may be due to restriction of range, they are still high enough to infer that children who do know more about identification of parts, tend to get higher scores on knowledge of the entire system. For example, if a child knows something about digestion it is likely they will be able to correlate some of the parts with digestive function.

One would conclude that the results do provide some evidence that Brown's instrument has construct validity.

Question 9

Further evidence of construct validity for the instrument was provided by correlating knowledge of one system with knowledge of each of the other systems using the Pearsons product-moment correlation. Areas of knowledge were correlated across systems in the following manner.

1. Identification of parts in each system with identification of parts in each of the other systems.
2. Location of parts in each system with location of parts in every other system.
3. Function of parts in each system with function of parts in every other system.

4. Purpose of an entire system with purpose of every other system.

The 105 correlations for each knowledge area were ordered from high to low and the median was determined. These values are depicted in Table 11.

TABLE 11

SUMMARY OF CORRELATIONS BETWEEN CORRESPONDING AREAS OF KNOWLEDGE ACROSS SYSTEMS

Comparison	Low	Median	High
Parts/Parts	-.11	.43	.74
Loc./Loc.	-.12	.36	.74
Func./Func.	-.23	.46	.82
System/System	-.02	.38	.69

The correlations across systems tended to fall in a moderate range (.30's and .40's) as compared to the correlations in the .70's to .90's among the knowledge areas of parts, location, and function of parts, within systems.

Discussion

One might predict that because the body systems themselves are interrelated, if a child knows about parts of a particular system, he/she is also likely to know something about parts of other systems that are related to that one. For example, if a child knows something about digestion, he/she is likely to know about urine elimination, eg., if you drink fluids, some of them will come out as urine, and about bones and muscles, eg., the food we eat makes bones and muscles grow.

One would again conclude that these results provide further evidence of the instrument's construct validity.

CHAPTER IV

QUALITATIVE RESULTS AND DISCUSSION

Descriptive Analysis: Children's Comments

Introduction

The development of children's knowledge about their bodies was also investigated by doing a content analysis of those children's comments which could not be coded. In a very general way, the nine research questions and corresponding hypotheses presented quantitatively in Chapter III, are addressed in the descriptive analysis. Children's overall knowledge of the 15 systems investigated and the developmental sequence of this knowledge of body parts, location and function of body parts, and the purpose of systems, is presented. The increase in knowledge across grade levels is demonstrated with the selected children's comments as well as the numerical tabulation of the knowledge of body parts by system, displayed on Table 12.

The children's comments were collated by grade into the 15 systems. As in the statistical analysis (Chapter III), consideration was given to the four areas addressed for each system: 1) identification of body parts, 2) location of body parts, 3) function of parts, and 4) the purpose of systems. Three additional areas are also included in the descriptive part of this analysis: 1) the inter-relationships between systems, 2) the health aspect of each system, and 3) children's knowledge of illness for each system. These increase an

understanding of the overall level of children's knowledge about their bodies at different grade levels.

Children's knowledge of their bodies, as discussed in the literature, is presented for each of the 15 systems investigated. These are compared with the findings of the present study and are presented in summary form at the end of this chapter.

Children's Ideas About the Digestive System

Children's understanding of the parts and function of the digestive system is explored at length in the literature (Denehy, 1984; Gellert, 1962; Schilder & Weschler 1935; Nagy, 1953; and Tait & Ascher, 1955).

Of the five internal organs most often drawn in the Tait & Ascher study, the gastrointestinal system was most often represented with drawings of the stomach and intestines. The G.I. system is also one of the three systems most frequently represented in Porter's work. The Schilder & Weschler interviews reveal that children perceive the whole inside of the body as being filled with recently eaten food. Young children in particular, conceived of the body contents in terms of what they observed being put in and coming out, such as food, drink, feces, and urine. Most children associated food intake with the stomach (Denehy, 1984; Gellert, 1962; and Nagy, 1974).

Digestion was included in the three systems dealt with in Nagy's (1953) work. Parts of the system identified by Nagy's Hungarian subjects, were the mouth and the stomach. Most children located the stomach incorrectly by placing it high in the upper abdomen. They said

the stomach was for eating and keeping food. Five percent associated the stomach with breathing. According to Nagy's subjects, "we eat to live, to keep healthy, to build our body, to grow and to prevent hunger".

Only four out of Gellert's (1962) 71 subjects thought the stomach to be the most important part of the body. In contrast to Nagy's subjects, those of Gellert located the stomach below its actual anatomical position. Her younger children thought: 1) food is never eliminated, 2) food is not assimilated but is egested directly from the digestive tract, and 3) some food is egested after going to the body. A few children associated the stomach with breathing and the idea of food dropping and going down to the feet and legs is expressed. At all ages these children thought food was for growth. Gellert (1962) found the idea of transforming food from one kind of matter to another, generally conceivable at about age eight.

Second graders in Denehy's (1984) study thought the stomach was for "eating food" and "getting big and strong". The idea of the stomach for breathing was also presented. Her fourth grade children included the idea of transformation when speaking of the stomach as the place where food is broken down and dissolved. Sixth graders referred to assimilation when they discussed food being digested by gastric juices and nutrients being absorbed by the body.

Brown's Inventory of Body Knowledge Questionnaire is designed to identify what children know about their bodies. Initially, questioning is directed at what children know about the things that "go in" and

"come out" of their bodies. Questions about the digestive system in this study are divided into these two categories.

The ingestion of food and liquids is in the first section which discusses things that go into the body. The egestion of fluids is discussed in the questions about the urinary system, followed by questions regarding bowel elimination. The identification and location of parts of the digestive system are explored as children discuss the ingestion/egestion process.

Ingestion questions included "when you eat an apple, where does it go?", "does it ever come out?", and for egestion, "where does urine (pee pee) and feces (poop) come from?". "What would happen if you never went to the bathroom?".

Most children in this study demonstrated some hesitancy in talking about the bodily function of elimination. The interviewer, sensitive to these feelings, made every effort to carefully elicit information in a non-invasive manner.

All children in this study knew about the mouth, teeth and the stomach. The majority had an awareness of the tongue's role in the digestive process but only a small percent were aware of other digestive related body parts such as the esophagus, liver, intestines, and rectum.

First Grade

Three first grade children thought the purpose of the uvula was to help with swallowing. Five children made comments about the stomach including the idea that it "vibrates", "makes you swallow", "squirts

juices all over", and "makes gall that goes into the blood pond". Comments about the stomach, associating it with respiratory function, include "the stomach helps you breathe in and out" and "food and drink is needed for breathing". First graders generally located the stomach all over the abdomen. The liver, located in the left chest area by one child, "keeps us running" and "is important for the stomach" whereas the spleen, also located in the same area, "helps the powerful pushers push into the blood pond". When blood goes through the gallbladder, this child said that "the gall catches up and goes into the blood pond".

When discussing ingestion, first graders comment that food "gets crunched up", "stays in the stomach", "never comes out", and "disappears". One child comments that "everything is in the stomach -- air, food, pee and poop". In contrast, another comments that "food goes to your feet, hands, and inside your body".

First graders associated food with bowel elimination by comments such as, "food is in the stomach before you go to the bathroom", "food goes to poop -- I saw cheerios", "food goes to poop when the stomach is too full", and "food and milk come out". Poop is in a "container", "stomach", "upper thigh", "comes from your bottom", and according to one child, is "loose inside".

Urinary elimination is associated with the ingestion of fluids. Comments include, "pee comes from liquids", "part of fluid comes out in pee", and "juice melts to pee". Two first graders said that pee is "not in a container" while one notes, "it ain't loose inside".

First graders said that food is needed "to survive", "make strong muscles", "help us run, grow, have energy", and "keep us healthy". "If we eat good, nutritious food, the stomach will get strong and grow more meat". According to one child, "if we don't eat, we will die". A stomach ache, fever, and throwing up are problems first graders associated with the digestive system.

Second Grade

The esophagus is first recognized and mentioned by three second grade children, as a "tube that hooks to the stomach". The uvula, noted by two children, "separates food", and the tonsils, help you "swallow" and "talk". Teeth (baby and false) help chew. The intestine is "where air you breathe goes". Second grade children's only awareness of the liver is that it is "something to eat that is yukky".

Second grade comments about the digestion of food and liquids include the idea that food, "dissolves in the stomach to make room for more food", "sloshes around and comes apart", "floats in the stomach" and "goes around". Absorption of nutrients (protein, vitamins, minerals) is mentioned by two children. The end result of ingestion varies according to second grade comments. "Food goes to the arms and legs", "the good part of food goes to the body, some to poop, the rest disappears", "food goes in your mouth and out your bottom", "food only comes out when you vomit", and "the little guy in the stomach takes food everywhere".

In answer to the questions about egestion, second graders said that poop "is from food" and "from the stomach". Four second graders

said that poop is "loose inside", while only one thought it to be in a special container. One child stated that "poop is in the same container as pee". Urinary elimination is related to fluid ingestion with comments such as "fluids come out as pee" and "pee is from milk".

Eating good food is important to keep the digestive system healthy, according to second graders. Food "helps us grow big and strong", "builds up muscles", and "gives energy". Illnesses of the digestive system included a stomach ache and vomiting (puke, throw up). Constipation is alluded to with the comments "we will get sick if our tubes get plugged" and "if we never pooped, we will die". One girl notes that "if we don't go to the bathroom, we will get our underwear all dirty".

Third Grade

An increase in the knowledge of body parts is demonstrated by third grade children as they identify the liver, salivary glands, rectum, canines (eye teeth), molars, appendix, and the spleen.

The stomach, located incorrectly in the lower abdomen by one child, "warms food up" and "crushes it". The esophagus, located in the chest, is a "tube down the throat that is hooked to the mouth and goes to the stomach". One child stated, "food goes here after the stomach". The intestines are a "long tube"; the small intestine "turns paste to liquid". The uvula "helps us swallow (it hangs down and tells the brain food goes down the throat)" and salivary glands are "like wet sponges in the mouth". The liver, located near the heart, "does something to food somewhere in the stomach". If we didn't have a

liver, "we would die". Chickens have a liver and three children note, it is "yukky to eat". The appendix, located correctly in the right lower quadrant, "cleans the food". The pancreas, located underneath the stomach, behind the intestines, and under the heart, "gets germs out". Located in the pubic area, the gallbladder "helps you go to the bathroom", "is where you hold water", and "cleans out blood". "Food goes to the kidneys after the stomach, where it is made into minerals". The kidneys "use the minerals and waste the rest".

A system is first defined by third grade children who comment, "a system is like a computer"; "a system is something that needs each other to work" and, "things are hooked together in a system".

Third graders discuss the process of digestion with comments such as food "gets small like sand" and "breaks into pieces". Awareness of absorption of nutrients is identified with "food goes to blood and blood cells", "cells need food", and "the body uses protein". Assimilation is mentioned as children note food "gives us energy", "helps us grow", and "think".

Comments about egestion of food by third grade children include the idea that "food comes out as poop", "only part of food comes out when we go to the bathroom", and "poop is food we don't need". The origin of poop includes the stomach and kidneys. Urinary elimination is noted with the comment, "milk comes out as pee". Four third graders said that poop was "in a container" while two thought it was "loose inside". If we never went to the bathroom, children said "our stomach would hurt", "we would get infected", and "we would die".

Third grade children associated good health with eating nutritious food,necessary for bone and muscle growth. "Sweets will give us bad teeth" and "pop, caffeine, and sugar will make us fat". One child comments, "don't overeat because when you are stuffed or eat too fast, you can collapse and kill yourself ... that's bad!".

Allergies, vomiting (throw up), a stomach ache, diarrhea (runny poo poo), and constipation (f we eat too much and don't let the poop out, we will get constipated) are problems associated with the digestive system. "If we don't eat we will starve and die" and "if we don't drink, we will dry up and die".

Fourth Grade

Third and fourth graders are pretty similar in their knowledge of body parts for the digestive system. Differences include the gallbladder, named by two fourth versus one, third grader and the liver, named by 8 fourth, versus 6 third grade children. The stomach is located correctly by fourth grade children. The esophagus is a "tube for air", located "above the stomach" or, according to one child, "between the salivary glands which are inside the throat". Children comment that the intestine is "part of the stomach", "hooked to the stomach", "hooked to the heart", "in your head", and "like a tendon". We can't live without a liver, according to one child. Located in the chest, the liver "cushions the heart" and "dissolves and stores sugar". Urine is stored in the gallbladder according to two children. Tonsils "help us swallow", "molars are four teeth fit together", and "the spleen is in the head".

Acid works on food" which is "chopped into little pieces" and is "divided up" in the digestive process. Food "makes us live", "keeps our stomach from growling or starving", and "water keeps our voicebox wet". Food "goes to the lung", "stays in the stomach", and according to one child, "never comes out".

Absorption and assimilation of nutrients is discussed with comments such as, "food helps us grow", "the body takes the food it needs", and "what the body doesn't want, it turns to fat". "Food goes to cells for skin, blood, and bones", "food goes to muscles by the blood stream", and "blood, from the food we eat, carries minerals to the body". "Particles of food keep the blood system rich", "food helps heal sores", and "fluids clean out the system by washing stuff that sticks to the side of the tubes". The calcium in milk "hardens bones and teeth" according to four children, and "helps us go to sleep". Five fourth graders note that the vitamins in food give us energy and strength.

When talking about egestion, four children state that poop "is from the stomach", "from food we don't use", and "contains poisons". Food goes out as sweat, roughage, and vomit. Pee is from "liquids we drink". Three fourth graders note that poop is in a container, while two thought it was loose in the intestines. One stated that poop is "loose inside". If we never went to the bathroom, fourth graders said we would "die", the "poop would get hard", "our stomach would burst", and "we would go in our pants".

The flu (germs in food make you sick in the stomach so you baarf), constipation, vomiting, choking, stomach ache (the intestine can get a hole burned in it), and infection are illnesses related to digestion.

Summary Digestion

In this study a gradual increase in the knowledge of body parts, the correct location and function of these parts, was identified. There appears to be a greater increase in knowledge of parts between the second and third grade than between first and second or third and fourth graders.

First grade children associate eating with breathing, possibly because they associate it with the abdomen going in and out with respiration. They believe everything goes to the stomach, think food drops in the body, and goes to poop and pee. Second graders discuss the digestion of food (food gets smaller), and look very briefly at the idea of absorption. Digestion, absorption of nutrients, and assimilation of food and fluids at the cellular level, is first discussed by third grade children. All children exhibit a general understanding of the importance of good food in helping us live, grow, have energy, and keep healthy.

Children's Ideas About the Urinary System

It is sometimes presumed that since the urinary bladder provides obvious sensation in association with elimination, children should be able to identify and locate it easily. This, however, is not the case. Gellert (1962) found in her study that one of the least familiar parts of the body is the bladder which, in some cases, is confused with the

gallbladder. Gellert did find, as did this investigator, that at every age a small number of children relate the urinary bladder to elimination. The kidneys, ureters, and the urinary system as a whole, are generally unfamiliar to young children.

First Grade

None of the first graders knew the name for the bladder or had any awareness of the kidneys or ureters. One identified the bladder as the stomach, two recognized the term and associated it with a container for urine, and three correctly lcoated the bladder in the lower abdomen. Called a "storage place", "storage tank", and "private place", four children indicated "pee pee" to be in a container while four stated it "loose" inside. Five children associated the drinking of fluids and urination during the questioning about digestion. First grade children did not relate the elimination of fluids with their ingestion during questioning about the urinary system.

In response to the question"If you could not find a bathroom what would you do?" one first grader responded, "Something awful would happen ... you would have to go to the forest". A general feeling of privacy existed when both bowel and bladder questions were discussed.

Second Grade

Only one second grade child spontaneously identified the term bladder and related this knowledge to a TV program in which a pig's bladder was used as a balloon. The term, when mentioned by the interviewer was noted by four children as a container for urine. Two thought the urine was "loose inside". None of the second grade

children knew about the kidneys although one child stated that the "water in the blood is made into yellow pee." The bladder was located by four second graders in the genital or crotch area. Seven children said that pee is from ingested fluids such as water and milk, and one said that pee comes from the stomach.

According to second graders, "a stomach ache will occur if you do not go to the bathroom", "you will die if you get too full of pee", and "if you cannot find a bathroom, you will just have to go in the field".

Third Grade

An increase in awareness of the urinary system was found in third grade children. The term "bladder" was recognized by five children, with one child emphatically calling the bladder a "spladder". Urine was thought to be in a container by seven third graders; three thought that pee was "loose inside and just sloshed around". The bladder as a container for urine, is referred to as a "stomach", a "special container for pee and poop", a part that "helps us go to the bathroom", and "a place that gets all the stuff you do not need and lets it go down". The bladder was correctly lcoated by six children and one stated that "the bladder is in your throat". Six children identified the source of urine from food and three said it was from things we drink. For example, "pee is from water we drink and do not need any more".

Three third graders were the first to identify the kidneys. Located in the inguinal area and lower abdomen, these children said

that kidneys "clean out the blood", "digest food", and "store poop". Based on a family experience, one child described kidney failure and dialysis which "removes waste from the body".

In answer to the question "What would happen if we never went to the bathroom, third graders comment, "we would wet our pants", and "we know when we have to go to the bathroom because it feels heavy". To keep our urinary parts healthy, two children said we should eat good food. The function of the urinary system is colorfully described by one third grade body who state "when milk and water get too old, you use it as bathroom; when it gets yukky, you let it out and get clean water". One child also comments, "if the spladder gets full, there is no more room and you will throw up".

Fourth Grade

In the urinary system five, fourth grade children identified the bladder and six, the kidneys. The bladder is called a "little sac" and a "container". Two children said that urine stays in the container for awhile, whereas two stated that urine is loose inside the body. Kidneys, located below the rib cage by one child and behind the shoulder bones by another, help "have babies" and "help go to the bathroom.

Five fourth graders commented that urine is from "things you drink" and, according to one child, is "made in the intestines". Children comment, "the more you drink, the more you pee" and "when you drink milk, it turns to yellow juice and then to pee". If you never

went to the bathroom, you would get a "stomach ache" or "pee your pants".

Problems identified in the urinary system included a rash and "soreness where your pants rub". Children said one needed to drink good things to keep the urinary system healthy.

Summary Urinary

One of the least familiar parts of the body is the urinary system. Although at every age a small number of children associated the urinary system with elimination, the parts of the system such as bladder and kidneys are not identified until the third and fourth grade level. Although the bladder is confused with the term gallbladder, it is correctly located by most of the children as they get older.

Children's Ideas About the Respiratory System

When Nagy (1953) asked "what happens inside your body?" she found most children (4 to 12 years) dealt with three areas. One of these areas was the respiratory system. Children in her study, by the age of six, spoke of breathing as a process and by age nine, the majority (70%) recognized the function of taking in and expelling air. Although children knew it was necessary to breathe, they did not know why and had no understanding of oxygen exhange.

The lungs were located above the shoulders in the head and neck region, by 50% of Nagy's subjects. Not until the age of ten, did the majority place the lungs in the thoracic cavity. Children did not recognize the lungs as specific for breathing until the end of childhood. Gellert (1962) found that over 50% of children under seven

had no idea of lung function; over nine, 65% associated the lungs with breathing and it was not until age 15 that the lungs were identified as essential to life.

More recently Denehy (1984) interviewed 140 second, fourth and sixth grade children about the function of their lungs. Second graders recognized the lungs as necessary for "breathing air" while most fourth grade children stated that "lungs inhale and exhale air". Some knew about oxygen, but it was not until the sixth grade that her children discussed oxygen and carbon dioxide exchange. Children at a younger age (7 to 8 years) had a greater understanding of lung function in Denehy's study in contrast to earlier work which demonstrated this knowledge at the age of nine to ten.

First Grade

Although seven first graders recognized the term "lungs", most did not spontaneously identify the lungs as part of the respiratory system. One child noted that there are "100" lungs. The tonsils, voicebox (to help us talk), and glands were parts of the respiratory system named by first graders. Tonsils and the voicebox were located in the throat, neck, and mouth. Lungs were located by two children in the throat and cheeks. The function of breathing was associated with tonsils, with the heart, and with the lungs. The process of respiration is described by a first grade child this way: "there are small passenger holes in the walls and air is so flat; it gets flatter and flatter so it can squeeze through the little holes".

The first grade child's understanding of air exchange is described in contrasting ways. For example, "air in is the same as air out" or "air in is different than air out". "The good air goes in, the bad air out", "air goes in your mouth and out your nose:, "air goes to your stomach", and "air comes out when you talk". Two children associated air with living. Most first graders, even though they felt air was important, were not sure why.

Illnesses associated with the respiratory system include those with which children appear to have some experience such as bronchitis, bronciolitis, tonsillitis, a sore throat, and colds. Choking and smoking are bad for your lungs, and, as one child comments, "bad air is not very good stuff -- it drains oxygen".

Second Grade

Second graders added "pipes" and lips to the parts of the respiratory system. Tonsils were located in the mouth, throat, and cheeks and the number of lungs varied from one to 3 or 4.

The concept of air going in and out is identified by nine of the second grade children. Five said that the "air in is different than the air out", while two noted that "air in and out is the same". Two children said that "air in is good and air out is bad or dirty". Other comments include "air goes in the nose and out the mouth", "there are two kinds of air, hot and cold", "air is necessary for life", "air goes to the stomach", and "air out, gets the germs". Speech is associated with respiration twice and one child stated "the brain helps you breathe".

Four second graders said that to keep the respiratory system healthy, one must avoid smoking and eat good food. Laryngitis, swollen glands, "sick" tonsils, sore/strep throat, flu, colds, bloody nose, and a "bone stuck in the throat", are illnesses and problems associated with the respiratory system by the second grade children.

Third Grade

A gradual increase in the number of parts identified in the respiratory system is seen with the third grade children as they include the trachea, blood cells, and cilia. Only one third grade child located the lungs in the head and throat area. The correct number of lungs was mentioned by four children and nine correctly identified the lungs as an important part of this system. comments regarding lung function include, "to circulate air", "to sort out the oxygen and send it to the body in the blood", and "to allow wastes to escape".

