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ABSTRACT

DEAF CHILDREN'S KNOWLEDGE OF THEIR INTERNAL BODY PARTS

By

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In child developmental literature children's knowledge of their internal body parts is placed within a Piagetian framework. Comparison of deaf and hearing children's knowledge also occurs within this framework. Reframing the comparison, with an understanding of the concept of Deaf culture, affects the methodology and interpretation of research studies. This study utilized a drawing test with 29 Deaf children and American Sign Language interviews with half of these children.

Results from the drawing exercise suggest the children know names for fewer body parts than would be expected for their ages based on previous studies with hearing children. The children were able to name a greater number of parts during the interviews than on their drawings. The children's explanations regarding the function of the heart and the movement of food through the body did not correspond with previously generated developmental stages, based on studies with hearing children.

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Introduction

Medical school involves a certain enculturation process. My experience has involved a transformation of my framework for understanding the human body. I entered medical school still equipped with vague ideas about the function of various organs. For example, I was certain the spleen had some other function aside from its ability to "rupture". I have learned new stories about the body. As they are repeated over and over again these new stories become my story.

Children undergo a similar transformation in their increasing understanding of human body structure and functions. They may begin with initial observations: blood coming from a wound, the sensation of a pounding heart, a bowel movement, or the act of swallowing food, but the story tying these observations together arises from their particular culture. Initial idiosyncratic notions are replaced as the culturally accepted story is repeated again and again in different forms.

Language plays a central role in passing and assimilating cultural information. In most situations a common language is taken for granted. The child and adult come from the same culture, a language is shared and ideas are communicated in that language.

ASL and Deaf Culture

Deaf parents and their Deaf children share a common language. In these situations deafness can be seen not as a handicap, but as an ethnicity. In this environment the child learns a native language, American Sign Language (ASL). The parents and the child all use the same language and ideas are communicated easily. Numerous authors have discussed various aspects of Deaf culture including shared values, the role of Deaf clubs and organizations, Deaf humor, the high rate of intermarriage among Deaf individuals, and American Sign Language as a natural language with a grammar independent from spoken English. Analyzing the Deaf community and redefining it as a culture allows for a clearer recognition of different child- rearing environments and the impact these environments have on communication.

In the previous paragraph a distinction between "deaf" and "Deaf" has been introduced. In current writings concerning Deaf culture this distinction has come in to use permitting a differentiation between "deaf" (non-hearing) and "Deaf" (relating to cultural aspects). Padden (1980) contributes to the further understanding of this distinction by discussing the differentiation between deaf community and the culture of Deaf people. In making this differentiation she uses a definition of community which incorporates common goals, geographic location, and some degree of freedom.

Based on this definition the deaf community is viewed as encompassing Deaf members, hearing people, and deaf people who are not culturally Deaf. These groups may interact on a daily basis and unite in working with Deaf people on various common concerns. Padden then differentiates the deaf community from Deaf culture explaining, "The culture of Deaf people, however is more closed than the deaf community. Members of the Deaf culture behave as Deaf people do, use the language of Deaf people, and share the beliefs of Deaf people toward themselves and other people who are not Deaf." (Padden 1980, p.93)

To understand the trend towards self-definition of Deafness as a culture, a brief review of the historical context of deaf education is needed. As Beryl Lieff Benderly (1980) points out, it is not the history of deaf people that can be examined, for that is not part of recorded history. Instead, "what has come down to us is the history of their treatment at the hands of the hearing". (Benderly 1980, p.106) Two main threads run throughout recorded history: first a manualist tradition (focusing on the use of sign language for communication), and, alternately, an oralist tradition (focusing on speech and lip reading for communication).

The manualist tradition in education finds its roots in the return of Thomas Hopkins Gallaudet to the U.S. from an investigation of the methods of deaf education overseas. He

brought with him Laurent Clarc, a French manualist deaf educator, to begin a school.

Later in the eighteenth century a school centered on oral training was formed. Students were taught to lip read and communicate using speech. In this environment sign language was viewed as a weakness and students were discouraged from using this form of communication. The oralist movement grew and educationally dominated the scene until very recently.

Throughout the domination of the oralist method the manualist tradition continued among many Deaf individuals. In August 1880, a convention involving 250 to 300 Deaf people initiated the National Association of the Deaf. (Benderly 1980, p.129) This spark of solidarity grew, but the influence of Deaf people on education practices was negligible. For, example, in 1900 an international congress of teachers of the deaf met in Paris. (Benderly 1980, p.129) Hearing professors rallied in support of oralism. Deaf professors met separately and agreed in favor of sign language. The hearing congress refused to meet with the Deaf teachers. In fact, "the chair rejected even a summary of the [D]eaf section's proceeding." (Benderly 1980, p.129) In addition, the report favoring speech was released as the resolution of the congress at large, rather than just the resolution of the hearing group. Although hearing educators were unprepared to accept the use of sign language in

education, the Deaf movement continued to grow.

In the mid-1960's changes appeared again. The idea that possibilities existed beyond the white American norm paved the way for a renewed examination of a Deaf culture. Manual methods began to sweep through deaf school systems.

Each of these two traditions represents a different approach to the rearing of deaf children. "Accepting sign language implies accepting [D]eaf people as a distinct and valid cultural reality." (Benderly 1980, p.133) Oralists maintain that to participate fully in society a person must know the English language and, that with proper training, deaf people can master speech. Furthermore, "hearing society is where deaf people should seek their personal identity and most important relationships." (Benderly 1980, p.144)

Societal norms define the boundaries within which choices about self-definition may occur. The set of boundaries for the deaf population is visualized by Jeffrey and Adenith Nash as in Figure 1. (Nash 1981, p.81)

The continuum of normal socialization refers to how the deaf person views her/himself, ranging from "normal" to "abnormal". Weak normal socialization signifies an acceptance of deafness as a stigmatism. Strong socialization represents the individual who does not view their deafness as an abnormality.

The continuum of acculturation deals with the

individual's involvement in Deaf culture. Unless an individual is born to Deaf parents, this acculturation process will generally occur among peers, as in a residential school for the deaf. Passive acculturation denotes a person who

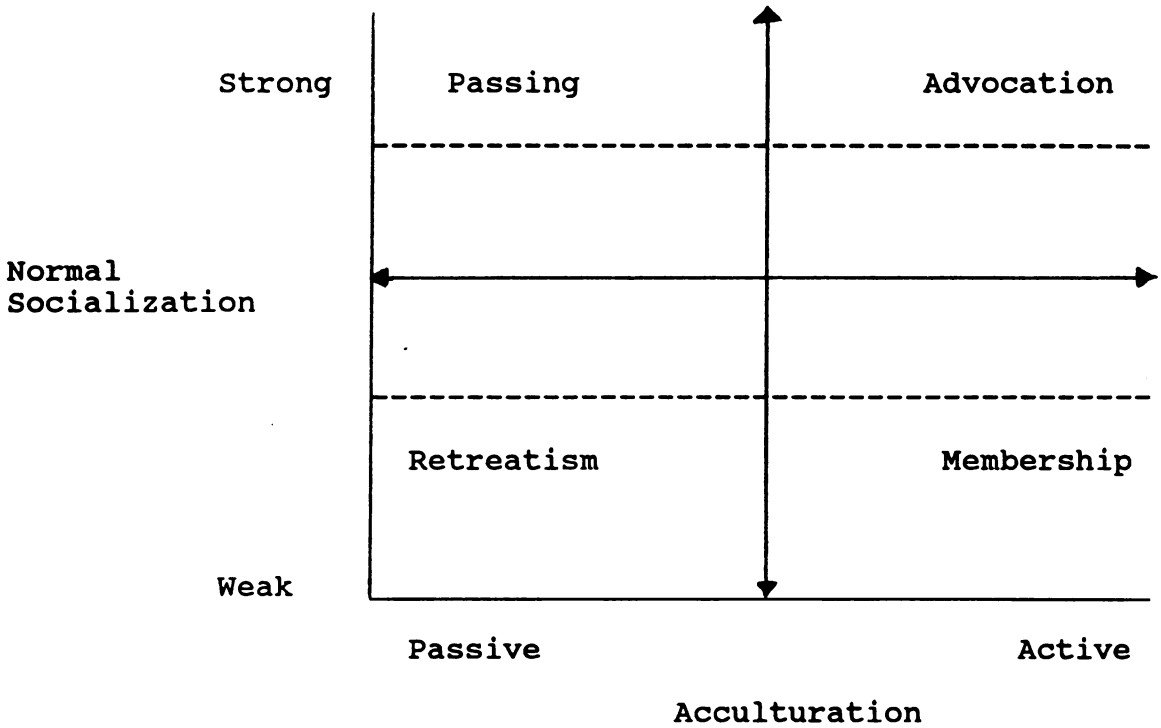


Figure 1- Boundaries for the Deaf Population

misses out on this Deaf socialization process. This structure, which allows for the placement of individuals within a framework of categories (passing, retreatism, advocation, and membership), further emphasizes the effects of different environments on deaf children.

