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AN INVESTIGATION OF THE RELATIONSHIP OF PROTOWRITING (INVENTED SPELLING) AND COGNITIVE DEVELOPMENT IN YOUNG CHILDREN

The University of Oklahoma PH.D. 1982

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AN INVESTIGATION OF THE RELATIONSHIP OF PROTOWRITING (INVENTED SPELLING) AND COGNITIVE DEVELOPMENT IN YOUNG CHILDREN

A DISSERTATION

SUBMITTED TO THE GRADUATE FACULTY

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE

DEGREE OF

DOCTOR OF PHILOSOPHY

By

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Norman, Oklahoma

1982

AN INVESTIGATION OF THE RELATIONSHIP OF PROTOWRITING
(INVENTED SPELLING) AND COGNITIVE DEVELOPMENT
IN YOUNG CHILDREN

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This dissertation is dedicated to my husband, Walter Barnes Loeffler, who has provided enthusiasm and support for this project in all the right ways and at all the important times.

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I WOULD LIKE TO EXPRESS MY SINCERE APPRECIATION TO THE MEMBERS OF MY COMMITTEE WHO HAVE BEEN PATIENT, CHALLENGING, SUPPORTIVE, AND RIGOROUS, IN THE RIGHT PROPORTIONS AND AT THE RIGHT TIMES.

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INTRODUCTION

The behavioral phenomenon of writing before reading (termed protowriting or invented spelling) has been observed in young children across several different cultures.

The young uninstructed four and five year old children, whose spontaneous writings have been reported by many observers, appear to have extracted the relevant information about sound/symbol or word/symbol associations informally from their environments before they have had any type of reading or writing instruction. These young children have been able to use this information to map their spoken language onto the written code of the culture. The apparent spontaneity of this activity makes this behavior an interesting phenomenon for further study. The purpose of this research is to examine the phenomenon and to search for the genesis and significance of this activity.

Building upon the contemporary ontogeny/phylogeny models suggested in the works of S. Gould (1977), E. Bates (1979), J. Lamendella (1976), and K. Gibson and S. Parker (1979), it is postulated by the author that young children's spontaneous writing is an expression of behaviors in a young

CHILD'S DEVELOPMENTAL SEQUENCE THAT HAVE HAD HIGH ADAPTIVE VALUE IN HUMAN HISTORY AND HAS EMERGED HISTORICALLY AS A NEW BEHAVIOR CONSTRUCTED FROM TWO UNIVERSAL BEHAVIORS PREVIOUSLY ADAPTED FOR OTHER FUNCTIONS. THE WRITING BEHAVIOR IS ADAPTIVE FOR THE YOUNG CHILD BECAUSE IT LEADS TO FURTHER INTERACTION WITH THE ENVIRONMENT CAUSING IT TO CHANGE AND THE CHILD TO CHANGE.

THE THEORY PROPOSES THAT THE ABILITY TO ENCODE THE SPOKEN LANGUAGE OF A CULTURE INTO WRITTEN FORM IS A COMPETENCY AVAILABLE TO ALL HUMANS SINCE IT IS A COORDINATION OR SYNTHESIS OF TWO UNIVERSAL BEHAVIORS, SPOKEN LANGUAGE AND GRAPHIC REPRESENTATION; HOWEVER, THE BEHAVIOR IS EXPRESSED ONLY WHERE THE CULTURAL ENVIRONMENT SUPPORTS AND/OR REQUIRES SUCH AN ENDEAVOR.

THE THRUST OF THE RESEARCH IS TO SECURE SUPPORTING EVIDENCE FOR THIS THEORY, TO MAKE PREDICTIONS BASED UPON ITS THEORETICAL ASSUMPTIONS, AND TO TEST THESE PREDICTIONS IN THE BEHAVIORS OF YOUNG CHILDREN.

THE SPECIFIC PREDICTIONS TO BE TESTED, EMANATING FROM THE THEORETICAL POSITION, ARE AS FOLLOWS: THAT PARTICULAR THRESHOLD LEVELS OF COMPETENCE IN SPOKEN LANGUAGE (LINGUISTIC AWARENESS) AND IN GRAPHIC REPRESENTATION MUST BE ATTAINED BY A CHILD BEFORE PROTOWRITING CAN OCCUR; AND THAT THESE COMPETENCIES ARE ORGANIZED AND COORDINATED BY THE SAME UNDERLYING COGNITIVE STRUCTURES THAT SUPPORT MORE GENERAL, NON-LINGUISTIC, INTELLECTUAL BEHAVIORS. THE THEORY, ITS ASSUMPTIONS AND PREDICTIONS WILL BE DEVELOPED MORE FULLY IN

LATER SECTIONS OF THIS CHAPTER.

History of the Research Problem

THE PHENOMENON OF SPONTANEOUS WRITING BEFORE READING FIRST WAS DESCRIBED IN SOME DETAIL IN 1912 BY DR. MARIA MONTESSORI, AN ITALIAN PHYSICIAN AND EDUCATOR. MONTESSORI (1964) DESCRIBED THE BEHAVIOR AS A SUDDEN 'EXPLOSION INTO WRITING' THAT FOUR AND FIVE YEAR OLD ITALIAN CHILDREN, WHO LIVED IN THE SAN LORENZO PUBLIC HOUSING DISTRICT IN ROME, DEMONSTRATED AFTER LEARNING (THROUGH THE SANDPAPER LETTERS) THE SOUND/SYMBOL ASSOCIATIONS OF THE ITALIAN LANGUAGE.

ONCE THESE YOUNG CHILDREN DISCOVERED THAT THEY COULD SOUND OUT AND WRITE ANY WORD IN THEIR SPEAKING VOCABULARIES, THEY WROTE WORDS WITH CHALK ON THE FLOOR, ON THE BENCHES, ON THE WALLS, WHEREVER THERE WAS A FLAT SURFACE SO DELIGHTED WERE THEY WITH THEIR NEW-FOUND ABILITY TO WRITE DOWN WHATEVER THEY COULD THINK OR SAY. THE FACT THAT FEW OF THE CHILDREN'S PARENTS COULD READ OR WRITE MADE THE ACTIVITY EVEN MORE SIGNIFICANT.

AT FIRST THE ADULTS AT THE CHILDREN'S HOUSE, WHERE THE CHILDREN SPENT THE DAY WHILE THEIR PARENTS WORKED, WERE AMAZED WITH THIS ACTIVITY. AFTER OBSERVING IT MANY TIMES, HOWEVER, MONTESSORI WROTE, THEY ACCEPTED IT AS A NATURAL PHASE OF CHILD DEVELOPMENT.

ALTHOUGH MONTESSORI'S CHILDREN WERE TAUGHT THE SOUND/SYMBOL ASSOCIATIONS THROUGH THE SANDPAPER LETTERS, CHARLES

Read (1971, 1975) in Massachusetts some sixty years later, found the same phenomenon occurring in middle class American children who had not received any specific instruction. The spontaneous writings of these children, unlike Montessori's, did not closely resemble the conventional adult spellings of the culture. Because of the irregular nature of English spelling, unlike Italian, these children's 'invented spellings' reflected the inherent phonology of the English language that they had intuited from their implicit knowledge of the spoken language and had combined with whatever knowledge of the sound/symbol associations they had incidentally acquired.

Additional research, also with American children, by Carol Chomsky (1976) and Rhea Paul (1976) confirmed Read's findings and added new details to the research. Paul noted that spontaneous writers, whom she observed, passed through four distinct stages of spelling. These ranged from a beginning stage, in which only the initial letter stood for the whole word, to a fourth and final stage in which invented spellings were replaced by conventional spellings in the child's spontaneous writings.

All of the researchers have stressed the inventive aspect of the spontaneous writing and have noted that the reason that none of the children appeared to have difficulty in the transition to conventional spelling stemmed from the fact that the child's writings are continually repeated inventions and never assume the quality of a habit. Both Chomsky and Read noted that children often cannot read their

own written productions especially if a period of time has elapsed between the writing and the attempted reading. Paul commented that children she observed rarely invented the same spelling twice but seemed to attack each word as a new problem often coming up with a different solution than they had found before.

Chomsky has provided an explanation for this variability of outcome. She suggests that spontaneous writing is basically a creative endeavor and that it shares some aspects of drawing a picture. The child writes creatively, according to what s/he perceives in a word and considers worthy of representation. In fact, the two activities are often done as one with some of the first spontaneous writings being the labeling of the child's own drawings.

Read, in his research, identified more than twenty-one specific phonetic features that young children represent in their spontaneous writings by associating them with letters whose names or sounds they have learned informally.

The later work of Beers (1974) and Henderson and Beers (1977) has supported Read's conclusions that young children's spontaneous spellings were systematic, logical and reflected a tacit system of phonological categorization of speech sounds.

Beers and Henderson have identified four distinct stages that American school children, who were beginning spellers, moved through, and they note that each stage represents a different spelling strategy. These stages are

SIMILAR TO THE STAGES OBSERVED BY PAUL WITH FIVE AND SIX YEAR OLD CHILDREN. THE PROGRESSION OF OBSERVED STRATEGIES, DESCRIBED BY HENDERSON AND BEERS, IMPLIES A MOVEMENT BY THE CHILDREN FROM A FOCUS UPON THE PHONOLOGICAL SURFACE FEATURES OF THE LANGUAGE TO A GROWING UNDERSTANDING OF THE DEEPER (MEANING RELATED) STRUCTURES THAT ARE REPRESENTED IN THE WRITTEN ENGLISH CODE, ACCORDING TO THESE RESEARCHERS.

ZUTTELL IN HIS RESEARCH (1975) HAS CONCLUDED THAT THE TRANSITION FROM DOMINANCE OF SURFACE FEATURES TO DOMINANCE OF UNDERLYING FEATURES (LEXICAL REPRESENTATION) IN SPELLING STRATEGIES IS RELATED TO A GENERAL COGNITIVE PROGRESSION IN WHICH THE CHILD BECOMES LESS PERCEPTUALLY BOUND AND CENTERED UPON A SINGLE ASPECT OF A SITUATION OR STIMULUS AND BECOMES ABLE TO PERCEIVE AND INTEGRATE SEVERAL DIFFERENT VARIABLES SIMULTANEOUSLY.

ZUTTELL, QUOTING JEAN PIAGET, THE SWISS PSYCHOLOGIST, DESCRIBES THE PERIOD FROM FOUR TO SEVEN OR EIGHT YEARS OF AGE AS A TIME WHEN THE CHILD, THROUGH A SERIES OF DEVELOPMENTAL SUBSTAGES, BECOMES ABLE TO MOVE FROM AN ACTION CENTERED WORLD TO A WORLD IN WHICH HE BECOMES ABLE TO TRANSFORM REALITY BY MEANS OF INTERNALIZED ACTIONS OR OPERATIONS THAT CAN BE GROUPED INTO COHERENT REVERSIBLE SYSTEMS (JOINING, SEPARATING, ETC.).

PIAGET REMINDS US, ACCORDING TO ZUTTELL, THAT IN THIS STAGE OF CONCRETE OPERATIONS, THE CHILD MUST FIRST LEARN TO MENTALLY REPRESENT WHAT HAS ALREADY BEEN ABSORBED ON THE LEVEL OF ACTION AND THEN MUST PROGRESS FROM AN

INITIAL STATE IN WHICH EVERYTHING IS CENTERED ON THE CHILD'S OWN BODY AND ACTIONS TO A 'DECENTERED' STATE IN WHICH THE CHILD'S BODY AND ACTIONS ASSUME THEIR RELATIONSHIPS WITH REFERENCE TO ALL OTHER OBJECTS AND EVENTS REGISTERED IN THE UNIVERSE.

ZUTTELL BELIEVES THAT PIAGET'S NOTION OF THESE QUALITATIVELY DISTINCT STAGES IN COGNITIVE DEVELOPMENT MAY PROVIDE A KEY TO UNDERSTANDING THE PROGRESSIVE, SEQUENTIAL SPELLING STRATEGIES DISCOVERED AND SUBSTANTIATED BY READ, HENDERSON AND BEERS. IT SEEMS PLAUSIBLE TO ZUTTELL THAT A CHILD'S SPELLING STRATEGIES WILL BE DEPENDENT UPON THE ABILITY TO GENERATE AND COORDINATE ABSTRACT STRUCTURES FOR DEALING WITH LANGUAGE. HE NOTES THAT PIAGET'S DISTINCTION BETWEEN PREOPERATIONAL (2-7 YEARS) AND CONCRETE OPERATIONAL MODES OF THINKING (7-12/15 YEARS) SEEMS TO BE ESPECIALLY RELEVANT TO UNDERSTANDING THE CHILD'S CHANGING APPROACH TO THE WAY WORDS ARE SPELLED, ESPECIALLY DURING THE TRANSITIONAL PERIOD FROM FIVE TO EIGHT YEARS OF AGE.

FOR EXAMPLE, ACCORDING TO ZUTTELL,

> THE PREOPERATIONAL CHILD'S CENTERING ON PERCEPTUAL CUES SHOULD DICTATE A FAIRLY CONSISTENT LETTER/NAME STRATEGY WHILE THE OPERATIONAL CHILD SHOULD BE ABLE TO USE MORE SOPHISTICATED PATTERNS LIKE ORTHOGRAPHIC MARKINGS, ETC. (ZUTTELL, 1975, P. 43)

MANY OBSERVERS HAVE DOCUMENTED THE RELATIONSHIP BETWEEN COGNITIVE DEVELOPMENT (AS DEMONSTRATED THROUGH PIAGETIAN TASKS) AND PROFICIENCY IN READING (ALMY, 1966; ELKIND, 1965; COX, 1977; RENNER, 1979). A RECENT STUDY BY GENTRY (1977)

PINPOINTS THE RELATIONSHIP BETWEEN SPELLING STRATEGIES AND READING ACHIEVEMENT. BUILDING UPON THE EARLIER WORK OF HENDERSON, BEERS AND ZUTTELL, GENTRY HAS SHOWN THAT THE TRANSITION OF THE CHILD'S FOCUS FROM SURFACE STRUCTURE OF LANGUAGE (SOUNDS) TO LEXICAL REPRESENTATION (MEANING), AS REFLECTED IN PROGRESSIVELY MORE ADVANCED SPELLING STRATEGIES, IS CORRELATED WITH THE CHILD'S INCREASING ACHIEVEMENT IN READING.

THESE DATA LEND SUPPORT TO C. CHOMSKY'S (1976) VIEWS ABOUT THE RELATIONSHIP OF SPONTANEOUS WRITING TO LATER READING. THIS RELATIONSHIP CAN BE UNDERSTOOD, ACCORDING TO CHOMSKY, BY THE FACT THAT, THROUGH WRITING, THE CHILD INVENTS THE PHONETIC CODE AND FOLLOWS PIAGET'S DICTUM THAT TO INVENT (OR REINVENT) IS TO KNOW. IT IS THIS CONTINUAL ACTIVE PROCESS OF INVENTION WITH ITS GRADUAL APPROXIMATION TO STANDARD SPELLING THAT PROVIDES THE CHILD WITH THE NECESSARY HYPOTHESIS ABOUT HOW SOUNDS AND LETTERS RELATE TO EACH OTHER, ACCORDING TO CHOMSKY,

> THE PRINTED WORD 'BELONGS' TO THE SPONTANEOUS SPELLER FAR MORE DIRECTLY THAN TO CHILDREN WHO HAVE EXPERIENCED IT ONLY READY-MADE. FOR ONCE YOU HAVE INVENTED YOUR OWN SPELLING SYSTEM, DEALING WITH THE STANDARD SYSTEM COMES EASY. A CONSIDERABLE AMOUNT OF THE INTELLECTUAL WORK HAS ALREADY BEEN DONE. (1976, P. 64)

THIS DISCOVERY OF THE ABILITY TO 'WRITE DOWN' THEIR OWN SPEECH THAT YOUNG CHILDREN EXPERIENCE MAY BE ANOTHER EXAMPLE OF WHAT ELIZABETH BATES (1979) HAS CALLED THE JERRY-BUILT SYSTEM THAT IS LANGUAGE WITH HUMANS DISCOVERING AND ELABORATING THEIR CAPACITY FOR SYMBOLIC COMMUNICATION BY A ROUTE SIMILAR TO ONE THAT LED OUR ANCESTORS INTO LANGUAGE.

Thus the examination of the process by which young children become able to map their spoken language onto the written code of the culture may provide information into the linguistic/cognitive development of the individual child as well as provide insight into the development and evolution of writing in humans.