Comments about other respiratory parts include, "tonsils and lips help you talk", "blood cells help with the gas exchange of oxygen and carbon dioxide", "nose hair (cilia) clears out the air", and "the trachea is a tube down to the thighs". "Air is molecules that has waste oxygen in it when it goes out". The concept of air exhange, as described by third grade children, include the idea that "air goes in and out" and "the air in is different than air out", (good air goes in, bad air out). Only one child said that "air in and out is the same".

A contrast in conceptualization of air exhange occurs in statements from two children. "Air goes to the lungs, the blood (tiny vessels) and cells, where it burns and goes out as carbon dioxide" as

compared to, "air goes in the stomach and that is why the stomach goes in and out". The interrelationship between the cardiovascular and respiratory system is first made by the third grade children who discussed blood, blood cells and transportation of air, oxygen, and carbon dioxide.

To keep the respiratory system healthy, one third grader said it was important to breathe clean air, while two stated it was "bad to smoke" (smoking will hurt your lungs; the lungs can pop and turn gray, and if the lungs pop you might die). Third graders added cancer to the list of illnesses mentioned by the younger children.

Fourth Grade

Fourth grade children added bronchii to the list of parts identified. Lungs were mentioned nine times. The number of lungs varied from "none" to 0 to 10. The lungs were located in the throat by four, fourth graders. One child stated "air goes to the stomach" and another, "food goes to the lungs".

Fourth graders expanded upon the ideas about air to include, "air goes through a tube to the lungs", "air is carbon dioxide which stays in the lungs", "air doesn't go anywhere besides the lungs", "air goes through the heart to get clean air", "air is pumped through tubes by the heart" and "air is important so we won't die". None of the children said that the air in and out were the same. About oxygen, fourth graders said that "oxygen helps us breathe", and "air goes to the brain with oxygen".

Three fourth graders associated respiratory and cardiac function. Only one child mentioned not smoking as a way to keep the respiratory system healthy (smoking makes the lungs black and pollution in the air can make you sick).

Summary

In this study, as in Nagy's (1953) work, all children ages six and up identified the concept of breathing and air exchange. The idea of "good air" versus "bad air" and the need to breathe to live, is expressed at all ages.

Children in this study identified air exchange at a younger age (first grade) than in previous work (nine years). By the fourth grade all children believed the air in to be different than the air out.

As in the work of Denehy (1984), children recognized the lungs as essential for breathing at a younger age (second grade) than in previous studies. Children consistently located the lungs in the neck and throat area until they reached the fourth grade level.

The oxygen and carbon dioxide exchange process is mentioned by both a third and fourth grade child. Oxygen, as a term, is referred to at all levels.

Illness associated with the respiratory system may, in most cases, be experientially related. However, children's awareness of cancer and lung disease or damage caused by smoking, is encouraging from a disease prevention perspective.

Children's Ideas About the Cardiovascular System

The literature speaks of the cardiovascular system as the one most often represented by children(Gellert, 1962 & Porter, 1974). Tait and Ascher (1955) postulate that children conceive of the contents of their bodies in terms of what they observe being put in and coming out, inclusive of blood. In children's drawings the heart is one of the most important organs in the body. Gellert's (1962) study showed the blood vessels, heart, and blood among the most frequently mentioned parts. By age seven, the heart is "needed to live" and about nine to ten, children started to associate heart function with respiration.

Under age 11, Gellert found children's ideas about function including the concepts that the heart makes and pushes blood. Second graders in Denehy's (1984) study identified the heart as beating or pumping air and/or blood to all parts of the body.

In this study all children mentioned and/or recognized the terms heart and blood. Knowledge of other parts of the cardiovascular system as well as their function, showed an increase with grade level.

First Grade

According to first graders, the heart which is "big as a fist", "keeps us alive", "makes us breathe", "moves blood", "makes new blood", and, as one child said, "shows us how to love Jesus and our family". People will "die" if they have no heart or blood.

Blood is not directly discussed in relation to the heart by first graders. Four children comment that blood is "all over the body", two state it to be "loose inside", two think blood is "in a container", and one says it is "in the stomach". Blood is needed to "survive" and to

"help us live" according to two children. One child comments that "blood is moved by a powerful pusher in the body". Another says, "the body makes new blood by sucking blood out and pushing it back in".

Veins, identified by seven children, are red and blue, located on the arm, wrist, or back of hand, and are the same as blood vessels. One child noted that blood vessels are "tubes with blood inside them" that are all over the body.

It is interesting to note that four children made an association between the cardiac and respiratory system with comments such as "the heart makes you breathe" and "blood moves by the heart and air".

To keep the heart healthy, five first graders said that one must eat good food, sleep, and drink. Illnesses mentioned by two children, included a bloody nose and a heart attack.

Second Grade

Red blood cells are added to the parts of the cardiovascular system identified by second graders. According to this age group, the heart, thought to be the most important part of the body by several children, "pushes or sends blood out all over the body", "beats", "gets clean blood", "makes you move", and "gives you strength". Drawn by one child , the heart "makes you love".

Two second graders said that blood is "loose all over"; two thought it to be "in a container (tubes)". Children comment that blood "moves when we move", "moves from hands to toes", and "comes from bones". The air we breathe makes blood move according to two children and one child commented that the "blood carries messages to the body to

move the arm". The majority of second graders did not associate the movement of blood with cardiac function. Four said that the "body makes blood", three thought this occurred in the heart, while one said blood came from fluids we drink. Two children stated that the body did not make new blood.

Veins, noted by eight second graders, were located by five children either on the forearm or back of the hand. Two children located veins in the throat area. Veins "hold blood and move it", "help us stand up", and "carry food". One child stated that "bones in the veins make us move" and another, "veins help us swallow". Thinking of veins as ink marks, one child announced she "tried to scrub them off her arm". Blood vessels are "pipes" or "little round things" according to three children. Blood "moves in these pipes" and "carries messengers". Red blood cells are thought important by one child, so "we can live".

The relationship with the respiratory system is noted by three children with the comments, "the heart helps us breathe so we won't die", "blood moves when you breathe", and "the air we breathe makes blood move".

To keep the heart and blood healthy two second graders said that children must eat vitamins and good food; two stated we should breathe in clean air and "not smoke". In regard to illness, two children comment that "if the heart stops beating, you will die" while another said "if the heart beats slow, you are almost dead". A heart attack and heart disease are mentioned by two children.

Third Grade

The parts of the cardiovascular system discussed by third grade children, in addition to heart and blood, include veins, arteries, blood vessels, blood cells, red blood cells, and white blood cells.).

Comments about the heart, located correctly by nine chidren and incorrectly in the lower abdomen by one, include "the heart is a pump with doors so the blood can go one way, but cannot get out", "is a round thing with hoses coming off", "makes new blood", "pumps and pushes blood all over", "beeps", "beats", and is "important for life". Children said that death will occur if you "have no heart", "if the heart beats too fast", "stops pumping", or is "hurt bad". According to four third graders, people who have a heart attack or heart failure will also die.

One third grader noted that "when we develop, we get blood". According to third grade children, blood "moves", "is still", "goes all over the body", "goes into the bones", "helps bones move", "makes us move", and is "needed for life". Blood is thought to be "loose inside" by four children. Two state that blood is "made in the heart" and one comments that blood "carries things like protein so you can move oxygen".

Veins, identified by nine children, are located on the forearm and head. They "carry blood" and "go all over". Veins are "blue" and can be "skinny or fat". Arteries, noted by five children, are big veins

that are red. They "keep blood clean", "send food to the body", and "carry blood where needed.

Six third graders identified blood vessels as being the same as veins. Two children comment that blood vessels are "little blue things on the arms that have blood and oxygen in them". One notes they are "pointed tubes that can be big or little and make blood go to all different parts of the body". Red blood cells are "red", have "blood in them", and "carry good things that are microscopic" while white blood cells are "white" and are "soldiers to protect the body from infection".

Third grade children noted a relationship between the cardiovascular system and respiration with comments, "air in the blood keeps us alive", and "when we breathe, blood moves".

To keep the cardiovascular system healthy four children report "we need to eat good food (no sweets)", "exercise", "not smoke", and "keep poisons out of the blood". In addition to the heart problems previously mentioned, illnesses include a "bloody nose" and a reference to "cancer".

Fourth Grade

The radial and carotid pulses and the four chambers of the heart are added to the list of parts of the cardiovascular system identified by fourth grade children. The heart is necessary to "keep us alive", according to four children. It "pumps clean air", "pumps blood with pressure", and "keeps the veins moving". Two children note that air makes the blood and heart move.

Blood is from food we eat, according to one child. Two noted that blood was made in the heart and three children said that if we lose blood, our body will make new blood "especially when the old blood dries up". Fourth graders state that blood goes "through tubes or veins", "is in a container", and "is everywhere in us". Two children thought that blood was "loose inside" the body. One commented that "blood moves when the heart beats and when you breathe" and another, "dirty blood comes back to the heart".

Veins, located by the majority of children on the back of the hands, "carries" and "moves" blood. Arteries, like veins, "go all over the body and blood vessels, also like veins, "move and circulate through the body". Blood cells in general are "blue", "hold the blood in", "help pump blood out", "help blood flow", and "carry dirty blood". Red blood cells "carry minerals to the cells", while white blood cells "destroy infection" and "get rid of germs". One child commented that "if you get cut, white blood cells help mend the cut together.

Interrelationships are noted between the respiratory system by four children, the muscles by one (blood helps the muscles move us), and the neurological by one (the brain tells cells where to go in the body). A broader look at problems associated with the cardiovascular system are reported by fourth grade children. Comments include, "if there were no veins to run the blood, it would dry up and die", "if there wasn't a heart to pump blood, you would die", "a heart attack can happen", and "too much fat clogs little veins and blood vessels so the blood can't circulate through the body". "Food can get stuck in the

throat and cause you to die" and "cuts can lead to infection and gangrene".

Summary Cardiovascular

All children in this study identified the heart and blood in the cardiovascular system. The majority correctly located the heart and believed it to be essential for life. A gradual progression in knowledge of parts is seen with an increase in grade level. Children across ages had an awareness of veins and blood vessels. Younger children demonstrated veins on their forearm, supporting the idea that children learn early, those things they can see and feel. Older children discussed the function of blood vessels as well as demonstrating their location. Fourth grade children identified the previously unmentioned parts, radial and carotid pulses and the four chamber heart.

Unlike Gellert's (1962) study, children in this study associated respiratory effort with cardiac function at the first grade level. The correlation between the movement of blood and cardiac function is not made until the third grade level when children discuss the idea that the heart pumps blood. Young children do not think about the body making new blood but at the third grade level, children begin to view the heart as the origin of blood.

Children across grade levels have an awareness of the importance of the heart. Loss of cardiac function is associated with serious illness and/or death. Most children state that good food, not smoking, and exercise, are essential to good health.

Children's Ideas About Tears

The literature does not address what children know about tears. In an attempt to identify what children know about things that come out of their bodies, the following questions about tears were asked. "Where do tears come from?", "Are tears important?", and "When do we have tears?"

Although all children in this study were aware of tears and that tears come from the eyes, with the exception of one third grade child, none knew parts of the lacrimal system. However, when asked the origin of tears, children located several areas of the system by pointing to the inner corner of the eye and the side of the nose. According to one child, tears just "plop out".

First Grade

Two first graders thought tears came from somewhere else in the body, one child specified the heart while another thought tears were from the stomach. One first grader commented, "you drink water and it spills into tears".

While two children believed tears to be important, six first graders stated that they were unimportant. Comments about when we have tears include sadness mentioned by six children. Getting something in the eye, falling down, or getting a spanking are other reasons given by individual children. Three boys who identified tears as unimportant, associated crying with punishment or injury; five girls related sadness or emotional response with tears and crying.

Second Grade

Tears were generally believed to be important according to five second grade children. The origin of tears included the idea by three children, that they come from somewhere besides the eye. Other ideas expressed by individual children as to the origin of tears include the back of the eye, salt (because they taste salty), and from fluids we drink. One child commented that "tears come up the back of the throat to the head and out the eyes".

We have tears according to three second grade boys, when we are hurt. Two boys and two girls associated tears with the emotions of being sad and being happy.

Third Grade

Most third graders didn't know the origin of tears. One child thought that tears came from the stomach and another, from some kind of drainage system. Tears are important according to one child, to keep the eyes wet because if there is no water the eyes will dry out.

To most third graders, tears are important for emotional expression. Seven children expressed this with comments such as "tears are important so you know you are crying" and "we need tears when we are sad and really happy." Tears are needed to let out hurt feelings and to tell other people we are sad, Aside from the emotional issue, one child comments that if "we get something in our eyes, tears help it slide out".

Fourth Grade

Individual fourth graders state that tears originate from a sac in the eyes, from water in the stomach, and from water soaked up by the

skin in the bathtub. Three children felt it important to get rid of tears and one commented that you have to "drain a little to let the water out".

Four children related crying and tears to getting in trouble or getting hurt. Two commented that tears are for when you are sad.

Summary Tears

Children are aware that tears come from the eyes and most, associate them with emotional response. Although the parts of the lacrimal system are unknown to the children in this study, most appeared to believe that tears are derived from somewhere else in the body.

Children's Ideas About Sweat

The literature does not speak to any research investigating body secretions such as sweat and tears. The purpose, origin, and importance of such body products from a child's perspective have not been investigated. The studies look at what children know about their bodies in terms of importance and these two areas are simply not identified as essential to life.

Although sweat is not included in Gellert's (1962) study, she postulates that children conceive of skin as being impermeable. Nothing can enter through skin; it is moisture proof (p. 347). Comments by subjects in this study did not concur.

In this study children were asked "Where do you see sweat?", "Where is sweat from?", and "Is it important for your body?" All children identified sweat as being seen on a body surface with the

exception of one first grader who declined comment with "I don't know anything about it".

First Grade

Most first graders think sweat originates from the outside the body (the sun, the air, or just "outside"). Only three children realized that it originated inside their bodies. One child commented that "the powerful pushers push skin juices out". Eight children recognize that we sweat when we are hot or work and play hard. Sweat is located by most first graders, on the head, face, and hair. The comment is made that "sweat is important to keep you running and if we had no sweat, we could not have exercise."

Second Grade

The majority of second grade children describe sweat as originating from inside the body while three children perceived it as coming from outside (sun, salt). Described as slippery stuff that happens when playing, working, and getting hot, sweat is located by most of the children on the neck, face, and forehead. Second grade children comment that sweat is important because if "we don't sweat we will freeze to death","when we get too much fluid we need to get rid of some", and "sweat keeps us healthy".

Third Grade

At the third grade level, sweat is thought to come from outside the body by only two children. Again, children in the third grade associated sweat with working, playing, and getting hot. One child

comments "we would have to lay down if we never sweated when we were hot".

Sweat is viewed as being important by two third graders because it "helps our body" and "washes off the dirt". Other comments by children include "sweat smells bad when it gets in clothes", and "sweat is like a car when it gets hot -- the stuff cleans out the engine so it cools down".

Fourth Grade

None of the fourth grade subjects thought that sweat came from the outside. Several were unsure of the origin but four stated sweat definitely came from within the body. Pores are first mentioned by fourth graders with several comments such as "sweat comes out the pores to eliminate wastes", "water is soaked up by the skin and when you sweat, the pores open up and it comes out", and "the body takes water out of the head and it comes out the pores".

According to four children, sweat is important to get rid of poisons, bad stuff, and wastes. One child states that "sweat is to keep the temperature down to cool the body", and "if we didn't sweat we would get a sunburn".

Summary Sweat

Most of the younger children view the origin of sweat as external. By the fourth grade level no child believed sweat to originate outside the body. Children as a rule, associate sweat with being hot, working, and playing hard. The concept of sweat as a vehicle for the excretion

of waste products via pores, is first identified by fourth grade children.

Children's Ideas About Skin

The concept of skin as a boundry between the inside and outside of the body has been an area of interest in the literature from both the illness and health perspective. Gellert (1962) in her work, identified that children view the skin as not particularly important to life, but as a boundry with functions of personal appearance and protection (p. 345-347). Under age nine, Gellert's subjects thought the skin was important to hold or bind the body together and for a good personal appearance. Older children (>9) identified the skin's function as that of protection from external, environmental influences.

Children in this study described similar ideas about the skin. Personal appearance, cohesiveness of body parts,and protection from the external environment were all described. Second graders (7 1/2 to 8 1/2 years) started describing the skin as a protective mechanism at a younger age than those in the Gellert study. Questions asked about the skin included "What do you know about your skin?", "Are there different parts to your skin?", and "What would happen if you didn't have a skin?"

First Grade

Several first graders associated hair, muscles, and freckles with skin. None demonstrated knowledge of the parts of the skin, nor did they associate skin with any sensory or neural function. Children commented that the purpose of skin is "so you won't fall apart", to

"keep the bones inside us", to "keep the blood from showing", and from "falling or leaking out". Without skin first grade children said that one would "hurt bad", "look like bones or a skeleton", "be able to see all the meat", and "look funny". To keep the skin healthy one child emphasized the importance of washing hands and cuts.

Second Grade

More parts of skin were ntoed by second grade children. Freckles (little dots), muscles, the sense of touch, the idea of three layers, and the color of black, noted by a caucasian child, were mentioned. Two children associated the skin with neural function. Second graders commented that skin "covers up the bones and veins so they stay in one place", "keeps blood from running out so you won't die", "prevents germs from getting in", and "peels off and grows back". Several further commented that if we didn't have a skin we would "look like a skeleton with all our bones and meat showing", "our insides would fall out", we would "bleed to death", "look dead", and "would not be protected if a dog bit us".

Third Grade

Third graders associated cells, the idea of layers, holes, hair, and the brain with the skin. Comments included skin is "white and soft", "protects and helps our body", and "the oil on our hands keep the skin from drying up". If a person did not have skin, third grade children said that they would "look ugly", "see bones, veins, and blood vessels" and "blood would come out". One child stated, "the skin keeps all our guts from running out".

Fourth Grade

Fourth grade children primarily perceived skin as a protective mechanism for the body. Comments related to this idea include, skin "covers us up", "protects body parts, i.e., brain, blood, veins, cells," and "holds all the pieces in our body". If cut, "the two underneath layers prevent the germs from getting in to make us sick". "Skin is important so we won't be all gishy inside", and skin "keeps the veins from popping out".

Three fourth grade children identified the idea of three layers of skin. One child confused the three layers of skin with the three degrees of burns in his statement: "one layer is dead skin, the second degree you scrape off, and the third degree is really bad". Dead cells, pores, and hair were also mentioned.

Children in the fourth grade said that if we did not have a skin "the body would crumble into bits", "you could see blood, bones, and veins up close", and "people would look scary and all red".

Comments related to illness included the idea that the skin can be injured. "The blood cells have to fight germs if there is a break in the skin", "cells of the skin fights stickers and pushes them out", and "if you get burned, the skin will blister".

Summary Skin

The skin as a boundry between the inside and outside of the body, is recognized and verbalized by the majority of subjects in this study. Young children view skin as necessary for personal appearance as well as for protection. A gradual progression in knowledge of parts of the

skin, as well as the idea of cohesiveness is seen with increase in grade level. The concept of skin color and more than one layer is first mentioned at the second grade level. Older children begin to view the integrity of the skin as a protective mechanism from the external environment.

Children's Ideas About the Skeletal System

In the studies reviewed, bones are found to be one of the most frequently identified parts of the body (Gellert, 1962; Porter, 1974; Schilder & Weschler, 1935; and Williams, 1979). The ribs are among the most often drawn parts in Tait & Ascher's (1955) study and the musculoskeletal system is one of the most frequently represented in Porter and Gellert's work. Brumback (1977) noted that children perceive of visible body parts first. The feeling of hardness and angularity is thought to be a major factor in the awareness of the bones, even by very young children (Gellert, 1962). Children in Gellert's and Williams' study said that bones give shape, structure, hardness, and strength, contribute to mobility, and hold the body together. Children of all ages in Gellert's work felt that bones contributed to hardness and structure while increasing emphasis was given to mobility as children grew older.

In this study the skeletal system is addressed with questions such as "Do you know what bones are?", "Tell me or show me all the bones you know", and "What do bones do?" Specific questions are asked about the function of the ribs and skull. The child received credit if they named and located the bone in lay terminology, for example, arm, head,

and face. All children studied had an awareness of bones but few knew the correct anatomical terminology. Exception to this is terms such as skull, ribs, and vertebrae. As with all systems, information about health and illness of the skeletal system was generated with specific questioning. A progressive increase with age is seen in the number of bones identified in the skeletal system.

First Grade

First grade children commented primarily about bones of the upper and lower extremities. In addition, the joints, face bones (jaw, cheek, chin), knee cap, backbone, tailbone, and tendon were also identified and located.

Four children said that bones move (help us walk) and make the fingers and toes move. Two thought bones and joints were hooked together but according to one child, "a joint is what you smoke". A skull or noggin is identified as the brain by one child; another commented that there are two backbones. Without bones first grade children indicated "we would be all floppy".

To keep our bone healthy two children said we needed to eat and drink good food. Four children related broken bones as problems occurring to the skeletal system.

Second Grade

All second grade children had an awareness of bones, particularly those they could see and feel. The skull (head, scalp, brain) was named by seven children, the backbone by five, ankle by three, and joints by four second graders. Children located the bones they named,

demonstrating movement (flexion, extension, and joint function). Three children said that bones are hooked together by muscles or joints. Second graders commented that "the bones protect us" and "hold the body together".

About the skull, children said it "helps us think", "moves the head", "keeps the brain stored in", and "helps the brain not wiggle". The vertebrae "keeps the back hard", "moves the back", "holds it together", and "helps us bend". Ribs are "hooked to the spine", "help us move", and "help us breathe".

If we did not have bones, second graders said we would "flop to the ground" or "flop around" all the time. Exercise, drinking milk to "keep the bones hard" and "eating good food" is essential to keep the bones healthy according to seven, second graders. Fractures or broken bones, chips and sprains are identified by five, as problems happening to the bones.

Third Grade

Third grade children knew about bones, their location and in many cases, had a general understanding of the function of movement and protection.

The skull or head,named by all third grade children, "protects the brain", "helps it to think", "keeps the brain from damage (from getting squished)", and "from falling out". A comment about the spine, named by two children, is "the spine is in the backbone which helps us to bend forward".