Less than ten percent of prelingually deaf children

Less than ten percent of prelingually deaf children grow up in a family with older deaf relatives. (Meadow 1972, p.19) For the majority of deaf children the situation concerning the potential for language acquisition is less than optimum. Johnson, Liddell and Erting explain:

> Typically, a deaf child is the first deaf person that the members of his [or her] family have ever encountered. For such parents, having a deaf child is generally unexpected and traumatic. Furthermore, their first advice usually comes from a pediatrician or an audiologist, many of whom do not understand the importance of early sign language acquisition. Thus, the parents and siblings of deaf children seldom have the communication skills or the knowledge and experience required to provide these children with an accessible context for the acquisition of either a natural language or the cultural understandings and experiences available to hearing children. (Johnson, Lidell and Erting 1989, p.1)

Without a common language the passage of cultural norms is partially blocked. Many kinds of cultural stories, including stories about the body cannot be retold.

In this situation deafness acts as a handicap. The child is unable to completely master the language of the dominant culture. Usually hearing parents of deaf children find their way to the deaf education system, whose goal has historically been to teach the child the parent's language. Ideally, the child's handicap can be overcome through specialized teaching methods. The parent(s) and the child then share the same language and cultural stories presumably flow freely.

In theory both parents and, later, teachers communicate with the child using "oralist" or "total communication" methods. Oralist methods focus on lip reading skills and speech. The total communication method involves speaking and signing simultaneously. However, since a large majority of educators and parents are hearing, speech is the primary signal and signs are generally made to conform to speech patterns. The result is a simplification of both English and American Sign Language (ASL). To comprehend the language difficulties inherent in the Total Communication environment the concept of American Sign Language as a language distinct from English must be understood. William Stokoe pioneered the linguistic analysis of American Sign Language in 1960 with his publication Sign Language Structure: An Outline of the Visual Communication Systems of the American Deaf. This work led to a movement of further linguistic analysis of ASL elucidating its unique morphology and syntax.

Part of the difficulty in achieving the acceptance of ASL as a language distinct from English lies in the absence of a written form. When signs are represented by concepts in capitalized letters the language appears simplistic. Attempts to devise a system allowing a written translation incorporating the complexities of ASL including facial expression, space, directionality, and descriptor signs often fall short. The more nuances that are captured, the

more unwieldly the text becomes. Translating a visually based language into text will always insufficiently capture the nuances of the language.

Another obstacle blocking the acceptance of ASL lies in the search for a "pure" form of ASL (in many ways similar to the concept of "proper" English). There is not one distinct form of ASL. Many variations, including geographical and subcultural variations (i.e. Southern ASL, African-American ASL), exist.

This problem is exacerbated by intra-cultural communications between Deaf and hearing individuals. Dennis Cokely (1983) hypothesizes that the variations found in signed communication between Deaf and hearing contacts are best understood as an interplay between foreigner talk, judgements of proficiency, and attempts of a learner to master a target language. (Cokely 1983, p.20) When members of the Deaf culture communicate with hearing people both parties tend to alter their sign communications. Deaf individuals will tend to do most of the alterations, modifying signs into a more easily understood simplified form.

Erting (1980) provides an example of a typical clip of total communication found in her research (the child's responses have been eliminated from the interaction). In this situation the teacher is mainly using her primary language (English), and attempting to force signs to fit the

string of words.

Speech: Tell
Signs: TELL

Speech: tell the Easter Bunny...
Signs: SAY HORSE RABBIT

Speech: He said: "no", he's all out
Signs: NO ALL OUTSIDE

Speech: You can take a different color
Signs: DIFFERENT COLOR HIM (index)

Speech: You forgot to say you're...
Signs: FORGET TELL

Speech: say thank-you
Signs: THANK-YOU

Speech: Ah, well go back and make him say thank-you...
Signs: COME BEFORE(past) MAKE TELL THANK-YOU

(Erting 1980, p.171)

Erting points out that not only do the signs and speech not match in this communication, sometimes the meaning of

the teacher's signs contradict the meaning of her speech. Note that the above example involves only a simple communication. It is easy to imagine the further complications involved in communicating increasingly complex ideas, such as cultural stories about the body.

This paper describes research concerning a group of Deaf children's knowledge of human body structure and function. These can be difficult concepts to communicate about, even with a shared language. Although knowledge is the focus of the research, methods of communication played a crucial role in the design of the project, as well as in the collection and evaluation of the data. Rather than viewing the project as repeating previously completed research with "normal" (i.e. hearing) children and comparing it to the results of "handicapped" (i.e Deaf) children, the project is best understood in the above context of ASL and Deaf culture. The implications of this viewpoint will emerge throughout the rest of this paper.

Discussion of Literature

Relevant literature concerning deaf children's knowledge of their internal body parts comes from many fields. The first is studies that have been done with hearing children. A simple Piagetian framework provides the basis for many of these studies. In this type of framework the pre-operational child, age 5-6, perceives the body in a

global, undifferentiated manner. The concrete operational child begins to integrate and/or connect parts. The formal operational child of 10-11 years organizes the body into systems.

The major drawback to this structuralist approach is that it imbues the developmental process with an underlying evolutionary drive. Children begin with primitive, undifferentiated ideas and rise towards higher thinking. In the discussion of her findings Gellert, one of the first investigators to explore children's awareness of their body parts, reminds the reader that:

> [i]t must be kept in mind that the term, correct answers, refers to probable adult norms, rather than to a comprehensive, scientific understanding of human anatomy or physiology. If they were explored, many conceptions lay adults have about the body probably would be found to be fragmentary and inaccurate indeed! (Gellert 1960, p.388-9)

It is not likely that the majority of adults are developmentally stunted. Cultural norms exist concerning ideas about the interior of the body. Most adults learn these norms, incorporate them, and pass them along. This is not to dispute the role of cognitive development; clearly if a child does not develop cognitively there will be a limit to the depth of cultural information the child will assimilate. In addition to cognitive development, the role of culturally determined stories must be taken into account when considering children's knowledge of the inside of their bodies. The "correct answers" will vary from culture to

culture.

A second group of pertinent studies concerns similar investigations with deaf children. These are also based on a Piagetian foundation, imposing the framework and methodologies used with hearing children onto deaf children. A third set of data concerns deaf children's cognitive development compared to that of hearing children. This set of studies raises issues about linguistic skills and cognitive development.

In the first two sets of studies the importance of the cultural environment and communication is not addressed. In the first group of studies conducted with hearing children, a similarity of cultural backgrounds and easy communication is assumed to exist between parents and children. Although this assumption does not remain true for the second cluster of studies conducted with deaf children, the assumption remains unchallenged. The third set of studies struggles with the idea of interactions between linguistic skills and cognitive development, but the question of how they interact for the deaf child remains unanswered.

Review of Literature

Tait and Ascher conducted an investigation in 1955 to developing a psychiatric screening test based on an individual's drawing of the inside of their body. Individuals were asked to draw the inside of the body,

including all internal organs, to draw a line from each organ to the outside, and to label the organ. This research is of interest due to its inclusion of both adult and child subjects.