Scope, Purpose, and Rationale for the Present Study

Previous research into protowriting (invented spelling) has provided valuable insights into this spontaneous activity of young children and has revealed the changing strategies employed by the child as linguistic knowledge develops. According to this research, linguistic development appears to proceed from an initial focus upon perceptually salient surface features of words to an increasing awareness and sensitivity toward the deep structures or semantic features of the language as it is represented through the conventional orthography.

C. Chomsky's writings also have suggested a relationship between protowriting and the child's construction of knowledge while Zuttell's research has demonstrated a correlation between decentration, a measure of flexibility in thinking, and the child's movement toward conventional spelling. Each of these studies has contributed substantially to our understanding of this unique activity of young children

while focusing on a particular aspect of the behavior.

The present research seeks to expand the breadth and depth of the inquiry into protowriting by attempting to place the behavior within a more general framework of development as it relates both to the individual child and to human evolution. In order to accomplish this goal, the research, of necessity, has enlarged its scope to include the broader perspectives of anthropology and human development (psychology). The following sections will provide a research rationale for each of these disciplines.

Anthropological Rationale

It has been suggested by several contemporary theorists (Bates, 1979; Gould, 1977; Gibson and Parker, 1979) that spontaneous behaviors that appear with regularity in the developmental sequence of children seem to represent activities that have had high adaptive value in human history and continue to have adaptive significance in childhood.

Although the ability to encode and decode written language is not universal in humans, as the ability to produce and comprehend spoken language appears to be, the fact that a written language does appear in many diverse cultures and among a wide range of persons in those cultures indicates that its development represents a prevalent and not a rare ability.

Lamendella (1976) contends that ontogenetic traits

DO NOT HAVE TO BE MANIFESTED IN EACH AND EVERY INDIVIDUAL OF A SPECIES IN ORDER TO BE INNATE WITHIN SOME SUBGROUP. HE ASSERTS THAT AT ANY GIVEN TIME IN A SPECIES' HISTORY, INDIVIDUAL MEMBERS OF THE SPECIES MANIFEST A DIFFERENTIAL CAPACITY TO ACQUIRE AND USE CERTAIN TYPES OF ADAPTIVE BEHAVIOR PATTERNS. THUS HIS USE OF INNATE SEEMS TO IMPLY AN INNATE PREDISPOSITION FOR CERTAIN TYPES OF BEHAVIOR RATHER THAN AN ASSURANCE OF THEIR EXPRESSION.

ELIZABETH BATES (1979), A PSYCHOLINGUIST WITH AN ANTHROPOLOGICAL PERSPECTIVE, HAS SUGGESTED THAT NEW SYSTEMS OF BEHAVIOR CAN OCCUR OUT OF THE FORTUITOUS COMBINATIONS OF OLD SYSTEMS THUS REQUIRING SIMILAR ENVIRONMENTAL CONSTRAINTS BUT LITTLE GENETIC CHANGE TO APPEAR. BATES USES THIS HYPOTHESIS IN DEVELOPING A MODEL FOR THE EVOLUTION AND DEVELOPMENT OF SYMBOL SYSTEMS INCLUDING LANGUAGE. IN FORMULATING THIS MODEL, BATES HAS BORROWED FROM STEPHEN GOULD'S (1977) CONTEMPORARY VERSION OF DARWINIAN EVOLUTIONARY THEORY, PARTICULARLY DARWIN'S NOTION OF PREADAPTATION AND GOULD'S MODERN APPLICATION OF THIS IDEA.

BATES WRITES THAT ACCORDING TO THE DOCTRINE OF PREADAPTATION,

> COMPONENTS THAT WILL EVENTUALLY COME TOGETHER TO SERVE A SPECIALIZED NEW FUNCTION FIRST EVOLVE SEPARATELY IN THE SERVICE OF COMPLETELY DIFFERENT PRIOR FUNCTIONS. THESE IMPERFECT INTERMEDIATE STEPS TOWARD THE NEW FUNCTIONS ARE THEN MAINTAINED BY THE ADAPTIVE VALUE THEY SERVE IN AN OLD SYSTEM. (1979, P. 22)

BATES SURMISES THAT ONCE A NEW SYSTEM EMERGES, IT CAN BE TRANSMITTED TO A NEW GENERATION IN ONE OF TWO WAYS:

EITHER BY DIRECT GENETIC CONTROL; OR BY HIGH PROBABILITY "BETS" THAT OLD GENOTYPES, WHEN CONFRONTED WITH NEW BUT FIRMLY CONSTRAINED PROBLEMS IN SIMILAR CONTEXTS, MAY NEED VERY LITTLE GENETIC MONITORING TO FALL INTO THE MOST EFFICIENT SOLUTIONS. THE RESULT MAY BE A SITUATION IN WHICH INDIVIDUALS REPEAT THE SAME CONSTRUCTION PROCESS THAT LED TO THE NEW SYSTEM IN THE FIRST PLACE. ONTOGENY THUS MAY AT LEAST PARTIALLY RECAPITULATE PHYLOGENY.

BATES, LIKE GOULD, BELIEVES THAT NATURE BUILDS MANY NEW SYSTEMS OUT OF OLD PARTS AND SELECTS FOR ORGANISMS THAT CAN CARRY OUT THE SAME CONSTRUCTION PROJECT ONTOGENETICALLY.

BY CAREFULLY OBSERVING THE DEVELOPMENT OF INFANTS FROM 9-13 MONTHS, BATES HAS MADE A TENTATIVE IDENTIFICATION OF THE PREADAPTED BEHAVIORS THAT APPEAR TO BE PRECURSORS OF SYMBOLIC BEHAVIOR INCLUDING SPOKEN LANGUAGE.

THE THREE CAPACITIES THAT BATES HAS IDENTIFIED IN HER PRELIMINARY RESEARCH ARE:

(1) THE CAPACITY FOR IMITATION OF POORLY UNDERSTOOD BEHAVIORS,

(2) THE CAPACITY TO ANALYZE WHOLE SITUATIONS INTO PARTS AND LOCATE SUBSTITUTES FOR MISSING PARTS (TOOL USE),

(3) A SOCIAL MOTIVATION TO COMMUNICATE VERBALLY OR NONVERBALLY THROUGH SHARING REFERENCE TO EXTERNAL OBJECTS, FOR INSTANCE, POINTING, GIVING, ETC. (FUNCTIONAL INTENT).

BATES SAYS,

> IN PHYLOGENY THERE IS REASON TO BELIEVE THAT THESE THREE CAPACITIES PREDATED THE EMERGENCE OF LANGUAGE. THAT IS THEY WERE 'PREADAPTED' IN THE SERVICE OF DIFFERENT FUNCTIONS. HOWEVER, ONCE CERTAIN CRITICAL THRESHOLD LEVELS WERE REACHED IN EACH OF THESE THREE DOMAINS, IT WAS

> POSSIBLE FOR THE SAME THREE CAPACITIES TO JOIN IN THE SERVICE OF A NEW FUNCTION, THE SYMBOLIC CAPACITY. . . . ONCE THRESHOLD IS REACHED IN ALL THREE DOMAINS, A QUALITATIVELY NEW PATTERN OF INTERACTION CAN EMERGE. (BATES, 1979, P. 367)

THE MODEL THAT ELIZABETH BATES HAS DEVELOPED FOR THE ORIGIN AND EVOLUTION OF SPOKEN LANGUAGE SEEMS TO SUGGEST A NATURAL EXTENSION AND ELABORATION OF THIS MODEL FOR THE ORIGIN AND EVOLUTION OF WRITTEN LANGUAGE AS WELL.

THE POSSIBILITY THAT THE SPONTANEOUS WRITING OF UNINSTRUCTED CHILDREN REFLECTS THE INNATE PREDISPOSITION OF HUMANS TO CONSERVE SPEECH AND COMMUNICATE THROUGH VISUAL LANGUAGE AS WELL AS SPOKEN IS AN INTRIGUING PREMISE. A CAREFUL STUDY OF THE YOUNG CHILDREN WHO ARE JUST BEGINNING TO MANIFEST SPONTANEOUS WRITING WOULD SEEM TO PROVIDE AN OPPORTUNITY TO GAIN INSIGHT INTO THIS PROCESS AND ITS POSSIBLE RELATIONSHIP TO THE EVOLUTION OF WRITTEN LANGUAGE IN HUMANS.

FOLLOWING BATES' IDEA THAT NEW SYSTEMS CAN EMERGE THROUGH THE FORTUITOUS COMBINATIONS OF OLD, IT IS INTERESTING TO SPECULATE, FIRST, ON WHAT THE OLD SYSTEMS THAT LED TO WRITING MIGHT HAVE BEEN AND, SECONDLY, TO ASK WHY THIS SPONTANEOUS PROTOWRITING SHOULD FIRST APPEAR AT THE PARTICULAR STAGE THAT IT DOES (FOUR TO FIVE YEARS OF AGE) IN THE DEVELOPMENTAL SEQUENCE.

IN REGARD TO THE FIRST QUESTION, WHAT MIGHT THE EARLIER SYSTEMS HAVE BEEN THAT COMBINED TO CREATE WRITTEN LANGUAGE? TWO UNIVERSAL ACTIVITIES OF HUMANS APPEAR TO BE IMPLICATED IN THE INVENTION OF WRITING: SPOKEN LANGUAGE AND GRAPHIC REPRESENTATION (DRAWING, PAINTING, SCULPTING, ETC.).

It is the premise of this writer that these two universal human behaviors emerged as part of an adaptive package leading to a flowering of culture in the first modern Homo sapiens around 35,000-40,000 years ago.

According to researchers such as Alexander Marshack (1976), Glynn Isaac (1976), and Mary Le Cron Foster (1978), the archeological record provides evidence that spoken language, as we know it today, probably evolved then and was directly associated with the appearance of graphic art (cave wall paintings and carvings) and with simple notations such as crude calendars and counting devices.

It seems likely that the cognitive capacities for these behaviors and a primitive language capability may have been available much earlier (Wynn, 1979), and there is evidence that a human cultural and organizational capability had been developing slowly over at least a 200,000 year time span; however, it was not until the period between 50,000-100,000 years ago that a noticeable quickening of the tempo of change is documented in the archeological record. This acceleration culminated in what appears to be the crossing of a developmental threshold at 35,000-40,000 years ago characterized by "the emergence of much more complex and style-ridden systems of material culture." (Isaac, 1976)

Whether this surge of change, to use Isaac's phrase, represents some sort of discontinuity due to a discrete innovation (such as a crucial developmental step in language) or whether it marks "the trace of a critical bend in a

GEOMETRIC OR HYPERGEOMETRIC GROWTH CURVE," AGAIN BORROWING ISAAC'S TERMINOLOGY, THE SUDDEN APPEARANCE OF MODERN LANGUAGE, GRAPHIC ARTS, AND EARLY NOTATION, DOCUMENTS THE BEGINNINGS OF A MODERN HUMAN CULTURAL ADAPTATION WHICH IS STILL EVOLVING.

HOOKS (1954) AND GELB (1952), IN THEIR HISTORICAL STUDIES OF WRITING, EACH TELLS US THAT THE EARLIEST WRITTEN LANGUAGES WERE COMPRISED OF STYLIZED PICTURES (LOGOGRAPHICS) EACH OF WHICH REPRESENTED, IN AN IDENTIFIABLE WAY, THE MEANING OF A PARTICULAR SPOKEN WORD. LATER LANGUAGES HAD PICTURE CHARACTERS THAT REPRESENTED SYLLABLES. THESE WERE OFTEN ONE SYLLABLE WORDS AND, SINCE THESE LANGUAGES ALSO CONTAINED MANY HOMONYMS, THESE CHARACTERS COULD BE COMBINED IN MANY WAYS TO FORM MULTI-SYLLABLE WORDS WITH VARIED MEANINGS FOR THE CHARACTERS. STILL LATER, THE PICTURES BECAME FURTHER STYLIZED AND CONSONANT AND VOWEL SOUNDS BECAME SEPARATED IN REPRESENTATION LEADING FINALLY TO ALPHABETIC LANGUAGES WITH SEPARATE NON-PICTORIAL CHARACTERS, REPRESENTING INDIVIDUAL PHONEMES.

THE FACT THAT WRITTEN LANGUAGE HAS EVOLVED FROM PICTORIAL OR GRAPHIC REPRESENTATIONS OF OBJECTS, EVENTS, OR IDEAS CAN BE TRACED THROUGH THE WRITTEN SYMBOLS OF MANY LANGUAGES WITH CHINESE AND JAPANESE PICTOGRAPHS BEING OBVIOUS EXAMPLES.

CONTEMPORARY ANTHROPOLOGISTS SUCH AS MARVIN HARRIS (1971) SUGGEST THAT WRITTEN LANGUAGES EVOLVED FROM A NEED FOR RECORD KEEPING OF SEASONAL ACTIVITIES (CALENDARS, RITUAL

OBSERVANCES AND COMMERCIAL EXCHANGES BETWEEN PERSONS AND GROUPS).

V. GORDON CHILDE (1951), HAS DESCRIBED, IN RATHER GRAPHIC DETAIL, THE TYPES OF PRESSURES UPON INDIVIDUAL AND GROUP MEMORIES THAT HE SURMISED WERE IMPORTANT IN CREATING THE NEED FOR MNEMONIC DEVICES SUCH AS WRITING AND NOTATION.

ACCORDING TO CHILDE, THE ECONOMIC REVOLUTION BROUGHT ABOUT BY THE UTILIZATION OF NEW TECHNOLOGIES IN THE SUMERIAN AND EGYPTIAN CULTURES WAS INSTRUMENTAL IN BRINGING ABOUT THE DEVELOPMENT OF BOTH MATHEMATICS AND WRITING. THE URBANIZATION OF THESE CULTURES AND THE STRATIFICATION OF CLASSES THAT WAS BUILT UPON THE PRODUCTION OF SURPLUSES OF FOOD AND OTHER NECESSITIES, CREATED PRACTICAL NEEDS IN THE NEW ECONOMIES THAT EVOKED THESE INNOVATIONS.

IN THE COUNTRY OF SUMER, THE RESOURCES, ACQUIRED BY THESE CULTURAL CHANGES, APPEAR TO HAVE BEEN ACCUMULATED IN TEMPLES AND ADMINISTERED BY PRIESTS. SINCE THE WEALTH OF THESE TEMPLES WAS VAST AND COMMERCIAL EXCHANGES MANAGED BY THEM WERE COMPLEX AND EXTENSIVE, THE ADMINISTRATIVE RESPONSIBILITIES INVOLVED WERE VERY GREAT. THE PRIESTS WHO ADMINISTERED THESE REVENUES HAD TO GIVE AN ACCOUNTING TO THE DIVINE MASTER OR DEITY WHO OWNED THEM ALL, AND KEEPING TRACK OF THESE TRANSACTIONS PRESENTED A PROBLEM UNPRECEDENTED IN HUMAN HISTORY, ACCORDING TO CHILDE.

NO LONGER COULD THE PRIEST RELY UPON HIS OWN MEMORY OR UPON SOME PERSONAL MEMORY DEVICE, SUCH AS TYING KNOTS IN A STRING. THE PRIEST WAS MORTAL BUT THE CORPORATION FOR

WHICH HE WORKED, LIKE THE GOD IT SERVED, WAS IMMORTAL; THEREFORE, SOME KIND OF COMMON SOCIAL DEVICE WAS NEEDED SO THAT THE PRIESTHOOD, AND NOT JUST AN INDIVIDUAL PRIEST, COULD INTERPRET THE RECORD.

TO SOLVE THIS VERY PRACTICAL PROBLEM, A SOCIALLY RECOGNIZED SYSTEM OF RECORDING CAME INTO BEING WHICH WAS THE FORERUNNER OF OUR PRESENT WRITING SYSTEM. IN THE BEGINNING THE AGREED UPON WRITING SYMBOLS REPRESENTED IDEAS AND WERE ACTUALLY PICTURES OF THE THING OR ACTION TO BE REPRESENTED. GRADUALLY, THESE PICTURES BECAME MORE STYLIZED AND CAME TO REPRESENT, IN MANY INSTANCES, THE FIRST SYLLABLE OF THE WORD ORIGINALLY DEPICTED. IN THIS WAY, WRITTEN SYMBOLS CAME TO REPRESENT SOUNDS IN MOST LANGUAGES, LEADING FINALLY TO THE ALPHABETIC SYSTEM OF THE GREEKS.