Nine children identified the ribs and rib cage. Individuals commented that the ribs "protect the heart and veins", "keeps the stomach from blowing up and popping", "keep the stomach out", and "protect the lungs so they won't get squished". "If there were no ribs a person would have heart damage and die".

Third graders said that a tendon "helps move the fingers", ligaments "help us move", and joints are "two bones hooked together that can move". Joints are "everywhere the body bends and moves" and "help us bend and walk". The collar bone, tail bone, chest plate, occiput, and eye orbits are added to the parts identified by third grade children.

If we did not have bones we would be "floppy like a blob of jelly" and "could not move".

Interrelationship with the muscles, neurological, and cardiac system is made with comments "the brain tells the bones to move", and "blood helps bones to move". To keep bones healthy, five third graders said "we need to eat good food (protein, vegetables, fruit, milk) and exercise. Injuries that might happen to the skeletal system include a fractured skull or concussion, broken bones, and a cut tendon. According to one child, a cast can be used on a fracture so it "won't move and will heal together".

Fourth Grade

Cartilage and reflex function is first mentioned by fourth grade children. "There is tissue between bones so they can move" and "the gum in between bones helps us bend". "When you get hit on the knees, a

reflex makes the knees move". Bones are associated with the neurological system with the comment, "the mind sends a message to the bones".

Fourth graders said that "bones hold the back together", "help us move", and "keep us standing". "A skeleton is a little frame that keeps us up".

All children identified the ribs; nine mentioned the skull, and eight knew about the backbone and joints. The pelvic girdle is named by three children and the collar bone, by one. Fingernails, toenails, and hair, which "protects skin", are incorrectly noted in the skeletal system.

According to two children, "the skull is the brain". The rib cage "stores air", "protects the heart", and "separates the heart and lungs from blood cells in the body". The backbone "holds up the back" and "helps with movement", while joints (nuckles) help "move fingers, arms, and elbows", "bend or flex the knee", and "connect two bones together". If we did not have bones, children comment we would be "paralyzed" or "flimsy".

Eight of the fourth grade children associated eating good food, including milk, the four food groups, and vitamins B & C, with healthy bones. Dental hygiene, such as good tooth brushing, is also recommended.

Broken bones, sprains, dislocations, a "cracked head", cavities, and "weak knees", are problems related to the skeletal system. According to one child, "when you get old, you get weak".

Summary Bones

In this study, as in the literature reviewed, all children knew about bones. Younger children identified those bones they could see and feel such as the arms and legs, while older children began to deal conceptually with the function and purpose of individual components of the skeletal system such as the ribs and skull. The number of bones identified, increased with age and grade level. Fourth grade children included cartilage and reflex activity in their comments. The function of bones is generally identified as movement, support, and protection. Most children had an understanding that good food is essential for healthy bones and that bones can get broken in an accident.

Children's Ideas About Muscles

The muscles as a separate system are only mentioned briefly in the studies looking at what children know about their bodies. Musculoskeletal responses are identified by Porter (1974) and Tait & Ascher (1955). In contrast to bones, which are among the most frequently identified body parts, muscles are infrequently identified (Brumback, 1977; Gellert, 1962; and Williams, 1979).

Children were asked about their muscles in this study with questions such as "Show me where you have a muscle", "What does that muscle do?", "Are muscles attached or loose inside?" Credit was given if a child named a muscle using lay terminology, for example arm, leg, or shoulder. If a child pointed to a particular muscle on the body, he/she was given credit for the location of that muscle as named in the coding mechanism (eg., biceps and triceps).

All children were aware of the term "muscle" and the majority in all age groups pointed to the upper arm, flexing and extending that part to demonstrate function.

First Grade

Eight first grade children identified and located the muscles in the upper arm. Five demonstrated function of the upper arm by flexion of the extremity. According to seven children, muscles are hooked to skin. Three said that muscles are loose inside and not hooked on. First graders said that muscles help us move, work, and keep us strong.

Second Grade

The stomach is added to the list of muscles by second graders. All identified the arm muscle with nine children pointing to, and/or, flexing the arm to demonstrate function. Three second graders said that muscles are hooked to bones and to other muscles. Comments about the function of muscles include the idea that muscles make us strong, help move bones, and help bend, stand, talk, lift and run. One child said that we need muscles to help us to "punch back" and "fight".

The idea of muscle atrophy is presented by two second grade children with the comments "we might lose muscles if we stand and sit still", and "if muscles are unhealthy, they will go away and get weak". Food and milk are important to keep muscles healthy and as one child noted, "we need to be careful of muscles so they do not get squished."

Third Grade

Third grade children added tendons and the heart to the list of parts. Comments such as "the brain helps muscles move", and "the heart

is a muscle that pumps blood to and from the body", indicate an increase in awareness of the neurological and cardiac relationship with muscular function.

Third graders stated that there are different kinds of muscles and, according to one child, "muscle cells change shape when you flex your arm". He drew an air picture to demonstrate this concept.

According to third graders, muscles are attached to the skin and to bones; they make us strong, help us move, keep our eyelids from drooping, and help us talk and breathe.

To keep muscles healthy, third graders said that eating food, lifting weights, and exercising is necessary. Muscle diseases mentioned included Cerebral Palsy, Multiple Sclerosis, and Muscular Dystrophy ("a disease when muscles do not move and you have to be in a wheelchair"). One child stated that, "when you get old, your muscles get weak".

Fourth Grade

The first child to correctly identify a muscle in anatomical terminology was a fourth grader who correctly named and located, the biceps and triceps. Fourth graders said that muscles stay in one place, are attached to skin and hooked to bones, keep up the body and, according to one child, are all connected to the spine. A fourth grader commented that muscles help the heart pump blood.

To keep muscles healthy, fourth graders said people need to eat good food to feed the muscles and if people do not eat right, they will

get flabby. According to one child, Multiple Sclerosis is a disease of the muscles that makes it hard to write.

Summary Muscles

Although all children recognized the word muscle, none knew the correct anatomical terminology with the exception of a single fourth grade child who correctly named and located the biceps and triceps. Most children in this study flexed and extended their upper arm when the term muscle was mentioned. Younger children primarily identified and located muscles they could see and feel, such as the arms and legs.

A gradual increase in identification and location of muscles occurred with an increase in grade level. The stomach was first mentioned by a second grade child and the heart, by a third grader. A marked increase in cognitive awareness appeared with the association of neurological function, cardiac activity, respiration, and speech among the third and fourth grade children.

A number of children said that muscles are important to make us strong and keep us healthy. Muscle diseases mentioned, appeared to be those learned about from school or television. The interesting concept of muscle atrophy with disuse, is first presented at the second grade level and identified at all subsequent grade levels.

Children's Ideas About the Neurologicl System

In the literature the studies looking at how children learn about their bodies, discuss children's knowledge about the nervous system, in particular the brain and nerves (Brumback, 1977; Gellert, 1962; Nagy, 1953; Porter, 1974; Tait & Ascher, 1955 and Williams, 1979).

The brain is among the five most commonly drawn organs in Tait's work. Porter's subjects named the brain among the three most often identified parts of the body. In contrast to Gellert's (1962) findings that children knew little about the nervous system before the age of nine, Brumback found children at all ages studied (first to sixth grade) able to identify the brain.

Nagy (1953) dealt primarily with three areas, among them the nervous system. Children in her study associated the brain most often with intellectual activity or thinking. Nerves were associated with feeling and the term "nerves" was often confused with the emotional state of nervousness. Gellert (1962) also found that children associated nerves with a state of nervousness resulting from a negatively charged emotional situation.

The neurological system in this study is investigated with questioning directed toward the brain and nerves and their function. Questions asked included, "What part of you helps you to think?", "Does your brain do anything besides thinking?", "Is there a special part of the body that carries messengers?", and "What are these messengers called?"

All children, first through fourth grade, recognized the brain as a body part. The term "mind" is often used in reference to the brain. Nerves and the spinal cord are identified, starting at the second grade level.

First Grade

First grade children's thoughts about brain function included learning, thinking, touching, and sending messages to the body. Comments include: the brain "helps you close your eye", "tells what you touch", and "tells you to move your hand when you touch something hot". One child stated "the brain has passengers and locates more air, oxygen, and blood to the body".

The actual work nerves, is not associated with the idea of a messenger but is expressed most often in relation to emotional response such as "getting nervous" and "angry feelings". For example, "nerves are like when your mom says, you are getting on my nerves!" One child identified nerves as a "big record in the body".

Second Grade

All second grade children identified the brain (noggin, head). Five mentioned nerves and one, the spinal cord. Children said the brain is important for thinking, talking, breathing, touching, hearing, seeing, smelling, and playing the piano. According to several second graders the brain "sends a little noise to tell the rest of the body what to do", "tells you to move if something is hot", and "talks to the rest of the body and tells it everything". About nerves, "the message comes down the shoulder to the arm" and "blood sends the message". Nerves make the "eyes open and shut", "help your heart", "help you to hear and to see". One child comments, "the nervous system makes you work". Three second graders associated nerves with nervousness and with the emotions of fear, sad, and happy (I get nervous when I hear a fire drill or have to be in a Christmas play).

Headaches, dizziness, head injury and nerve damage are mentioned as illnesses happening to the nervous system.

Third Grade

More children in the third grade identify nerves (messengers) and the spinal cord. Functions of the brain include thinking, memory, movement of bones and muscles, and the sense of taste, touch, smell, vision, and hearing.

Third graders said that nerves or messengers, "carry messages up and down the brain to the body" and "tell the mind what to do". One child described the nervous system with the comment, "if we did not have a nervous system and got burned, the part would burn off because we wouldn't know to move". Association with the cardiovascular system is made by a child who comments, "nerves are veins". Three children said that blood carries messages to the body from the brain".

Sad, happy, scared, and angry feelings are associated with nerves with comments such as, "you get mad and punch" and, "you have to keep nerves from acting up too fast".

To keep healthy, third graders said we need to eat good food. The nervous system gets sick if "blood gets clogged in the brain". Children comment, "you will shake a lot if you are sick with nerves" and, "you can be retarded". One child said, "I don't think a plant has a brain!".

Fourth Grade

In addition to the brain, nerves (messengers), and the spinal cord, a fourth grade child identified the right and left lobe of the

brain stating, "the left side helps the right side of the body to work". Interrelationships between the nervous system and sensory function is demonstrated with comments about hearing, vision, taste, smell, and touch. The brain is thought necessary for musculoskeletal and reflex activity (tells our arm to move), and respiratory function (the brain keeps us alive by helping us breathe).

According to fourth graders, "nerves help you feel" and "make you shiver and shake". Three children said nerves were "veins that carry messages". According to one child, the function of the spinal cord is to "hold the back together" and "to provide contact for the brain to tell the arms, legs, and feet what to do".

Injuries (if you break your skull it will jam into your brain), blindness, mental retardation (when the brain can't send messages to parts of the body), and drugs (mixes up your brain), are problems fourth graders associated with the nervous system.

Summary Neurological

Children of all ages recognize the brain as a body part and generally, describe its primary function as one of "thinking". A gradual increase in awareness of parts of the nervous system occurs with an increase in grade level, i.e., fourth graders mention the lobes of the brain and reflexes. The idea of messengers is presented at the first grade level. This concept is not associated with the function of peripheral nerves and the spinal cord, until the fourth grade. Across grade levels the term "nerve" is related to the idea of nervousness.

Sensory function, respiration, and speech is associated with the nervous system at the second and third grade level.

Children's Ideas About Hearing

As is true regarding other sensory organs, there is very little written in the literature about children's knowledge of hearing. An exception is Gellerts (1962) work in which "ears" is the third most frequently listed item in the head identified by her subjects. All children interviewed in this study knew about the ears and that ears are for hearing. The eardrum was identified by 6 first graders, 4 second, 9 third, and 8 fourth grade children. None correctly named the eardrum, the tympanic membrane.

First Grade

When asked "Where does the sound go?", two first grade children responded "inside the ear". The rest said "somewhere else", "the stomach", "no where", "across the head", and "in and out the ear". Two children stated that the mouth helps us hear, implying an association between speech and hearing. One first grade child stated "we have a drum in our ear" and another made the association between the brain and the function of hearing.

Second Grade

In contrast to first graders, three second grade children correctly related the brain and messengers to the hearing process with comments such as "the brain tells what sound it hears and sends a messenger back" and "the brain makes you talk".

In addition to the eardrum, parts mentioned as being inside the ear include bones, wax, and a hearing tube. To preserve hearing function second graders said one must "avoid loud noises", "wear a hat", and when cleaning the ears, "do not push too hard because you will push the wax against the brain". Loss of hearing (deafness), earache, ear infection, and plugged up ears are discussed as illnesses.

Third Grade

A relationship between the brain (mind), nervous system and hearing is made by eight third grade children. The eardrum, mentioned by nine, "makes the sound louder"; the bones, "anvil" and "hammer", vibrate like a "drummer making noises", and "sound tells you what to say".

Cleaning the ears (wax) is important for good health. Problems children identify include ear infections, earache, a broken eardrum, external ear infection, an object in the ear, tubes in the ear, the need for a hearing aid, and deafness resulting at birth or, according to one child, from loud noises like an "army boom". Health advice is given by third grade children with the statements, "do not stick things in the ears" and "eat good food".

Fourth Grade

Hearing is associated with the brain and neurological function by eight fourth grade children who comment that the brain "tells what you hear" and "figures out the sound". Sound "echoes in the ear" and "comes in one ear and goes out the other side", according to two children.

The eardrum, discussed by eight children, is located inside the ear by all but one who stated, "the eardrum is behind the ear (mastoid area)". The eardrum "hears sound", "vibrates", and "helps you hear". Sounds can "hurt the eardrum", and "ear tubes help us hear".

Illnesses of the ear that fourth graders identify include ear infections, swimmer's ear, earache, water in the ear, deafness and loss of hearing.

Summary Hearing

All first through fourth grade children had an awareness that one can"hear with their ears". As children develop there is a gradual increase in knowledge about the eardrum. Other parts of the ear are not identified until fourth grade when the bones, "hammer and anvil", are mentioned. By second grade the majority of children demonstrated a beginning awareness of the interrelationship between the function of hearing and the brain. They generalize the concept that "messages" go back and forth between the ear and the brain.

This investigator believes children's awareness of ear disease is, in most cases, experientially developed. Their ideas about illnesses occurring to the "hearing parts" reflect a broad range of common childhood illnesses, i.e., ear infections, and earache.

Children's Ideas About Vision

In the literature the eyes are briefly mentioned as one of many parts identified by children (Brumback, 1977; Gellert, 1962; and Tait & Ascher, 1955). Children's knowledge of visual function is not explored.

In this study children were asked questions such as "What parts of the body helps you see?", "Where does the picture go?", and "What happens after the picture you see gets inside the eye?"

All children interviewed had an awareness of the importance of the eyes for seeing. There is a progression by grade in knowledge of eye parts, as well as a gradual increase in awareness about the relationship between the brain and visualization.

First Grade

Two first grade children associated seeing with the brain. Four children thought the pupil was a black color whereas only one recognized it as a hole. Other parts of the eye were not identified.

When asked "Where does the picture go?", three children responded by saying inside the eye, while two thought the picture was in front of, or outside the eye. Eye infection and blindness are two illnesses mentioned by two different children.

Second Grade

An increase in knowledge of body parts is noted by second graders. The pupil is identified by four children and eye muscles, eyelid, eyelash and eyeball are mentioned. Two children thought the pupil to be a color; two described it as a hole and one child called the pupil a "pimple". Six second graders associated seeing with the brain. Comments include, "the brain helps you know what you see" and "the brain tells the body the difference between pictures".

Individual second graders expressed a basic knowledge of function with comments such as "eye muscles make the eye move", and "when the

sun shines the pupil opens and closes". Two second graders thought the picture you see goes inside the eye while two believed the picture stayed outside the eye.

Blindness, identified by five children, comes from bright lights, the sun, or from sitting too close to the T.V. Other eye problems include getting your eyes poked out or getting something in your eyes. To keep the eyes healthy children thought you should eat good food. One child commented, "you need to rest and close the eyes sometimes".

Third Grade

Six third grade children who associated seeing with the brain made comments such as the "brain gets a mesage by a messenger", the "brain sends a messenger", and the "brain helps you see". The pupil is thought to be a black color by four children. Two children identified pupillary function with the comment that the pupil constricts and dilates to light and dark.

The lens, first mentioned by one third grade child, is compared to a camera. Two children thought the picture one sees, stays outside the body; one believed it stayed inside the eye.

Individual children identified causes for blindness including poisoning, illness, reading little words, and being born blind. Color blindness, a foreign body in the eye, and wearing glasses is mentioned. One suggestion for taking good care of the eyes is to "not poke them".

Fourth Grade

Nine fourth graders associate the brain with vision with comments such as, "the brain filters what we see" and "tells what picture we are

seeing". The pupil, also identified by nine children, "constricts to get smaller in the light and dilates to get larger in the dark" according to one child. Only one fourth grader noted the pupil to be a color rather than a hole.

An additional part mentioned by fourth graders is the iris called "a ring" by one child. Two children mentioned the lens. Eye function is described by one child with the comment "the picture goes in and crosses over like a camera".

According to fourth grade children, blindness, blurry vision, allergies, and getting something in the eye, or getting the eye poked out are things that can happen to eyes. One child stated that you "might need glasses or medicine if chlorine gets in your eyes" and another, "if you look at the sun you will get cross eyed; your eyes will lock and you will be cross eyed for a long time".

Summary Vision

All subjects in this study associated the eyes with vision. A progressive increase in knowledge of eye parts and neurological function is seen with the increase in grade level. The association between the brain and vision is first made at the second grade level; ninety percent of fourth graders make this association, explaining the process at a higher cognitive level. The pupil is noted to be a color by younger children but by the third and fourth grade the function of constriction and dilatation in response to light, is identified.

Children's Ideas About Taste

As with smell, how and when children develop an understanding of the function of taste, has not been investigated.

Children in this study all identified the mouth for eating and associated this with tasting. One first grade and two second grade children did not associate the tongue with tasting. Taste buds are noted by a single first and one second grader. A neurological relationship is less clearly defined, with only one third grade child mentioning the brain and nerves as essential to tasting.

Taste buds are referred to by the first and second grade children as bumps on the tongue. One second grader further elaborated, stating "the bumps are different kinds".

Five third grade children identified taste buds. Two children had an awareness of different kinds of taste buds with one child stating the types as sweet, salty, sour, and bitter. Taste buds are called bumps and pimples. For example one child states, "the pimples on the tongue are like suction cups that catch our food so it won't slip out of our mouth". The interrelationship between taste and smell was noted by a third grade child.

Taste buds, mentioned by six fourth graders, were called bumps and things on the tongue. One child listed three types of taste buds as sweet, sour, and salty. Children made reference to the gums, the tongue, saliva, and tonsils as playing a part in the function of taste.

Illnesses mentioned during the questioning about taste were respiratory related, eg., tonsillitis and strep throat.

Summary Taste

The mouth and tongue is associated with the function of taste by the majority of children in this study. The importance of taste buds is noted at the third grade level. An association between smell and taste and neurological function and taste, is generally not recognized by this sample of subjects.

Children's Ideas About Smell

Children's understanding regarding the sensory function of smelling or olfaction has not been previously investigated.

In this study all children grades one through four, associated the nose with the function of smell. There appears to be a gradual progression in understanding of the relationship between smell and the brain as children get older. The mechanism of nerves as a route between the brain and the nose for identification of smell is noted by one third grade child.

When asked "Where do you think the smell goes?", first graders said to the air, a flower, the stomach, or somewhere else. The smell goes in and out the nose or stays in the nostril according to two children's point of view. Three second, and four third graders thought smell went to the brain. One second grader stated that smell goes to the stomach and a third grade child presented the idea that smelling enhances taste.

Comments by third graders include the idea that the holes in the nose smell and smell goes in and out the nose. Fourth graders thought that smell can be good or bad and stay or go away. Half (5) of the fourth grade children associated smelling with neurological function.

Children's Ideas About Touch

Touch as a sensory function is explored in this study with such questions as "Tell me what part of your body helps you to touch?", "What tells you that what you are touching is smooth or rough?", and "What helps you to know when you touch something hot?"

All children named some part of the body surface in relationship to touching. First graders said that we touch with our legs, fingers, feet, hands, and skin. Four children related the brain to touching. One explained that the messenger from the brain sends information to the body. The term nerve was not identified. First graders further stated that the eyes tell us what we touch, the body tells by feeling, and the skin tells us different textures of objects.

Four second graders related the brain with touching indicating that the brain sends a message and helps to intercept danger by telling you to pull your hand away from a match. Fingertips, hands, arms, bones, and blood are named as body parts that help touch.

Thirteen out of 20 third and fourth grade subjects made the association between the neurological system and touching. Comments such as "the brain tells what we feel" and "protects us by telling us to withdraw from the heat" validate this level of understanding. The term nerves is recognized by three third and three fourth grade children. Nerves are called feelers and messengers by these children.

Summary Touch

Children associate the body surface with touching. The relationship of neurological function to touching is not generally

identified by very young children. There appears to be a gradual increase in the idea of a "messenger" with increasing grade level. The actual term "nerve" is not recognized until the third grade.

Summary

Comparisons of Findings with the Literature

Results of this study are congruent with similar investigations found in the literature. In contrast to Gellert's (1962) study however, one major dissimilarity exists. Gellert found children to have little knowledge of the body until the age of nine to ten years while in this study children appeared better informed in all areas at a younger age level. Porter (1974) made this observation as well.

As noted in previous work, children in this study appeared to learn in a proximal-distal manner, naming the head, arms, and legs prior to the trunk and internal body organs (Brumback, 1977; Gellert, 1962; Goodenough, 1926; and Williams, 1979). As they grew older, children in this study were able to spontaneously identify an increasing number of items, naming and locating those body parts felt and seen (eyes, ears, nose, bones) prior to recognizing those organs located within the body. The frequency of reference to nearly every system increased with increasing age/grade level. As discussed in the literature (Gellert, 1962; Gessell & Ilg, 1946; and Goodenough, 1926), children in this study demonstrated a marked increase in knowledge between the ages of eight to ten years.