The groups tested included 100 Naval Academy candidates (all men), 150 patients from psychiatric, medical, and surgical wards of a naval hospital, and 22 sixth grade students. The results of the 100 Naval Academy candidates and the 22 sixth grade students as well as the investigator's framework of body parts and systems is shown in Table 1. The number of internal organs named by the participants is tabulated, and the twelve most popular organs from each group are depicted in the table. In addition, the authors analyzed the drawings according to organ systems. For example, if someone labeled the heart or blood vessels they would be categorized as having included the cardiovascular system in their drawing.

The researchers found that adults labeled the heart most often and the most frequently represented systems for adults were the cardiovascular and gastrointestinal systems. Among the children the single most often mentioned organ was the brain, and skeletomuscular responses predominated. Respiratory and urinary responses ranked seventh and ninth for the children compared to third and fourth for the adults. Identical instructions to draw and label the body's internal organs resulted in different portrayals by children

Table 1- Results of Tait and Ascher Study

	Naval candidates	Sixth-graders
Organs		
Heart	91	14
Lung	86	**
Stomach	74	11
Intestines	81	7
Kidney	44	**
Brain	38	16
Ribs	**	11
Liver	44	**
Penis	18	**
Trachea	16	**
Esophagus	29	**
Pancreas	28	**
Appendix	20	**
Eyes	**	12
Nose	**	12
Knee	**	10
Teeth	**	8
Mouth	**	8
Neck	**	8
"Bones"	**	8
Ear	**	7
Systems		
Cardiovascular	92	14
Gastrointestinal	93	18
Respiratory	85	7
Urinary	47	1
Central Nervous	41	16
Skeletomuscular	17	19
Genital	34	0
Regional	17	13
Special Senses	14	12
Skin	1	3
Hematopoietic	7	0
Endocrine	7	0

and adults. Eventually children become adults and their ideas about the body change. The mystery is how and why they change. As previously mentioned, a simple

developmental framework is often applied to interpret the changes in explanation.

Using her studies concerning children's conceptualizations of their bodies, Crider (1981) attempts to further augment the simple Piagetian developmental framework and describes eight levels of conceptualization through which the ideal child would progress. The first stage includes the absence of knowledge of certain body parts. It also includes parts listed by their geography in the body, rather than by their function. During the second stage organs are assigned global functions. For example, "The heart is for love". (Crider 1981, p.54). In the third stage the child will assign perceptual attributes to organs, such as shape or motion.

Further development leads to stage four when children differentiate structure and function. In addition children link structures together using another substance. For example, at this stage a child might connect the mouth to the stomach by the movement of food. At the fifth stage, children begin to understand organs as active agents (i.e. the heart pumps blood through blood vessels). During the sixth stage there is further discrimination concerning the movement of substances through the body. In this stage the child may depict the heart as having two sides, or the movement of food through the stomach continuuing beyond to involve digestion and the excretion of waste material.

In the seventh stage, transformations of body substances are recognized. For instance, breathing in good air and breathing out bad air. Finally, transformations are understood at the level of cells and chemical reactions. This change allows for physiological explanations to emerge.

Crider admits that in her experience, all children are transitional, manifesting aspects of more than one stage. She also admits that there is a lack of data concerning whether or not the highest developmental levels are consonant among adults. She conjectures that they are not. Despite these conflicts Crider asserts the construction of stages is theoretically useful in understanding the development of children's ideas about their bodies. The application of developmental frameworks to various children's health issues has blossomed over the last two decades and led to the investigation of a wide array of issues: perception of internal body parts, causality of illness, health beliefs, conceptions of medical procedures, and understanding of medical instruments.

Examining the existing literature on the evolving knowledge of internal body parts reveals that the number of body parts named by children increases with age. (Gellert 1962, Porter 1985, Crider 1981, Glaun and Rosenthal 1988). The brain, blood, bones and heart are the most commonly named body parts at younger ages. The stomach and lungs are later added, followed by parts such as the intestines, liver

and kidney. The average number of body parts named at different ages varies by how body parts are defined by the investigator (i.e. is "ribs" different from "bones"). Gellert's data found the average number of parts named at age five to be 3.3, while at the age of 10/11 years the average named was 9.6. Porter found an average of 6.2 parts named at 6/7 years and 15.6 parts named by 10/11 years. Glaun and Rosenthal's study reported an average of 3.4 parts named at 5 years and 8.7 by 10/11 years.

Porter's study, regarding the development of ideas about internal body parts, included 144 children in the first, third and fifth grades. She explains, "Children older than 11 were not studied because, beyond the fifth grade, health teaching increasingly becomes a part of the curriculum so that the child's perceptions are influenced by acquisition of knowledge." (Porter 1985, p.44) This statement reflects an artificial separation between development independent of any formal instruction, and development in relation to the acquisition of knowledge in school. In the educational system, adults teach children culturally accepted information (albeit the dominant culture). It is a formalized system to transfer culturally accepted knowledge. Researchers in this field assume cultural transmission of information concerning the body will occur outside the school system and children's development will result in evolving interpretations of that

information. Information acquired within the school system is treated as contaminating the results of "pure" development.

Two studies completed later attempted to replicate studies about the development of ideas about internal body parts using deaf children as subjects. Gibbon's study (1985) compared the knowledge of ten deaf children to ten hearing children. The ages of the children ranged from 8-10 years old. She used the same test as Porter, providing a prepared outline drawing of a child's body with the facial features drawn in. The children were instructed to draw and label the internal body parts within the outline drawing. She found a significant difference between the number of responses of the two groups. The mean number of body parts named for the non-deaf group was 9.3, compared to 3.0 for the deaf group. (Gibbons 1985, p. 37)

A recent study completed by Badger and Jones (1990) repeated Gibbon's study with much larger numbers. Their study included 80 deaf children and 190 hearing children. They divided the children into three age groups: 5-7 year olds, 8-11 year olds, and 12-15 year olds. The groupings were intended to reflect the three Piagetian developmental stages: preoperational, concrete operational, and formal operational. Using ANOVA they found significant differences in knowledge of the inside of the body based on age and hearing status. They note that the average number of body

parts named by the 5-7 year old hearing children, 4.90, is similar to the average number of parts named by the 12-15 year old deaf children, 4.17 (specific numbers were not provided for the other age groups). (Badger and Jones 1990, p. 203) Badger and Jones concluded that while the developmental pattern was similar for the two groups, the deaf children progressed at a much slower pace through Piaget's cognitive stages.

The validity of the previously discussed assumptions about the cultural transmission of information in relation to these two studies is questionable. The likelihood of cultural transmission of information outside the school system for the deaf children is not addressed. It is not clear if the deaf children in these two studies rely more on the school system for the transmission of culturally based ideas about the body. If this was true the artificial division accepted in previous studies, which assumes the cultural transmission of body stories outside of the school system, may not be valid for all deaf children. Badger and Jones conclude from their study that the deaf children develop at a much slower pace than the hearing children. The differences found may reflect delayed development, the lack of cultural transmission, or an interaction between the two.

Two studies in the third category of research illustrate the difficulty in evaluating cognitive

development separate from linguistic skills. Best and Roberts study (1975) included hearing and deaf children, aged 23-38 months during the first testing, which included sensorimotor tests. The second testing in their research included children aged 36-54 months and incorporated a classification test. They found that deaf children proceeded through Piaget's sensorimotor stage at a pace similar to that of hearing children. In addition, they found similarities among the two groups on cognitive tasks requiring interaction with the environment.

A difference was found between the two groups on a classification task requiring the children to sort picture cards into similar groups. Best and Roberts believe the classification task represents an example of cognitive development more dependent on verbal interaction with the environment, Piaget's "social transmission". (Best and Roberts 1975, p. 25) According to this explanation deaf children lag behind cognitively due to communication difficulties interfering with the part of cognitive development dependent on social interactions.