THE FACT THAT WRITTEN LANGUAGE UNLIKE SPOKEN IS NOT UNIVERSAL WOULD SEEM TO BE ACCOUNTED FOR BY THE LACK OF NEED IN SOME CULTURES FOR A COMMON WRITTEN MEMORY DEVICE. WHERE THE CULTURAL GROUP IS SMALL AND SELF-SUFFICIENT, WITH SIMPLE EXCHANGES THAT CAN BE EASILY REMEMBERED BY THE PARTIES INVOLVED, THERE ARE NO CULTURAL PRESSURES FOR A WRITING SYSTEM, AND, WITHOUT OUTSIDE INFLUENCES, NONE ARE INVENTED. HOWEVER, EVERY CULTURE HAS SOME FORMS OF GRAPHIC OR SYMBOLIC REPRESENTATION SUCH AS BODY PAINTING, AMULETS, MASKS, DECORATIONS ON POTTERY, DECORATIONS ON HUTS, WEAVING DESIGNS, ETC.

CHILDREN'S DRAWINGS AND CHILDREN'S SPONTANEOUS WRITINGS MAY EVOLVE FROM THIS UNIVERSAL NEED OF HUMANS TO COMMUNICATE THEIR IDEAS TO OTHERS AND, IN CULTURES WHERE A WRITTEN

LANGUAGE DOES EXIST, TO EXPRESS THESE IDEAS BY THE USE OF A WRITING TOOL.

THE LATE RHODA KELLOGG, A CALIFORNIA-BASED EARLY CHILDHOOD EDUCATOR, COLLECTED MORE THAN A MILLION SAMPLES OF CHILDREN'S ART FROM MORE THAN THIRTY COUNTRIES DURING HER LIFETIME. FROM THIS EXTENSIVE COLLECTION, SHE EXTRACTED A DEVELOPMENTAL SEQUENCE OF REPRESENTATIONAL ART FROM SCRIBBLES TO PICTORIAL DRAWINGS.

HERBERT READ, A WELL-KNOWN SCHOLAR IN THE GRAPHIC ARTS, DESCRIBES KELLOGG'S WORK IN A 1963 PAPER, QUOTED IN KELLOGG'S WRITINGS, IN WHICH HE DISCUSSES THE UNIVERSALITY OF THESE ART FORMS.

> IT HAS BEEN SHOWN BY SEVERAL INVESTIGATORS, BUT MOST EFFECTIVELY BY RHODA KELLOGG OF SAN FRANCISCO, THAT THE EXPRESSIVE GESTURES OF THE INFANT, FROM THE MOMENT THAT THEY CAN BE RECORDED BY A CRAYON OR A PENCIL, EVOLVE FROM CERTAIN BASIC SCRIBBLES TOWARD CONSISTENT SYMBOLS. OVER SEVERAL YEARS OF DEVELOPMENT, SUCH BASIC PATTERNS GRADUALLY BECOME THE CONSCIOUS REPRESENTATION OF OBJECTS PERCEIVED; THE SUBSTITUTIVE SIGN BECOMES A VISUAL IMAGE. OUT OF THE AMORPHOUS SCRIBBLINGS OF THE INFANT EMERGE FIRST CERTAIN BASIC FORMS, THE CIRCLE, THE UPRIGHT CROSS, THE DIAGONAL CROSS, THE RECTANGLE, AND THEN TWO OR MORE OF THESE BASIC FORMS ARE COMBINED INTO THAT COMPREHENSIVE SYMBOL KNOWN AS THE MANDALA, A CIRCLE DIVIDED INTO QUARTERS BY A CROSS. LET US IGNORE FOR THE PRESENT THE GENERAL PSYCHOLOGICAL SIGNIFICANCE OF THE PROCESS; I MERELY WANT YOU TO OBSERVE THAT IT IS UNIVERSAL AND IS FOUND, NOT ONLY IN THE SCRIBBLINGS OF CHILDREN, BUT EVERYWHERE WHERE THE MAKING OF SIGNS HAS HAD A SYMBOLIZING PURPOSE WHICH IS FROM THE NEOLITHIC AGE ONWARD. (KELLOGG, 1969)

HOWARD GARDNER (1980) ALSO HAS WRITTEN ABOUT CHILDREN'S GRAPHIC REPRESENTATIONS AND HAS RELATED ITS DEVELOPMENT TO THE CHILD'S COGNITIVE GROWTH.

It is interesting to note that the development of written language in individual children seems to follow the same general sequence as that observed in the history of human writing. This can be construed as interesting but of no significant import or alternatively, as supporting the premise subscribed to by many contemporary anthropologists, including this researcher, that activities remain in the developmental sequence that have had high adaptive survival value for our early ancestors and continue to provide adaptive rehearsal for developing humans.

Examples can be cited that seem to provide support for this view. Gibson and Parker (1979) have noted many examples in children's play (imitation, construction, shelter building, food sharing, and throwing aimed missiles) that represent adaptive activities of early humans. Slobin (1965) and Lancaster (1968) have pointed to the young child's two-word stage of language as probably being analogous to the early forms of language in human history.

Writing seems to represent a synthesis of two universal activities, language and graphic representation. Each of these activities has been adapted for man's communicative needs and more recently in man's history, they have been joined in the elaboration of the communicative function into a new and more complex form, writing.

The apparent replication of this sequence in young children, as they move from spoken to written language and

FROM DRAWING PICTURES TO WRITING LETTERS AND WORDS, DESERVES EXAMINATION.

A BRIEF REVIEW OF THE STAGES OF THE HISTORY OF HUMAN WRITING AND THE STAGES IN THE DEVELOPMENT OF CHILDREN'S WRITING REVEAL THE FOLLOWING PARALLELS.

History of Writing	Children's Development
1. Pictographic writing The first stage of writing was the use of schematic pictures to provide a narrative account or picture/symbols (like a crest) as a memory aid to an event or a person.	1. Children use drawings to depict things that they know in the world. Single letters are sometimes included in their drawings.
2. Logographic writing The second stage of writing utilized a stylized picture for each individual word in the language.	2. Young children sometimes combine pictures and written words to convey a message. For example, a four year old drew around her hand and then wrote her name, Emily. She said the name of the picture was "Emily's Hand".
3. Phonetization This third stage utilizes pictures to depict syllables. For instance, the picture of an eye and a saw for "I saw." This worked well because in the Sumerian language most words were one syllable and there were many homonyms. At this stage, pictures were placed in a particular sequence, as they were to be read, for the first time.	3. Children enjoy using rebus pictures to read messages, compound words, etc.; however, they usually are not able to invent these themselves. At this stage, they can segment words in their spoken language into syllables (ba-by, Ma-ry) or in chanting, but they cannot yet segment by individual sounds.

History of Writing	Children's Development
4. Syllabic writing The simplification of pictures led to their gradual modification into nonpictorial characters that depicted monosyllabic sounds. One character or letter stood for a syllable. Later the individual letters had small markings beside them to indicate which vowel sound was to be used with the consonant to make the syllable.	4. When children begin spontaneous writing (protowriting) they use consonants only, leaving out the vowels. These consonant letters, however, seem to stand for whole syllables including the vowels. In segmenting their oral language, children are just beginning to be able to separate the initial sound from the rest of the word.
5. Alphabetic writing The Greeks decided to separate the vowel markings (and their sounds) from the consonants thus leading to an alphabetic system with each letter standing for an individual sound.	5. At this stage, vowels begin to be included in the protowriting although the choice of vowels is not consistent as yet. Children can now segment words by individual sounds.

Whether one chooses to explain the analogies between the history of writing and the writing development of the child through a contemporary recapitulation model such as that espoused by Stephen Gould (1977) and others, a terminal addition model as suggested by Gibson and Parker (1979), or prefers to view the similarities as interesting but unrelated phenomena, one thing from the history of writing seems clear. The twin strands of language and the graphic arts have been interwoven over time, into a complex fabric of cognitive and motor activities that we call writing.

Paralleling the developmental sequence of children's writing is a progressive ability to segment spoken language

INTO ITS DISCRETE PARTS, FIRST INTO WORDS, THEN INTO SYLLABLES, AND FINALLY INTO INDIVIDUAL PHONEMES OR SOUNDS. THIS SEGMENTATION SEQUENCE APPEARS TO BE CORRELATED WITH THE WRITING SEQUENCE AND MAY BE THE FOUNDATION FOR PROTOWRITING'S CHANGING CHARACTERISTICS. THERE IS EVIDENCE TO SUGGEST THAT "LINGUISTIC AWARENESS" OF THE SOUND SEGMENTS OF ONE'S OWN LANGUAGE HAS BOTH A MATURATIONAL AND A CULTURAL BASE. D. B. ELKONIN (1973) HAS COMMENTED UPON THIS DEVELOPING ABILITY TO SEGMENT, FIRST BY SYLLABLES, AND THEN BY PHONEMES, AMONG YOUNG RUSSIAN CHILDREN AND HAS POINTED OUT THE DIFFICULTY OF MAKING CHILDREN CONSCIOUS OF THE "SOUND STRUCTURE" OF WORDS AS REVEALED BY THEIR LACK OF AWARENESS OF THE INDIVIDUAL PHONEMES IN FAMILIAR WORDS.

HARRIS SAVIN (1972) ALSO HAS COMMENTED UPON THIS SEGMENTATION PROGRESSION IN AMERICAN SCHOOL CHILDREN AND HAS NOTED HIS OWN OBSERVATIONS THAT CHILDREN WHO HAVE DIFFICULTY IN LEARNING TO READ AT SIX OR SEVEN YEARS OF AGE SEEM TO LACK AN AWARENESS OF THE SOUND SEGMENTS OF THEIR OWN LANGUAGE ALTHOUGH THEY APPEAR TO HAVE NO DIFFICULTY IN PROCESSING SPOKEN LANGUAGE.

JEANNE CHALL (1963) HAS SUGGESTED THAT THE ABILITY TO BLEND THE SEPARATE PHONEMES OF A WORD INTO A MEANINGFUL WHOLE, AS REQUIRED IN READING, APPEARS TO BE PRIMARILY MATURATIONAL.

ON THE CULTURAL SIDE, LINGUISTS, SUCH AS MARGARET BENDER-SAMUELS OF THE INTERNATIONAL LINGUISTIC CENTER AT THE UNIVERSITY OF TEXAS (PERSONAL COMMUNICATION), IN

ATTEMPTING TO DEVELOP WRITTEN LANGUAGES FOR CULTURES POSSESSING ONLY SPOKEN LANGUAGES, HAVE COMMENTED UPON THE DIFFICULTY OF GETTING NATIVE SPEAKERS TO BE ABLE TO SEGMENT THEIR ORAL LANGUAGES INTO UNITS OF SOUND OR, IN SOME CASES, EVEN INTO MEANINGFUL WORD UNITS. WITHOUT A TRADITION OF SOUND ANALYSIS, MANY CULTURES APPEAR TO POSSESS NO LINGUISTIC AWARENESS OF THE SOUND UNITS OF THEIR RICH AND EXPRESSIVE LANGUAGES; HOWEVER, IT HAS BEEN NOTED THAT ADOLESCENTS IN THESE CULTURES MAY BECOME QUITE PROFICIENT AT SEGMENTATION ONCE THEY HAVE BECOME AWARE OF THE POSSIBILITY OF SOUND ANALYSIS.

Psychological Rationale

THE GENETIC PSYCHOLOGY OF JEAN PIAGET WITH ITS SUGGESTED STAGES OF INTELLECTUAL DEVELOPMENT OFFERS A POSSIBLE EXPLANATION FOR THE SPONTANEOUS APPEARANCE OF WRITTEN LANGUAGE, IN CULTURES WHERE IT EXISTS, AMONG UNSCHOOLED CHILDREN OF FOUR AND A HALF TO FIVE AND A HALF YEARS OF AGE.

PIAGET'S THEORY (1970) POSTULATES THAT INTELLIGENCE (A GENERIC TERM) INDICATES THE SUPERIOR FORMS OF ORGANIZATION OR EQUILIBRIUM OF COGNITIVE STRUCTURES ACHIEVED BY HUMANS IN THEIR ADAPTATION TO THEIR PARTICULAR ENVIRONMENTS. THE GRADUAL DEVELOPMENT OF THESE FORMS OF ORGANIZATION FROM THEIR EARLIEST SENSORI-MOTOR MANIFESTATIONS TO THE COMPLEX ADULT STRUCTURINGS DESCRIBED AS ABSTRACT THOUGHT REFLECT A PROGRESSIVE MOVEMENT FROM AN EGOCENTRIC NON-REVERSIBLE INITIAL SYSTEM OF RHYTHMS AND REGULATIONS TO AN OBJECTIVE

REVERSIBLE BALANCED SYSTEM OF RECIPROCAL COMPENSATIONS IDENTIFIED BY PIAGET AS THE UNDERLYING ORGANIZATION OF ADULT FORMAL THOUGHT.

THE DISTINCTIVE STAGES ALONG THE WAY, DESCRIBED BY PIAGET AS SENSORI-MOTOR (BIRTH TO TWO YEARS), PREOPERATIONAL (TWO TO SEVEN YEARS), CONCRETE OPERATIONAL (SEVEN TO TWELVE/FIFTEEN YEARS), AND FORMAL OPERATIONAL (FIFTEEN/EIGHTEEN YEARS THROUGH ADULTHOOD) INDICATE SUCCESSIVE, PROGRESSIVE RESTRUCTURINGS OR COGNITIVE REORGANIZATIONS CHARACTERISTIC OF HUMAN INTELLECTUAL DEVELOPMENT.

PIAGET NOTES THAT THESE OVERALL STRUCTURES ARE INTEGRATIVE AND NON-INTERCHANGEABLE. EACH, ACCORDING TO PIAGET, RESULTS FROM THE PRECEDING ONE, INTEGRATING IT AS A SUBORDINATE STRUCTURE. EACH ALSO PREPARES FOR THE SUBSEQUENT STRUCTURE INTO WHICH IT EVENTUALLY WILL BE INTEGRATED.

THE PERIOD AT WHICH PROTOWRITING APPEARS IN YOUNG CHILDREN IS DESCRIBED BY PIAGET AS THE INTUITIVE SUBSTAGE OF THE PREOPERATIONAL STAGE. DURING THIS SUBSTAGE, ACCORDING TO PIAGET, THE CHILD IS BEGINNING TO DEVELOP THE GROUPINGS THAT WILL BECOME THE FOUNDATIONS OF OPERATIONAL THOUGHT.

A FIRST SYSTEM OF GROUPINGS IS FORMED BY THE OPERATIONS THAT PIAGET TERMS LOGICAL OPERATIONS. CLASSIFICATION, SERIATION (ASYMMETRY), SUBSTITUTION, AND SYMMETRY ARE ALL MEMBERS OF THIS SYSTEM. A SECOND SET OF GROUPINGS, TERMED THE INFRALOGICAL GROUPINGS BY PIAGET, ALSO ARE DEVELOPING PARALLEL TO THE FIRST SET DURING THIS SAME PERIOD. THESE OPERATIONS, CONSIDERED BY PIAGET TO BE OF EQUAL IMPORTANCE

WITH THE LOGICAL GROUPINGS "SINCE THEY FASHION OUR NOTIONS OF SPACE AND TIME," INCLUDE THE ADDITION OF PARTS INTO A WHOLE, CHANGE OF ORDER WITHOUT MEASUREMENT, AND SPATIO-TEMPORAL SUBSTITUTIONS OR DISPLACEMENTS.

PIAGET HAS DEVISED A SERIES OF CHILDREN'S TASKS THAT PROVIDE CLUES TO SUCCESSIVE LEVELS OF DEVELOPMENT IN ACHIEVING BOTH LOGICAL AND INFRALOGICAL GROUPINGS. FOUR OF THESE COGNITIVE TASKS, TWO DEALING WITH INFRALOGICAL, HAPTIC PERCEPTION AND LINEAR ORDER, AND TWO DEALING WITH LOGICAL GROUPINGS, CONSERVATION OF DISCRETE QUANTITY (NUMBER) AND CONSERVATION OF CONTINUOUS QUANTITY, APPEAR TO HAVE RELEVANCE FOR SPONTANEOUS WRITING. (SEE TABLE 1)

IN REPORTING ON RESEARCH REGARDING THE CHILD'S CONCEPTIONS OF SPACE, PIAGET AND INHELDER (1967) HAVE DELINEATED THE SUBSTAGES OF DEVELOPMENT IN PERFORMING TWO OF THE INFRALOGICAL TASKS, ONE MEASURING HAPTIC PERCEPTION (THE RECOGNITION OF SHAPE FROM KINESTHETIC INFORMATION) AND ONE ASSESSING THE CHILD'S ABILITY TO GENERATE A PRESCRIBED LINEAR ORDER WITH OBJECTS.