Young children (first and second graders) in this study were not able to explain function of body parts in terms of transformation (gas exchange), or complimentary function (assimilation of food at the cellular level) whereas at the third and fourth grade level, children discussed these more complex processes at a very beginning level of understanding. Similarly, Nagy (1953) in her work with four to twelve year old children, found the younger children able only to give an organ a single, specific function in a one-to-one correspondence such as the "brain for thinking" and the"lungs for breathing".

The body parts, the heart, brain, and bones and the cardiovascular, gastrointestional, and musculoskelatal systems are the most often identified in the literature (Brumback, 1977; Gellert, 1962; Porter, 1974; & Williams, 1979). In this study body parts most often identified are for the sensory functions inclusive of eyes, ears, nose, mouth, and the brain. The bones and heart are identified next, followed by internal organs such as the stomach and lungs. These findings do compare similarly with results from the literature if consideration is given to the fact that no other study addresses the area of the sensory body parts, their location, function and purpose of the overall system.

Those areas least mentioned by children in previous studies (Gellert, 1962 and Williams, 1979) include the lungs and urinary bladder. In this study the least known parts represented

included those of the muscular, urinary, and integumentary systems. The reproductive system is not mentioned. Questions were not asked in this area.

Table 13 presents an overall summary of findings from the literature, identifying individual approaches used and the age group investigated. Similarities between finding in this study as compared to the literature, are summarized on Table 14. Those studies which support findings in this study are identified on this table. In only two areas were the studies investigated nonsupportive of the findings in this study. Those studies not listed were not necessarily non-supportive of the findings. Because the studies reviewed were not done in exactly the same manner or the same body systems investigated, and because the age range in each study was different, a direct comparison cannot be made.

TABLE 12

A TOTAL OF THE NUMBER OF TIMES PARTS ARE IDENTIFIED

FOR 15 SYSTEMS BY GRADE LEVEL

SYSTEM	Total# First Grade	Total# Second Grade	Total# Third Grade	Total# Fourth Grade
Digestive				
Mouth	10	10	10	10
Teeth	10	10	10	10
Tongue	9	8	10	10
Stomach	10	10	10	10
Intestines	0	1	2	6
Esophagus	0	3	3	3
Liver	2	0	6	8
Throat	0	2	2	3
Uvula	3	2	0	0
Salivary glands	0	0	2	1
Rectum	0	0	1	0
Canines	0	0	2	2
Molars	0	0	2	2
Appendix	0	0	1	1
Spleen	1	0	1	1
Gallbladder	1	0	0	2
Pancreas	0	0	1	0
Urinary				
Bladder	2	4	5	5
Kidney	0	0	3	6
Respiratory				
Nose	10	10	10	10
Mouth	10	10	10	10
Lungs	7	9	9	9
Voicebox	0	3	5	1
Bronchii	0	0	0	2
Tonsils	5	4	5	4
Throat	2	1	0	3
Trachea	0	0	1	0
Cells	0	0	1	0
Cilia	0	0	1	0
Lymph glands	1	1	1	1

TABLE 12 (Cont'd)

SYSTEM	Total# First Grade	Total# Second Grade	Total# Third Grade	Total# Fourth Grade
Cardiac				
Heart	10	10	10	10
Blood	10	10	10	10
Blood vessels	5	5	6	7
Veins	7	8	9	9
Arteries	0	0	5	1
Blood cells	0	1	7	6
RBC's	0	0	3	4
WBC's	0	0	2	4
Pulses	0	0	0	1
4 Chambers	0	0	0	1
Tears				
Eye	10	10	10	10
Eyelid	0	2	0	2
Eyelash	0	4	0	4
Lacrimal Puncta	0	0	1	0
Eyebrow	0	0	1	1
Sweat				
Skin	10	10	10	10
Sweat	9	10	10	10
Pores	0	0	0	2
Skin				
Brain	0	2	2	2
Hair	2	0	2	2
Layers	0	1	1	2
Cells	0	0	1	1
Nerves	0	0	1	0
Skeletal				
Bones	10	10	10	10
Skull	5	7	10	9
Ribs	7	7	9	10
Arms	6	9	10	9
Legs	7	9	8	9
Backbone	3	5	10	8
Joint	4	4	6	8
Kneecap	2	6	4	4
Face	4	4	4	5
Tendon	1	1	3	0

TABLE 12 (Cont'd)

SYSTEM	Total# First Grade	Total# Second Grade	Total# Third Grade	Total# Fourth Grade
Skeletal (cont'd)				
Ligament	0	1	2	0
Shoulder	2	5	6	5
Toes	5	6	7	8
Fingers	6	7	8	8
Wrist	0	1	3	0
Tailbone	1	0	1	1
Ankle	0	3	3	1
Pelvic Girdle	0	0	1	3
Clavicle	0	0	2	1
3 Type joints	0	0	0	1
Muscles				
Arm	8	10	7	6
Leg	2	8	6	5
Heart	0	0	1	1
Back	0	3	0	1
Stomach	0	1	0	0
Neurological				
Brain	10	10	10	10
Spinal Cord	0	5	6	5
Peripheral Nerves	0	1	4	8
Hearing				
Ears	10	10	10	10
Eardrum	6	4	9	8
Brain	1	8	8	8
Auditory Nerve	0	0	1	0
Vision				
Eyes	10	10	10	10
Pupil	4	4	4	9
Brain	2	6	7	9
Lens	0	0	1	2
Iris	0	0	0	1

TABLE 12 (Cont'd)

SYSTEM	Total# First Grade	Total# Second Grade	Total# Third Grade	Total# Fourth Grade
Taste				
Mouth	10	10	10	10
Taste Bud	1	1	5	6
Nose	0	1	2	0
Tongue	9	8	10	10
Brain	0	0	1	0
Peripheral Nerves	0	0	1	0
Smell				
Nose	10	10	10	10
Brain	0	3	4	5
Peripheral Nerves	0	0	1	0
Touch				
Skin	10	10	10	10
Brain	4	4	7	6
Nerves	1	1	3	3

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age/ Grade	N	Research Approach	Focus of Research	FINDINGS
Goodenough	1926			Children's Drawings	Concept of looking at physical exterior as method of determining personality and child's intelligence.	1. Knowledge of body regions proceeds from head to legs to arms to trunk. 2. The number of "inside parts" cited spontaneously increases with age. Preschoolers identify 1-2 "inside items". A sharp rise occurs in number of items identified at 8-10 years of age.
Schilder and Weschler	1935	4-13 years	40	Interview	Body Structure	1. Children think of the entire inside of the body as filled with food. 2. Young children state that the body contains recently eaten food. 3. Over 50% of children ages 4-14, identified one stationary part--bones. 4. After age 11 emphasis not on ingestion and egestion, but on structural elements (vital organs).

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF
THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Nagy, M.	1953	(cont.)				Lungs (cont.) c) 50% of sample studied, above the shoulders in the head, neck area. d) did not recognize the lungs as specific to breathing until the end of childhood. 3. Digestion (no age breakdown identified) a) Food goes to head or neck. b) Food goes to stomach. c) Food goes beyond stomach and is evacuated or assimilated. d) named mouth and stomach; did not idendity esophogus or intestine. e) stomach for eating and keeping food. f) stomach located higher than it actually is. g) eat to live, keep healthy, grow, build body, prevent hunger.

SUMMARY OF CHILDREN"S KNOWLEDGE OF
THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Nagy, M.	1953	4-12 years	650	1. Interview 2. Essay 3. Timed testing with 7 page booklet.	Functioning areas investigated: 1. Brain 2. Respiration 3. Digestion	Overall: 1. Children dealt mainly with 3 systems when asked "Tell me what happens inside your body." (brain, respiration, digestion) 2. Body organs represented as non-specific, roundish, closed figures. 3. Each organ given a single, specific function in a one-to-one correspondence such as lungs/breathe and brain/think. Systems: 1. Neurological Brain a) performs mainly intellectual activity. b) "thinking" "Brain helps think". Nerves a) feeling b) confused with nervousness 2. Respiration Lungs a) breathing a process b) by age 9, 70% recognize function to take in and expell air.

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Tait and Ascher	1955	11-12	22	"Inside of the Body Test". Draw inside of the body in 3 minutes. Draw organs with line to outside and label.	Evaluate distorted perceptions of the body interior.	1. Children drew 5 internal organs; heart, stomach, intestines, brain, ribs. They also gave musculoskeletal responses. 2. Cardiovascular and Gastrointestional systems were most frequently identified. 3. Young children conceived contents in terms of what observed "being put in and coming out" of the body such as food, beverages, feces, blood and urine.
Gellert "Children's Conceptions of the Content and Functioning of the Human Body"	1962	4 yr. 9 mo. to 16 yr 11 mo.	96	"Gellert Index of Body Knowledge" 1. Interview 2. Front/back body drawing of size, location of body organs and systems.	To study the developmental progression in children's knowledge about their bodies. Parts, location and function of parts and body processes (cont.).	<u>General</u> 1. Children's drawings proceed from head to legs to arms to trunk. 2. The number of items cited spontaneously increased with age. 3. A sharp increase in knowledge occurred at 8 to 10 years of age. 4. No difference male and female knowledge. 5. Most mentioned parts: bones, blood vessels, heart, blood, and brain.

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Gellert, E.	1962			(continued)	Body Processes: a) Digestion b) Respiration c) Circulation d) Locomotion	6. Most mentioned systems: musculo-skeletal and cardiovascular. 7. Least mentioned parts: gallbladder, bladder, ribs. 8. Least mentioned systems: reproductive, reticuloendothelial, integumentary. 9. Most important part, heart. Age 7--need heart to live. Age 9 to 10-associate heart with respiration. Skin A boundry between external and internal aspects of body; age 5 to 9 relate to personal experience; skin holds body together. Over 9, 50% related to protection eg. "to keep insides in" and "to keep harmful environment out". Bones 1. Skeletal system considered basic to being human. 2. Greatest emphasis to extremities and bones in head.

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Gellert, E.	1962			(continued)		Bones cont. 3. Over age 8 all gave some function. 4. At all ages, state bones provide structure and hardness. 5. An increasing awareness of mobility with increase in age. 6. 26% said bones hold body together. Nervous System 1. Under age 9 little known about nerves. 2. Some associate nerves with bad things or being nervous. 3. By age 11, 50% have accurate information regarding function of nerves. Urinary System 1. Bladder one of least familiar parts. 2. Bladder confused with gallbladder. Respiratory System 1. Below age 11 most believe lungs located in small area in head and neck region.

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Gellert, E.	1962			(continued)		Respiratory cont. 2. 50% of 7 to 11 years of age, lungs placed neck, head, and throat. 3. Over 10 majority accurately located lungs in thoracic area. 4. Most children said lungs smaller than they are. 5. Under 7, 50% had no idea of lung function. 6. Under 9, few related lungs to vital body processes whereas over 9, 65% associated lungs with breathing. 7. At age 15, lungs essential to life. <u>Circulatory System</u> 1. By age 11 all kids knew where heart located (chest area); 16% gave shape as being a heart. 2. Over 7, know heart important part of body necessary for life. 3. Under 11 said heart "makes,pushes blood.

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Gellert, E.	1962			(continued)		4. Over 11, 50% said circulation moves blood to parts of the body. 5. Older children associated breathing with the cardiovascular system. <u>Digestive System</u> 1. Majority kids located stomach lower abdomen; most associated food intake with stomach and 3/4 exagerated size of stomach. 2. Under age 11,11% kids said the stomach helps us breathe. 3. 5 to 8 year old children thought ingested food goes to the "abdomen"; food moves to body parts; food drops to legs and feet. 4. About elimination, 5 to 8 year olds thought food is never eliminated, food is egested directly from the digestive tract, and some food is egested after going to the body.

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Gellert, E.	1962			(continued)		5. At all ages, children thought food gets smaller and makes us grow. 6. The possibility of transforming one kind of matter to another generally conceivable at age 8. 7. Over age 10 children located the liver in the lower abdomen and chest area. 8. At age 9 to 10 children thought feces had some connection to food. They said bowel movements are important to "keep from being too full" and to "maintain health and life".
Porter, C.	1974	Grade 1, 3, 5	144	Projective Technique and Body Outline Drawing. Children had 15 minutes to draw "everything inside your body	Perception of Body Parts	In general Porter found children to be better informed than in Gellert's (1962) study. 1. Heart, brain, bones parts most frequently named. 2. Cardiovascular, gastrointestional, musculoskeletal systems most frequently represented.

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Porter, C.	1974			(continued)		3. Actual number of internal parts named showed an increase with age. 4. The frequency of reference to nearly every system increased with increasing age. 5. At every age level boys named more parts than girls. 6. 4 out of 144 mentioned reproductive system.
Brumback,R.	1977	Grade 1 to 6	150	"Inside of the Body Test" Children were to draw the inside of a person, including all the parts and draw a line and label. No time limit.	Parts of the Body	In general Brumback found that young children perceive visible body parts first eg. bones. As children get older, they begin to view body as composed of many other internal organs. 1. The complexity of drawings and number of parts increased with grade level. 2. The heart is the part most often identified (89%). 3. The brain was identified by children of all grades. 4. 8 sixth graders identified penis.

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF
THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Williams,P.	1979	Grade 1, 3, 5	35	Identify inside body parts. Draw parts of human figure outline. State function of parts named.	Body Parts Function of body parts	1. The number of correct responses increased with age. 2. The number of other items (water, food, air, feces, urine) decreased with age. 3. Bones most frequently named part. 4. Lungs the least frequently namend part. 5. Fifth graders mentioned sex glands. 6. Bones give shape, structure to the body; provide hardness, strength, and body movement. 7. Few children gave specific function of organ such as "the skull protects the brain".
Denehy,J.	1984	Grade 2, 4, 6	140	Interview	Functionof 5 body organs: heart, lungs stomach, kidney, and bladder	<u>Heart</u> Grade 2) Beats and pumps blood. 4) Pumps blood to entire body. 6) Pumps blood that carries oxygen and nutrients to the entire body via the circulatory system.

TABLE 13

SUMMARY OF CHILDREN'S KNOWLEDGE OF
THEIR BODIES FROM THE LITERATURE

Researcher	Date	Age Grade	N	Research Approach	Focus of Research	FINDINGS
Denehy, J.	1984	Grade 2, 4, 6		(continued)		Lungs Grade 2) For breathing air. 4) Inhaling and exhaling oxygen. 6) Providing oxygen to body cell, carbon dioxide, names of other parts of respiratory system. Stomach Grade 2) For eating food, getting big and strong. 4) Where food is broken down or dissolved. 6) Food is digested by gastric juices; Nutrients are absorbed. Kidneys and Bladder Grade 2) Most have never heard of them. 4) Related to going to the bathroom. 6) Related to going to the bathroom. Bladder related to urine.

TABLE 14

COMPARISON OF FINDINGS IN THE LITERATURE
WITH FINDINGS IN THE CURRENT STUDY

SYSTEM	STATEMENT	GRADE	SUPPORTING STUDIES	AGE	NON SUPPORTING STUDIES
Digestive	1. The whole inside of the body is filled with food.	First	Schilder & Weschler (1935)	Young children	
			Gellert (1962)	5 to 10	
	2. What goes in comes out.	First through Fourth	Nagy (1953)	4 to 12	
			Tait & Ascher (1955)	11 to 12	
			Gellert (1962)	8 to 16	
			Denehy (1984)	Second & Fourth Grade	
	3. Food associated with stomach.	First through Fourth	Nagy (1953)	none given	
			Gellert (1962)	5 to 16	
			Denehy (1984)	Second grade	
	4. Food moves.	First through Fourth	Gellert (1962)	5 to 16	
	4. Food gets smaller	Second through Fourth	Gellert (1962)	5 to 16	
			Denehy (1984)	Second Grade	
	6. Food drops to legs and feet.	First	Gellert (1962)	5-8	
	7. Stomach associated with breathing.	First	Gellert (1962)	under 11	

TABLE 14

COMPARISON OF FINDINGS IN THE LITERATURE

WITH FINDINGS IN THE CURRENT STUDY

SYSTEM	STATEMENT	GRADE	SUPPORTING STUDIES	AGE	NON SUPPORTING STUDIES
Digestive (cont.)	8. We eat to live and grow healthy.	First through Fourth	Nagy (1953)	none stated	
			Gellert (1962)	5 to 16	
	9. Food digested, nutrients absorbed.	Third and Fourth	Gellert (1962)	over 8	
			Denehy (1984)	Fourth and Sixth Grade	
	10. Liver located chest.	First	Gellert (1962)	over 10	
	11. Bowel movement associated with food.	First through Fourth	Gellert (1962)	over 9	
	12. Need bowel movement to be healthy.	First through Fourth	Gellert (1962)	over 9	
Urinary	1. Parts of the urinary system those least mentioned.	First through Fourth	Gellert (1962)	4 to 16	
			Denehy (1984)	Second through Sixth Grade	
	2.Urinary bladder confused with gallbladder.	First and Second	Gellert (1962)	not given	
			Denehy (1984)	Second Grade	

TABLE 14

COMPARISON OF FINDINGS IN THE LITERATURE

WITH FINDINGS IN THE CURRENT STUDY

SYSTEM	STATEMENT	GRADE	SUPPORTING STUDIES	AGE	NON SUPPORTING STUDIES
	3. A gradual increase in knowledge of fluids in and out.	First through Fourth	Denehy (1984)	Second through Sixth	
	4. Young children not familiar with bladder.	First	Denehy (1984)	Second and Fourth	
Respiratory	1. Breathing is a process	Second through Fourth	Nagy (1953) Denehy (1984)	6 years Fourth Grade	
	2. Lungs associated with breathing.	Third and Fourth	Nagy (1953) Gellert (1962)	11 to 12 over 9	
	3. Lungs located head and neck areas.	First and Second	Nagy (1953) Gellert (1962)	4 to 12 7 to 11	
	4. Oxygen and Carbon Dioxide exchange at cell level.	Third and Fourth	Denehy (1984)	Fourth and Sixth Grades	
	5. Breathing attributed to stomach.	First	Gellert (1962)	under 11	
	6. Cardiovascular and respiratory system related.	Third and Fourth	Denehy (1984)	Sixth Grade	

TABLE 14

COMPARISON OF FINDINGS IN THE LITERATURE

WITH FINDINGS IN THE CURRENT STUDY

SYSTEM	STATEMENT	GRADE	SUPPORTING STUDIES	AGE	NON SUPPORTING STUDIES
Cardiovascular	1. Heart most important part of the body.	First through Fourth	Gellert (1962) Brumback	all children Entire Sample	
	2. Heart needed to live	First through Fourth	Gellert (1962)	7 to 11	
	3. Heart one of most often named parts of body.	First through Fourth	Gellert (1962) Porter (1974) Brumback (1977)	Entire Sample	
	4. Heart beats and pumps blood to the body.	Third and Fourth	Gellert (1962) Denehy (1984)	over 7 Second through Sixth Grades	
	5. Blood carries Oxygen to the body.	Fourth	Denehy (1984)	Sixth Grade	
Sweat	1. Sweat from inside body	Third and Fourth	no studies done		
	2. Skin impermeable and and moisture proof so nothing can enter.	not noted			Gellert (1962)

TABLE 14

COMPARISON OF FINDINGS IN THE LITERATURE

WITH FINDINGS IN THE CURRENT STUDY

SYSTEM	STATEMENT	GRADE	SUPPORTING STUDIES	AGE	NON SUPPORTING STUDIES
Skin	1. Skin is a boundry.	First through Fourth	Gellert (1962)	Overall Sample	
	2. Skin important for appearance.	Second through Fourth	Gellert (1962)	5 to 9	
	3. Skin holds body together.	First through Fourth	Gellert (1962)	5 to 9	
	4. Skin protective mechanism from environment.	Second through Fourth	Gellert (1962)	over 9	
Skeletal	1. Bones most often named & identified.	First through Fourth	Schilder & Weschler (1935) Gellert (1962) Porter (1974) Williams (1979)	all ages all ages Increase with age	

TABLE 14

COMPARISON OF FINDINGS IN THE LITERATURE
WITH FINDINGS IN THE CURRENT STUDY

SYSTEM	STATEMENT	GRADE	SUPPORTING STUDIES	AGE	NON SUPPORTING STUDIES
Skeletal cont.	2. Bones identified first are are those with hardness and angularity.	All ages	Gellert (1962) Brumback (1977) Williams (1979)	All Ages	
	3. Holding body together most important function of the bones.	First through Fourth	Gellert (1962) Brumback (1977) Williams (1979)	4 to 7 All Ages Studied	
	4. Young children perceive visible parts first.	First through Fourth	Same as #2 and #3		
	5. Bones give shape, structure hardness, movement.	First through Fourth	Same as #2 and #3	All Ages with and increasing emphasis with age	

TABLE 14

COMPARISON OF FINDINGS IN THE LITERATURE
WITH FINDINGS IN THE CURRENT STUDY

SYSTEM	STATEMENT	GRADE	SUPPORTING STUDIES	AGE	NON SUPPORTING STUDIES
Muscles	1. Identified with skeletal.	Second	Tait & Ascher (1955)	Sixth Grade	
			Porter (1974)	First through Sixth Grade	
Neurological	1. Brain essential for thinking.	First through Fourth	Nagy (1953)	All Ages	
			Gellert (1962)	All Ages	
	2. Nervousness associated with emotionally charged situation.	First through Third	Nagy (1953)	All Ages	
			Gellery (1962)	5 to 8	
	3. Brain one of most often named parts.	First through Fourth	Tait & Ascher (1955)	All Ages	
			Gellert (1962)	Overall Sample	
			Porter (1974)		
	4. Beginning awareness overall function of nervous system.	Second Grade	Gellert (1962)	11 years	Gellert's sample showed this knowledge at a later age than current study.