In 1976 Schlesinger and Meadow compared the performance of deaf and hearing children on three major intelligence tests. They found deaf children generally scored lower on the intelligence tests. (Meadow 1980, p.57) Meadow offers two possible interpretations of the differences observed between the two groups. One interpretation of the

discrepancy reflects an understanding of the communicative difficulties deaf children often encounter in testing situations. (Meadow 1980, p.57) Intelligence tests, while meant to test cognitive abilities rather than knowledge, presuppose a command of the English language. There is also the presupposition that the person administering the exam will speak the same language as the examinees and therefore will be able to clearly communicate directions.

The second interpretation focuses on the lack of linguistic skills adversely affecting cognitive development. (Meadow 1980, p.57) If this hypothesis is true then the scores of deaf children accurately reflect cognitive deficits. Meadow admits the difficulty in distinguishing between the two interpretations and concludes, "It does not appear possible to separate language from thought, and therefore it is not possible to determine precisely whether the difficulties in communication interfere with the performance aspects or with the central processing procedures of intellectual functioning." (Meadow 1980, p.57)

The second finding of Schlesinger and Meadow's study was that even though deaf children scored lower on intelligence tests than hearing children, the pattern of the performance was similar between the two groups. There appeared to be no cognitive gaps among the deaf children. Meadow explains,

> there was no striking difference in the pattern of performance demonstrated by the

> two groups of children. The generalized deficit was not distributed differently over the range of skills tapped by the various subtests. That is, for the performance measures used, no cognitive "holes" were observed among the deaf children, despite their generally lowered IQ ratings. (Meadow 1980, p.57)

These studies, while not providing clear answers, emphasize the importance in questioning the reasons behind deaf children scoring lower on deveopmental exercises.

A factor meriting consideration in the evaluation of a deaf child's test results is the child's environment (i.e. home, school, friends). For example, Gibbons mentions that each of the ten deaf children included in her study have hearing parents. No mention is made of the hearing status of instructors, the parents signing skills, the instructors signing skills, the availability of deaf adults as role models, or what method of manual communication was used by the interpreter. These kind of environmental factors can be expected to affect both the testing setting and result expectations.

Hypotheses

Originally I had four hypotheses. (1) The group of Deaf children in this study would manifest knowledge about internal body parts in a manner similar to that previously reported for hearing children, but at a later age. (2) If the children in this study were tested using the language they were most likely to use amongst themselves and with

other Deaf adults (ASL), a greater number of body parts would be named as compared to test results dependent on English language knowledge. (3) The explanations offered by children in this study concerning the function of the heart would become increasingly complex with increasing age. (4) The explanations offered by children in this study concerning the movement of food through the body would become increasingly intricate with increasing age.

My first hypothesis was based on the previous research concerning hearing children's knowledge of their internal body parts, deaf children's knowledge of their internal body parts, and deaf children's cognitive development. The two studies previously completed which included deaf children reveal differences between hearing and deaf children's knowledge of body parts, with deaf children scoring lower. From the viewpoint of cognitive research this could reflect either communication difficulties or a lack of cognitive development due to language deficits. Looking at the environments of hearing and deaf children from an anthropological perspective, hearing children benefit from the cultural transmission of "body stories". This cultural transmission is not necessarily assured for deaf children, although the likelihood increases for those children more assimilated into Deaf culture. As this is more likely as children grow older, cultural transmission may occur at a later age.

My second hypothesis was based on the idea of linguistic skills and communication impacting the results of test scores. Recognizing that the drawing test presupposes a command of the English language through its requirement of English labels for body parts, I believed changing the testing parameters to exclude this presupposition would result in different findings. Previous research completed with deaf children concerning their knowledge of internal body parts has not challenged this presupposition.

My third hypothesis was based on research completed by Gellert, and later Crider with hearing children pertaining to the function of the heart. They found increasingly complicated explanations of function with increasing age, and this is what I expected to find in the interviews with the Deaf children in the study.

As far as I am aware, there has been no previous research with hearing or Deaf children concerning explanations of the movement of food, the topic of my fourth hypothesis. Based on the previously mentioned studies I expected to find increasingly intricate explanations with increasing age in the section of the interview pertaining to the movement of food also.

Methodology

My research was conducted at a residential school for the deaf. I received permission and support to include

first through eighth graders in the project. Fifty-three students met the grade level criteria. Of that group 41 parents (77%) responded to a letter and follow-up phone call requesting permission for their child's participation in the study. Thirty parents granted permission to have their child included in both the interviewing and drawing exercises. I eliminated one child from the study due to obvious mental deficits and was left with a final sample size of 29.

The age breakdown as shown in Table 2 includes thirteen girls and sixteen boys. Thirteen of the children have hearing parents, fourteen have hard of hearing or deaf parents, and two of the children's parental hearing status is unknown (one child was adopted and one child did not have the information included in their file). The lengths of time the children had attended the school ranged from 1 year to 7 years. The average length of attendance for the 27 students about which this information was available was 3.11 years (Standard deviation=2.04).

Table 2- Age of Children

Age		# of Children	% of Children
6-8	(72-96 Mos.)	6	21%
8-10	(97-120 Mos.)	3	10%
10-12	(121-144 Mos)	11	38%
12-14	(145-168 Mos.)	7	24%
14+	(169+ Mos)	2	7%

A variety of elements impact the children's school environment. Although a few important positions are filled by Deaf adults, the majority of the staff at the school are hearing. Many of the students are from out of town and stay at the school during the week. These children stay in dorms, and many of the dormitory staff are Deaf adults. All children are required to go home on the weekend. The children unable to go home go to foster parents for weekends. Total communication is used in the classrooms; the teachers speak and sign simultaneously during school.

This sample is not representative of deaf children in two major ways. First, less than 10% of deaf children in the general population have Deaf parents, whereas in this sample half of the children do. Second, most deaf children currently attend mainstream programs as a result of legislation requiring children to attend school in the least restrictive environment. Students in mainstreamed programs are kept in a separate classroom in a school for the hearing and/or mainstreamed into hearing classrooms using interpreters. The children in this study attend a residential school. Increasingly, Deaf parents of Deaf children are petitioning state education departments to have their Deaf children placed in schools for the Deaf, arguing that these schools are the least restrictive environments for their children. Sentiments such as these contribute to the higher percentage of Deaf children with Deaf parents in

this sample.

The strength of this sample lies in the fact that the residential school environment is conducive to developing ASL skills through interactions with Deaf adults, and interactions with peers that have learned ASL as a natural language. The second half of this research project assumes a knowledge of ASL equivalent to or better than the child's knowledge of English. It presumably would make no difference to give children an opportunity to express themselves in ASL if they had never learned it. Another important strength of this sample is the large number of students located in one school. Most mainstreaming programs include only a few deaf students, making it difficult logistically to arrange this kind of study with a large number of students.

All of the children included in the study were tested using a projective drawing and labeling test. Half of these children were randomly chosen for interviewing. Of the children interviewed, some were given the drawing exercise before the interview and some after the interview in attempts to minimize any interactive effect. The projective test consisted of an outline drawing of the body with the eyes, nose, mouth and hair drawn in (see Appendix A). Each child was asked to draw the inside of the body and label the parts drawn.

The validity of the drawing exercise when testing Deaf

children is undoubtedly higher than a completely English focused methodology, such as having them write out the body parts they know in a list form. English is still a crucial component in the exercise, as half of the test involves labeling the parts drawn with English names. The purpose of the exercise is to test the child's knowledge of internal body parts, not their knowledge of English. While this is not an issue for most hearing, English speaking children, differences in English skills make it an issue for the children in this sample.

Using the drawing exercise could result in two possible outcomes. First, the children could draw the parts they know and not label the parts they didn't know English names for. Second, the students could only draw parts they know English labels for, leaving out parts they are unable to label. I wanted to maximize the first scenario. During the explanation of the directions, I told the children they should draw all the parts they knew, label all the parts they could and leave the rest unlabeled. Emphasizing the acceptability of not knowing the English names for all the parts, I encouraged children to draw all they knew.