AN ANALYSIS OF CHILDREN'S PROTOWRITING SUGGESTS THAT BOTH HAPTIC PERCEPTION AND LINEAR ORDER PLAY A PART IN THE CHILD'S ABILITY TO WRITE SPONTANEOUSLY USING FORMS OF INVENTED SPELLINGS REFLECTIVE OF THE CHILD'S LINGUISTIC KNOWLEDGE.

THE ABILITY TO DISCRIMINATE LETTER SHAPES SEEMS TO BE RELATED TO A HAPTIC AS WELL AS A VISUAL DIMENSION. A. R. LURIA (1960), A RUSSIAN PSYCHOLOGIST, HAS REPORTED THAT YOUNG CHILDREN LEARN SHAPES MORE QUICKLY IF THEY ARE ABLE TO FEEL

TABLE I

STAGES OF DEVELOPMENT

Stages of Development	Haptic Perception	Linear Order	Conservation of Discrete Quantities
STAGE I (Below Threshold)	No exploration. Rubs object between palms. Passive examination.	Can select objects, but only partial order.	Unable to make equivalent sets.
STAGE 2 (Threshold)	Grasps object, feels it, turns it around, content with first haphazard centration. No decentration. More than 8 errors.	Can order objects when placed directly below model.	Can make equivalent sets but thinks that quantities are changed when appearance is changed.
STAGE 3 (First Level above Threshold)	Objects are recognized by topological relationships. Child feels two sides of perimeter by pressing edge with palms. 8 or less errors.	Can order objects when placed to one side but still has trouble reversing order.	Can confirm that horizontally rearranged sets are still the same but must count and/or cannot give reason why they are. May still be confused by vertical rearrangement and think that they are not the same.
STAGE 4 (Transition)	Review after early exploration complete though hesitant and in one direction only. Exploration is now with finger rather than palms. A few children may have achieved systematic exploration but still continue to make identification errors. 3 or less errors.	Can maintain correspondence between circular and linear order. Also can reverse order after many trial approximations and judgments.	Can confirm that horizontally rearranged sets are still the same without counting but can't tell why. Also may still have to count vertically arranged set.
STAGE 5 (Mature)	Systematic exploration. All choices are correct.	Can do all ordering and reversals without difficulty.	Can confirm that sets are still the same without counting and can tell why.

TABLE 1, CONTINUED

CONSERVATION OF CONTINUOUS QUANTITIES	GRAPHIC REPRESENTATION	SEGMENTATION	INVENTED SPELLING
WHEN EQUIVALENT SETS ARE MADE, CHILD THINKS AMOUNTS ARE CHANGED WHEN APPEARANCE IS CHANGED. CAN'T GIVE REASON.	MANDALAS, SUNS.	CANNOT CLAP SYLLABLES OR IDENTIFY INITIAL SOUNDS.	CANNOT WRITE LETTER TO LABEL PICTURE AND/OR SELECTS MOVABLE LETTERS RANDOMLY AND PLACES IN ANY ORDER.
STILL THINKS AMOUNTS ARE CHANGED WHEN APPEARANCE IS CHANGED AND GIVES REASONS INVOLVING ONE DIMENSION.	HUMANS AND/OR A REPRESENTATION OF SOMETHING REAL THAT IS USUALLY IDENTIFIED AFTER THE FACT.	CAN IDENTIFY 2 OR 3 ITEMS IN AN 8-ITEM COLLECTION WHEN INITIAL SOUND CUE IS GIVEN. CAN CLAP 2-SYLLABLE WORD.	CAN WRITE FIRST LETTER IN WORD. LETTER REPRESENTS WHOLE WORD.
STILL THINKS AMOUNTS ARE CHANGED WHEN APPEARANCE IS CHANGED, BUT IS NOTICING TWO DIMENSIONS.	ANIMALS, VEHICLES, BUILDINGS, ETC., DRAWN WITH INTENT TO REPRESENT.	CAN IDENTIFY ALL ITEMS IN 8-ITEM COLLECTION WHEN INITIAL SOUND CUE IS GIVEN. CAN CLAP 2 OR 3 SYLLABLES AND/OR CAN IDENTIFY A FEW OBJECTS IN NEAR ENVIRONMENT WHEN SOUND CUE IS GIVEN.	WRITES LETTERS FOR FIRST AND LAST SOUNDS. SOMETIMES LONG VOWELS (LETTER NAMES) ARE INCLUDED, BUT SOME SOUNDS ARE STILL OMITTED.
SAYS AMOUNTS ARE NOT CHANGED WHEN APPEARANCES ARE CHANGED BUT CAN'T GIVE REASON.	MANY OBJECTS IN PICTURES WITH SOME EVIDENCE OF OVERALL DESIGN (SCALE, BALANCE, PLACEMENT, ETC.).	CAN IDENTIFY OBJECTS WHEN INITIAL SOUND CUES ARE GIVEN AND CAN GIVE SOUND CUES FOR INITIAL SOUNDS, IN 8-OBJECT COLLECTION. CAN ALSO GIVE SOUND CUES FOR A FEW OBJECTS IN ENVIRONMENT.	WRITES LETTERS FOR FIRST, MIDDLE AND LAST SOUNDS. PLACEMENT OF VOWELS IS SOMETIMES CORRECT BUT VOWEL SPELLING IS USUALLY INCORRECT. NASALS ARE OFTEN OMITTED IN SPELLING.
KNOWS AMOUNTS HAVE NOT CHANGED AND CAN GIVE REASONS.	NOTICEABLE OVERALL DESIGN ELEMENTS. ADVANCED PICTORIAL DEPICTION.	CAN DO ALL OF THE ABOVE, CAN GIVE INITIAL SOUND CUES FOR MANY OBJECTS IN ENVIRONMENT. CAN CLAP 1, 2, AND 3 SYLLABLES.	SIGHT WORDS APPEAR CORRECTLY SPELLED (THE, WAS, YOU, ETC.). DIGRAPHS ARE USED (TH, WH, CH, SH) VOWEL PLACEMENT IS CORRECT BUT SPELLING MAY BE INACCURATE STILL. CHILD HAS BEGUN TO READ.

AS WELL AS SEE THEM. DR. MARIA MONTESSORI (1964) NOTED THAT YOUNG CHILDREN REMEMBER LETTER SHAPES AND THEIR ASSOCIATIONS TO SOUNDS MORE QUICKLY IF THEY CAN TRACE OVER THE LETTERS OR HOLD CUT-OUT LETTERS IN THEIR HANDS. SHE TERMED THIS A "MUSCULAR MEMORY." YOUNG CHILDREN OFTEN ARE OBSERVED TRACING LETTER SHAPES IN THE AIR OR IN THEIR HANDS WHEN THEY ARE FIRST LEARNING TO READ. THIS HAPTIC DISCRIMINATION OF SHAPES WOULD APPEAR TO BE AN IMPORTANT COMPONENT OF THE YOUNG CHILD'S ABILITY TO WRITE WHETHER WITH A PENCIL OR WITH CUT-OUT LETTERS.

THE RELATIONSHIP OF LINEAR ORDER TO PROTOWRITING IS QUITE DIRECT. A RECOGNITION OF THE NEED FOR A PRECISE ORDER IN REPRESENTING THE SOUNDS HEARD THROUGH A CONSTRUCTED SEQUENCE OF LETTER SYMBOLS IS THE ESSENCE OF THE ABILITY TO ENGAGE IN SUCCESSFUL PROTOWRITING BY YOUNG CHILDREN. NO MATTER THAT THE LETTERS CHOSEN MAY NOT BE THOSE OF THE ADULT ORTHOGRAPHY OF THE CULTURE, THE SEQUENCE OF SOUNDS AND THE REGULARITY OF THEIR LETTER REPRESENTATIONS, BASED ON THE CHILD'S IMPLICIT KNOWLEDGE OF THE PHONOLOGY OF THE MOTHER TONGUE, ARE EVIDENCE THAT LINEAR ORDER IS A MAJOR COMPONENT OF EARLY SPONTANEOUS WRITING.

IN THE DEVELOPMENT OF THE LOGICAL STRUCTURES, TWO OF PIAGET'S CONSERVATION TASKS, ONE DEALING WITH THE CONSERVATION OF CONTINUOUS QUANTITY (SUBSTANCE) AND THE OTHER WITH CONSERVATION OF DISCRETE QUANTITY, SEEM PARTICULARLY RELATED TO PROTOWRITING. AS ZUTTELL HAS SUGGESTED IN HIS RESEARCH, PIAGET'S DESCRIPTION OF THE MOVEMENT FROM AN EGOCENTRIC

VIEWPOINT OF THE WORLD TO A MORE DECENTERED VIEW IN WHICH THE CHILD FIRST LEARNS TO FOCUS ON A SUCCESSION OF CENTERS OR VARIABLES AND THEN GRADUALLY BECOMES ABLE TO INTEGRATE THESE SUCCESSIVE "CENTERINGS" INTO A COHESIVE REVERSIBLE SYSTEM OF COMPENSATIONS AND RECIPROCITIES, APPEARS TO HAVE IMPORTANT CORRELATIONS WITH THE STAGES OF PROTOWRITING (ZUTTELL'S INVENTED SPELLINGS). PAUL'S DESCRIPTIONS OF THE STAGES OF INVENTED SPELLING THAT SHE OBSERVED IN HER OWN CLASSROOM, ALSO BEAR A STRIKING RESEMBLANCE TO THE DESCRIPTIONS OF THIS DECENTERING PROCESS GIVEN BY PIAGET (1976). (SEE TABLE 2)

ALTHOUGH THE DECENTERING PROCESS IS INVOLVED IN THE ACQUISITION OF ALL THE CONSERVATIONS (QUANTITIES, AREA, VOLUME, AND WEIGHT), THE CONSERVATIONS OF QUANTITIES, BOTH CONTINUOUS AND DISCRETE, ARE AMONG THE EARLIEST TO BE ACHIEVED AND BEGIN TO APPEAR IN A FEW CHILDREN, AT AROUND FIVE YEARS OF AGE.[1] SINCE THESE PARTICULAR CONSERVATIONS APPEAR TO REQUIRE AT LEAST A MINIMAL LEVEL OF DECENTERING IN ORDER TO OCCUR, THE POSSIBILITY THAT THE SAME UNDERLYING COGNITIVE STRUCTURES ARE INVOLVED IN ACHIEVING BOTH THE CONSERVATION OF QUANTITIES AND PROTOWRITING IS SUGGESTED.

ANOTHER COMPONENT OF PROTOWRITING THAT IS BEING EXAMINED FOR ITS COGNITIVE IMPLICATIONS IS THE NOTION OF LINGUISTIC AWARENESS. THE TERM LINGUISTIC AWARENESS WAS FIRST

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[1] AVERAGE AGE FOR 75% ATTAINMENT OF THIS CONSERVATION IS 84 MONTHS IN OKLAHOMA CITY SCHOOL DISTRICT (RENNER, 1973); 72 MONTHS AT CASADY SCHOOL.

TABLE 2

Concrete Thinking Operations	Protowriting Stages
Preconceptual Subperiod 2-4 Years	**Stage 1**
Children's preconcepts-notions attached to first verbal signs (midway between generality of concept and individuality of its elements).	Child may write own name and/or put a letter in a picture but there is no evidence of sound/letter association.
Intuitive Subperiod 4-6 Years	**Stage 2**
Child focused on most salient attributes, ignores the rest. Child's thinking is one-directional but goal oriented.	Child uses one letter to represent initial sound only. The letter stands for whole word or idea.
Child is aware of the initial and final stages of an action, but is not yet aware of the intermediate or transforming steps.	**Stage 3**
Child is able to perform a true mental experiment by symbolizing a sequence of actions.	Child writes letter for first and last consonant sounds; also vowels that say their names.
Child can alternate centrations but cannot integrate them (successive regulations with successive centrations).	**Stage 4**
	Child begins to insert vowels into words although no consistency in vowel choice is evident. Vowel placement is correct.
Early Concrete Operations	**Stage 5**
Child is able to relate different aspects of change (compensation). Child takes other's viewpoints into account. Child establishes invariances.	Digraphs such as ch, sh, th, begin to appear. Children have begun to read as well as write. Sight vocabulary words such as was, saw, house, etc., are spelled correctly. Children's writings tend to be longer since encoding is more rapid.

Although the descriptions of the child's logic in the left hand column (Piaget, 1976, The Psychology of Intelligence) certainly did not have protowriting in mind when written, one is struck by the correspondences between the two sets of descriptions.

used by Mattingly (1972) to describe a conscious awareness of certain aspects of language that seems to be a necessary component of learning to write and to read. An example of linguistic awareness might be the recognition that bat and boat both begin with the same sound. This ability to analyze consciously one's own language into discrete sound segments, which was mentioned in the previous section, suggests the necessity of a decentering process (focusing on successive sound segments in a word rather than perceiving it in a holistic way) analogous to that necessary to achieve the early conservations.

Although Piaget (1976) has not dealt with linguistic awareness as such, he has explored the process through which cognizance of the child's own activity is acquired. His view is that cognizance of one's own activity, like other aspects of intelligence, is constructed. He traces its development through a succession of levels from the early "practical intelligence" during which the child monitors his own motor activity and adjusts his actions to accomplish a task, to the final level of this construction, at ten or eleven years of age, when through reflected abstractions, which are conscious products of the earlier reflexive abstractions, cognizance begins to be extended into a reflection of thought on itself.

Another aspect of intellectual development, delineated by Piaget, that suggests itself for further examination in regard to protowriting is Piaget's differentiation

BETWEEN OPERATIVE AND FIGURATIVE KNOWLEDGE. THE DISTINCTION THAT PIAGET HAS MADE BETWEEN THE TWO TYPES OF KNOWLEDGE IS BASICALLY A DISTINCTION BETWEEN THE ASSIMILATORY OR TRANSFORMING ACTIVITY OF THE FORMER AND THE ACCOMMODATORY OR STATIC REPRESENTATIONAL (RE-PRESENTING) NATURE OF THE LATTER. IN PIAGET'S VIEW, ONLY OPERATIVE ACTIVITIES ARE CONSTRUCTIVE IN NATURE AND PROVIDE A NECESSARY COGNITIVE FRAMEWORK FOR FIGURATIVE KNOWLEDGE. PIAGET, THEREFORE, REGARDS OPERATIVE ACTIVITIES AS MORE FUNDAMENTAL AND IMPORTANT THAN FIGURATIVE ACTIVITIES. (1970)

RECENTLY, HOWEVER, PIAGET (1976) HAS QUOTED HERMINE SINCLAIR, ONE OF HIS GENEVAN COLLABORATORS, AS REPORTING ON A VERBAL TRAINING EXPERIMENT THAT SHE CARRIED OUT IN AN ATTEMPT TO ACCELERATE THE ACQUISITION OF SERIATION AND THE EARLY CONSERVATIONS. IN THE REPORT, SINCLAIR HAS SUGGESTED THAT IN THIS EXPERIMENT, A LINGUISTIC EXERCISE, THOUGH APPARENTLY ONLY VERBAL SINCE THE SUBJECT HANDLED NOTHING, CAN IN THE PARTICULAR INSTANCE OF SERIATION CONSTITUTE AN "OPERATORY" EXERCISE. THIS IS IN CONTRAST TO THE "FIGURATIVE" CHARACTER THAT PIAGET PREVIOUSLY HAS ASSIGNED TO LANGUAGE ACTIVITIES PRIOR TO THE BEGINNING OF THE FORMAL OPERATIONAL STAGE.

IT IS THE PREMISE OF THIS RESEARCHER THAT PROTOWRITING (INVENTED SPELLING) ALTHOUGH A LANGUAGE ACTIVITY AND REPRESENTATIONAL IN ONE SENSE, IS ALSO, IN PIAGETIAN TERMS, AN OPERATIVE RATHER THAN A FIGURATIVE ACTIVITY BECAUSE OF THE

INVENTIVE, CONSTRUCTIVE NATURE OF THE TASK. IT IS FURTHER HYPOTHESIZED THAT, FOR THIS REASON, ITS SUCCESSIVE STAGES, AS DESCRIBED BY READ, CHOMSKY, ZUTTELL AND PAUL, WILL CORRELATE WITH STAGES OF COGNITIVE ACTIVITIES SUCH AS SERIATION AND CONSERVATION PREVIOUSLY IDENTIFIED AS OPERATIVE BY PIAGET.