TABLE 14

COMPARISON OF FINDINGS IN THE LITERATURE
WITH FINDINGS IN THE CURRENT STUDY

SYSTEM	STATEMENT	GRADE	SUPPORTING STUDIES	AGE	NON SUPPORTING STUDIES
Hearing	1. Ears Identified	All ages	Gellert (1962)		
Vision	1. Eyes Identified	All ages	Tait & Ascher (1955)	All	
			Gellert (1962)	Ages	
			Brumback (1977)		
Overall Findings congruent with Literature	1. Actual number of internal parts showed gradual increase with age.		Goodenough (1926)		FINDINGS SPECIFIC TO THIS STUDY
			Gellert (1962)		1. Uvula separates food and helps swallow.
			Porter (1974)		
			Brumback (1977)		2. Tonsils help us swallow.
			Williams (1979)		3. Young children (first through third grade) said sweat from outside body.
	2. Frequency of reference to nearly every system increase with age.		Porter (1974)		
					4. A joint is "what you smoke".
	3. As children get older, view body as composed of many other organs.		Brumback (1977)		5. Muscles waste/atrophy.
	4. Sharp increase in knowledge at age 8 to 10.		Goodenough (1926)		
			Gessell & Ilg (1946)		
			Gellert (1962)		

CHAPTER V

SUMMARY AND RECOMMENDATIONS

This chapter includes a summary of the study, recommendations for revision of Brown's instrument and coding mechanism, and limitations of the study. Implications for nursing practice and implications for further nursing research are presented.

Summary

The current literature suggests that young children's perceptions of their bodies and how the parts of the body and body systems function, is learned in a progressive, predictable manner. In general, these studies tend to support an awareness of body knowledge that proceeds from the outside in. More recent studies support the view that the progression of body knowledge proceeds much more quickly at a younger age than previously believed. The results of this study concur with these findings.

The purpose of this study was to investigate the validity and reliability of one specific instrument, "Brown's Inventory of Body Knowledge". Brown's instrument is a structured, open-ended questionnaire based on earlier work by Gellart (1962) and is designed to be used with children 2½ to 12 years of age. In addition to investigating the validity and reliability of the instrument, knowledge of how children learn about the content and function of their bodies was sought.

In the process of refinement, Brown's instrument underwent three revisions based upon feedback by parents, teachers, responses

from children, and analysis of 24 interviews with preschool children, done prior to the current study. The coding mechanism for the instrument also underwent several revisions. The procedure for the study included two stages. In Stage 1 the instrument was revised, face validity of the questionnaire established, a tool for standardizing interview quality developed, and the coding form revised. Construct validity was established by statistical and descriptive analysis in Stage 2.

A convenience sample of 40 children, grades one through four, was obtained from a grade school in the rural community of Canby, Oregon. Ten children from each grade level were interviewed and tape recorded using the refined instrument. The taped interviews were then coded and evaluated. Nine research questions, six of which incorporated directional hypotheses addressing the underlying construct, children's knowledge about their bodies, were statistically analyzed using Analysis of variance and the Pearsons product-moment correlation. A descriptive analysis of children's comments about their bodies in the four areas under investigation, knowledge of body parts, location of parts, function of parts, and the purpose of systems, as well as knowledge of the health and illness aspect of each of the 15 systems investigated, was evaluated and discussed.

The results of this study provide evidence that Brown's "Inventory of Body Knowledge" instrument has construct validity. The overall results support the following findings.

1. There is a developmental sequence with which children's knowledge of body parts, location of parts, and function of parts, and the purpose of systems is acquired.
2. Children in general appear to know more about the purpose of the overall system than about the specific details of parts, location of parts, and the function of these parts.
3. Children's awareness of the overall purpose of body systems is followed by knowledge of parts, location of parts, and last, the specific function of these parts.
4. The linear progression of knowledge suggests that children first learn about the sensory systems, followed by digestion and then, bones.
5. A child's knowledge of parts of the body appears highly related to the location and the function of those parts.
6. There appears to be a strong relationship between children's knowledge in the four areas under investigation (parts, location and function of parts, and the purpose of systems) and grade level.
7. The results suggest that there may be a leap in knowledge between the second and third grade, especially for the cardiac, skeletal, and neurological systems.
8. Descriptive comments by children suggest that the knowledge and awareness of health and illness for the 15 systems investigated, increases and expands as

children grow older.

The overall results of this study concur with those findings reported in the literature. This lends credibility to the research effort and further substantiates the construct validity of Brown's instrument. This study, with consideration of certain limitations which follow, provides a basis for further research with children grades one through four.

Limitations

Exploratory research such as this methodological study, has certain limitations. The design provides little control over certain variables that may affect the results. In this study, the population under investigation was not controlled in the areas of sex, parental education or occupation, and socioeconomic status. It is assumed that in a convenience sample such as this, only those parents who were interested in the topic, gave permission for their child's participation. Not all children were represented and the results cannot be generalized to the whole population. The sample size (N=40) is small, with only 10 children interviewed from each grade level. A larger sample size would diminish the probability of a markedly deviant or atypical value. For example, one particularly bright child in the third grade had scores large enough to pull the whole grade up. Coupled with the small sample, the number of items measuring the area "purpose of the entire system" is very small, whereas for the other areas of

knowledge, the number of items is much larger. Wherever a measure does not have very many items, that measure is not as sensitive and a large sample is needed to pick up the pattern. With this particular limitation in mind, the results relating to this area were interpreted with some caution. A final limitation is the investigation of interrater reliability. During Stage 2, following the interviews and coding process done by this investigator, interrater reliability was attempted. Mechanistic problems with the coding tool, coupled with the lack of a coding manual and coder training, limited an accurate evaluation of coder reliability. Specific recommendations for revision of the coding procedure as well as recommendations for revision of Brown's instrument, follow.

Revision of Coding Mechanism

Recommendations for revision of the coding mechanism for "Brown's Inventory of Body Knowledge" questionnaire include:

1. Development of an instruction manual with clearly identified criteria for coding each contextual unit of the 15 categories.
    a. Define acceptable terminology for body parts.
    b. Develop specific criteria for coding "location" of parts.
    c. Design criteria for "function" of each part identified and located.
    d. Elaborate upon the present criteria determining the child's knowledge of "function of the system".

e. Develop criteria for determination of "location of entire system".

2. Preparation of instructional materials for coder training.
3. Identification of acceptable level of interrater reliability.
4. Determination of category placement for lymph nodes and tonsils.
5. Development of criteria for evaluation of child's basic knowledge of the mouth, teeth, eyes, ears, and nose.

Revision of Questionnaire

Based upon interviews with 40 grade school children, the following areas of revision of "Brown's Inventory of Children's Knowledge about their Bodies" questionnaire are recommended.

1. Include parents' occupation under personal data. Knowledge regarding parent occupation will give the researcher additional insight into the origin of children's special knowledge. For example, one very curious child among the taught Montessori subjects developed a high level of knowledge by going over information with his father, a neurologist.
2. Develop questions in Part I (Digestion) relative to the mouth, teeth, function of swallowing, and saliva. Children do not have opportunity to discuss these parts and their function with the current design of the questionnaire. Questioning begins with "When you

swallow the apple, where does it go?". No questions are directed at oral function.

3. Expand terminology in Part B (word list) to include tonsils, mouth, teeth, saliva, eye, eyelid, eyelash, nose, cilia, hair, pores, freckles, diaphram, pulses, and cartilage. By specifically including parts commonly know to most, if not all children, coding of this information will be facilitated.

Implications for Nursing Practice

Implications for nursing practice and nursing research identified from this study may be addressed in two areas, the methodology and child development. In the process of attempting to establish the reliability and validity of Brown's instrument, a major focus and underlying purpose for this study, was to look at how children learn about body structure and function. It was anticipated that this knowledge might contribute and impact upon lifelong health awareness, the delivery of health education, and subsequent illness prevention, both physical and emotional, over the life span.

Implications for nursing in the practice setting may be identified. Those who work with children in a health care setting need to have an understanding of what children at different age levels know about their bodies. This facilitates communication with the child, giving a sense of control over those processes that normally occur. Identifying the perceptions

a child has about his body parts and body systems, provides a framework from which to begin interaction and discussion about the body's function as well as malfunction, leading to illness.

Secondly, this knowledge provides the basis for age-appropriate health education. Communication on the level a child comprehends is necessary if effective health teaching is to occur. It is apparant from this study that children at a very young age (first and second grade) have some sense for good health practices such as eating proper food, avoiding sweets (sugar bugs), avoidance of smoking to prevent illness and death, and the value of exercise. The nurse educator needs to take advantage of the child's enthusiasm for learning and their ability to absorb valid health information. This in turn, will impact upon the child's lifelong frame of reference pertaining to health practices. It was interesting to note how much spontaneous health teaching was done by this researcher in the actual interview setting. Generally, the interviewer was unaware that this teaching had occured until data coding, which revealed teaching in three areas: 1) positive feedback and reinforcement was provided children who identified good health practices, 2) clarification of misinformation related to health and illness, and 3) reassurance about fears expressed related to diseases such as cancer and heart disease and death, was given. Children responded to this hidden

agenda in a very positive way.

The health care provider needs to use appropriate terminology when discussing body parts and function. In this way young children can become familiar with their bodies, particularly those parts that appear to be less well known, for example the urinary system. Use of proper terminology will further provide the basis for assimilation of health education and the understanding of illness. For example, children in this study related nerves to "nervousness". An understanding of the similarities and differences between the two areas would increase parental and health provider awareness in helping the child cope with stress related circumstances. Younger children need information and reassurance about major diseases and handicapping conditions discussed extensively in the media such as multiple sclerosis, heart disease, and leukemia.

The health care provider, in dealing with the ill child, needs to understand children's level of conceptual development. They must clarify for the child, their misconceptions related to the illness that might interfere with the child's ability to co-operate with management plans. A child who thinks that blood is important to live but believes the body does not make new blood, will be terrified if he sees a lot of blood from an injury to his own body or that of a significant other. Explanation of how the body works also gives a frame-

work for discussion about how certain illnesses can be prevented.

A final, and perhaps most important implication for nursing has to do with the methodological focus of this study, that being the possibilities for further research.

Implications for Nursing Research

Through the methodological approach of this study, the construct validity of "Brown's Inventory of Body Knowledge" was established. This instrument may in general, be considered valid for use with other children, based upon the quantitative and qualitative findings. With consideration given to identified limitations of the study, the instrument may be viewed as an effective tool to get at the underlying construct, children's knowledge of their body parts, location and function of body parts, and the purpose of 15 body systems. To further establish the validity and reliability of the Brown instrument the following research ideas have been identified.

1) The age groups not researched in this study need to be included in the overall representation of children's knowledge about their bodies. The revised Brown instrument should be used to:
    a) interview children in the pre-operational stage of development, the preschool child age 4 to 6 years.
    b) interview older children, fourth through sixth

grade.

c) interview the same age grade school children, grades one to four, with emphasis on more demographic information such as educational background, parental education and professional orientation, and socioeconomic status.

2) A larger sample from several different schools could be studied in order to insure a good representation from all socioeconomic and geographic locations.

3) A replication of this study using only third and fourth grade children since the increase in children's knowledge appears to occur at the age of 8 to 10. Findings in this study, although somewhat supportive, did not strongly validate this assumption.

In addition, the following analysis of the data collected during this study, but not included in the results presented here, should be done. This will further help establish the reliability and validity of Brown's instrument.

1) The reliability of the instrument needs to be established. Statistical analysis of the individual items for each system, named and located by children, could be done.

2) Interrater reliability following coder training and coding mechanism revisions as discussed in the recommendations, should be done.

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APPENDICES

APPENDIX A

"Brown's Inventory of Children's Knowledge about Their Bodies" Questionnaire

THE CURRENT THESIS

"BROWN'S INVENTORY OF BODY KNOWLEDGE"

QUESTIONNAIRE

SECTION A

"Hi, I am _____ and I am trying to learn more about kids and what kinds of things kids know about how their bodies work. I would like for you to help me learn more about that. Sometimes children have very special ideas about how their bodies work. Do you ever think about how your body works? Would you share some of your special ideas with me?"

Question 1-7: Personal Data

1. Name
2. Date
3. Sex
4. Age
5. Special Circumstances
6. Interviewer
7. Coder

Part I (Ingestion)

"First, I want to ask you some things about what your body does with the food you eat. Let's pretend that you've just eaten an apple. First you chewed it up good; then you swallowed it."

8. "Where does it go after you swallow it?"
9. "Where is that located?" or "Can you show me?"
10. "What happens there?"
11. "Where does it go next?"

Continue a sequential questioning of where it goes next and what happens in that place until the child gives some kind of closure to the sequence. If the child has not spontaneously answered that it comes out of the body, then ask:

12. "Does it ever come out?"

13. "How?"

If the child gives only one method of excretion, ask:

14. "Are there any other ways it could come out?"

15. "How?"

16. "Does food do anything for your body?"

17. "What does it do?"

Next I am going to ask you some things about what your body does with the things you drink. This time, let's pretend you just drank a glass of milk."

18. "After you swallow the milk, where does it go?"

19. "Where is that located?" or "Can you show me?"

20. "What happens to it there?"

21. "Where does it go next?" etc.

Continue this line of questioning as above and again end with the final question (if the child has not commented on this spontaneously) of:

22. "Does it ever come out of your body?"

23. "Where?"

Again, if the child gives only one method of excretion ask:

24. "Is there any other way it can get out?"

25. "Are things we drink important for our bodies?"

26. "What does drinking liquids do?"

"We've talked about a lot of things about things you eat and drink. You've told me about the_____." (List parts named, such as stomach, etc.). These parts fit together in our body to make a system.

27. "Do you know the name of this system?"

28. "Why do you think we have a gastrointestional system?"

29. "What kinds of things happen in this system?" (Probe for function of entire system, eg. Absorption of nutrients, elimination of wastes, etc.).

30. "How do you know if that part is healthy or sick?"

31. "Can you think of something you can do to keep the parts of your gastrointestional system healthy?"

32. "Tell me all the sicknesses you know that can happen to that part of your body."

Part II Respiration

"We've been talking about things (like food) that go into our body. Another thing that goes into our body is air. Now I am going to ask you about what happens to the air that you breathe into your body. Let's pretend you just breathed some air."

33. "Where does it go after you breathe?"

34. "Where is that located?" or "Can you show me?"

35. "What happens to it there?"

36. "Where does it go next?"

37. "What happens to it there?"

If child mentions"lungs" or "bronchii", ask: "How many?"

38. "Do our bodies need air?"

39. "What does air have in it that is important for our body?"

40. "Does the air ever come out?"

41. "Where?"

42. "What is in it?"

43. "Is there any other way it can get out?"

"We've talked about a lot of things about how air goes into your body. You've told me about the _____." (List parts named such as lungs, bronchii, etc.). "These parts fit together in our body to make another system."

44. "Do you know the name of this system?" (If not, "Sometimes we call it a respiratory system").

45. "Why do you think we have a respiratory system?"

46. "What kinds of things happen in this system?" (Probe for function of entire system such as breathing, exchange of O2 and CO2).

47. "How to you know if that part is healthy or sick?"

48. "Can you think of some ways you can keep the parts of your respiratory system healthy?"

49. "Tell me all the sicknesses you know that can happen to your respiratory system."

Part III (Elimination)

"We've been talking about a lot of things that go into your body, like food, liquids and air. Now we're going to talk about some of the things that come out of your body. Let's start with urine; some kids call it pee-pee or wee-wee or tinkle: it's the water that comes out when you go to the bathroom."

50. "What do you call this water?"

51. "Where do you think it comes from?"

If child suggests resulting from liquid intake, then ask:

52. "How does the body make it into pee-pee?"

If child mentions "kidneys", ask:

53. "How many do you have?"

54. "Where are they located?"

55. "Where does it go next?"

56. "Does it stay inside your body for a while?"

57. "Why do you think your body wants to get rid of it?"

58. "What would happen if your body didn't get rid of it and never tinkled?"

59. "Lots of times, kids have to tinkle (or whatever word the child uses) but there's no bathroom, and they have to wait for a while until they find one. Has that ever happened to you?"

60. "Where did the tinkle stay inside of you while you were waiting?"

61. "Is there a special container inside of you or is it just loose in your body?"

If the container idea is mentioned, ask:

62. "Where did it come from before it came to the_____ (whatever term the child has for the bladder?)".

We've talked about a lot of things about how urine comes out of you. You've told me about the_____." (List parts names such as bladder,kidneys, etc.). These parts fit together in our body to make another system.

63. "Do you know the name of this system?" (If not, sometimes we call it a urinary system.")

64. "Why do you think we have a urinary system?"

65. "What kinds of things happen in this system?" (Probe for function of entire system such as elimination of wastes, etc.).

66. "How do you know if that part is healthy or sick?"

67. "Can you think of some ways you can keep the parts of your urinary system healthy?"

68. "Tell me all the sicknesses you know that can happen to your urinary system."

"One thing that comes out of your body is bowel movements; some kids call it poop or BM or #2; it's the brown solid material that comes out of your bottom when you go to the bathroom."

69. "Where do you think it comes from?"

70. "Where was it before it got there?"

71. "Is it in a special container or is it loose inside of you?"

72. "Does it ever come out?"

73. "What would happen if it didn't come out of you-- if you never pooped (or whatever term the child uses)?"

Part IV (Cardiovascular)

If the child has not included the circulatory system in his answers to Parts I, II, and III, probe it here. If he has only touched on it briefly, probe for expansions here. Begin by asking:

74. "Now I am going to be talking about something inside of you--blood. Have you ever cut yourself and seen some of your blood come out?"

If the answer is negative, ask if the child has ever seen anyone else cut themselves.

75. "Where does your blood come from?"

76. "Is the blood inside of us loose or is it in some kind of container?"

77. "Is it still or does it move?" If the answer is that it moves,ask:

78. "What makes it move--how does it move?"

If child mentions "heart", then ask:

79. "Where is it located?" or "Can you show me?"

80. "Are there different parts to the heart?"

81. "What are they?"

82. "Where are they located?"

83. "Where does the blood go after the heart pumps it out?"

84. "Where does it go then?" (Probe for description and/or names of arteries, veins, capillaries, and for transport of food, O2, etc., into other body parts.)

85. "Why do we have blood inside of us?"

If the answer is, "to keep us alive", ask:

87. "Does it carry anything else?"

88. "Does it have any other important jobs to do for us?"

89. "When we lose blood from inside our bodies, do our bodies ever make new blood?"

90. "How?"

91. "What is in this blood?" (If blood cells mentioned probe function of different types.).

"We've talked about a lot of things about the heart and blood. You've told me about the_____." (List parts named, such as the heart and blood vessels). These parts fit together in our body to make another system.

92. "Do you know the name of this system?" (If not, sometimes we call it a cardiovascular system).

93. "What kinds of things happen in this system?" (Probe for function of entire system such as transport of blood and transport of O2 and CO2).

95. "How do you know if that part is healthy or sick?"

96. "Can you think of some ways to keep the parts of your cardiovascular system healthy?"

97. "Tell me all the sicknesses you know that can happen to your cardiovascular system.

Part V (Tears)

Now let us talk about another thing that comes out of our body. Tears.

98. "When do we have tears?"

99. "What do tears do?"

100. "Are they important for our body?"

101. "Where do tears come from?"

102. "Where are they made?"

103. "Where is that located?" or "Can you show me?"

104. "Where do they come from before they get to your eye?"

Part VI (Sweat)

Another thing that we see on our body is sweat.

105. "Do you know what sweat is?"

106. "Where does your sweat come from?" (Specifically probe for whether it comes from inside or outside of the body).

If the child says "sweat glands", ask location.

107. "Why does your body sweat?"

108. "Does it do anything good for you?"

109. "What would happen if you never sweated?"

Part VII (Skin)

Another part of your body is your skin.

110. "What do you know about your skin?"

111. "Are there different parts to your skin?" "Tell me what these are."

If functions of the skin are not elicited, ask:

112. "Why do we have a skin?"

113. "What would happen if we didn't have a skin?"

Part VIII (Skeletal)

Another part of our bodies is bones.

114. "Do you know what bones are?"

115. "Do you know what a skeleton is?"

Use either word the child recognizes and continue:

116. "Do you have bones inside of you?"

117. "Tell me all the bones you know."

118. "Show me where they are located. Let us start at the top of your body."

119. "Why are bones important?"

120. "What do they do for our body?" (Try to elicit functions of protection, structure, place for muscles to attach.)

If not mentioned spontaneously, ask:

121. "Do you know what this bone is?" (Point to skull).

122. "What does it do for us?"

123. "What do ribs do?"

124. "Can our bones move?"

125. "What helps them move?" (Probe for joints, ligaments, tendons, muscles.)

126. "Is there anything else bones do for us?"

"We have talked about a lot of things about_____." (Identify area of discussion). "You have told me about the _____." (List parts named, such as types of different bones.). These parts fit together in our body to make a system called the skeletal system."

127. "Why to you think we have a skeleton?" (Probe for function of entire system such as support, structure, movement, etc.).

128. "How do you know if the parts of your skeleton is healthy or sick?"

129. "What can you do to keep the parts of your skeleton healthy?"

130. "Tell me all the sicknesses you know that can happen to your skeleton."

"Another thing that kids can do is to move--they can run, sit, stand, talk, and move all parts of their bodies. One part of our bodies that helps us to move is our bones. Do you know any other parts of your body that helps you move?"

If child doesn't identify muscles, say "Muscles help us move."

131. "So, our muscles help us to move--is there anything else they do?"

132. "Can you show me where you have a muscle?"

133. "Does that muscle have a name?"

134. "What does that muscle do?"

135. "Do you have any other muscles?" (Have child point to each and tell its function).

If child does not spontaneously locate muscle, ask to locate by pointing on his/her body.

136. "Are our muscles attached (hooked on to) other parts of our body, or are they loose inside of us?"

137. "What are they attached to?"

138. "Which parts of our bodies have muscles inside?"

139. "Are there parts that don't have muscles?"

140. "Which parts?"

141. "Do all muscles do pretty much the same thing?"

142. "What?" Do they do any other important jobs?"

"We have talked about a lot of things about muscles. You've told me about the_____. (List specific muscles named). When we talk about all of our muscles, we say we have a muscular system."

143. "Why do you think we have a _____system?"

144. "What kinds of things does the muscular system do for us?" (Probe for function of entire system).

145. "How do you know if your muscles are healthy or sick?"

146. "What can you do to keep your muscles healthy?"

147. "Tell me all the sicknesses you know that can happen to your muscles."

Part X (Neurological)

"One of the important things that makes kids different from plants and trees is that they can do a lot of different kinds of thinking--they can figure things out, they can think and pretend things, they can learn new things, they can remember things."

148. "What part of you does this kind of thinking?"