A short-coming in the drawing component of the exercise is even though children might be very willing to draw what they know a scribble, line, or dot having no significance for the researcher may be significant from the child's perspective. Whenever a child handed me a drawing with

scribbles I asked the child to name the scribble. Occasionally a child would sign DON'T-KNOW, but more often the answer was a body part including: BONE, BLOOD, SHIT, and LUNG.

The interview consisted of five sections. (see Appendix B) The first section of the interview tested the validity of the projective drawing test. The second and third sections provided depth to the picture of the children's knowledge of the inside of their bodies. The fourth section was to act as an initial exploration of the children's ideas about health and illness. Not all of the questions in this section were consistently asked, and for that reason this section will not be discussed in depth. The last section provided an opportunity for the children to talk about the body, health and illness on a more personal level.

Wanting to maximize communication I arranged for a Deaf adult familiar with the children to conduct the interviews, in addition to using ASL. This adult was a familiar face to the children, making interviews possible with some of the younger, shy students.

Results

Organizing the data involved recording the number of parts named, the number of parts drawn, the labels used, and additional notes on unusual aspects of the drawings. For the first part of the interview I tabulated the number of

parts signed when describing the inside of the body. I then reviewed each of the replies to questions concerning organ functions. The heart was the only organ consistently discussed, and therefore is the only organ included in the results.

In examining the explanations of where food goes when you swallow it, I recorded the children's descriptions and differences in the interview. After the first three interviews it became apparent that the children were only tracing half a path. The interview was changed to include a prompt if the child stopped at the abdomen when describing the path food takes. In these situations the child was asked if the food stayed in the abdominal area.

The first part of my analysis concerns the drawings completed by the children. After tabulating the number of labels used by each child, I used age as a variable for further evaluation. The mean number for each age group was computed, and a linear regression calculated using age as a predictor variable.

Reviewing the drawings shows that 17 of the children included unlabeled parts in their drawings. The breakdown of labeled parts appears in Table 3. I did not include labels such as "knee", "leg", "arm", "jaw", and "penis" in the results, as they are labels for externally seen parts. "Ribs" and "bones" were not counted as separate parts, as I considered ribs a type of bone. Five of the children drew

Table 3- Labeled Body Parts

	Age Group				
Body Part	6-8 n=6	8-10 n=3	10-12 n=11	12-14 n=7	14+ n=2
Brain	0	2	4	4	2
Esophagus/ Throat	0	0	4	2	1
Heart	0	1	6	5	2
Lungs	0	0	8	2	2
Liver	0	0	4	2	0
Stomach	0	0	5	2	2
Bladder	0	0	1	0	0
Bones	1	1	5	1	1
Muscle	0	0	3	0	1
Vein	0	0	1	0	0
Intestines	0	0	3	2	0
Gall Bladder	0	0	1	2	0
Pancreas	0	0	1	2	0
Rectum	0	0	2	2	0
Anus	0	0	2	2	0
Kidney	0	0	2	0	1
Blood	0	0	4	0	1
Uterus	0	0	1	1	0
Vagina	0	0	1	1	0

the ribs in and labeled them separately, other bones were not labeled separately. I included the label of "throat" drawn as a tube in the neck region in the same category as "esophagus". Interestingly, none of the children used the label "food tube", a label reported in other studies. This label was used in two of the textbooks I examined. The mean number of parts named by the group overall was 3.76 (Standard deviation=4.19). The mean number of parts named by each age group appears in Table 4. Running a linear

regression using age as the predictor variable and the number of parts drawn and labeled as the dependent variable shows a slope significantly different from zero. (T=2.42, p=.02) These findings support the hypothesis that as Deaf

Table 4- Number of Body Parts Named

Age Group	Mean # of parts named
6-8	0.17
8-10	1.33
10-12	5.45
12-14	4.43
14+	6.50
Overall	3.76
Standard deviation	4.19

children grow older they know more English names for body parts. They begin to learn the body story as told by their textbooks and hearing adults.

The implementation of the study itself contributed to some variation in the scores, due to changes in the teacher's behavior. Upon being informed of the study, two of the teachers chose to teach academic material pertaining to the human body. Most of the teachers told me directly they had not taught the human body in science yet. Four students were in the two classes that had recently taught material about the human body, three in one class and one in another.

The influence this had on the children's replies is represented by two children from the same class who drew and labeled the uterus and vagina . This was not material

included in the textbook, but taught by their teacher in class. Both children drew these parts in separate bodies on the back of the sheet of paper provided them, the parts were not integrated into the drawing of the body on the front. One student was a male child and one student female. Both drew two extra bodies on the back, one including a penis and the other including a uterus and vagina.

In this same class the children were taught from a textbook concentrating on the gastro-intestinal system. Two of the three children in this class included lines drawn into the limbs in their drawings, but did not label them. Labels were largely restricted to the gastro-intestinal system. One of the students in this class was interviewed, but not taped due to technical difficulties. She is not included in other calculations concerning differences between the drawing and interview exercises. I noted her inclusion of the signs BONE and BLOOD when describing the contents of her arms and legs at the time of her interview. She did not label these parts in her drawing, suggesting the teacher's focus in the class may have affected what she chose to concentrate on in the drawing.

The unexpected jump in the mean number of parts named in the 10-12 year old age group is best understood as arising from an outlier, a student in the other class teaching material about the human body. She named ten body parts, well above the mean of her age group, 5.45. This

child was not in the group selected for interviewing. I asked her about the functions of the body parts she drew after she completed her drawing, because she drew many more parts than the average child. She explained what each part was and wrote down the following information for specific parts: the lungs- "to breath", the heart- "pump the bleeds", the muscles- "to move", the kidney- "water to pee", the intestines- "to swallow the food to go in it", and the brain that she drew as a circle in the head but could not label- "to think right".

This child's parents are not deaf. I was told her mother signed a little and her father even less. Her class had made nearly life sized paper bodies and pasted different parts on them just previous to the beginning of this study. This child does not fit the expected pattern. She knew many body parts, could label the parts with English names, and could describe their functions. This is most likely the result of her recent exposure to the topic in class, and the manner in which it was taught. She also represents individual variation, probably not all the children in her class would have scored so high. When using a small sample individual variation can greatly affect the results, as demonstrated by the unexpected shift in the 10-12 year old age group.

The next step in the analysis adds the first part of the interview as a component. Data concerning the drawings

of the children interviewed is compared to the number of parts named during the interview using a T-test. In addition, a number of case examples are discussed. These examples emphasize both how the use of ASL improves communication with Deaf children and the significant impact this improvement has on the portrayal of the human body. While numbers help to illustrate this point, individual qualitative descriptions play an important role in further elucidating the effect of enhanced communication on the children's depictions of their bodies.

The average number of parts drawn by the children interviewed was 3.29. In the interview the average number of parts mentioned was 5.14, a statistically significant difference ($T=2.290$, $p=.04$). My results agree with Glaun and Rosenthal's experience with the descriptive method used with hearing children. They found scores to be increased in 71.4% of the children, the number of items added ranging from 1-7. I found additional parts named in 92.8% of the cases, the number of items added ranging from 1-9.

The children discussed as case examples have been assigned the pseudonyms Justin, Caitlin, Mario, and Shawn. Justin is approximately seven and a half years old, is male, and has Deaf parents. In his drawing he labeled one part, "bone". There were lines drawn in every part of the body converging in the middle, a round configuration drawn in the center of the body, and a scribble drawn in the head region.

In his interview he named seven parts: stomach, heart, lungs, muscle, blood, bone, and intestines. Clearly this child knows more about his body than reflected in his drawing or in his labeling.

The other three children I will discuss are Caitlin (approximately eleven and a half years old), Mario (twelve and a half years old), and Shawn (thirteen and a half years old). None of these children were able to label anything in their drawings. When I asked Shawn, a male child with hearing parents, to label the parts he had drawn he fingerspelled "food", and wrote it down in what appeared to be the stomach. Many authors note the inclusion of objects such as food in drawings as a sign of pre-operational thinking. Shawn drew a highly integrated drawing, and named nine parts in his interview. According to his English labels the child is pre-operational.