PREDICTIONS

SEVERAL PREDICTIONS BASED UPON THEORETICAL ASSUMPTIONS REGARDING THE NATURE OF SPONTANEOUS PROTOWRITING AND ITS RELATIONSHIP TO EARLIER UNIVERSAL PREADAPTED SYSTEMS HAVE BEEN MADE BY THIS RESEARCHER. A PROCEDURE HAS BEEN DEVELOPED AND IMPLEMENTED IN ORDER TO TEST THESE HYPOTHESES. THE ASSUMPTIONS ARE AS FOLLOWS:

1. WRITING HAS EVOLVED AS A NEW SYSTEM CONSTRUCTED FROM OLD SYSTEMS. THESE OLD SYSTEMS INCLUDE SPOKEN LANGUAGE AND GRAPHIC REPRESENTATION.
2. WRITING IS A HIGHLY ADAPTIVE LINGUISTIC ACTIVITY OF HUMANS BECAUSE IT PROVIDES MORE EFFECTIVE COMMUNICATION WITHOUT THE RESTRICTIONS OF TIME OR CONTEXT. IT ALSO EXPANDS FUNCTIONALLY THE HUMAN MEMORY CAPACITY.
3. CHILDREN'S SPONTANEOUS PROTOWRITING REPRESENTS THE "REINVENTION" OF A HIGHLY ADAPTIVE SYSTEM THROUGH THE INTEGRATION OF OLD SYSTEMS IN A TIGHTLY CONSTRAINED TASK WHICH IS THE MAPPING OF SPOKEN

LANGUAGE ONTO A CULTURALLY SPECIFIC, SEQUENTIAL, WRITTEN, LINGUISTIC CODE. THIS REINVENTION PROCESS OF CHILDREN MAY PROVIDE A MODEL FOR THE ORIGINAL INVENTION OF WRITTEN LANGUAGE IN HUMANS, AND THE HISTORICAL RECORD DOES SEEM TO CONFIRM PARALLELS BETWEEN THE SEQUENCE OF STAGES IN THE DEVELOPMENT OF WRITING IN HUMANS AND THE SEQUENCE OF STAGES IN THE SPONTANEOUS PROTOWRITINGS OF INDIVIDUAL CHILDREN.

4. THE ABILITY TO ENCODE THE SPOKEN LANGUAGE OF A CULTURE INTO A VISIBLE CODE IS A COMPETENCY AVAILABLE TO ALL HUMANS SINCE IT IS A COORDINATION OR SYNTHESIS OF TWO UNIVERSAL BEHAVIORS. HOWEVER, THIS BEHAVIOR WILL BE EXPRESSED ONLY WHERE THE CULTURAL ENVIRONMENT SUPPORTS AND/OR REQUIRES SUCH AN ENDEAVOR.

THE PREDICTIONS GENERATED BY THESE ASSUMPTIONS ARE AS FOLLOWS:

1. THRESHOLD LEVELS OF SPOKEN LANGUAGE COMPETENCE AND OF COMPETENCE IN GRAPHIC REPRESENTATION WILL COINCIDE WITH THE BEGINNING STAGE OF SPONTANEOUS PROTOWRITING. THESE THRESHOLD LEVELS CAN BE DESCRIBED AS: (A) THE DEVELOPMENT OF LINGUISTIC AWARENESS IN LANGUAGE, AND (B) THE DEVELOPMENT OF INTENTION IN GRAPHIC REPRESENTATION.

LINGUISTIC AWARENESS IMPLIES THE CAPACITY TO STEP BACK AND LOOK OBJECTIVELY AT ONE'S OWN LANGUAGE LEADING TO THE CAPACITY TO ANALYZE WORDS INTO

separate components of syllables and sounds.

Intentional representation implies the capacity to use some graphic means (drawing, modeling, etc.) with the intent to represent a real object or event.

2. The appearance and sequence of stages of protowriting in young children will coincide with the appearance and sequence of stages evidenced in cognitive tasks described by Piaget and Inhelder (1969, 1971) (haptic perception, linear order, conservations of discrete and continuous quantities) because these different behavioral competencies are assumed to share underlying cognitive structures.

The period from four to five years of age in children marks the beginning of a gradual transition in thinking from a one-directional, non-reversible, egocentric type of thought to a reversible, decentered though still concrete-based, type of thought. The sequence of substages in the development of the above named competencies denote significant landmarks in this transitional period which extends from four to approximately seven years of age. It is predicted that parallel progressions will be demonstrated between the sequence of protowriting and the sequence of cognitive development as measured on the described Piagetian tasks.

To test these predictions, methods have been developed for evaluating the particular behaviors and competencies that have been delineated.

IT IS FURTHER PREDICTED THAT THE OUTCOME OF THESE RESEARCH PROCEDURES WILL CONFIRM THE SPECIFIC PREDICTIONS, AND THAT THE PROPOSED MODEL FOR THE ORIGIN OF WRITTEN LANGUAGE AND ITS RELATIONSHIP TO THE PHENOMENON OF SPONTANEOUS PROTOWRITING, OBSERVED IN THE DEVELOPMENTAL SEQUENCE OF YOUNG CHILDREN, WILL HAVE RECEIVED PRELIMINARY SUPPORT.

CHAPTER II

METHOD

Subjects

A group of forty-eight children, sixteen four-year-olds, sixteen five-year-olds, and sixteen six-year-olds, with equal numbers of males and females at each age level, served as subjects for this study. The subjects were selected from the classes in the early childhood (Primary) division at Casady School, an Episcopal day school (one-thousand-fifty-six students in grades preschool through twelve) in Oklahoma City, Oklahoma. The majority of the school population is from middle and upper socio-economic levels, although a scholarship program exists at all levels of the school thus assuring a broader population range than tuition would allow. Children were selected from the class rosters by birthdate in order to provide as wide an age range within each group as possible.

Measures and Procedures

Seven sets of tasks were given to each child. Each was selected to test a specific aspect of development that appears to be related to the development of protowriting.

DESCRIPTIONS OF THE TASKS AND A RATIONALE FOR THEIR INCLUSION IS GIVEN.

TEST 1. THE FIRST TEST WAS DESIGNED TO EVALUATE THE CHILD'S LEVEL OF DEVELOPMENT IN DRAWING (GRAPHIC REPRESENTATION). THE REASON FOR THE SELECTION OF THE DRAWING TASK WAS THE ASSUMPTION, DESCRIBED IN AN EARLIER SECTION, THAT THE CHILD'S STAGE OF DEVELOPMENT IN DRAWING WOULD HAVE A CONSISTENT RELATIONSHIP TO THE CHILD'S STAGE OF DEVELOPMENT ON THE OTHER TASKS IN THE FOLLOWING WAYS: (A) IT WAS PREDICTED THAT THE CHILD'S STAGE OF DEVELOPMENT IN GRAPHIC REPRESENTATION SHOULD BE AT THE SAME OR AT A HIGHER LEVEL THAN THE CHILD'S STAGE OF DEVELOPMENT IN PROTOWRITING (INVENTED SPELLING) SINCE IT WAS ASSUMED THAT A THRESHOLD LEVEL IN GRAPHIC REPRESENTATION (TABLE 1) WOULD BE A PREREQUISITE FOR THE OCCURRENCE OF PROTOWRITING; AND (B) THE RESULTS OF THE TEST FOR GRAPHIC REPRESENTATION SHOULD EXHIBIT A HIGH LEVEL OF CORRELATION WITH THE RESULTS OF THE OTHER TESTS SINCE IT WAS ASSUMED THAT COMMON COGNITIVE STRUCTURES (SOFTWARE) WERE PROVIDING THE ORGANIZATIONAL FRAMEWORK FOR PERFORMANCE ON ALL SEVEN TESTS.

IN THIS TEST, EACH CHILD FIRST WAS ASKED TO DRAW A PICTURE, OF THEIR OWN CHOOSING, WITH A MAGIC MARKER, ON A LARGE SHEET OF PAPER. WHEN THE PICTURE WAS COMPLETED THE CHILD WAS ASKED TO LABEL THE PICTURE, "LIKE AN ARTIST WOULD," FIRST VERBALLY AND THEN, IF POSSIBLE, BY WRITING THE LABEL ON THE PICTURE.

An adaptation of Rhoda Kellogg's stages of drawing (Table 1) was used to judge the level of graphic representation that was exemplified in the picture. The stage of protowriting, reflected by the picture labeling, also was evaluated and recorded as a part of the protowriting test (see Table 1).

Test 2. A second test, administered to each of the children, tested the child's linguistic awareness as demonstrated by an ability to segment words first into syllables and then, at a later stage, into discrete sounds or phonemes. The purpose of the segmentation tasks was to test the assumption that the child's stage of development on these tasks would have a consistent relationship to the child's stage of development exhibited on the other tests in the following ways: (a) it was predicted that the child's stage of development in linguistic awareness (segmentation) should be at the same or at a higher level than the child's stage of development in protowriting (invented spelling) since it was assumed that a threshold level (see Table 1) in segmentation would be a prerequisite for the occurrence of protowriting; and (b) the results of the test for linguistic awareness (segmentation) should exhibit a high level of correlation with the results of the other tests since it was assumed that common cognitive structures (software) provided the organizational framework for performance on all seven tests.

The test for segmentation of syllables and phonemes

WAS DEVELOPED BY THE RESEARCHER AND WAS BASED UPON INFORMATION DERIVED FROM THE WORKS OF I. LIBERMAN (1972), D. ELKONIN (1973), H. SAVIN (1972), AND J. CHALL (1963) AMONG OTHERS, AND UPON EARLIER WORK BY THIS RESEARCHER (LOEFFLER, REFERENCE NOTE 1). (SEE TABLE 1 FOR STAGE DESCRIPTIONS)

IN THIS TASK, THE CHILD FIRST WAS ASKED TO SEGMENT WORDS INTO SYLLABLES BY CLAPPING THE PARTS (SYLLABLES) THAT WERE HEARD. A DEMONSTRATION OF THIS PROCEDURE WAS GIVEN AND THE CHILD THEN WAS ASKED TO CLAP THE PARTS USING FAMILIAR NAMES AND WORDS SUPPLIED BY THE TESTER. ONE, TWO, AND THREE SYLLABLE WORDS WERE USED IN BOTH THE DEMONSTRATION AND THE TESTING.

A SECOND PART OF THE SEGMENTATION TEST EVALUATED THE CHILD'S ABILITY TO IDENTIFY FAMILIAR OBJECTS BY THEIR INITIAL PHONEMES WHEN SOUND CUES WERE GIVEN (FOR INSTANCE, I'M THINKING OF AN OBJECT THAT BEGINS WITH THE SOUND "BUH" (B)), THUS TESTING THE CHILD'S ABILITY TO SEGMENT BY DISCRETE SOUND SEGMENTS RATHER THAN BY SYLLABLES. ON THE BASIS OF PERFORMANCE ON THESE TWO PROCEDURES, THE CHILD'S LEVEL OF SEGMENTATION WAS DETERMINED.

Test 3. A THIRD TEST, ADMINISTERED TO EACH OF THE CHILDREN, ANALYZED THE CHILD'S PROTOWRITING SAMPLES THAT HAD BEEN ELICITED DURING THE DRAWING TEST AND ALSO THOSE ELICITED BY THE DICTATION OF TWO MODEL SENTENCES. THE SENTENCES, "I LIKE MY MOM," AND "I LIKE SANTA CLAUS," WERE SELECTED FOR THEIR HIGH MOTIVATIONAL APPEAL AND BECAUSE THEY CONTAINED PARTICULAR FEATURES THAT IT WAS ANTICIPATED WOULD REFLECT

various stages of development in protowriting (Gentry, 1977). On the drawing segment, children were asked to write their picture labels with a writing tool, the magic marker. In writing the sentences, however, an alphabet box with twenty-six compartments, one for each letter, filled with 3" cardboard letters, was provided. Children were asked to use these letters to compose the dictated sentences. It was surmised that these writing options would help to eliminate any differences in protowriting that could be caused by differences in motor skill.

An adaptation of Paul's (1976) protowriting stages was used (see Table 1) to evaluate the protowriting samples. A comparison between these and Gentry's (1977) is shown (Table 3). The selection of the Paul sequence rather than the (Read, Henderson, Beer) Gentry sequence was made because, in working with younger children, it was felt that a more fine-grained analysis of the earlier levels, such as Gentry's prephonetic stage, needed to be made. The Paul protowriting sequence had divided this particular level into two distinct stages depending upon whether only one sound segment was represented or more than one sound segment (with still at least one sound omission), was represented in the child's protowriting. It was felt that this was a more precisely articulated progression for preschool and kindergarten aged children than the Gentry sequence.

Test 4. A fourth test, administered to each of the children, evaluated the child's development in haptic

TABLE 3

Gentry (et al.) Invented Spelling Sequence		Paul/Loeffler Protowriting-Invented Spelling Sequence
Deviant Strategy Letters put down in random order, numerals may be included.	→	**Stage 1** Child does not seem to associate sounds with letters. Child may be able to identify and write some letters in own name.
Prephonetic Strategy Discriminating characteristic is that an essential feature has been omitted.	→	**Stage 2** Child uses one letter to represent the whole word or idea. All essential features but one are omitted.
	→	**Stage 3** Child uses letters to represent first and last sounds in word. Also may use long vowels (letter names).
Phonetic Strategy Discriminating characteristic is that spellings are rendered phonetically on the basis of the letter names that best represent the surface sound sequence of a word. Letters are assigned strictly on the basis of sound without regard for cultural spelling conventions.	→	**Stage 4** Letters for first, middle and last sounds, some short vowels used (as well as long) though choice is not consistent. Nasal "n's" are usually omitted.
Transitional Strategy Discriminating characteristic is that the attributes of the orthographic system of the language are essentially in place; however, the execution of the general rules of the system may be imprecise even though the meaning is evident. The transitional pattern usually satisfies one of three requirements: (a) the feature is spelled incorrectly but with a phonetically acceptable letter sequence (MONSTOR for MONSTER); (b) the feature is spelled with appropriate letter configuration but out of order (TAOD for TOAD); (c) the feature is spelled correctly but other parts of the word are misspelled (EEGLE for EAGLE).	→	**Stage 5** Sight words appear correctly spelled, digraphs (sh, ch, th, etc.) are added. Vowel placement is correct though vowel spelling is still inaccurate. Child has begun to read.
Correct Strategy All parts of word spelled correctly.	→	No longer invented spelling (protowriting).

PERCEPTION, THE RECOGNITION OF OBJECTS OR SHAPES THROUGH THE SENSE OF TOUCH. AS MENTIONED IN AN EARLIER SECTION, A. R. LURIA, A RUSSIAN PSYCHOLOGIST, HAD NOTED THAT RUSSIAN RESEARCH DEMONSTRATED THAT PRESCHOOL AGED CHILDREN (2-4 YEARS) LEARNED TO DISCRIMINATE BETWEEN SHAPES MORE QUICKLY AND EASILY IF THEY HAD TACTILE EXPERIENCE AS WELL AS VISUAL EXPERIENCE WITH THE SHAPES. THE USE OF THREE DIMENSIONAL LETTERS, SANDPAPER LETTERS, AND OTHER MEANS OF PROVIDING TACTILE AND KINESTHETIC INPUT TO CHILDREN TO HELP IN DISCRIMINATING LETTER SHAPES HAS BECOME STANDARD EQUIPMENT IN PRESCHOOL AND KINDERGARTEN CLASSES AS WELL AS IN LEARNING CENTERS DESIGNED TO ASSIST CHILDREN WITH VARIOUS READING DISABILITIES. THIS RECOGNITION OF THE IMPORTANCE OF A HAPTIC DIMENSION IN SHAPE AND LETTER DISCRIMINATION PROVIDED A RATIONALE FOR THE ASSUMPTION IN THIS STUDY THAT THERE SHOULD BE A HIGH CORRELATION BETWEEN DEVELOPMENT IN HAPTIC PERCEPTION AND DEVELOPMENT IN PROTOWRITING.

JEAN PIAGET AND BARBEL INHELDER (1971) HAVE GIVEN DESCRIPTIONS OF SPATIAL TASKS IN BOTH HAPTIC PERCEPTION AND LINEAR ORDER. THE PROTOCOLS USED WERE ADAPTED FROM THEIR WORK. DESCRIPTIONS OF CHILDREN'S RESPONSES AT EACH OF THE SUBSTAGES LEADING TO THE SUCCESSFUL COMPLETION OF EACH TASK HAVE BEEN GIVEN IN THEIR WRITINGS AND WERE USED TO DEFINE LEVELS OF DEVELOPMENT IN HAPTIC PERCEPTION AND LINEAR ORDER AS DELINEATED IN TABLE I.