149. "Where is that located?" or "Can you show me?"

150. "Does it do anything else?"

151. "How does it do these things?"

152. "Does the brain have any other important job to do for us?" (If not spontaneously offered, continue--"I know another important job it does--it makes important decisions and tells the other parts of our body what to do. For instance, it tells our hands when to move or do certain things."

153. "How do you think it gets the message all the way from your head to your hand or other parts of your body?"

154. "Is there a special part of your body that carries the messages from the brain?"

155. "Now, let's pretend that you burn your finger on a match."

156. " How does your brain (if child has already mentioned this part--otherwise,use the word 'body') figure out that it is the flame that is hurting your finger and that you had better take your finger away?"

157. "How does the message get all the way from your finger to your brain?"

"We've talked about a lot of things about the brain and nerves. You've told me about the_____." (List parts named). These parts fit together in our body to make another important system."

158. "Do you know the name of this system?" "When we talk about nerves and the brain, we call this the nervous system."

159. "Why do you think we have a nervous system?"

160. "What kinds of things happen in this system?" (Probe for function of entire system.).

161. "How do you know if your nervous system is healthy or sick?"

162. "What can you do to keep the parts of your nervous system healthy?"

163. "Tell me all the sicknesses you know that can happen to your nervous system."

Part X (A) (Hearing)

"Another thing I am interested in is what kids know about hearing."

164. "Could you tell me everything you know about hearing?"

165. "What parts of your body help you to hear?"

166. "Where are these located?"

Probe for as many parts as you can.

167. "What happens when a sound comes into the ear?"

168. "Where does it go then?"

169. "Does the sound get inside of you?"

170. "What happens then?"

171. "Is there some part of you that helps you tell one sound from another?"

172. "Like, how can you tell whether a sound is a bell or a drum sound?"

Probe for the place of the brain in hearing.

Part X (B) (Vision)

"Another thing you do every day is see."

173. "Tell me what parts of your body help you see."

Probe for as many parts as you can.

174. "Where are these located?"

175. "What does each part do?" (i.e., pupils, lens, etc.)

176. "What happens after the picture you see gets inside your eye?"

177. "Are there parts of you that help tell whether the thing you see is a boat or a flower?"

178. "What are they?"

Part X (C) (Smell)

"Another thing you do every day is smell"

179. "Tell me what parts of your body help you smell."

Probe for as many parts as you can.

180. "Where are these located?"

181. "What does each part do?" (i.e. olfactory nerve, nose, brain.).

182. What happens after the smell gets inside your nose?"

183. "Are there parts of you that help tell whether the thing you smell is good or bad?"

184. "What are they?"

Part X (D) (Taste)

"Another thing you do is taste."

185. "Tell me what part of your body helps you taste."

Probe for as many parts as you can.

186. "Where are these located?"

187. "What does each part do?" (i.e., tongue, tastebuds, kinds).

188. "What happens after the taste gets inside your mouth?"

189. "Are there parts of you that help tell what the things you taste are?"

190. "What are they?"

Part X (C) (Touch)

"Another thing we do every day is touch."

191. "Tell me what part of your body helps you to touch."

Probe for as many parts as you can.

192. "Where are these parts located?"

193. "What does each part do?"

194. "What happens after you touch something?"

195. "Are there parts of you that help tell if what you touch is smooth or rough?"

196. "What are they?"

"We've talked about a lot of things about hearing and seeing and smelling and touching. You've told me about the_____. (List parts named). These parts fit together in our body to make another important system."

197."Do you know the name of this system?" When we talk about the hearing, seeing, tasting, and touching we call it the sensory system. "Why do you think we have a sensory system?"

198. "What kinds of things happen in this system?" (Probe for function of entire system).

199. "How do you know if your sensory system is healthy or sick?"

200. "What can you do to keep the parts of your sensory system healthy?"

201. "Tell me all the sicknesses you know that can happen to your sensory system."

SECTION B

"Now I am going to tell you some words that many kids don't know. I want you to tell me if you know what the word means." (Include only those words that the child did not use in Section A).

For all words identified by the child ask:

"Where is/are the_____? What is it for? Why is it important for your body?"

muscles	pancreas	blood vessels	heart	lymph nodes
nerves	esophagus	arteries	lungs	voice box
brain	spleen	veins	bladder	(larynx)
spinal cord	gallbladder	blood cells	bronchioles	
joints	liver	RBC's	trachea	
ligament	rectum	WBC's	bronchii	
tendon	kidneys	platelets	alveoli	
stomach	anus	plasma	appendix	
intestine				

APPENDIX B

Face Validity

QUESTIONNAIRE

CHILDREN'S KNOWLEDGE OF THEIR BODIES

This questionnaire is directed toward eliciting knowledge children already have about the anatomy and physiology of their bodies.

Please answer the following questions with yes or no and explain as indicated.

1. Are the questions phrased so a preschool/school age child can understand them? YES_____NO_____. If NO what area seems to be unclear? How might the question be rephrased?

2. Does the general terminology of the questions appear reasonable for this age group? YES_____NO_____. If NO what area/areas need revision?

3. Do the questions seem directed at eliciting knowledge of anatomical and physiological function, eg. respiration, digestion, and elimination? YES_____NO_____. If NO,explain.

4. Are there any questions not listed that you think might elicit more information about a particular area? Please identify.

5. Are there any other areas of anatomy or physiology that need to be addressed in the questionnaire? Please identify.

6. Do you think children of this age might be hesitant to answer the questions about elimination? YES_____NO_____. If YES, can you identify a possible reason such as teaching at home, etc..

7. Would it be better to say "children" or "boys and girls" rather than "kids" in the questions? YES_____NO_____.

ADDITIONAL COMMENTS: (Use back if needed)

Tabulation of Data

Question	Teachers		Mothers		Pediatric Specialists		Total	
	yes	no	yes	no	yes	no	yes	no
#1	5	0	4	1	5	0	14	1
#2	4	1	4	1	5	0	12	3
#3	5	0	5	0	5	0	15	0
#4	4	1	1	4	1	4	6	9
#5	0	5	2	3	5	0	7	8
#6	4	1	1	4	1	4	6	9
#7	0	5	2	3	1	4	3	12

APPENDIX C

Interviewer Analysis

BODY KNOWLEDGE QUESTIONNAIRE

INTERVIEW ANALYSIS

CODE		TOTAL #	COLUMN #
01	Questions not covered	____	___ ___
	List_____		1 2
	_____		
	_____		
	_____		
02	Questions covered incompletely	____	___ ___
	List_____		3 4
	_____		
	_____		
	_____		
03	Developmentally inappropriate questions	____	___ ___
	List_____		5 6
	_____		
	_____		
	_____		
04	Leading questions	____	___ ___
	List_____		7 8
	_____		
	_____		
	_____		
05	Bombardment Questions	____	___ ___
	List_____		9 10
	_____		
	_____		
	_____		
06	Double Questions	____	___ ___
	List_____		11 12
	_____		
	_____		
	_____		
07	Cutoffs	____	___ ___
	List_____		13 14
	_____		
	_____		
	_____		
08	Disapproval	____	___ ___
	List_____		15 16
	_____		
	_____		
	_____		

APPENDIX D

Coding Mechanism

CURRENT THESIS

C O D E S H E E T

"Brown's Inventory of Body Knowledge"
Questionnaire

Child's Name _____ Date of Birth _____

Interviewer's Name _____

Coder's Name _____

Date of Interview _____

School _____

VARIABLE	CODE	COLUMN #
1. Child	ID #	
2. Date	Day/Month/Year	
3. Sex	1 Male 2 Female	
4. Age	1 2 1/2 - 3 2 3+ - 3 1/2 3 3 1/2+ - 4 4 4+ - 4 1/2 5 4 1/2 + - 5 6 5+ - 5 1/2 7 5 1/2 + - 6 8 6+ - 6 1/2 9 6 1/2+ - 7 10 7+ - 7 1/2 11 7 1/2+ - 8 12 8+ - 8 1/2 13 8 1/2+ - 9 14 9+ - 9 1/2 15 9 1/2+ - 10 16 10+ - 10 1/2 17 10 1/2+ - 11 18 11+ - 11 1/2 19 11 1/2+ - 12 20 12+ - 12 1/2 21 12 1/2+ - 13 22 13+ - 13 1/2	

"Brown's Inventory of Body Knowledge" Questionnaire (Continued)

VARIABLE	CODE	COLUMN #
5. Special Circumstances	1 Pretest 2 Post-test	__
6. Interviewer		__
7. Coder		__

Part I: Digestion

8. Accurately identified parts:		1 yes 2 no
	Mouth	__
	Tongue	__
	Teeth	__
	Canines	__
	Incisors	__
	Molars	__
	Wisdoms	__
	Salivary Glands	__
	Salivary Ducts	__
	Uvula	__
	Epiglottis	__
	Esophagus	__
	Stomach	__
	Small Intestine	__
	Large Intestine	__
	Rectum	__
	Anus	__
	Liver	__
	Gallbladder	__
	Spleen	__
	Pancreas	__
	Appendix	__
	Other (List):	__
	_____	
	_____	
	_____	
	*Throat	__
	Jaws	__
	Gums	__
	Saliva	__
	Intestines	__
	Bile duct	__
	Soft palate	__
	Hard palate	__
	Blood	__

* New additions not coded previously.

VARIABLE	CODE	COLUMN #
Part I: Digestion (Continued)		
9. Total number of accurately identified parts.		__
10. Total number of inaccurately identified parts.		__
11. List specific inaccuracies: _____ _____ _____ _____		
12. Location: Accuracy of locating entire system.	1 yes 2 no	_
List inaccuracies: _____ _____ _____ _____		
13. Location: Accuracy of locating specific parts of system.	1 yes 2 no	

Part	Inaccurate (Describe)	Accurate (Code)
Mouth	_____	_
Tongue	_____	_
Teeth	_____	_
Canines	_____	_
Incisors	_____	_
Molars	_____	_
Wisdoms	_____	_
Salivary Glands	_____	_
Salivary Ducts	_____	_
Uvula	_____	_
Epiglottis	_____	_
Esophagus	_____	_
Stomach	_____	_
Small Intestine	_____	_
Large Intestine	_____	_

VARIABLE	CODE	COLUMN #
13. (Continued)		

Part	Inaccurate (Describe)	Accurate (Code)
Rectum	_____	_
Anus	_____	_
Liver	_____	_
Gallbladder	_____	_
Spleen	_____	_
Pancreas	_____	_
Appendix	_____	_
Other (List):	_____	_
_____	_____	
_____	_____	
Throat	_____	_
Jaw	_____	_
Gum	_____	_
Saliva	_____	_
Intestines	_____	_
Bile duct	_____	_
Soft palate	_____	_
Hard palate	_____	_
Blood	_____	_

VARIABLE	CODE	COLUMN #
14. Total number of specific parts of system accurately located.		__
15. Total number of specific parts of system inaccurately located.		__
16. Accurately identified purposes/functions of entire system.	1 yes 2 no	

Mastication	_
Transportation of food	_
Digestion of food	_
Absorption of nutrients/ water(growth/dydration)	_
Elimination of wastes	_
Other (List):	_
Repair body/heal	_

VARIABLE	CODE	COLUMN #
Part I: Digestion		
17. Total number of accurately identified purposes/functions of entire system.		--
18. Total number of inaccurately identified purposes/ functions of entire system.		--

List inaccurate functions/purposes of entire system:

_____ _____
_____ _____
_____ _____

19. Accurately identified functions of specific parts of the system. — 1 yes, 2 no

Function	Inaccurate (Describe)	Accurate (Code)
Mouth - where food enters		
Tongue - moves food		—
Teeth - bite, chew, grind food		—
Uvula - no function		—
Salivary Glands - soften food		—
Salivary Ducts - carry saliva to mouth		—
Epiglottis - "trap door" to esophagus		—
Esophagus - push food from throat to stomach		—
Stomach - mashes/mixes, dissolves food		—
Canines		—
Incisors		—
Molars		—
Wisdoms		—

VARIABLE	CODE	COLUMN #
Function	Inaccurate (Describe)	Accurate (Code)
19. (Continued)		
Small Intestine - dissolve food/bile added		—
Large Intestine - water absorbed		—
Rectum - container for waste products		—
Anus - waste products elimination		—
Liver - makes bile to breakdown fat		—
Spleen - reservoir for blood, disintegrates RBC's		—
Pancreas - secretes gastric juices to small intestine; carbohydrate metabolism		—
Gallbladder - storage house for bile		—
Appendix - pouch where things can get stuck		—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Throat		—
Jaw		—
Gum		—
Saliva		—
Intestines		—
Bile duct		—
Soft palate		—
Hard palate		—
Blood		—
20. Total number of accurately identified functions of specific parts of the system.		--

VARIABLE	CODE	COLUMN #
Part I: Digestions (Continued)		
21. Total number of inaccurately identified functions of specific parts of the system.		— —
22. Other specific facts mentioned.	_____ _____ _____ _____	
23. Health aspects of the system listed.	_____ _____ _____ _____	
24. Illness aspects of the system listed.	_____ _____ _____ _____	
25. Accurately identified interrelations with other systems:	1 yes 2 no	

Other Systems	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Circulatory	_____	—
Urinary	_____	—
Other (List):		
_____	_____	
_____	_____	
Muscular	_____	—
Skeletal	_____	—

26. Total number of accurate interrelations with other systems.		— —

VARIABLE	CODE	COLUMN #
Part I: Digestions (Continued)		
27. Total number of inaccurately identified interrelations with other systems.		— —
Part II: Urinary		
28. Accurately identified parts:	1 yes 2 no	
Kidneys		—
Ureters		—
Bladder		—
Urethra		—
Other (List):		
_____		
_____		
_____		
Genitals		
Penis		—
		—
29. Total number of accurately identified parts.		— —
30. Total number of inaccurately identified parts.		— —
31. List specific inaccuracies:	_____ _____ _____	
32. Location: Accuracy of locating entire system.	1 yes 2 no	—
List inaccuracies:	_____ _____ _____	

VARIABLE	CODE	COLUMN #

Part II: Urinary (Continued)

33. Location: Accuracy of locating specific parts of system. — 1 yes, 2 no

Part	Inaccurate (Describe)	Accurate (Code)
Kidneys	_____	—
Ureters	_____	—
Bladder	_____	—
Urethra	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Genitals		
Penis	_____	—
	_____	—

34. Total number of specific parts of system accurately located. — — —

35. Total number of specific parts of system inaccurately located. — —

36. Accurately identified purposes/functions of entire system. — 1 yes, 2 no

Absorption of water/ wastes from blood	
Dissolving wastes	—
Elimination of wastes	—
	—
Other (List):	
_____	
_____	
_____	

37. Total number of accurately identified purposes/functions of entire system. — —

VARIABLE	CODE	COLUMN #

Part II: Urinary (Continued)

38. Total number of inaccurately identified purposes/functions of entire system. — —

List inaccuracies:

_____

_____

_____

39. Accurately identified functions of specific parts of the system. — 1 yes, 2 no

Function	Inaccurate (Describe)	Accurate (Code)
Kidneys - absorbs H_2O/waste from blood	_____	—
Ureters - urine passage from kidney to bladder	_____	—
Bladder - storage tank for urine	_____	—
Urethra - excretion tube for urine	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Genitals		
Penis	_____	—
	_____	—

40. Total number of accurately identified functions of specific parts of the system. — —

VARIABLE	CODE	COLUMN #
Part II: Urinary (Continued)		
41. Total number of inaccurately identified functions of specific parts of the system.		— —
42. Other specific facts mentioned.		
_____		
_____		
_____		
43. Health aspects of the system listed.		
_____		
_____		
_____		
44. Illness aspects of the system listed.		
_____		
_____		
_____		
45. Accurately identified interrelations with other systems:	1 yes 2 no	

Other Systems	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Circulatory	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Digestive	_____	—

VARIABLE	CODE	COLUMN #
Part II: Urinary (Continued)		

Other Systems	Description of Interrelationship (If inaccurate, describe)	Accuate (Code)
46. Total number of accurate interrelations with other systems.		— —
47. Total number of inaccurately identified interrelations with other systems.		— —

VARIABLE	CODE	COLUMN #
Part III: Respiration		
48. Accurately identified parts:	1 yes 2 no	
Nose		—
Mouth		—
Trachea		—
Larynx		—
Bronchi		—
Bronchioles		—
Alveoli		—
Lungs		—
Other (List):		
_____		
_____		
_____		
Tonsils		—
Throat		—
Lymphglands		—
Blood cells		—
Cilia		—
Lips		—
Diaphram		—
"Adams Apple"		—
49. Total number of accurately identified parts.		— —
50. Total number of inaccurately identified parts.		— —

VARIABLE	CODE	COLUMN #

Part III: Respiration (Continued)

51. List specific inaccuracies:

_____
_____
_____
_____

52. Location: Accuracy of locating entire system. — 1 yes, 2 no — ___

List inaccuracies:

_____
_____
_____
_____

53. Location: Accuracy of locating specific parts of system. — 1 yes, 2 no

Part	Inaccurate (Describe)	Accurate (Code)
Nose	_____	___
Mouth	_____	___
Trachea	_____	___
Larynx	_____	___
Bronchi	_____	___
Bronchioles	_____	___
Alveoli	_____	___
Lungs	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Tonsils	_____	___
Throat	_____	___
Lymphglands	_____	___
Blood cells	_____	___
Cilia	_____	___
Lips	_____	___
Diaphram	_____	___
"Adams Apple"	_____	___

VARIABLE	CODE	COLUMN #

Part III: Respiration (Continued)

54. Total number of specific parts of system accurately located. — ___

55. Total number of specific parts of system inaccurately located — ___

56. Accurately identified purposes/functions of entire system. — 1 yes, 2 no

Allow transport of air (breathing)	___
O_2 - CO_2 exchange	___
Allows O_2 to enter	___
Allows CO_2 to escape	___
Speech	___

Other (List):

_____
_____
_____

57. Total number of accurately identified purposes/functions of entire system. — ___

58. Total number of inaccurately identified purposes/functions of entire system. — ___

List inaccurate functions/purposes of entire system:

_____
_____
_____

VARIABLE	CODE	COLUMN #
Part III: Respiration (Continued)		
59. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Nose - allows air to enter body, moisten/ warm air, smell		
Mouth - allows air to enter		—
Trachea - allows air to pass to bronchi		—
Larynx - part of trachea, allows air to pass, sound production		—
Bronchi - passes air from trachea to lung		—
Bronchioles - passes air from bronchi to alveoli		—
Alveoli - allows passage/exchange of O_2 & CO_2		—
Lungs - structure for above/allows O_2/CO_2 exchange		—
Other (List)		
_____		
_____		
_____		
Tonsils		—
Throat		—
Lumphgland		—
Blood cells		—
Cilia		—
Lips		—
Diaphram		—
"Adams Apple"		—

60. Total number of accurately identified functions of specific parts of the system.		— —

VARIABLE	CODE	COLUMN #
Part III: Respiration (Continued)		
61. Total number of inaccurately identified functions of specific parts of the system.		— —
62. Other specific facts mentioned.		
_____		
_____		
_____		
63. Health aspects of the system listed.		
_____		
_____		
_____		
64. Illness aspects of the system listed.		
_____		
_____		
_____		
65. Accurately identified interrelations with other systems:	1 yes 2 no	

Other Systems	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Cardiovascular	_____	—
Neurological (brain, olfactory)	_____	—
Other (List):		
_____	_____	
_____	_____	

66. Total number of accurate interrelations with other systems.		— —

VARIABLE	CODE	COLUMN #
Part III: Respiration (Continued)		
67. Total number of inaccurately identified interrelations with other systems.		— —
Part IV: Circulatory System		
68. Accurately identified parts:	1 yes 2 no	
Heart		—
Atria		—
Ventricles		—
Valves		—
Blood Vessels		—
Arteries		—
Veins		—
Capillaries		—
Blood		—
Blood Cells		—
RBC's		—
WBC's		—
Platelets		—
Plasma		—
Bone Marrow		—
Other (List):		
_____		
_____		
_____		
Pulses		
Radial pulse		—
Carotip pulse		—
Aorta		—
Vena cava		—
69. Total number of accurately identified parts.		— —
70. Total number of inaccurately identified parts.		— —

VARIABLE	CODE	COLUMN #
Part IV: Circulatory System (Continued)		
71. List specific inaccuracies:		
_____		
_____		
_____		
_____		
72. Location: Accuracy of locating entire system.	1 yes 2 no	—
List inaccuracies:		
_____		
_____		
_____		
_____		
73. Location: Accuracy of locating specific parts of system.	1 yes 2 no	

Part	Inaccurate (Describe)	Accurate (Code)
Heart		
Atria	_____	—
Ventricles	_____	—
Valves	_____	—
Blood Vessels	_____	—
Arteries	_____	—
Veins	_____	—
Capillaries	_____	—
Blood	_____	—
Blood Cells	_____	—
RBC's	_____	—
WBC's	_____	—
Platelets	_____	—
Plasma	_____	—
Bone Marrow	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	

VARIABLE	CODE	COLUMN #
Part IV: Circulatory System (Continued)		
73. (Continued)		
Part	Inaccurate (Describe)	Accurate (Code)
Pulses		
Radial pulse	_____	___
Carotid pulse	_____	___
Aorta	_____	___
Vena aorta	_____	___
74. Total number of specific parts of system accurately located.		___
75. Total number of specific parts of system inaccurately located.		___
76. Accurately identified purposes/functions of entire system.	1 yes 2 no	
Transport of blood		___
Transport of O_2		___
Transport of CO_2		___
Transport of wastes		___
Other (List):		
_____		
_____		
_____		
Transport nutrients		___
77. Total number of accurately identified purposes/functions of entire system.		___

VARIABLE	CODE	COLUMN #
Part IV: Circulatory System (Continued)		
78. Total number of inaccurately identified purposes/functions of entire system.		___
List inaccurate functions/purposes of entire system:		
_____		
_____		
_____		
79. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Heart - pumps to circulate blood	_____	___
Atria - pumps to circulate blood	_____	___
Ventricles - pumps to circulate blood	_____	___
Valves - sep. atria from vents., sep. blood vessels from atria/vents.	_____	___
Blood vessels - transport blood	_____	___
Arteries - transport blood w/O_2, food to body parts	_____	___
Veins - transport waste products from body part to waste organ for elimination	_____	___
Capillaries - connect arteries & veins	_____	___
RBC's - carry O_2 to body cells	_____	___
Blood	_____	___
blood cells	_____	___