All of the investigators discussed in the literature review are hearing individuals from a shared culture. Unspoken expectations underlie these studies, the children will label concepts of internal body parts with labels from the investigator's realm of experience. Shawn does have labels for internal body parts, but they are signed rather than written. The acceptable English label he can produce does not reflect his level of conceptual thinking.

Mario, another male child of hearing parents, named four parts in the interview: bones, blood, heart, and lung.

When the interviewer asked Mario if there was anything else besides blood and bones in his abdominal area he explained that there was a "jelly-like substance". The interviewer and I interpreted this to be a similar concept to the English label "guts". In his drawing, Mario included some kind of mass in the abdominal region. He could not label it in the drawing, but he used a pantomimed sign conveying the shape and the consistency of the mass.

This may reflect the communicative difficulties faced by many deaf children in a testing situation. In an optimum communication setting, one on one with another deaf individual, Mario was able to convey through circumlocution the conceptualization of an image he was unable to label. In written testing situations he would have no way to communicate the thought.

Caitlin, a female child of hearing parents, drew a disjointed picture. What appears to be bones are drawn in the left arm and leg. The right leg is colored in. A tube in the throat area connects to what appears to be lungs. A roundish object is drawn below the umbilicus, and a colored in circle is drawn in the head. Caitlin named three objects in the interview: heart, brain, and bone. She does not mention in the interview objects in the drawing that appear to be a trachea, lungs, and stomach. Caitlin had a difficult time beginning her drawing, and only began after encouragement was provided. I asked her at the time what

was the circle she had drawn in the abdominal area was, she could not tell me. I asked her if she could fingerspell any of the objects she had drawn, she told me no.

Caitlin appeared to lack linguistic skills more than the other children. The interviewer repeated herself often, and had to use a variety of explanations in the interview with Caitlin. Despite these efforts Caitlin looked confused through much of the interview. In the second part of the interview Caitlin was the only child who answered DON'T-KNOW to questions about both the function of the heart and the brain. She also communicated a limited understanding of where food goes. In the previously discussed situations the children appeared to greatly benefit from the utilization of an additional communication method. Caitlin produced no English labels, few signed labels, and showed little understanding of what she did sign. She did not appear to benefit much from the addition of ASL to the testing situation.

These children illustrate a range of experiences. On the one end are children who greatly improve their scores in a testing situation through the addition of communication in ASL. At the other end of the spectrum are children for whom this added channel makes little or no difference. However, the statistics show overall there is a significant difference between the use of a projective drawing test and a descriptive test relying on ASL. These individual case

examples serve to illustrate the data from the first part of the test can mask a tremendous amount of variability in deaf children's performance in these two situations. They also portray the difference the interview makes in accurately depicting children's knowledge of body parts.

The third part of the analysis focuses on the second section of the interview dealing with the function of internal organs. Specifically, I examined the children's responses describing the heart's function. After recording the children's responses, I compared their responses to a framework constructed from earlier research with hearing children.

Crider, whose work was discussed in the review of literature, constructs a range of explanations of the function of the heart based on Gellert's research with hearing children. She lists them from those most often named by younger children to those listed by older children. They are as follows:

1. Don't know.
2. Function related to emotional processes-for example, to love.
3. Function related to health-for example, to keep you well.
4. Function related to superego-for example, to make you do the things you should.
5. Description of heart sounds-for example, ticks.
6. Description of heart actions-for example, thumps, beats, pumps.
7. Heart is essential to life.
8. Function related to breathing.
9. Function related to being able to move the body or supply energy.
10. Description of variation in heart rate or speed-for example, goes fast when you run.

11. Function related to blood, without concept of circulation-for example, blood comes from the heart.
12. Function related to purification and/or renewal of body parts or content.
13. Heart is essential to life explained in terms of circulation, blood, or oxygen.
14. Heart pumps blood, makes it circulate.

(Crider 1981, p.52)

The thirteen replies to the question "HEART #DO" in my study were as follows, listed by age:

1. Breathing.
2. It pumps the blood.
3. Breathing. If you didn't have a heart you would die.
4. Makes you live.
5. For living. For blood. Moving around makes it beat faster.
6. Don't know.
7. It beats and controls what you do. If you didn't have one you would die. Playing and running makes it go faster.
8. It controls your blood. Your heart beats as you move.
9. If it stops you die.
10. For blood. If it stops you die. Helps you breathe.
11. Pumps blood. Keeps you strong. Helps you move.
12. Pumps blood. Breathing. Makes you comfortable. Supports veins.
13. It beats. It's for breathing air (so is the lungs).

If these replies are then compared to Crider's categories the relationship is as follows:

Child interviewed (children listed by age)	Crider's category
1.	8
2.	14
3.	8, 7
4.	7
5.	7, 11, 10
6.	1
7.	6, 9, 7, 10
8.	11, 6

9.	7
10.	11, 7, 8
11.	14, 9, 9
12.	14, 8, 3
13.	6, 8

If Deaf children follow the same developmental pattern as hearing children, but in a delayed fashion I would expect the younger replies listed by Crider to appear frequently in older deaf children's responses. That was not the outcome in this study. Possible explanations for this unexpected pattern will be discussed in the conclusion.

In the third part of the interview the children were asked "where does food go when you eat", signed FOOD SWALLOW, WHERE GO. Each child's response is described in this analysis, as well as differences in the interview. During the first three interviews the children showed food following a path leading to the abdomen. Wondering if this accurately represented their knowledge, we began asking the children that ended the path of food on the abdomen if food stayed there. The answer was no in every case but one. When pressed further, most of the children explained the food came out eventually as a bowel movement. This reluctance to explain the entire pathway of food, especially the bowel movement, suggests the possibility of cultural influences affecting the children's descriptions.

The replies listed in order by age are as follows:

1. Traces a path down to the abdomen and around (did not ask if it stays there).

2. Traces path down the throat to abdomen (did not ask

if it stays there).

3. Traces path down to the abdomen, then signs TOILET.

4. Traces path down throat to the abdomen (asked if food stays in the abdomen and the reply is yes).

5. Traces path down abdomen and around (asked if it stays there the reply is no, you go to the bathroom).

6. Traces path to the abdomen (asked if it stays there, reply is no, TOILET).

7. Traces path to abdomen (asked if it stays there, the reply is no but no alternative explanation is given).

8. Traces path down to abdomen. What is good is saved, what is bad is discarded. The food is digested, then you go to the bathroom.

9. Traces path down to abdomen, says DON'T-KNOW NAME "i", traces path around abdomen (asked if it stays there, the reply is no, TOILET).

10. Traces path down to the abdomen (asked if it stays there, the reply is no, TOILET).

11. Traces path down to the abdomen, shows it spreading out from there (asked if it stays in the abdomen, the reply is no, it spreads out to the body from there).

12. Traces path down to the abdomen, it's digested and sent to different parts of the body.

13. You swallow, it goes down your throat, through your chest, past your heart, into the stomach. It's digested and spreads through the body. It goes through the intestines and then stops in two areas, one on each side of the body. When you're ready you have a bowel movement.

14. Traces path to the abdomen, mixes up so you can grow (did not ask if it stays there).

In this section of the interview different levels of conceptualization appear related to age. At younger ages

the food is shown taking a direct path through the body. At later ages an integration of the digestive system with the rest of the body emerges.

After reviewing the children's replies, I was impressed by the difference between the explanations provided in the interview and the depiction of the gastro-intestinal system in their drawings. To further explore these differences I reviewed both sets of data using Glaun and Rosenthal's concept of integration. They describe integration as, "the extent which organs and parts are inter-connected to form bodily systems." (Glaun and Rosenthal 1988, p.66) I was interested in two aspects of integration. First, how much integration appeared in the children's drawings and how did it relate to age. Second, how was the integration in the drawings, or lack thereof, reflected in the explanations of the gastro-intestinal system during the interview.