THE FIRST TASK IN HAPTIC PERCEPTION INVOLVED RECOGNITION OF COMMON OBJECTS BY TOUCH ALONE. THE CHILD WAS PLACED

BEFORE A BOX WITH ROUND HOLES ON EACH SIDE SO THAT THE CHILD'S HANDS COULD BE PLACED THROUGH THE HOLES. THE BOX WAS OPEN ON THE EXAMINER'S SIDE ONLY AND THE EXAMINER COULD HAND OBJECTS TO THE CHILD AND OBSERVE HOW THE CHILD EXAMINED THE OBJECTS BY TOUCH WITHOUT THE CHILD BEING ABLE TO HAVE ANY VISUAL CONTACT WITH THE OBJECT. A DUPLICATE SET OF OBJECTS WAS AVAILABLE TO THE CHILD FOR VISUAL EXAMINATION, AND AFTER FEELING AN OBJECT, THE CHILD WAS ASKED TO POINT TO THE SAME OBJECT IN THE VISUAL DISPLAY. THIS PROVIDED A MEANS OF EVALUATING THE CHILD'S HAPTIC PERCEPTION FOR THE EXAMINER.

A SECOND TASK, USING THE SAME PROCEDURES AS THE FIRST BUT ASKING THE CHILD TO IDENTIFY ABSTRACT SHAPES RATHER THAN FAMILIAR OBJECTS, WAS GIVEN. THREE SETS OF SHAPES WERE USED WITH EACH SUCCESSIVE SET BEING MORE ABSTRACT AND LESS FAMILIAR TO THE CHILD THAN THE PREVIOUS ONE.

Test 5. A FIFTH SET OF TASKS GIVEN TO EACH CHILD EVALUATED THE CHILD'S UNDERSTANDING OF LINEAR ORDER. AUDITORY-TEMPORAL SEQUENCE OR ORDER APPEARS TO BE DIRECTLY INVOLVED IN DETERMINING WHICH SOUNDS TO WRITE AND IN WHAT ORDER. VISUAL-SPATIAL SEQUENCE OR ORDER ALSO WOULD SEEM TO BE ESSENTIAL IN DETERMINING THE ORDER OF WRITTEN LETTERS ASSOCIATED WITH THESE SOUNDS THAT WOULD BE USED IN WRITING A WORD. THE RATIONALE FOR CHOOSING THESE TASKS WAS THE ASSUMPTION BY THIS RESEARCHER THAT LINEAR ORDER IS AN IMPORTANT COMPONENT OF INVENTED SPELLING.

ALTHOUGH PIAGET AND INHELDER (1971) HAVE NOT DEALT WITH AUDITORY-TEMPORAL ORDER (THE ORDERING OF SOUNDS) IN

THEIR INVESTIGATIONS, THEY HAVE DESCRIBED SEVERAL TASKS RELATING TO VISUAL-SPATIAL ORDER. THESE TASKS WERE USED TO MEASURE THE CHILD'S LEVEL OF DEVELOPMENT IN LINEAR ORDER.

IN THE FIRST OF THESE TASKS IN LINEAR ORDER, THE CHILD WAS SHOWN A MODEL CONSISTING OF SEVEN TO NINE VARI-COLORED BEADS ON A ROD AND WAS ASKED TO PLACE A SIMILAR SET IN THE SAME ORDER ON A SECOND ROD. CARE WAS TAKEN TO ASSURE THAT THE CHILD COULD RECOGNIZE THE DIFFERENT COLORS AND SHAPES OF THE BEADS BY ASKING THE CHILD TO SORT THE BEADS BY COLOR AND SHAPE BEFORE BEGINNING. MORE BEADS WERE PROVIDED THAN NEEDED TO COMPLETE THE PATTERN SO THAT THE CHILD WAS REQUIRED TO MAKE A SELECTION EVEN ON THE FINAL BEAD.

IN A SECOND LINEAR ORDER TASK IN THIS SERIES, THE CHILD WAS ASKED TO PLACE BEADS ON A ROD IN REVERSE ORDER FROM THE MODEL AND IN A THIRD TASK, THE CHILD WAS SHOWN A NEW PATTERN ON A CIRCULAR MODEL (BEADS ON A HEAVY CORD CURVED IN A CIRCLE) AND WAS ASKED TO REPEAT THIS PATTERN ON A STRAIGHT ROD.

A SECOND TYPE OF LINEAR ORDER TASK INVOLVED THE USE OF SIMULATED CLOTHES LINES WITH CUT-OUT PAPER ARTICLES OF FAMILIAR PIECES OF CLOTHING TO BE HUNG ON THE LINES. IN THE FIRST TASK IN THIS SERIES, TWO WASHING LINES WERE PRESENTED, ONE PLACED SIX INCHES ABOVE THE OTHER. SMALL PIECES OF "WASHING" WERE ARRANGED TO HANG ON THE FIRST LINE. THE CHILD THEN WAS ASKED TO HAND THE TESTER SPECIFIC PIECES OF CLOTHING FROM A COLLECTION OF PIECES ARRANGED IN FRONT OF THE CHILD. REQUESTS SUCH AS "PLEASE GIVE ME THE RED DRESS," "THE GREEN

PANTS," ETC., WERE MADE AND CARRIED OUT IN ORDER TO ASSURE THAT THE CHILD COULD DISTINGUISH BETWEEN THE PIECES. AFTER THIS WAS DONE, THE CHILD WAS ASKED TO PLACE THE CORRESPONDING OBJECTS IN THE SAME ORDER ON THE SECOND WASH LINE WHICH WAS PLACED DIRECTLY BELOW THE FIRST.

IF THE CHILD WAS ABLE TO PLACE THE OBJECTS ON THE LINE IN THE EXACT ORDER, THE CLOTHES THEN WERE REMOVED FROM THE TWO CLOTHES LINES AND THE LOWER LINE WAS MOVED SIX INCHES TO THE RIGHT SO THAT THE TWO LINES WERE NO LONGER ALIGNED WITH EACH OTHER. A NEW "LINE OF WASHING" THEN WAS PLACED ON THE UPPER LINE AND THE CHILD WAS ASKED TO MAKE AN IDENTICAL LINE OF CLOTHES ON THE LOWER LINE.

IF THE CHILD ATTEMPTED TO MOVE THE LOWER LINE DIRECTLY UNDER THE MODEL, THE CHILD WAS ASKED IF IT WAS POSSIBLE TO PLACE THE CLOTHES WITHOUT MOVING THE LINE. IF THE CHILD WAS UNABLE TO DO SO, PERMISSION WAS GIVEN TO MOVE THE LOWER LINE AND TO CARRY OUT THE TASK AS BEFORE.

A FINAL TASK IN THIS SERIES ASKED THE CHILD TO REMOVE THE CLOTHES FROM THE LOWER LINE IN THE REVERSE ORDER FROM WHICH THEY HAD BEEN PLACED ON THE LINE AND TO PILE THE CLOTHES IN A MINIATURE WASH BASKET SO THAT EACH PIECE WOULD BE PLACED ON TOP OF THE PREVIOUS ONE. THE CHILD THEN WAS ASKED TO TELL THE EXAMINER WHICH PIECE WAS ON THE BOTTOM OF THE BASKET, WHICH PIECE WAS NEXT TO THE BOTTOM, ETC. THE UPPER WASH LINE PROVIDED A MODEL FOR THE CHILD TO REFER TO, IF THE CHILD REALIZED THE RELATIONSHIP OF THE TWO SEQUENCES AND DID NOT TRY TO RELY ON MEMORY ALONE.

The final set of tasks dealt with conservation of quantity. The conservations tested were: (a) conservation of discrete quantities (number) and (b) conservation of continuous quantity (substance).

The rationale for using these particular tasks was as follows: all conservation tasks involve decentration. The sequential stages of protowriting (invented spelling), as described by Rhea Paul, appear to reflect various degrees of centration. For instance, in the initial stage the child focuses or centers on the initial sound and letter only; in the second stage, the child appears to be reflecting successive centrations, first the initial sound, then the final sound; in the third stage, the child places the middle consonant as well and occasionally a few vowels reflecting a higher level of successive centrations; and, in the fourth and final stage, the child seems to be dealing with the word as a whole indicating some sort of synthesis of all parts.

The particular conservation tasks were used because these conservations have been the earliest reported in child development (Renner, 1979) and because they both involve linear space and present problems of decentration and spatial arrangement, problems that also face the child in protowriting.

The task for testing conservation of discrete quantities was as follows: the child was given a set of blue chips (ten) and was asked to make a row with "just as many" chips as the row that the examiner had made. The examiner's row

HAD SEVEN CHIPS. IF THE CHILD WAS UNABLE TO MAKE AN EQUIVALENT SET, USING ONE TO ONE MATCHING, THE TEST WAS CONCLUDED. IF THE CHILD WAS ABLE TO MAKE AN EQUAL ROW, THE CHIPS IN ONE ROW WERE SPREAD APART AND THE CHILD WAS ASKED IF THE ROWS EACH HAD JUST AS MANY OR IF THERE WAS MORE IN ONE ROW. THE CHILD ALSO WAS ASKED TO GIVE A REASON FOR THIS ANSWER. CHIPS THEN WERE RETURNED TO THEIR ORIGINAL POSITIONS AND THE CHILD AGAIN WAS ASKED IF THE AMOUNTS WERE THE SAME OR IF ONE ROW HAD MORE THAN ANOTHER.

IF THE CHILD DEMONSTRATED CONSERVATION OF DISCRETE QUANTITY (NUMBER) WITH HORIZONTAL REARRANGEMENT, ONE OF THE ROWS WAS THEN STACKED VERTICALLY AND THE SAME QUESTIONS WERE ASKED AND ANSWERED WITH REASONS REQUESTED IN EACH INSTANCE.

THE FINAL TASK, CONSERVATION OF CONTINUOUS QUANTITY (SUBSTANCE) WAS AS FOLLOWS: THE CHILD WAS SHOWN TWO BALLS OF CLAY AND WAS ASKED TO DETERMINE IF ONE HAD THE SAME AMOUNT AS THE OTHER. WHEN THE CHILD WAS SATISFIED THAT THEY DID (BY ADDING OR SUBTRACTING CLAY IF NECESSARY) ONE BALL WAS ROLLED INTO A SAUSAGE AND THE CHILD AGAIN WAS ASKED IF THEY WERE STILL THE SAME. THE CHILD, AS BEFORE, WAS ASKED TO GIVE A REASON FOR THE ANSWER. THE CLAY WAS THEN RETURNED TO ITS ORIGINAL FORM AND THE CHILD WAS ASKED IF NOW THEY CONTAINED THE SAME AMOUNT, ETC.

THE PROTOCOLS USED FOR THE CONSERVATION TASKS WERE ADAPTED FROM THOSE DESCRIBED IN <u>LEARNING, DEVELOPMENT AND COGNITION</u>, BY INHELDER, SINCLAIR, AND BOVET, HARVARD UNIVERSITY PRESS, 1974.

The protocols for the spatial tasks (haptic perception and linear order) were adapted from The Child's Conception of Space, Piaget and Inhelder, Compton Printing, London, 1971.

Descriptions of children's responses at each of the substages leading to final competence in the tasks are given in these references. These descriptions have provided the basis for the delineation of the stages of development evidenced in performing the infralogical and logical tasks outlined in Table 1, Chapter 1.

Scoring

Scoring for each developmental task was done on a one to five scale with one being least developed and five being most highly developed. The stages from lowest to highest were enumerated as follows: Stage 1, Below Threshold; Stage 2, Threshold; Stage 3, First Stage Above Threshold; Stage 4, Transition; and Stage 5, Competence.

As an example, in Haptic Perception the levels of competence ranged from Stage 1 (lowest level of competence), "No exploration, child rubs object between palms, passive examination" to Stage 5 (highest level of competence), "Systematic exploration is carried out effectively, child finds a locus point to begin exploration and returns to it. All identifications are accurate." Children were scored 1, 2, 3, 4, or 5, with scores indicating their stages of competence on the one to five scales. Detailed descriptions of scoring criteria are given in Table 1, Chapter 1.

CHAPTER III

RESULTS

Quantitative Data

Pearson Product Moment Correlation Coefficients were computed between performance measures on the seven tasks that measure infralogical development, logical development, proto-writing (invented spelling), and its suggested prerequisite behaviors, linguistic awareness (segmentation) and graphic representation (drawing). (See Table 4)

As predicted, correlations among all measures were substantial, suggesting that underlying common cognitive structures are responsible for the positive relationships since the tasks themselves are quite diverse even requiring different sense modalities to perform.

Separate correlation coefficients also were computed for male and female performances on the tasks. (See Tables 5 and 6)

Several interesting items can be noted in the data. Sex does not seem to be a significant factor in performance on any of the seven tasks when all groups are combined. Age has a higher correlation with performance on all tasks among males than among females with particularly high correlations

TABLE 4

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS AMONG MEASURES OF PROTOWRITING CLUSTER AND PIAGET'S INFRALOGICAL AND LOGICAL-TASKS 4, 5, 6 YEAR OLD MALES AND FEMALES (N=48)

		SEX	AGE	HAP	LINEAR	CDQ	CCQ	DRW	SEG	INV.SP.
	SEX	1								
	AGE	.00	1							
Infra-Logical Tasks	HAP	.05	.50	1						
	LINEAR	-.21	.54	.37	1					
Logico-Math. Tasks	CDQ	-.15	.50	.52	.41	1				
	CCQ	-.03	.35	.54	.39	.74	1			
Proto-Writing Cluster Tasks	DRW	-.29	.60	.36	.44	.42	.48	1		
	SEG	-.06	.47	.53	.65	.59	.51	.49	1	
	INV.SP.	-.20	.75	.60	.58	.59	.64	.64	.75	1

Key: HAP = Haptic

CDQ = Conservation of Discrete Quantity (Number)

CCQ = Conservation of Continuous Quantity

DRW = Drawing

SEG = Segmentation (Linguistic Awareness)

INV.SP. = Invented Spelling

TABLE 5

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS AMONG MEASURES OF PROTOWRITING CLUSTER AND PIAGET'S INFRALOGICAL AND LOGICAL-TASKS

4, 5, 6 YEAR OLD MALES (N=24)

		AGE	HAP	LINEAR	CDQ	CCQ	DRW	SEG	INV.SP.
	AGE	1							
Infra-Logical	HAP	.57	1						
Infra-Logical	LINEAR	.61	.51	1					
Logico-Math.	CDQ	.78	.58	.54	1				
Logico-Math.	CCQ	.80	.68	.55	.86	1			
Proto-Writing Cluster	DRW	.65	.54	.49	.52	.64	1		
Proto-Writing Cluster	SEG	.84	.47	.67	.79	.77	.60	1	
Proto-Writing Cluster	INV.SP.	.84	.57	.63	.60	.77	.70	.75	1

Key: HAP = Haptic

CDQ = Conservation of Discrete Quantity (Number)

CCQ = Conservation of Continuous Quantity

DRW = Drawing

SEG = Segmentation (Linguistic Awareness)

INV.SP. = Invented Spelling

TABLE 6

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS AMONG MEASURES OF PROTOWRITING CLUSTER AND PIAGET'S INFRALOGICAL AND LOGICAL-TASKS 4, 5, 6 YEAR OLD FEMALES (N=24)

		AGE	HAP	LINEAR	CDQ	CCQ	DRW	SEG	INV.SP.
	AGE	1							
Infra-Logical	HAP	.45	1						
Infra-Logical	LINEAR	.48	.28	1					
Logico-Math.	CDQ	.64	.50	.22	1				
Logico-Math.	CCQ	.71	.42	.21	.64	1			
Proto-Writing Cluster	DRW	.60	.23	.27	.24	.32	1		
Proto-Writing Cluster	SEG	.54	.58	.69	.43	.31	.42	1	
Proto-Writing Cluster	INV.SP.	.69	.71	.46	.56	.52	.50	.79	1

Key: HAP = Haptic

CDQ = Conservation of Discrete Quantity (Number)

CCQ = Conservation of Continuous Quantity

DRW = Drawing

SEG = Segmentation (Linguistic Awareness)

INV.SP. = Invented Spelling

FOR MALES BETWEEN AGE AND SEGMENTATION (.84) AND AGE AND INVENTED SPELLING (.84) COMPARED TO FEMALES, (.54) AND (.69) RESPECTIVELY.