VARIABLE	CODE	COLUMN #
Part IV: Circulatory System (Continued)		
Function	Inaccurate (Describe)	Accurate (Code)
79. (Continued)		
WBC's - fight infection	_____	___
Platelets - clotting	_____	___
Plasma - fluid part of blood that corpuscles are suspended in.	_____	___
Bone Marrow - produces blood cells	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Pulses		
Radial pulse	_____	___
Carotnio pulse	_____	___
Aorta	_____	___
Vena cava	_____	___
	_____	___
80. Total number of accurately identified functions of specific parts of the system.		___
81. Total number of inaccurately identified functions of specific parts of the system.		___
82. Other specific facts mentioned:		
_____		
_____		
_____		
_____		
83. Health aspects of the system listed:		
_____		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part IV: Circulatory System (Continued)		
84. Illness aspects of the system listed:		
_____		
_____		
_____		
_____		
85. Accurately identified interrelations with other systems:	1 yes 2 no	

Other system	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Neurological	_____	___
Respiratory	_____	___
Urinary	_____	___
Gastrointestinal	_____	___
Endocrine	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Muscular	_____	___

86. Total number of accurate interrelations with other systems.	___
87. Total number of inaccurate interrelations with other systems.	___
Part V: Tears	
88. Accurately identified parts:	1 yes 2 no
Eye	
Eyelid	___
Eyelash	___
Lacrimal Gland	___
Lacrimal Puncta	___
Lacrimal Duct	___

VARIABLE	CODE	COLUMN #
Part V: Tears (Continued)		
88. (Continued)		
Other (List):		
_____		
_____		
_____		
Nose		—
89. Total number of accurately identified parts.		— —
90. Total number of inaccurately identified parts.		— —
91. List specific inaccuracies:		
_____		
_____		
_____		
92. Location: Accuracy of locating entire system.	1 yes 2 no	—
List inaccuracies:		
_____		
_____		
_____		
93. Location: Accuracy of locating specific parts of system.	1 yes 2 no	

Part	Inaccurate (Describe)	Accurate (Code)
Eye		—
Eyelid		—
Eyelash		—
Lacrimal Gland		—
Lacrimal Puncta		—
Lacrimal Duct		—
Other (List):		
_____		
_____		
_____		
Nose		—

VARIABLE	CODE	COLUMN #
Part V: Tears (Continued)		
94. Total number of specific parts of system accurately located.		— —
95. Total number of specific parts of system inaccurately located.		— —
96. Accurately identified purposes/functions of entire system.	1 yes 2 no	
Lubricating/irrigating the eye		—
Special Needs: (a) Emotion		—
(b) Protection from irritants		—
Other (List):		
_____		
_____		
_____		
97. Total number of accurately identified purposes/functions of entire system.		— —
98. Total number of inaccurately identified purposes/functions of entire system.		— —
List inaccurate functions/ purposes of entire system:		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part V: Tears (Continued)		
99. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Eye - sight	_____	___
Eyelid - protection of orbit	_____	___
Eyelash - Protection of orbit	_____	___
Lacrimal Gland - tear formation	_____	___
Lacrimal Puncta - drainage system for tears	_____	___
Lacrimal Duct - drainage system for tears	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Nose - exit tears		___

100. Total number of accurately identified functions of specific parts of the system.		___
101. Total number of inaccurately identified functions of specific parts of the system.		___
102. Other specific facts mentioned.		
_____		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part V: Tears (Continued)		
103. Health aspects of the system listed.		
_____		
_____		
_____		
_____		
104. Illness aspects of the system listed.		
_____		
_____		
_____		
_____		
105. Accurately identified interrelations with other systems:	1 yes 2 no	

Other Systems	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Inner Eye	_____	___
Neurological (Optic nerve/ brain)	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	

106. Total number of accurate interrelations with other systems.	___
107. Total number of inaccurate interrelations with other systems.	___

VARIABLE	CODE	COLUMN #
Part VI: Sweat		
108. Accurately identified parts:	1 yes 2 no	
Skin		___
Sweat gland		___
Sweat		___
Other (List):		
_____		
_____		
_____		
Pores		___
109. Total number of accurately identified parts.		__
110. Total number of inaccurately identified parts.		__
111. List specific inaccuracies:		
_____		
_____		
_____		
112. Location: Accuracy of locating entire system.	1 yes 2 no	___
List inaccuracies:		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part VI: Sweat (Continued)		
113. Location: Accuracy of locating specific parts of system.	1 yes 2 no	
Part	Inaccurate (Describe)	Accurate (Code)
Skin	_____	___
Sweat Gland	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Pores	_____	___
Sweat	_____	___
114. Total number of specific parts of system accurately located.		__
115. Total number of specific parts of system inaccurately located.		__
116. Accurately identified purposes/functions of entire system.	1 yes 2 no	
Cool the body		___
Emotional response		___
Other (List):		
_____		
_____		
_____		
Elimination Wastes/Poisons		___
117. Total number of accurately identified purposes/functions of entire system.		__

VARIABLE	CODE	COLUMN #
Part VI: Sweat (Continued)		
118. Total number of inaccurately identified purposes/functions of entire system.		— —
List inaccurate functions/purposes of entire system:		
_____		
_____		
_____		
119. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Skin - protective/ transport	_____	—
Sweat gland - production/means of cooling system	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Pores	_____	—
Sweat	_____	—

120. Total number of accurately identified functions of specific parts of the system.		— —
121. Total number of inaccurately identified functions of specific parts of the system.		— —

VARIABLE	CODE	COLUMN #
Part VI: Sweat (Continued)		
122. Other specific facts mentioned.		
_____		
_____		
_____		
_____		
123. Health aspects of the system listed.		
_____		
_____		
_____		
_____		
124. Illness aspects of the system listed.		
_____		
_____		
_____		
_____		
125. Accurately identified interrelations with other systems:	1 yes 2 no	

Other systems	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Neurological	_____	—
Muscular	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Skin		

VARIABLE	CODE	COLUMN #
Part VI: Sweat (Continued)		
126. Total number of accurate interrelations with other systems.		— —
127. Total number of inaccurately identified interrelations with other systems.		— —
Part VII: Skin		
128. Accurately identified parts:	1 yes 2 no	
Skin		—
Epidermis		—
Dermis		—
Subcutaneous Tissue		—
Sweat Gland		—
Sebaceous Gland		—
Hair		—
Hair Follicle		—
Peripheral Nerves		—
Brain		—
Other (List):		
_____		
_____		
_____		
Skin cells		—
Pores		—
Melona (freckles)		—
3 layers		—
129. Total number of accurately identified parts.		— —
130. Total number of inaccurately identified parts.		— —

VARIABLE	CODE	COLUMN #
Part VII: Skin (Continued)		
131. List specific inaccuracies:		
_____		
_____		
_____		
_____		
132. Location: Accuracy of locating entire system.	1 yes 2 no	—
List inaccuracies:		
_____		
_____		
_____		
133. Location: Accuracy of locating specific parts of system.	1 yes 2 no	

Part	Inaccurate (Describe)	Accurate (Code)
Skin		
Epidermis	_____	—
Dermis	_____	—
Subcutaneous Tissue	_____	—
Sweat Gland	_____	—
Sebaceous Gland	_____	—
Hair	_____	—
Hair Follicle	_____	—
Peripheral Nerves	_____	—
Brain	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Skin cells	_____	—
Pores	_____	—
Melana (freckles)	_____	—
3 layers	_____	—

VARIABLE	CODE	COLUMN #
Part VII: Skin (Continued)		
134. Total number of specific parts of system accurately located.		— —
135. Total number of specific parts of system inaccurately located.		— —
136. Accurately identified purposes/functions of entire system.	1 yes 2 no	
Protection		—
Heat Regulation		—
Sensation (tactile)		—
Other (List):		
_____		
_____		
_____		
137. Total number of accurately identified purposes/functions of entire system.		— —
138. Total number of inaccurately identified purposes/functions of entire system.		— —
List inaccurate functions/purposes of entire system:		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part VII: Skin (Continued)		
139. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Skin - protection, sensation, heat regulation	_____	—
Epidermis - protects body from environment	_____	—
Dermis - contains blood vessels & nerves	_____	—
Subcutaneous Tissue - regulates body heat	_____	—
Sweat Gland - helps cool body	_____	—
Sebaceous gland - protects elasticity of skin/hair	_____	—
Peripheral Nerves - carry tactile message to brain	_____	—
Brain - receive tactile message, interpret, respond	_____	—
Hair	_____	—
Hair follicle	_____	—
Skin cells	_____	—
Pores	_____	—
Melana (freckles)	_____	—
3 layers	_____	—

140. Total number of accurately identified functions of specific parts of the system.	— —
141. Total number of inaccurately identified functions of specific parts of the system.	— —

VARIABLE	CODE	COLUMN #

Part VII: Skin (Continued)

142. Other specific facts mentioned:

_____
_____
_____

143. Health aspects of the system listed:

_____
_____
_____
_____

144. Illness aspects of the system listed:

_____
_____
_____
_____

145. Accurately identified interrelations with other systems: 1 yes 2 no

Other System	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Neurological	_____	__
Muscular	_____	__
Cardiovascular	_____	__
Other (List):		
_____	_____	
_____	_____	
_____	_____	

146. Total number of accurate interrelations with other systems. __ __

VARIABLE	CODE	COLUMN #

Part VII: Skin (Continued)

147. Total number of inaccurate interrelations with other systems. __ __

Part VIII: Skeletal System

148. Accurately identified parts: 1 yes 2 no

Bone	
Ligament	__
Cartilage	__
Tendon	__
Hinge Joint	__
Rotating Joint	__
Ball and Socket Joint	__
Skull	__
Vertebrae (Backbone)	__
Pelvic Girdle	__
Rib Cage	__
Sternum	__
Clavicle	__
Scapula	__
Humerus	__
Radius	__
Ulna	__
Carpals	__
Phalanges (fingers)	__
Femur	__
Tibia	__
Fibula	__
Patella	__
Tarsals	__
Phalanges (toes)	__
Other (List):	__
_____	
_____	
_____	

VARIABLE	CODE	COLUMN #
Part VIII: Skeletal System (Continued)		
148. (Continued)		
Teeth		—
Metatarsals		—
Metacarpals		—
Tailbone		—
Parietal bone		—
Occeptal bone		—
Joints		—
Nose		—
Elbow		—
Jaw		—
Facebones		—
Cheek		—
Eye orbit		—
Chin		—
149. Total number of accurately identified parts.		— —
150. Total number of inaccurately identified parts.		— —
151. List specific inaccuracies:		
_____		
_____		
_____		
152. Location: Accuracy of locating entire system.	1 yes 2 no	—
List inaccuracies:		
_____		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part VIII: Skeletal System (Continued)		
153. Location: Accuracy of locating specific parts of system.	1 yes 2 no	

Part	Inaccurate (Describe)	Accurate (Code)
Bone	_____	—
Ligament	_____	—
Cartilage	_____	—
Tendon	_____	—
Hinge Joint	_____	—
Rotating Joint	_____	—
Ball and Socket Joint	_____	—
Skull	_____	—
Vertebrae (Backbone)	_____	—
Pelvic Girdle	_____	—
Rib Cage	_____	—
Sternum	_____	—
Clavicle	_____	—
Scapula	_____	—
Humerus	_____	—
Radius	_____	—
Ulna	_____	—
Carpals	_____	—
Phalanges (fingers)	_____	—
Femur	_____	—
Tibia	_____	—
Fibula	_____	—
Patella	_____	—
Tarsals	_____	—
Phalanges (toes)	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Teeth	_____	—
Metatarsals	_____	—
Metacarpals	_____	—
Tailbone	_____	—
Parietal bone	_____	—
Occepital bone	_____	—
Joints	_____	—
Nose	_____	—

VARIABLE	CODE	COLUMN #
Part VIII: Skeletal System (Continued)		
153. (Continued)		
Elbow	_____	—
Jaw	_____	—
Facebones	_____	—
Cheek	_____	—
Eye orbit	_____	—
Chin	_____	—
154. Total number of specific parts of system accurately located.		— —
155. Total number of specific parts of system inaccurately located.		— —
156. Accurately identified purposes/functions of entire system.	1 yes 2 no	
	Gives body shape and structure	—
	Attachment for muscles to allow for movement	—
	Protectrion of important organs	—
	Other (List):	
	_____	
	_____	
	_____	
	Movement	—
157. Total number of accurately identified purposes/functions of entire system.		— —

VARIABLE	CODE	COLUMN #
Part VIII: Skeletal System (Continued)		
158. Total number of inaccurately identified purposes/functions of entire system.		— —
List inaccurate functions/purposes of entire system:		
_____		
_____		
_____		
_____		
159. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Bone - structure, movement, protection	_____	—
Ligament - attachment of bones	_____	—
Cartilage - cushions bones	_____	—
Tendon - attachment of muscle	_____	—
Hinge Joint - bend (1 direction)	_____	—
Rotating Joint - turning/circular movement	_____	—
Ball and Socket Joint - circular movement	_____	—
Skull - protect brain	_____	—
Vertebrae (Backbone) - protects spinal cord	_____	—
Pelvic Girdle - protects intestines	_____	—
Rib cage - protect heart and lungs	_____	—
Sternum - protect heart and lungs	_____	—
Clavicle - protect heart and lungs	_____	—

VARIABLE	CODE	COLUMN #

Part VIII: Skeletal System (Continued)

159. (Continued)

Function	Inaccurate (Describe)	Accurate (Code
Scapula - protect heart and lungs		
Humerus - movement of upper arm		
Radius - movement of forearm		
Ulna - movement of forearm		
Carpals - movement hand/wrist		
Phalanges (fingers) - movement		
Femur - movement upper leg/thigh		
Tibia - movement lower leg		
Fibula - movement lower leg		
Patella - movement lower leg		
Tarsals - movement foot/toes		
Phalanges (toes) - movement		
Other (List):		
Teeth		
Metatarsals		
Metatarsals		
Tailbone		
Parietal bone		
Occepital bone		
Joints		
Nose		
Elbow		
Jaw		
Facebones		
Cheeks		
Eye orbit		
Chin		

VARIABLE	CODE	COLUMN #

Part VIII: Skeletal System (Continued)

160. Total number of accurately identified functions of specific parts of the system. — —

161. Total number of inaccurately identified functions of specific parts of the system. — —

162. Other specific facts mentioned:

163. Health aspects of the system listed:

164. Illness aspects of the system listed:

VARIABLE	CODE	COLUMN #
Part VIII: Skeletal System	(Continued)	
165. Accurately identified interrelations with other systems:	1 yes 2 no	

Other System	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Muscular	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Neurological	_____	—
Digestive	_____	—

166. Total number of accurate interrelations with other systems.		— —
167. Total number of inaccurate interrelations with other systems.		— —
Part IX: Muscular System		
168. Accurately identified parts.	1 yes 2 no	
Muscles		—
Biceps		—
Triceps		—
Deltoid		—
Tendon		—
Other (List):		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part IX: Muscular System	(Continued)	
168. (Continued)		
Feet		—
Leg (gastrocnemius)		—
Thigh (sartorius)		—
Quadriceps		—
Back (latismue dorsii)		—
Hand		—
Heart		—
Stomach		—
Rectus abdominus		—
Trapezius (shoulder)		—
Face		—
Chest (pectoralis major)		—
Sternocleidomastoid		—
Hamstrings		—
Gluteus maximus		—
169. Total number of accurately identified parts.		— —
170. Total number of inaccurately identified parts.		— —
171. List specific inaccuracies:		
_____		
_____		
_____		
_____		
172. Location: Accuracy of locating entire system.	1 yes 2 no	—
List inaccuracies:		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #

Part IX: Muscular System (Continued)

173. Location: Accuracy of locating specific parts of system. — 1 yes, 2 no

Part	Inaccurate (Describe)	Accurate (Code)
Muscles		
Biceps		
Triceps		
Deltoid		
Tendon		
Other (List):		
Feet		
Leg (gastrocnemius)		
Thigh (sartorius)		
Quadriceps		
Back (latismus dorsii)		
Hand		
Heart		
Stomach		
Rectus abdominus		
Trapezius (shoulder)		
Face		

174. Total number of specific parts of system accurately located. — — —

175. Total number of specific parts of system inaccurately located. — —

176. Accurately identified purposes/functions of entire system. — 1 yes, 2 no

Movement - bone, joints, posture —
Expression - facial, postural —

VARIABLE	CODE	COLUMN #

Part IX: Muscular System (Continued)

176. (Continued)

Other (List):

Make strong —
Growth —
Cardiac function —

177. Total number of accurately identified purposes/functions of entire system. — —

178. Total number of inaccurately identified purposes/functions of entire system. — —

List inaccurate functions/purposes of entire system:

179. Accurately identified functions of specific parts of the system. — 1 yes, 2 no

Function	Inaccurate (Describe)	Accurate (Code)
Muscles - movement		
Biceps - flexes the arm		
Triceps - extends the arm		
Deltoid - raises the shoulder		
Tendon - attaches muscle to bone		
Other (List):		

VARIABLE	CODE	COLUMN #

Part IX: Muscular System (Continued)

179. (Continued)

Feet		
Leg (gastrocnemius)		
Thigh (sartorius)		
Quadriceps		
Back (latismus dorsii)		
Hand		
Heart		
Stomach		
Rectus abdominus		
Trapezius (shoulder)		
Face		
Chest (pectoralis major)		
Sternocleidomastoid		
Hamstrings		
Gluteus maximus		

180. Total number of accurately identified functions of specific parts of the system. ___

181. Total number of inaccurately identified functions of specific parts of the system. ___

182. Other specific facts mentioned:

_____
_____
_____
_____

183. Health aspects of the system listed:

_____
_____
_____
_____

184. Illness aspects of the system listed:

_____
_____
_____
_____

VARIABLE	CODE	COLUMN #

Part IX: Muscular System (Continued)

185. Accurately identified interrelations with other systems: 1 yes, 2 no

Other System	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Skeletal		
Other (List):		
_____		
_____		
_____		
Skin		
Digestive		
Neurological		
Cardiovascular		
Respiratory		

186. Total number of accurate interrelations with other systems. ___

187. Total number of inaccurate interrelations with other systems. ___

Part X: Neurological System

A. Entire System

188. Accurately identified parts. 1 yes, 2 no

Brain	
Spinal cord	
Peripheral Nerves	
Other (List):	
_____	
_____	
_____	
Lobes (frontal, parietal, temporal, occepital)	
Brain stem (medulla)	
Hypothalmus	
Thalmus	

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
A. Entire System (Continued)		
189. Total number of accurately identified parts.		— —
190. Total number of inaccurately identified parts.		— —
191. List specific inaccuracies:		
_____		
_____		
_____		
_____		
192. Location: Accuracy of locating entire system.	1 yes 2 no	—
List inaccuracies:		
_____		
_____		
_____		
_____		
193. Location: Accuracy of locating specific parts of system.	1 yes 2 no	

Part	Inaccurate (Describe)	Accurate (Code)
Brain		
Spinal cord	_____	—
Peripheral Nerves	_____	—
	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Lobes (frontal, parietal, temporal, occepital)		
Brain stem (medulla)	_____	—
Hypothalmus	_____	—
Thalmus	_____	—
	_____	—

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
A. Entire System (Continued)		
194. Total number of specific parts of system accurately located.		— —
195. Total number of specific parts of system inaccurately located.		— —
196. Accurately identified purposes/functions of entire system.	1 yes 2 no	
Problem-solving		—
Sending messages to parts of body		—
Controlling internal state		—
Sensory (taste, touch, smell, etc.)		—
Other (List):		
_____		
_____		
_____		
Speech		—
197. Total number of accurately identified purposes/functions of entire system.		— —
198. Total number of inaccurately identified purposes/functions of entire system.		— —
List inaccurate functions/purposes of entire system:		

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
A. Entire System (Continued)		
198. (Continued)		
199. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Brain - memory, imagination, problem-solving, sending messages to/from rest of nervous sytem	_____	___
Spinal cord - send/ receive messages to/from peripheral nerves & brain	_____	___
Peripheral Nerves - bring messages to brain from outside & inside world	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Lobes (frontal, parietal, temporal, occepital	_____	___
Brain stem (medulla)	_____	___
Hypothalmus	_____	___
Thalmus	_____	___

200. Total number of accurately identified functions of specific parts of the system.	___
201. Total number of inaccurately identified functions of specific parts of the system.	___

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
A. Entire System (Continued)		
202. Other specific facts mentioned:		
_____		
_____		
_____		
_____		
203. Health aspects of the system mentioned:		
_____		
_____		
_____		
_____		
204. Illness aspects of the system listed:		
_____		
_____		
_____		
_____		
205. Accurately identified interrelations with other systems.	1 yes 2 no	

Other System	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Cardiovascular		
Eye (vision)	_____	___
Ear (hearing)	_____	___
Sweat	_____	___
Respiratory	_____	___
Urinary	_____	___
Muscular	_____	___
Endocrine	_____	___
	_____	___

VARIABLE	CODE	COLUMN #

Part X: Neurological System

A. Entire System (Continued)

205. (Continued)

Other (List):

_____ _____
_____ _____
_____ _____

Skeletal	_____	
Skin (touch)	_____	—
Nose (smell)	_____	—
Mouth (taste)	_____	—
Speech	_____	—

206. Total number of accurate interrelations with other systems. — —

207. Total number of inaccurately identified interrelations with other systems. — —

B. Hearing

208. Accurately identified parts: 1 yes 2 no

Ears	
Auricle (ear lobe)	—
Semicircular canal	—
Maleus (hammer)	—
Auditory Canal	—
Incus (anvil)	—
Cochlea	—
Stapes	—
Tympanic Membrane	—
Auditory Nerve	—
Brain	—

Other (List):

_____
_____
_____

Cerumen (wax)	
Eustachian tube	—
Cilia	—
	—

VARIABLE	CODE	COLUMN #

Part X: Neurological System

B. Hearing (Continued)

209. Total number of accurately identified parts. — —

210. Total number of inaccurately identified parts. — —

211. List specific inaccuracies:

_____
_____
_____
_____

212. Location: Accuracy of locating entire system. 1 yes 2 no —

List inaccuracies:

_____
_____
_____
_____

213. Location: Accuracy of locating specific parts of system. 1 yes 2 no

Part	Inaccurate (Describe)	Accurate (Code)
Ears		
Auricle	_____	—
Semicircular canal	_____	—
Maleus	_____	—
Auditory Canal	_____	—
Incus	_____	—
Cochlea	_____	—

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
B. Hearing (Continued)		
213. (Continued)		
Stapes	_____	—
Tympanic membrane	_____	—
Auditory Nerve	_____	—
Brain	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Cerumen (wax)	_____	—
Eustachian tube	_____	—
Cilia	_____	—
214. Total number of specific parts of system accurately located.		— —
215. Total number of specific parts of system inaccurately located.		— —
216. Accurately identified purposes/functions of entire system.	1 yes 2 no	
Sensation (auditory)		—
Transportation of sound waves		—
Interpretation of sound (communication)		—
Other (List):		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
B. Hearing (Continued)		
217. Total number of accurately identified purposes/functions of entire system.		— —
218. Total number of inaccurately identified purposes/functions of entire system.		— —
219. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Ears - hearing	_____	—
Auricle - catches sound waves	_____	—
Semicircular Canal - fluid filled, moves sound wave	_____	—
Maleus - attached to/ moves incus	_____	—
Auditory Canal - tunnel carries sound wave to T.M.	_____	—
Incus - attached to/ moves stapes	_____	—
Cochlea - fluid filled; moves sound wave	_____	—
Stapes - attached to cochlea, moves cochlear fluid	_____	—
Tympanic Membrane - bounces to push/pull maleus	_____	—
Auditory nerve - sends message to brain	_____	—

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
B. Hearing (Continued)		
219. (Continued)		
Function	Inaccurate (Describe)	Accurate (Code)
Brain - receives, interprets sound message	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Cerumen (wax)	_____	___
Eustachian tube	_____	___
Cilia	_____	___
220. Total number of accurately identified functions of specific parts of the system.		___
221. Total number of inaccurately identified functions of specific parts of the system.		___
222. Other specific facts mentioned:		
_____		
_____		
_____		
_____		
223. Health aspects of the system listed:		
_____		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
B. Hearing (Continued)		
224. Illness aspects of the system listed:		
_____		
_____		
_____		
_____		
225. Accurately identified interrelations with other systems.	1 yes 2 no	
Other System	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Neurological (entire)	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	
226. Total number of accurately identified interrelations with other systems.		___
227. Total number of inaccurately identified interrelations with other systems.		___

VARIABLE	CODE	COLUMN #
Part X: Neurological System (Continued)		
C. Sight		
228. Accurately identified parts:	1 yes 2 no	
Eyes		
Iris		
Pupil		
Lens		
Optic Nerve		
Vitreous Body		
Brain		
Other (List):		
Sclera		
Cornea		
Retina		
Blood vessels		
Eye muscles		
229. Total number of accurately identified parts.		
230. Total number of inaccurately identified parts.		
231. List specific inaccuracies:		
232. Location: Accuracy of locating entire system.	1 yes 2 no	
List inaccuracies:		

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
C. Sight (Continued)		
233. Location: Accuracy of locating specific parts of system.	1 yes 2 no	

Part	Inaccurate (Describe)	Accurate (Code)
Eyes		
Iris		
Pupil		
Lens		
Optic Nerve		
Vitreous Body		
Brain		
Other (List):		
Sclera		
Cornea		
Retina		
Blood vessels		
Eye muscles		

234. Total number of specific parts of system accurately located.		
235. Total number of specific parts of system inaccurately located.		
236. Accurately identified purposes/functions of entire system.	1 yes 2 no	
Sensation (visual)		
Transportation of light waves/picture		

VARIABLE	CODE	COLUMN #

Part X: Neurological System

C. Sight (Continued)

236. (Continued)

Other (List):

_____
_____
_____

Interpretation of visual information ___

237. Total number of accurately identified purposes/functions of entire system. ___

238. Total number of inaccurately identified purposes/functions of entire system. ___

List inaccurate functions/ purposes of entire system:

_____
_____
_____

239. Accurately identified functions of specific parts of the system. 1 yes 2 no

Function	Inaccurate (Describe)	Accurate (Code)
Eyes - vision	_____	___
Iris - similar to camera shutter, accom. light/dark	_____	___
Pupil - similar to camera aperature, constrict/dilate to light/dark	_____	___
Lens - carries picture to brain	_____	___
Optic nerve - carries picture to brain	_____	___
Vitreous Body - carries picture to brain	_____	___

VARIABLE	CODE	COLUMN #

Part X: Neurological System

C. Sight (Continued)

239. (Continued)

Function	Inaccurate (Describe)	Accurate (Code)
Brain - similar to film, records picture, interprets picture	_____	___
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Sclera	_____	___
Cornea	_____	___
Retina	_____	___
Blood vessels	_____	___
Eye muscles	_____	___

240. Total number of accurately identified functions of specific parts of the system. ___

241. Total number of inaccurately identified functions of specific parts of the system. ___

242. Other specific facts mentioned:

_____
_____
_____
_____

243. Health aspects of the system listed:

_____
_____
_____
_____

VARIABLE	CODE	COLUMN #

Part X: Neurological System

C. Sight (Continued)

244. Illness aspects of the system listed:

_____
_____
_____
_____

245. Accurately identified interrelations with other systems:

1 yes
2 no

Other System	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Neurological (entire)	_____	__
Outer Eye (tears)	_____	__
Other (List):		
_____	_____	
_____	_____	
_____	_____	

a. Total number accurately identified interrelations with other systems __ __

b. Total number inaccurately identified interractions with other systems __ __

D. Taste

246. Accurately identified parts:

1 yes
2 no

Mouth		
Tongue	_____	__
Taste Buds	_____	__
Nose	_____	__
Brain	_____	__
Peripheral Nerves	_____	__
	_____	__

VARIABLE	CODE	COLUMN #

Part X: Neurological System

C. Taste (Continued)

246. (Continued)

Other (List):

_____ _____
_____ _____
_____ _____

Saliva	_____	__
Taste buds-the types	_____	__

247. Total number of accurately identified parts. __ __

248. Total number of inaccurately identified parts. __ __

249. List specific inaccuracies:

_____
_____
_____

250. Location: Accuracy of locating entire system.

1 yes
2 no

__

List inaccuracies:

_____
_____
_____

251. Location: Accuracy of locating specific parts of system.

1 yes
2 no

Part	Inaccurate (Describe)	Accurate (Code)
Mouth		
Tongue	_____	__
Taste Buds	_____	__
Nose	_____	__
Brain	_____	__
Peripheral Nerves	_____	__
	_____	__

VARIABLE	CODE	COLUMN # 1/2
Part X: Neurological System		
D. Taste (Continued)		
251. (Continued)		
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Saliva	_____	—
Types of taste buds	_____	—
252. Total number of specific parts of system accurately located.		— —
253. Total number of specific parts of system inaccurately located.		— —
254. Accurately identified purposes/functions of entire system.	1 yes 2 no	
Sensation (pleasure, taste)		—
Protection (from poisoning)		—
Other (List):		
_____		
_____		
_____		
255. Total number of accurately identified purposes/functions of entire system.		— —
256. Total number of inaccurately identified purposes/functions of entire system.		— —

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
D. Taste (Continued)		
256. (Continued)		
List inaccurate functions/purposes of entire system:		
_____		
_____		
_____		
_____		
257. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Mouth - food/liquid reservoir	_____	—
Tongue - tastes	_____	—
Taste Buds - taste discriminate	_____	—
Nose - smell enhances taste	_____	—
Brain - receives taste message, interprets pleasure/dislike	_____	—
Peripheral nerves - send taste message to brain	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Saliva	_____	—
Types of taste buds	_____	—

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
D. Taste (Continued)		
258. Total number of accurately identified functions of specific parts of the system.		— —
259. Total number of inaccurately identified functions of specific parts of the system.		— —
260. Other specific facts mentioned:		
_____		
_____		
_____		
_____		
261. Health aspects of the system listed:		
_____		
_____		
_____		
_____		
262. Illness aspects of the system listed:		
_____		
_____		
_____		
_____		
263. Accurately identified interrelations with other systems:	1 yes 2 no	

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
D. Taste (Continued)		
263. (Continued)		

Other System	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Neurological	_____	—
Digestive	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	

264. Total number of accurately identified interrelations with other systems.		— —
265. Total number of inaccurately identified interrelations with other systems.		— —
E. Smell		
266. Accurately identified parts:	1 yes 2 no	

Nose (nostril)	_____	—
Brain	_____	—
Peripheral nerves	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
E. Smell (Continued)		
267. Total number of accurately identified parts.		— —
268. Total number of inaccurately identified parts.		— —
269. List specific inaccuracies:		
270. Location: Accuracy of locating entire system.	1 yes 2 no	—
List inaccuracies:		
271. Location: Accuracy of locating entire system.	1 yes	

Part	Inaccurate (Describe)	Accurate (Code)
Nose (nostrils)		—
Brain		—
Peripheral Nerves		—
Other (List):		

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
E. Smell (Continued)		
272. Total number of specific parts of system accurately located.		— —
273. Total number of specific parts of system inaccurately located.		
274. Accurately identified purposes/functions of entire system.	1 yes 2 no	
Sensation (pleasure - aroma)		—
Sensation (enhanse taste)		—
Protection (noxious inhalants)		—
Other (List):		
275. Total number of accurately identified purposes/functions of entire system.		— —
276. Total number of inaccurately identified purposes/functions of entire system.		— —
List inaccurate functions/purposes of entire system:		

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
E. Smell (Continued)		
277. Accurately identified functions of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Nose - smell	_____	__
Brain - receives olfactory message; interprets pleasure/ dislike	_____	__
Peripheral nerves - send olfactory message to brain	_____	__
Other (List):		
_____	_____	
_____	_____	
_____	_____	

278. Total number of accurately identified functions of specific parts of the system.	__ __
279. Total number of inaccurately identified functions of specific parts of the system.	__ __
280. Other specific facts mentioned:	
_____	
_____	
_____	
_____	

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
E. Smell (Continued)		
281. Health aspects of the system listed:		
_____		
_____		
_____		
_____		
282. Illness aspects of the system listed:		
_____		
_____		
_____		
_____		
283. Accurately identified interrelations with other systems:	1 yes 2 no	

Other System	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Neurological (entire)	_____	__
Respiratory	_____	__
Other (List):		
_____	_____	
_____	_____	
_____	_____	

284. Total number of accurate inter-relations with other systems.	__ __
285. Total number of inaccurately identified interrelations with other systems.	__ __

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
F. Touch		
286. Accurately identified parts:	1 yes 2 no	
Any body surface		—
Brain		—
Peripheral nerves		—
Other (List):		
_____		
_____		
_____		
Spinal cord		—
287. Total number of accurately identified parts.		— —
288. Total number of inaccurately identified parts.		— —
289. List specific inaccuracies:		
_____		
_____		
_____		
_____		
290. Location: Accuracy of locating entire system.	1 yes 2 no	—
List inaccuracies:		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
F. Touch (Continued)		
291. Location: Accuracy of locating specific parts of system.	1 yes 2 no	
Part	Inaccurate (Describe)	Accurate (Code)
Body Surface	_____	—
Brain	_____	—
Peripheral nerves	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Spinal cord	_____	—
292. Total number of specific parts of system accurately located.		— —
293. Total number of specific parts of system inaccurately located.		— —
294. Accurately identified purposes/functions of entire system	1 yes 2 no	
Sensation (tactile, pleasure, pain)	_____	—
Protection (withdrawal from heat)	_____	—
Tactile expression of emotion	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
F. Touch (Continued)		
295. Total number of accurately identified purposes/functions of entire system.		— —
Total number of inaccurately identified purposes/functions of entire system.		— —
List inaccurate functions/purposes of entire system:		
_____		
_____		
_____		
296. Accurately identified functions of specific parts of the system.	1 yes 2 no	

Function	Inaccurate (Describe)	Accurate (Code)
Body surface - touch		
Brain - receives tactile message; interprets pleasure/ danger	_____	—
Peripheral Nerves - send tactile message to brain	_____	—
	_____	—
Other (List):		
_____	_____	
_____	_____	
_____	_____	
Spinal cord	_____	—

VARIABLE	CODE	COLUMN #
Part X: Neurological System		
F. Touch (Continued)		
297. Total number of accurately identified functions of specific parts of the system.		— —
298. Total number of inaccurately identified functions of specific parts of the system.		— —
299. Other specific facts mentioned:		
_____		
_____		
_____		
_____		
300. Health aspects of the system listed:		
_____		
_____		
_____		
_____		
301. Illness aspects of the system listed:		
_____		
_____		
_____		
_____		

VARIABLE	CODE	COLUMN #

Part X: Neurological System

F. Touch (Continued)

302. Accurately identified interrelations with other systems:

1 yes
2 no

Other System	Description of Interrelationship (If inaccurate, describe)	Accurate (Code)
Neurological		
Muscular		
Skin		
Other (List):		

303. Total number of accurately identified interrelations with other systems. ___

304. Total number of inaccurately identified interrelations with other systems. ___

APPENDIX E

Informed Consents

School and Parents

THE OREGON HEALTH SCIENCES UNIVERSITY

School of Nursing
Department of
Family Nursing

3181 S.W. Sam Jackson Park Road Portland, Oregon 97201 (503) 225-8382

April 12, 1983

Mr. Ted Lotze, Principal
Howard Eccles School
562 N.W. 5th St.
Canby, Oregon
97013

Dear Mr. Lotze:

Please find enclosed materials relevant to our conversation of March 29th, 1983, regarding my desire to interview Eccles students as part of a research study.

I am a graduate nursing student in the Ambulatory Pediatric Master's program at the Oregon Health Sciences University, Portland, Oregon and am particularly interested in the physical and emotional development of the school age child. It is my wish to meet the course research requirement by looking at the age group represented in grades one through four.

For this research effort I have been afforded the opportunity and priviledge to work with Dr. Marie Scott Brown, a University Professor, who has done considerable work in the area of children's understanding about their bodies, emotions, and the relationship between the two. With Dr. Brown's permission, I have enclosed a copy of the abstract, literature review, and bibliography from the grant she wrote for her research with the preschool age child in the above mentioned areas.

My particular part of her project will be to broaden the data base to include the school age child in an effort to further get at how children developmentally learn about the physiological processes of their bodies. The enclosed tool, developed by Dr. Brown, needs to be tested for reliability and validity with this particular age group. My thesis topic will focus on this area.

As discussed with you, my need is for a population of approximately forty children that I can interview via tape recorder using the enclosed questionnaire. I would like to request permission to collect this data at Eccles

school and should permission be granted, would like to do so during the summer of 1983.

I am aware of the need to obtain parental permission and will develop and submit a letter for this purpose. The Health Sciences University Human Subjects Committee has reviewed and approved Dr. Brown's research project (see enclosed copy). I will also assume the responsibility for gaining parental approval as well as providing pre-interview and post-interview information to those parents who agree to participate in the study.

I will be happy to comply in providing you with any further information necessary and wish to thank you for consideration of my request.

Sincerely,

[redacted]

Sara Scheer, R.N., B.S.N.

THE OREGON HEALTH SCIENCES UNIVERSITY

School of Nursing
Department of
Family Nursing

3181 S.W. Sam Jackson Park Road Portland, Oregon 97201 (503) 225-8382

June 23, 1983

Mr. Ted Lotze, Principal
Howard Eccles School
562 N. W. 5th St.
Canby, Oregon
97013

Dear Mr. Lotze:

Please find enclosed the cover letter to parents and the permission form for my study. These have been approved by my advisor, Dr. Marie Scott Brown and also meet the standards required by the Human Subjects Committee at the Oregon Health Science University.

If this information meets with your approval, I will prepare the materials for distribution to four classes, one from each grade level. In thinking about summer schedule, it seems feasable to try to get enough students out of four classes from B track. The permission forms could be distributed after they settle into the new school year toward the end of July or the first part of August.

I would appreciate meeting with the teachers as you suggested, for explanation of the study and the data collection process. Perhaps this could be done soon after they return from the July break. My schedule for interviewing is flexible through the end of September but I would like to get started after the August vacation.

I will call next week to see if the enclosed information is acceptable. Thank you so much for your assistance in this project.

Sincerely,

[redacted]

Sara Hewitt Scheer, R.N., B.S.N.

THE OREGON HEALTH SCIENCES UNIVERSITY

School of Nursing
Department of
Family Nursing

3181 S.W. Sam Jackson Park Road Portland, Oregon 97201 (503) 225-8382

July 15, 1983

Dear Parent:

I am a Registered Nurse currently working on a research study toward completion of thesis requirements toward a Master of Nursing degree. My primary interest is in the area of children's understanding of their physical development.

My research in this area is being conducted under the direction of Marie Scott Brown, R.N., Phd., a University Professor who has done considerable work in the area of children's understanding about their bodies, emotions and the relationship between the two.

The focus for my part of this study is to look at how children developmentally learn about the anatomy and physiology of their bodies. In order to obtain this information, a tape recorded interview will be conducted with each participant, using the "Body Knowledge" questionnaire developed by Dr. Brown. Content areas on the questionnaire include the digestive system and elimination, the respiratory and circulatory system, bones and muscles, the nervous system with the brain and spinal cord, the eyes, ears, and the skin. A copy of the questionnaire is available upon request (see below).

I would appreciate your permission to have your child participate in this study. Interview time is expected to be 10 to 30 minutes per child and will be conducted by the investigator during the school day.

Your child will not directly benefit from participation; however the knowledge obtained may contribute to an increased knowledge of children's awareness of body structure and function which in turn might impact upon health awareness, the delivery of health education,and subsequent illness prevention over the life span.

I would appreciate your completing the attached permission slip and returning it to the school. If you wish to see a questionnaire prior to giving permission for your child to participate, please sign below and return to the school. If you have further questions, please contact Sara Scheer at 266-2511.

Thank you.

Sara Hewitt Scheer, R.N., B.S.N.

I would like to see the "Body Knowledge" questionnaire prior to granting permission for my child to participate in the study about how children developmentally learn about their body and how it works.

_____ (Date)

_____ (Parent/Guardian Signature)

THE OREGON HEALTH SCIENCES UNIVERSITY

School of Nursing
Department of
Family Nursing

3181 S W Sam Jackson Park Road Portland, Oregon 97201 (503) 225-8382

INFORMED CONSENT

You are being asked to participate in a study entitled, "The Development of Children's Knowledge of Their Bodies, Their Emotions, and the Relationship Between the Two" conducted by Sara Hewitt Scheer, R.N., B.S.N. under the direction of Marie Scott Brown, R.N.,Phd. The purpose of this phase of the study is to learn more about young children's understanding of their body and how it works. If your child becomes anxious or nervous during the interview he or she will be free to stop the interview.

If you choose to allow your child to participate in the study, he or she will be interviewed on one occasion for a period of 10 to 30 minutes. During this session, the interviewer will ask him/her about his/her understanding of the body and how it works. He or she will be free to refuse to participate or to stop participation at any time.

There will be no direct benefits or risks to your child should you decide to allow him or her to participate in the study.

It is not the policy of the Department of Health and Human Services, or any other agency funding the research project in which you are participating to compenstae or provide medical treatment for human subjects in the event the research results in physical injury. The Oregon Health Sciences University, as an agency of the state, is covered by the state liability fund. If you suffer any injury from the research project, compensation would be available to you only if you establish that the injury occurred through the fault of the University, its officers or employees. If you have further questions please call Dr. Michael Baird, MD, at (503) 225-8014.

Sara Scheer, under the direction of Dr. Brown has offered to answer any questions I might have. I have read the foregoing and agree to allow my child to participate in this study.

_____ _____

date Signature of parent

_____ _____

date Signature of witness

AN ABSTRACT OF THE THESIS OF

Sara Hewitt Scheer

For the MASTER OF NURSING

Date of Receiving this Degree: June 14, 1985

Title: THE DEVELOPMENT OF CHILDREN'S IDEAS ABOUT THE CONTENT AND FUNCTION OF THEIR BODIES: A METHODOLOGICAL STUDY

Approved: _____
Marie Scott Brown, R.N., Ph.D., Thesis Advisor

This study was designed to investigate the validity and reliability of one specific instrument "Brown's Inventory of Body Knowledge" which is a structured, open ended questionnaire designed to be used with children 2½ to 12 years of age. Children's knowledge of their body parts, location of parts, function of parts, and the purpose of systems for 15 body systems was investigated using this instrument which in the process of refinement, underwent three revisions.

Forty grade school children, grades one through four, were interviewed and audio taped. Following coding, nine research questions, six of which incorporated directional hypotheses addressing the underlying construct, children's knowledge about their bodies, were statistically and descriptively analyzed. In the descriptive analysis

children's knowledge of the health and illness aspect of each of the 15 systems investigated was evaluated.

Results provide evidence that the Brown instrument has construct validity. The findings reveal that there is a developmental sequence with which children's knowledge of their body is acquired. A strong relationship between children's knowledge of their body and grade level is evident and the results suggest that there may be a leap in knowledge between the second and third grade. A linear progression of knowledge suggests that children first learn about the sensory systems, followed by digestive processes and then, bones.

Children in general appear to know more about the purpose of the overall system than about the specific details of parts, location and function of parts. Children's knowledge of body parts also appears to be highly related to the location and function of those parts.

The overall results of this study support those findings reported in the literature. However, children in this study demonstrated knowledge of their bodies at a younger age than in Gellert's (1962) work upon which Brown based her original investigative effort. The findings add to the knowledge base of how children learn about their bodies and further identify children's developmental acquisition of this knowledge.

Children's early awareness of their sensory organs as well as their specific ideas about health and illness of 15 body systems, was identified in the results. An unexpected, positive result revealed in the coding process, was the spontaneous health teaching that occured during the interview process.

Through the methodological approach of this study, the construct validity of "Brown's Inventory of Body Knowledge" instrument was established. Related research to further establish the validity and reliability of the Brown instrument is suggested from the results.