Glaun and Rosenthal scored each child's drawing in their study on level of integration by dividing drawings into two categories. The first level included drawings depicting organs and parts as floating unconnected within the body. The second level included drawings showing some attempt to connect parts into systems. For example, a tube connecting the mouth to the stomach or the heart connected in some way to vessels in the extremities. They found an increasing amount of integration with age, but overall a low level. None of the five year olds and only 38% of the 10/11

year olds demonstrated integration. (Glaun and Rosenthal 1988, p.66)

Of the 29 drawings in my study, only six drawings showed some degree of integration. Of these six drawings, five showed integration of the GI system and two showed integration of the cardiovascular system. The ages of children producing these integrated drawings were surprisingly distributed: 80 months, 89 months, 131 months, 147 months, 160 months and 161 months. Based on Glaun and Rosenthal's results I expected to see integration in the drawings exclusively in the older age group.

Transcripts of the third section of the interview, containing descriptions of the gastrointestinal tract revealed a much greater level of integration than is expressed in the children's drawings. Only one of the children displaying integration in their picture was also interviewed, and the high degree of integration in the child's drawing was reflected in the explanation of food's pathway provided during the interview. The rest of the children interviewed showed no integration in their drawings. Every interviewed child was able to depict a pathway for food proceeding from the mouth to the abdomen. Several of the children were able to proceed beyond that point providing integrated explanations of food's migration through the body including digestion and bowel movements. This understanding was not reflected in their drawings. The

use of ASL allowed them to spatially express knowledge in a way that drawings did not.

Discussion of Results

The first of my original hypotheses involved the idea that Deaf children's concepts concerning the internal body would develop in a similar manner, but at a later age than hearing children. The average number of parts labeled by the Deaf children in this study was less than that reported in other studies with hearing children. In this respect, the results concur with similar studies completed previously on this topic. Using a linear regression to relate the number of parts labeled to the age of the child showed the number of English labels provided by the children increased with increasing age.

Neither of these findings is surprising, but speculations as to why Deaf children appear to know less than hearing children at equivalent ages should be pursued. A superficial explanation is that children without hearing are handicapped, deficient in a way that hearing children are not. Due to this deficiency they lag behind their hearing peers developmentally.

Alternatively, multiple factors can be elucidated as possibly contributing to the above results. First, communication difficulties may contribute to the differences seen. The drawing exercise is assumed to be an equivalent

evaluation of hearing and Deaf children's knowledge. The drawing exercise uses pencil and paper. Deaf children have conceivably faced repeated frustrations with such evaluations that hearing children have not at the same level. In addition, the drawing exercise utilizes English labels. Hearing children have these labels reinforced on a day to day basis through speech and hearing. Deaf children are more likely to associate a body part to a sign, something that has meaning for them. English labels can be understood as meaningful symbols for hearing children. They are much more likely to be nothing more than a memorized string of letters, possibly then associated with a sign in the mind of a Deaf child.

Communication difficulties also intervene at the level of instructions. Gibbons notes,

> The deaf children had some difficulty understanding the concept of 'inside' as indicated by their facial expressions, verbal questions, and frequency of external body parts drawn...A few subjects apparently had problems understanding the words 'body parts' as their test revealed merely scribblings, lines, or dots within the body boundaries. (Gibbons 1985, p.44)

This description emphasizes the difficulties involved in communicating with the deaf children. These difficulties are not present during the testing of the non-deaf group. While Gibbons attributes the difficulties to the children's lack of understanding of the concepts, details are not provided about the context of the misunderstanding. This

situation could arise either through the suggested misapprehension of ideas or as the result of poor communication skills on the part of investigators. There is no way to further evaluate this based on the provided information.

In my study after explaining who I was (my name, that I was a medical student, and that some day I would be a doctor) and what I was trying to find out (what they knew about the inside of their bodies) I would pass out the outline drawings. I would then set the following scenario: suppose you opened up your body and looked inside, what would you find? I want you to draw what you would find inside the body. I signed this SUPPOSE YOU BODY OPEN LOOK=inside body, WHAT FIND. I WANT YOU DRAW INSIDE=body. To further clarify this I would elaborate on opening the head, neck, chest, abdomen, arm and leg.

Once, when I encountered further confusion, I decided I could clarify this concept further by depicting an operation, and asked what a person would see if they operated on the body. Rewarded with a look of comprehension and the onset of drawing I sat back satisfied. The child brought me a drawing of the outline covered with several scars, apparently a depiction of the scars on her body. While this is an obvious example of miscommunication, it raises the possibility of numerous subtle misunderstandings.

Linguistic skills, or the lack thereof, on my part and

on the part of the children will contribute to communication difficulties. The children in this study have varying levels of competency in English and ASL. Currently the question of how cognitive development and linguistic skills interplay remains unanswered. If a lack of linguistic skills does augment a developmental lag cognitively, this could contribute to the findings of this study. I met several children who came to the school with very little English comprehension, and whose parents signed very little. Once in the school the children have the opportunity to pick up ASL from other Deaf adults and children. These are children lacking a natural language from birth. The developmental effects of this situation could contribute to the findings of this study.

Variations in communication can also impact the cultural transmission of ideas. If communication is hampered between adults and children the story of the body cannot be passed on. This may especially be true of the inside of the body and how it works, as these parts cannot be seen. Knowledge about the body is partially experiential (i.e., the pounding of the heart, the swallowing of food, the act of a bowel movement), but how these experiences are linked together is a cultural story requiring a language for transmission. While some of these children have Deaf parents, allowing this kind of story telling, many do not.

My second hypothesis compared the projective drawing

exercise to a descriptive exercise maximizing communication through the use of ASL by a Deaf adult. Improving communication resulted in a much more comprehensive picture of the children's knowledge. Argueably, the use of a descriptive method may result in an increase in displayed knowledge whether or not the child is Deaf. While this may be true in part, I would argue that for the Deaf child the switch to a descriptive methodology involves a switch in the cultural milieu. The addition of ASL to the testing situation will increase comfort in a way that adding English to the testing situation for hearing children does not.

The addition of a descriptive portion to the research project allowed further exploration into the children's ideas about body function and the movement of food through the body. In the section of the interview concerning the function of the heart, the answers the children provided do not fall in any expected order when compared to the framework proposed by Crider. There are several possible explanations for this result. One explanation is that the absence of a pattern is due to the small sample size and given a much larger sample a pattern would emerge. Another possible explanation involves examining the origins of the explanation's on Crider's list. The last six explanations are clearly more "scientific" explanations of the function of the heart. Knowing I was a medical student and the interviewer was in a health related position, it is possible

the children geared their answers more scientifically in response to what they thought we wanted to hear.

Examining some of the less scientific descriptions on Crider's list provides another possible explanation. The idea of the heart as being the center of love is readily apparent throughout our culture. Phrases such as "she stole my heart", "she broke my heart", and "I love you with all my heart" are common and found in writings, songs, and the multiple forms of the media. Ideas of the heart in relation to the superego are expressed in terms such as "she has a good heart" and "she has evil in her heart". These ideas compose part of the culture the majority of U.S. hearing children grow up within. It is possible that Deaf children are exposed to a different cultural environment than hearing children, and so these ideas are not as prevalent among Deaf children.

It is particularly striking that none of the children associated the heart with functions related to emotional processes. There are a number of ASL signs describing emotions that occur in the same area as the heart (i.e. CARE, SWEETHEARTS, GRIEF), so the idea of the heart as being related to emotions should not be completely foreign. Not knowing how strong the association is used around and amongst the children in this study makes it impossible to assess for certain the cultural explanation for the absence of this response. This section does challenge the simple

idea that Deaf children proceed through concepts in an identical manner, but at a slower pace than hearing children. That idea does not take into account possible cultural differences contributing to different outcomes.

There is no previous research with hearing children concerning the movement of food with which to compare the children's explanations in the third section of the interview. In this study increasingly complex explanations of the movement of food occurred with increasing age. Possible explanations for this change with age include: cognitive development, linguistic development, and increased exposure to cultural stories. These three factors are interlinked. Increased cognitive development may allow for increased linguistic development and visa-versa. Increased linguistic development may also allow for increased cultural transmission of information. In addition, cultural exposure to new ideas may further stimulate cognitive and linguistic development.