PERFORMANCE SCORE MEANS FOR THE SEVEN TASKS WERE COMPARED BY AGE FOR EACH SEX (SEE FIGURES 1 AND 2). THE DATA INDICATE THAT THE TWO PREREQUISITE BEHAVIORS, LINGUISTIC AWARENESS (SEGMENTATION) AND GRAPHIC REPRESENTATION (DRAWING), ARE EQUAL TO OR ABOVE PERFORMANCE SCORE MEANS FOR PROTOWRITING/INVENTED SPELLING AT ALL AGE LEVELS AND FOR BOTH SEXES.

WITH ONE EXCEPTION, PERFORMANCE SCORE MEANS ON ALL OTHER TASKS ALSO ARE APPROXIMATELY EQUAL TO OR ABOVE PERFORMANCE SCORE MEANS FOR INVENTED SPELLING, SUPPORTING THE RESEARCHER'S CONTENTION THAT COMMON COGNITIVE STRUCTURES (SOFTWARE) UNDERLIE PERFORMANCES ON ALL THESE DIVERSE TASKS. THE EXCEPTION TO THIS PATTERN WAS THE PERFORMANCE SCORE MEANS OF FOUR-YEAR-OLD FEMALES ON THE CONSERVATION OF QUANTITY TASKS. ALTHOUGH PERFORMANCE SCORE MEANS FOR CONSERVATION OF DISCRETE QUANTITY ARE EQUAL TO PERFORMANCE SCORE MEANS FOR INVENTED SPELLING IN THIS GROUP, THOSE FOR CONSERVATION OF CONTINUOUS QUANTITY ARE BELOW THOSE FOR INVENTED SPELLING AND BOTH CONSERVATION SCORES ARE WELL BELOW THOSE FOR ALL OTHER TASKS AMONG THIS YOUNGEST GROUP OF FEMALES. THIS WAS NOT FOUND IN THE DATA FOR FOUR-YEAR-OLD MALES. WHETHER THIS APPARENT DECALAGE IS DUE TO IDIOSYNCRATIC FACTORS ASSOCIATED WITH THE SMALL NUMBERS IN THIS STUDY (EIGHT MALES AND EIGHT

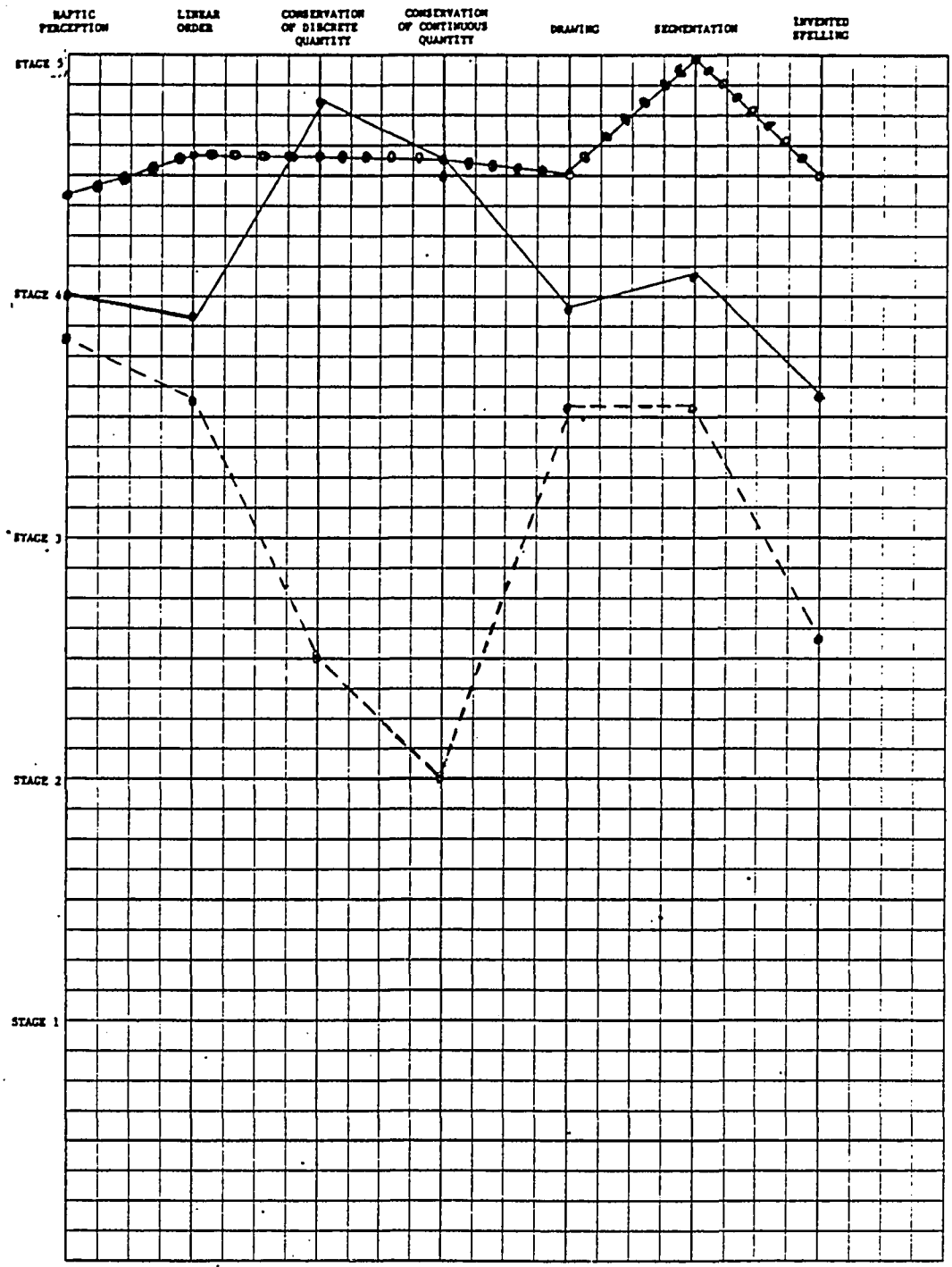

FIGURE 1

PERFORMANCE SCORE MEANS BY TASK FOR FEMALES

KEY - - - 4 yrs.
——— 5 yrs.
-o-o-o- 6 yrs.

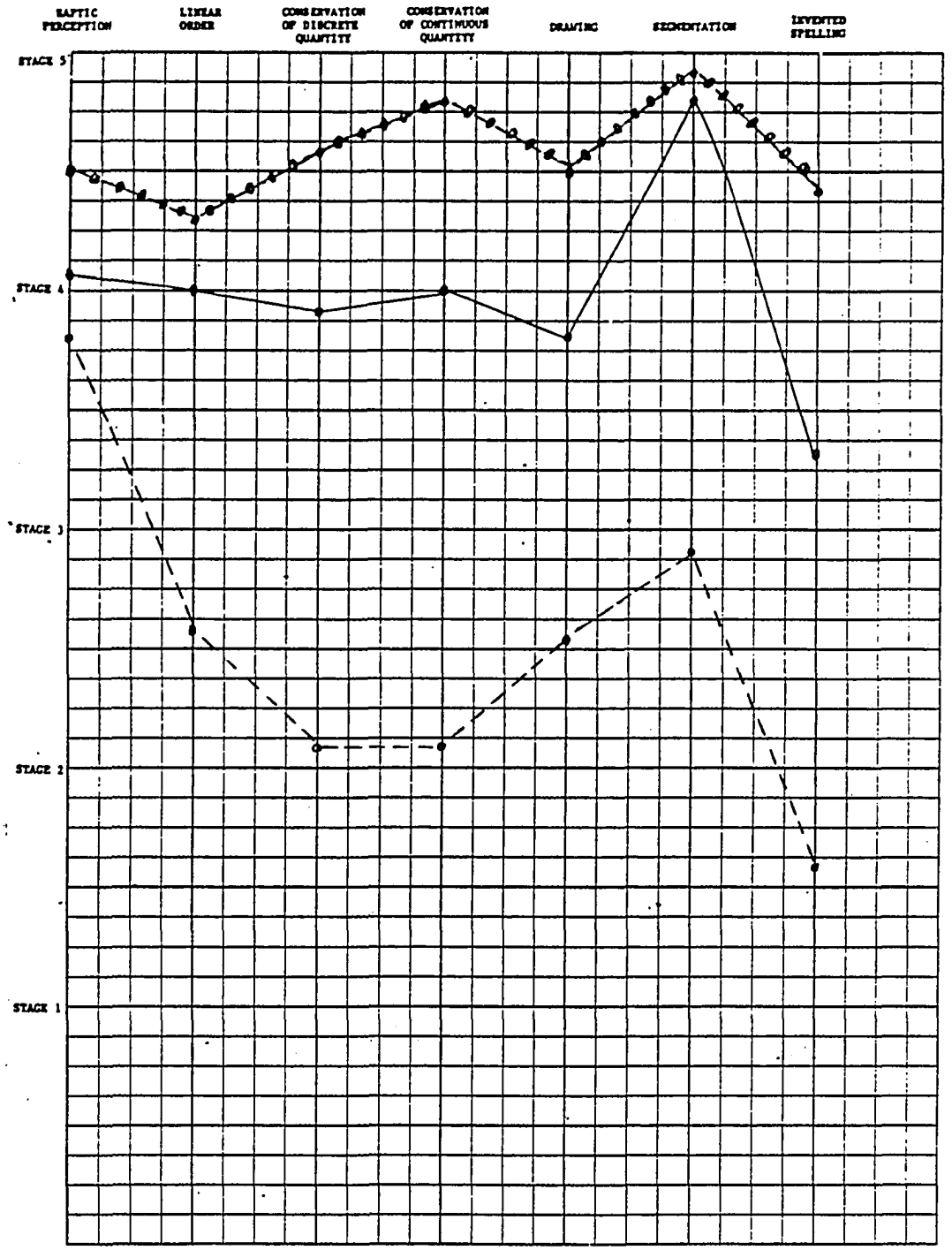

FIGURE 2

PERFORMANCE SCORE MEANS BY TASK FOR MALES

KEY - - - 4 yrs.
——— 5 yrs.
-o-o-o- 6 yrs.

FEMALES AT EACH AGE LEVEL) OR WHETHER IT MAY, IN FACT, REFLECT DIFFERING PATTERNS OF DEVELOPMENT FOR THE SEXES, IT IS AN INTERESTING ASPECT OF THE DATA THAT DESERVES FURTHER STUDY.

TABLES 7-12 PROVIDE DATA ON INDIVIDUAL CHILDREN IN SUPPORT OF THE PREMISE THAT ATTAINMENT OF THRESHOLD LEVELS OF LINGUISTIC AWARENESS (SEGMENTATION) AND OF GRAPHIC REPRESENTATION (DRAWING) ARE PREREQUISITES FOR THE EMERGENCE OF PROTOWRITING/INVENTED SPELLING. BASED ON THIS PREMISE, THE PREDICTION WAS MADE THAT CHILDREN'S PERFORMANCE SCORES ON THE DRAWING AND SEGMENTATION TASKS WOULD BE EQUAL TO OR ABOVE PERFORMANCE SCORES ON PROTOWRITING/INVENTED SPELLING.

THE PREDICTION WAS UPHELD BY THE DATA SINCE NO CHILD AT THE THRESHOLD LEVEL OR BELOW IN PROTOWRITING (STAGE 1 OR 2) SCORED BELOW THE PROTOWRITING/INVENTED SPELLING SCORE ON EITHER SEGMENTATION OR DRAWING. IN ALL CASES BUT ONE, WHERE THE CHILD WAS AT STAGE 2 OR BELOW IN PROTOWRITING/INVENTED SPELLING, THE SCORES ON THE OTHER TWO TASKS WERE ABOVE THIS SCORE. IN ONE CASE, A FOUR-YEAR-OLD MALE (SEE TABLE 8), THE SCORE FOR SEGMENTATION WAS BELOW THAT FOR PROTOWRITING/INVENTED SPELLING BUT THE SCORES FOR DRAWING AND PROTOWRITING/INVENTED SPELLING WERE THE SAME.

THE DATA (TABLES 7-12) ALSO INDICATE THAT AS CHILDREN BECOME MORE PROFICIENT IN PROTOWRITING, THEIR SCORES ON THAT TASK BEGIN TO EQUAL THE SCORES ON SEGMENTATION AND DRAWING, AND, FINALLY, AT THE HIGHEST LEVELS OF PROTOWRITING (STAGES

TABLE 7

MALES

Age	Stage of Drawing Above or Below Invented Spelling	Stage of Linguistic Awareness (Segmentation) Above or Below Invented Spelling	Stage of Invented Spelling (Protowriting)
4yrs. 1mo.	+	+	1
4yrs. 2mos.	Same	+	2
4yrs. 3mos.	+	+	1
4yrs. 4mos.	-	Same	3
4yrs. 5mos.	+	+	1
4yrs. 8mos.	Same	+	3
4yrs. 11mos.	+	+	1
5yrs. 0mos.	+	+	1

TABLE 8

FEMALES

Age	Stage of Drawing Above or Below Invented Spelling	Stage of Linguistic Awareness (Segmentation) Above or Below Invented Spelling	Stage of Invented Spelling (Protowriting)
4yrs. 2mos.	-	+	4
4yrs. 4mos.	+	Same	3
4yrs. 5mos.	+	+	1
4yrs. 7mos.	+	+	1
4yrs. 7mos.	-	+	4
4yrs. 8mos.	+	+	2
4yrs. 10mos.	+	-	3
4yrs. 11mos.	Same	+	4

TABLE 9

MALES

Age	Stage of Drawing Above or Below Invented Spelling	Stage of Linguistic Awareness (Segmentation) Above or Below Invented Spelling	Stage of Invented Spelling (Protowriting)
5yrs. 2mos.	-	+	3
5yrs. 2mos.	+	+	3
5yrs. 3mos.	+	+	3
5yrs. 4mos.	Same	+	3
5yrs. 7mos.	Same	+	3
5yrs. 9mos.	+	+	4
5yrs. 11mos.	Same	-	5
5yrs. 11mos.	+	+	2

TABLE 10

FEMALES

Age	Stage of Drawing Above or Below Invented Spelling	Stage of Linguistic Awareness (Segmentation) Above or Below Invented Spelling	Stage of Invented Spelling (Protowriting)
5yrs. 1mo.	Same	+	4
5yrs. 3mos.	+	+	4
5yrs. 4mos.	Same	+	4
5yrs. 5mos.	+	+	3
5yrs. 8mos.	Same	-	4
5yrs. 8mos.	Same	-	3
5yrs. 9mos.	Same	+	4
5yrs. 10mos.	Same	+	3

TABLE II

MALES

Age	Stage of Drawing Above or Below Invented Spelling	Stage of Linguistic Awareness (Segmentation) Above or Below Invented Spelling	Stage of Invented Spelling (Protowriting)
6yrs. 2mos.	-	+	4
6yrs. 2mos.	-	+	4
6yrs. 3mos.	Same	Same	4
6yrs. 3mos.	-	Same	5
6yrs. 4mos.	-	Same	5
6yrs. 5mos.	Same	Same	5
6yrs. 6mos.	+	+	4
6yrs. 6mos.	Same	+	4

TABLE 12

FEMALES

Age	Stage of Drawing Above or Below Invented Spelling	Stage of Linguistic Awareness (Segmentation) Above or Below Invented Spelling	Stage of Invented Spelling (Protowriting)
6yrs. 1mo.	-	Same	5
6yrs. 1mo.	+	+	4
6yrs. 2mos.	+	+	4
6yrs. 2mos.	Same	Same	5
6yrs. 3mos.	-	Same	5
6yrs. 3mos.	Same	+	4
6yrs. 4mos.	+	+	4
6yrs. 6mos.	-	Same	5

4 AND 5), DRAWING SCORES, IN PARTICULAR, DROP BELOW THE PROTOWRITING/INVENTED SPELLING SCORES. THIS ASPECT OF THE DATA MAY BE RELATED TO HOWARD GARDNER'S (1981) OBSERVATION THAT AS CHILDREN BECOME MORE PROFICIENT IN USING WRITTEN LANGUAGE, WRITING OVERTAKES DRAWING AS A PREFERRED MEANS OF EXPRESSION. THUS THOSE CHILDREN WHO ATTAIN HIGH LEVELS OF PROTOWRITING AT SIX OR YOUNGER, MAY BE LESS INVOLVED WITH DRAWING AS A CONSEQUENCE OF THEIR WRITING PROFICIENCY AND THUS MAY SLOW DOWN IN THEIR DEVELOPMENT IN DRAWING WHILE ACCELERATING IN THEIR DEVELOPMENT IN WRITING.