Comparing the interviews concerning the movement of food to the drawings the children had completed of the GI system led to the further exploration of the concept of integration. Only one of the children interviewed showed some integration in their drawing. All of the children showed some level of integration of the gastrointestinal system during the interview, at least drawing a path from the mouth to the abdomen. Analyses of the drawings and the

interviews would result in markedly different estimations of the children's levels of conceptualization of the gastrointestinal system, reinforcing the importance of the descriptive method.

The discrepancy between the drawings and the interviews may represent an inability to convey the concept of GI integration due to the lack of artistic ability. Language may provide a better conduit for intricate explanations, whether or not the child is hearing or Deaf. My expectation that the children would express the same level of integration on paper as they expressed in the interviews may in part be influenced by my biases as a hearing person viewing ASL. As a hearing person I believe there is a tendency to see the depiction of concepts in ASL as drawings in the air, or in the case of these descriptions, drawings on the body. I view the visual language as equivalent to a visual linear picture. This may not be the experience of a Deaf child using ASL to communicate difficult concepts.

Conclusions

Whenever research is undertaken with Deaf children the usual problems with research involving human subjects can be expected. Differences among samples can be expected based on socioeconomic status, gender, age, level of parental education, and a multitude of other factors. In addition, differences in cultural and linguistic backgrounds will have

a profound impact on results. In this research I tried to utilize information concerning the cultural and linguistic background in constructing the methodology, conducting the research, and analyzing the results. In actuality, I failed to incorporate much of this information into the analysis of my results. To construct the cultural and linguistic background of each child was beyond the scope of the project. If this information was obtained, analyzing on the basis of it would have resulted in very small sample sizes. This is a difficulty faced repeatedly in research concerning individuals with a hearing loss. Can a homogenous sample be gathered, and if it can will it be large enough to draw conclusions from?

The passing on of information from one generation to the next involves a sort of cultural story telling. This cultural story telling occurs in homes and in schools. It happens throughout every day in every child's life. Passing on difficult parts of a cultural story requires a complex, comprehensive communication system.

Total communication, the system used in most curriculums for deaf children, is in reality much less comprehensive than its name implies. The possibility of children with a hearing loss learning English as a comprehensive, complex, first language is greatly reduced by the fact that they will not auditorially absorb what the hearing child does. Currently, the chances are slight that

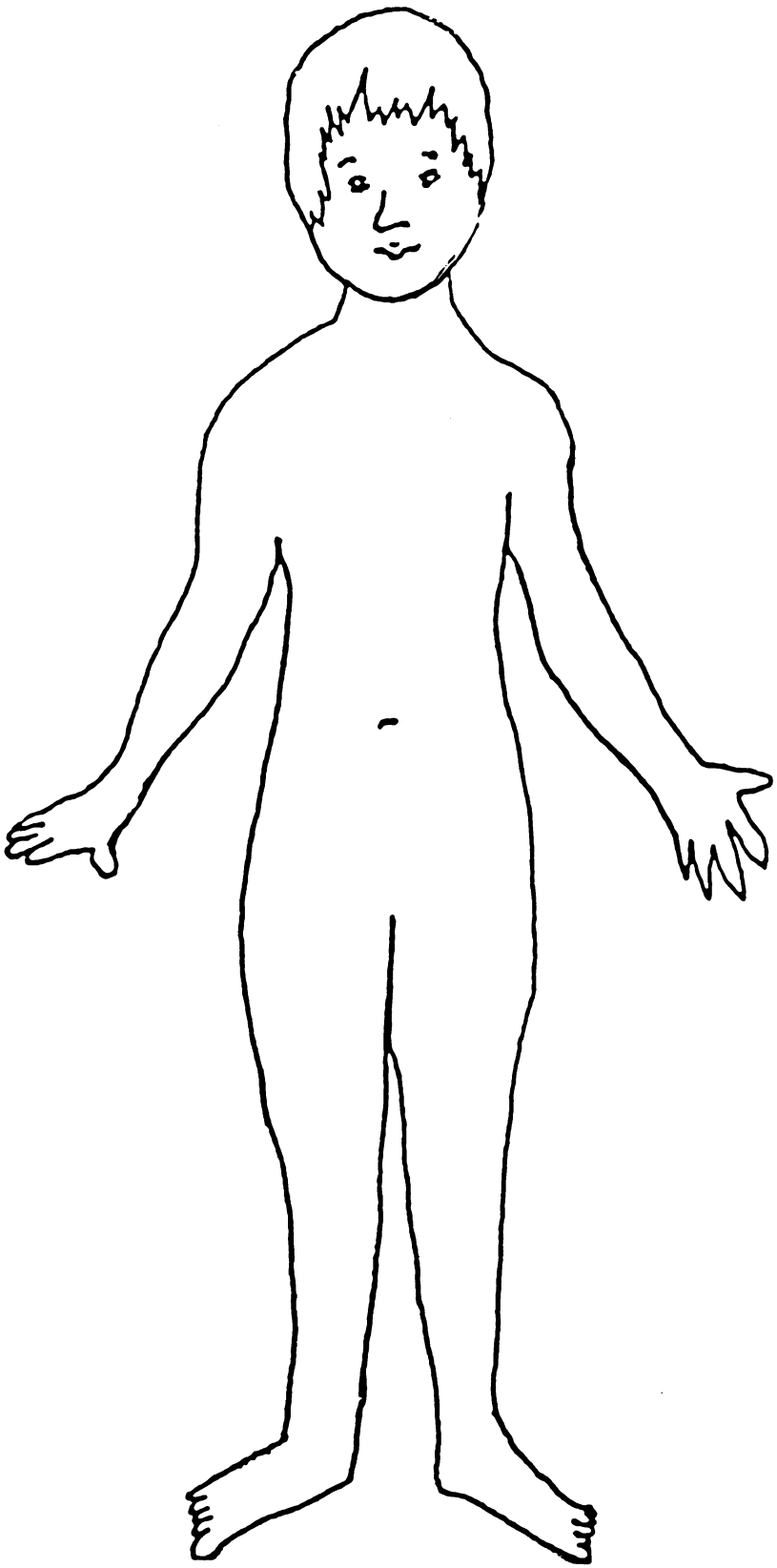
ASL will be available as a first language for the majority of deaf children.

Making ASL available as a first language would involve training both hearing parents and those educators who are hearing in bilingualism. This task is formidable in and of itself. Before approaching this task hearing parents and teachers would need to accept the idea of communicating with their children by foregoing a central and integral tenant of their own culture, their language. As ASL continues to gain acceptance as a language, and advocates for its use continue to grow, the task is approached. Until cultural and linguistic factors are taken into fuller account we can expect cultural story telling to be difficult between hearing adults and deaf children.

APPENDICES

APPENDIX A

FIGURE PROVIDED FOR DRAWING TEST



APPENDIX B

INTERVIEW FORMAT

Part I

Suppose you opened up your body, what would you find inside?

After initial response proceed to question about specific areas.

Suppose you opened your head (your neck, your chest, your belly, your leg, your arm), what would you find inside?

Part II

Go over the parts the child names and ask functions. Example: What does your heart do?

Part III

What happens to the food we eat?

What happens to the air we breathe?

Part IV

All kids get sick once in a while. How do kids know when they are sick?

How do kids get sick?

How can children keep from getting sick?

Sometimes children get stomachaches when they are sick. How do kids get stomachaches?

Sometimes when children get sick they get little bumps or spots on their skin that itch. How do kids get those bumps or spots?

Sometimes when children sick they have to stay in a hospital. What would be wrong with them that would make them have to stay in a hospital?

When children are sick, how can they get better again?

Sometimes when children get sick they have to take medicine. How does medicine work?

Part V

Attempt to elicit a conversation about the body based on a more personal experience.

Have you ever been sick?

Have you ever had an operation?

Has anyone in your family ben sick or had an operation? If the child answers yes, ask the child to describe what happened.

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