A MULTIPLE REGRESSION ANALYSIS USING THE GENERAL LINEAR MODELS (GLM) PROCEDURE WAS RUN ON THE DATA USING INVENTED SPELLING AS THE DEPENDENT VARIABLE AND THE OTHER SIX TASK VARIABLES, HAPTIC PERCEPTION, LINEAR ORDER, THE TWO CONSERVATIONS, DRAWING AND SEGMENTATION AS THE INDEPENDENT VARIABLES. THE RESULTS OF THIS ANALYSIS ARE SHOWN IN TABLE 13.

THE STATISTIC LABELED R-SQUARE MEASURES HOW MUCH VARIATION IN THE INDEPENDENT VARIABLE MAY BE ACCOUNTED FOR BY THE MODEL (THE BEST LINEAR COMBINATION OF INDEPENDENT VARIABLES TO PREDICT THE DEPENDENT VARIABLES). SINCE R^2 IS THE RATIO OF THE SUM OF SQUARES FOR THE MODEL DIVIDED BY THE SUM OF SQUARES OF THE CORRECTED TOTAL, A VALUE IN THE RANGE OF 1 TO 0 IS POSSIBLE, AND, IN GENERAL, THE LARGER THE VALUE OF R^2, THE BETTER THE MODEL'S FIT. THE R^2=.73 GENERATED BY THE MULTIPLE REGRESSION ANALYSIS FROM THIS DATA INDICATES A

TABLE 13

MULTIPLE REGRESSION ANALYSIS

SUMMARY TABLE

PARAMETER	ESTIMATE	PR >(T)
INTERCEPT	-1.74724347	0.0038
HAP	0.25286729	0.1029*
LINEAR	0.10029205	0.4690
CDQ	-0.01675636	0.8909
CCQ	0.18843069	0.1132
DRW	0.34490678	0.0131*
SEG	0.44092801	0.0042*

R-SQUARE	C.V.
0.728368	21.3808

DEPENDENT VARIABLE:

INVENTED SPELLING

SOURCE	DF	SS	MS	F
MODEL	6	55.84151225	9.30691871	18.32
ERROR	41	20.82515442	0.50793060	
CORRECTED TOTAL	47	76.66666667		

SUBSTANTIAL CONTRIBUTION OF THE SIX INDEPENDENT VARIABLES TO PREDICT THE BEHAVIOR OF THE DEPENDENT VARIABLE, PROTO-WRITING/INVENTED SPELLING.

A SECOND STATISTIC REFLECTING THE MODEL'S EFFECTIVENESS IS THE F VALUE AND ITS SIGNIFICANCE PROBABILITY, PR>F. THIS VALUE IS THE RATIO PRODUCED BY DIVIDING MS (MODEL) BY MS (ERROR) AND TESTS HOW WELL THE MODEL (AFTER ADJUSTING FOR THE MEAN) ACCOUNTS FOR THE BEHAVIOR OF THE INDEPENDENT VARIABLES. IF THE PROBABILITY (PR>F) IS SMALL, IT INDICATES SIGNIFICANCE. IN THE DATA FOR THIS STUDY GENERATED BY THE PROCEDURE, F=18.32 AND PR>F=.0001, INDICATING SIGNIFICANCE FOR THE MODEL.

THE MOST IMPORTANT SET OF STATISTICS DERIVED FROM THE MULTIPLE REGRESSION ANALYSIS IS PR>(T) WHOSE VALUES ANSWER THE QUESTION, "IF THE PARAMETER EQUALS 0, WHAT IS THE PROBABILITY OF OBTAINING A LARGER VALUE OF T?" A SMALL VALUE FOR THE PROBABILITY INDICATES THAT THE PARAMETER IS NOT LIKELY TO EQUAL ZERO, AND THAT THE INDEPENDENT VARIABLE CONTRIBUTES SIGNIFICANTLY TO THE MODEL.

THE THREE INDEPENDENT VARIABLES MARKED BY ASTERISKS ARE THOSE THAT CONTRIBUTE MOST SIGNIFICANTLY TO THE MODEL AND, THEREFORE, ARE MOST PREDICTIVE OR EXPLANATORY FOR THE DEPENDENT VARIABLE, PROTOWRITING/INVENTED SPELLING. THESE INDEPENDENT VARIABLES, IN THE ORDER OF THEIR SIGNIFICANCE TO THE MODEL, ARE SEGMENTATION (.0042), DRAWING (.0131), AND HAPTIC PERCEPTION (.1029). SINCE THE TWO VARIABLES PREDICTED

AS BEING PREREQUISITES FOR PROTOWRITING/INVENTED SPELLING ARE THE VARIABLES SHOWN TO CONTRIBUTE MOST SIGNIFICANTLY TO THE DEPENDENT VARIABLE IN THE MODEL, THE PREDICTION IS SUPPORTED BY THE RESULTS OF THE MULTIPLE REGRESSION ANALYSIS.

Qualitative Data

As a student of human development, this researcher believes that qualitative data are as important as quantitative data in studying a phenomenon like protowriting.

A wealth of incidental information was gleaned during the weeks that the tasks were being administered to the children at Casady School, and this information provides some fascinating insights into the remarkable and adaptable ways that young children function in the world.

B, one of the male children in this study, was, at the time of testing, four years and eight months of age. An attractive child of average size with very large blue eyes and light brown hair, B was very willing to participate in all aspects of the testing. His teachers were somewhat surprised because they said that, although he was very verbal, he sometimes was shy and reluctant to try new things.

When B was asked to draw a picture as the initial part of the testing, he indicated in advance that he was going to draw a house. He then proceeded to draw a two-story house with a flat roof that had two windows upstairs and two windows downstairs. The house also had a front door with

TWO WINDOWS, ONE AT THE TOP AND ONE AT THE BOTTOM, AND A LARGE HANDLE ON THE LEFT SIDE OF THE DOOR. THE HOUSE WAS VERY CAREFULLY DRAWN, AND THE WINDOWS AND DOOR WERE ALMOST PERFECT RECTANGLES. THERE WAS NOTHING ELSE IN THE PICTURE, NO GROUND, SKY, GRASS, ETC., ONLY THE LARGE TWO-STORY HOUSE IN THE EXACT CENTER OF THE PAPER.

WHEN B WAS ASKED TO GIVE HIS PICTURE A TITLE, HE SAID THAT HE WOULD CALL IT "HOUSE" AND, AFTER WRITING AN "H", HE ASKED HOW TO MAKE THE "UH" SOUND IN HOUSE. WHEN THE EXAMINER SUGGESTED THAT HE WRITE THE LETTER THAT HE THOUGHT IT MIGHT BE, HE SAID THAT HE THOUGHT THAT IT WOULD BE AN "I" AND SO HE WROTE H-I-S FOR HOUSE.

HE WROTE THE WORD IN LOWER CASE LETTERS WHICH WAS UNUSUAL FOR A CHILD HIS AGE SINCE MOST CHILDREN USE UPPER CASE LETTERS (CAPITALS) WHICH SEEM TO BE EASIER FOR THEM TO REPRODUCE.

HE WROTE THE TITLE, "HIS", IN VERY LARGE LETTERS IN THE UPPER LEFT QUADRANT OF THE PAPER AND WROTE HIS OWN NAME, ALSO IN LOWER CASE LETTERS EXCEPT FOR THE APPROPRIATELY CAPITALIZED FIRST LETTER, IN THE UPPER RIGHT QUADRANT OF THE PAPER, THUS CREATING A PERFECTLY SYMMETRICAL ARRANGEMENT WITH THE HOUSE IN THE CENTER BETWEEN THE TWO WORDS. B'S PICTURE WITH ITS SINGLE FEATURE OF A HOUSE OR BUILDING WAS CLASSIFIED AS A STAGE 3 DRAWING.

WHEN B WAS GIVEN THE SEGMENTATION TESTS AS PART OF THE STUDY, HE HAD DIFFICULTY IN UNDERSTANDING AND RECOGNIZING

THE IDEA OF A ONE SYLLABLE WORD ALTHOUGH HE WAS ABLE TO CLAP TWO AND THREE SYLLABLE WORDS WITH NO TROUBLE AFTER A DEMONSTRATION. HE ALSO WAS ABLE TO FIND ALL THE OBJECTS IN THE EIGHT OBJECT COLLECTION AND A FEW OBJECTS IN THE NEAR ENVIRONMENT WHEN INITIAL SOUND CUES WERE GIVEN BY THE EXAMINER, BUT HE WAS UNABLE OR UNWILLING TO PROVIDE SOUND CUES FOR INITIAL SOUNDS HIMSELF. THIS PLACED HIM AT STAGE 3 ON THE SEGMENTATION CONTINUUM.

WHEN, AS A PRELIMINARY TO THE WRITING TASK, B WAS ASKED TO NAME THE LETTERS IN THE ALPHABET BOX, HE WAS ABLE TO NAME ALL OF THE LETTERS OUT OF SEQUENCE. WHEN HE WAS ASKED IF HE KNEW ANY SOUNDS FOR THE LETTERS, HE WAS ABLE TO GIVE THE SHORT SOUND FOR "A" AND SOUNDS FOR ALL THE CONSONANTS EXCEPT "Q" AND "X".

ON THE WRITING TASK, B WROTE THE DICTATED SENTENCES "I LIKE MY MOM" AND "I LIKE SANTA CLAUS" AS FOLLOWS: "I LIK MI M" AND "I LIK SANT K." THESE SPELLINGS PLACED HIM AT THE STAGE 3 LEVEL OF PROTOWRITING/INVENTED SPELLING. WHEN ASKED IF HE COULD WRITE ANY OTHER WORDS, HE WROTE TMBL (TUMBLE), PG (PIG), AND I LIK IS KM (I LIKE ICE CREAM) WITHOUT HELP OR PROMPTING.

HE SEEMED ESPECIALLY PLEASED WITH HIS ABILITY TO WRITE AND WOULD HAVE CONTINUED EXCEPT THE SCHOOL DAY WAS ENDING.

ON ANOTHER DAY, B WAS GIVEN THE TASKS OF HAPTIC PERCEPTION. ON THE FIRST SET OF OBJECTS IN THE TASKS WHICH

WERE HOUSEHOLD ITEMS, B DID NOT KNOW THE NAME FOR THIMBLE, BUT WITH EACH OF THE OTHER ITEMS HE CALLED OUT THE NAME AS HE FELT THE OBJECT RATHER THAN JUST POINTING TO THE DUPLICATE IN THE ARRAY. HE ALSO PROVIDED ADDITIONAL INFORMATION BEYOND THE COMMON NAME; I.E., PLASTIC SPOON, LITTLE COMB, McDONALD'S RING, ETC. IN CARRYING OUT THE TASK, HE FINGERED BOTH SIDES AND THE EDGES OF EACH OBJECT, AS HE FELT IT WITHOUT SEEING IT, AND HE CORRECTLY IDENTIFIED ALL EIGHT OF THE ITEMS IN THE ARRAY.

ON THE SECOND SET OF OBJECTS, WHICH WERE GEOMETRIC SHAPES MADE OF CARDBOARD, B AGAIN WAS VERY VERBAL AND TALKED THROUGHOUT THE TASK. AGAIN, HE TRIED TO NAME ALL THE SHAPES AS HE FELT THEM. HE KNEW THE NAMES FOR TRIANGLE AND CIRCLE AND CALLED THE SEMICIRCLE WITH NOTCHED CHORD "TEETH", THE RING "A DOUGHNUT", AND THE ELIPSE "A CIRCLE". WHEN HE COULD NOT THINK OF AN APPROPRIATE NAME, HE WOULD SAY "THIS ONE" AS HE POINTED TO AN ITEM IN THE ARRAY, BUT HE ALWAYS ACCOMPANIED HIS POINTING GESTURE WITH SOME VERBAL RESPONSE. ALTHOUGH B INCORRECTLY IDENTIFIED TWO OF THE EIGHT SHAPES IN THIS SET, HE APPEARED VERY CONFIDENT AS HE FELT EACH ITEM, AND HE MADE HIS SELECTIONS SWIFTLY AND SURELY.

ON THE THIRD SET OF SHAPES IN THE HAPTIC PERCEPTION TASKS, B'S BEHAVIOR CHANGED NOTICEABLY. HE NO LONGER MADE ANY VERBAL RESPONSES BUT SEEMED TO BE FOCUSING HIS FULL ATTENTION AND CONCENTRATION ON A VERY THOROUGH TACTILE AND STEREOGNOSTIC EXPLORATION OF EACH SHAPE. USING HIS FINGERTIPS,

HE CHECKED OUT BOTH THE EDGES OF THE FIGURE AND ITS SURFACES AND HIS CONCENTRATION PAID OFF AS HE CORRECTLY IDENTIFIED SEVEN OUT OF THE EIGHT ITEMS.

ON THE FOURTH AND FINAL SET OF SHAPES WHICH WERE THE MOST COMPLEX AND LEAST FAMILIAR, B HAD GREATER DIFFICULTY WITH IDENTIFICATION BY TOUCH, IDENTIFYING ONLY FOUR OUT OF THE EIGHT CORRECTLY. HE EXPLORED EACH SHAPE IN THIS SET MORE HESITANTLY AND LESS THOROUGHLY. HE USED HIS FINGERTIPS THROUGHOUT THE EXPLORATION, BUT OFTEN HE DID NOT RETURN TO HIS STARTING POINT IN THE EXAMINATION, THEREFORE NOT COMPLETING A SYSTEMATIC EXPLORATION WHICH WOULD HAVE LEAD TO A CORRECT IDENTIFICATION.

HIS OVERALL PERFORMANCE ON THE SET OF HAPTIC PERCEPTION TASKS WAS JUDGED TO BE AT STAGE 3.

ON THE TASKS OF LINEAR ORDER, B PERFORMED AGAIN AT THE STAGE 3 LEVEL. WHEN HE WAS ASKED TO SORT THE BEADS BY COLOR, HE SELECTED THE SAME SHAPE AND COLOR AND THEREFORE DID NOT USE ALL THE BEADS. WHEN HE WAS TOLD THAT HE SHOULD USE ALL THE BEADS AND SORT ONLY BY COLOR, HE WAS ABLE TO DO SO AND LATER COULD SORT ONLY BY SHAPE WHEN ASKED.

AGAIN, B WAS VERY VERBAL DURING THE LINEAR ORDER TASKS. WHEN HE WAS ASKED TO DUPLICATE A MODEL WITH BEADS ON A ROD, HE DID SO WITH NO HESITATION, BUT HE NAMED THE COLOR OF EACH BEAD BEFORE HE PLACED IT ON THE ROD. WHEN HE WAS ASKED TO PLACE THE BEADS ON HIS ROD IN REVERSE ORDER FROM THE MODEL, HE DID NOT DO SO BUT AGAIN DUPLICATED THE MODEL.

B was able to transpose the pattern from a curved model to a straight rod with no hesitation and no difficulty. He did not attempt to straighten the curved model to accomplish the task nor did he do so to check his work after it was completed as some subjects did.

On the clothesline tasks, the second section of linear order, B could identify all of the pieces of clothing used except the skirt which he called a dress. He was able to duplicate on his own clothesline the sequence of clothes on the model line both when his line was placed directly below the model and when it was placed to one side.

He was able to remove the clothes from the line in reverse order but was unable to name the order of the clothes in the clothes basket by referring to the model. He alternated between looking at the basket and looking at the model, as he randomly named the items of clothing. He appeared to be using the model only as a memory aid in recalling the names of the various pieces of clothing in the basket; however, the random order of his naming indicated that he did not relate the order in the basket to the order of the model.

A further discussion of how other children performed on this task will be described in a later part of this chapter.

B's Stage 2 performance on the two tasks of conservation of quantity, both discrete and continuous, was slightly behind his Stage 3 performances on all other tasks. The

RESEARCHER DOES NOT ASSUME, HOWEVER, THAT THIS SLIGHT DECALAGE ON THE CONSERVATION TASKS ALTERS THE BASIC ASSUMPTION THAT COMMON COGNITIVE STRUCTURES UNDERLIE PERFORMANCES ON ALL SEVEN SETS OF TASKS. ACCORDING TO THE PIAGETIAN LITERATURE, YOUNG CHILDREN OF B'S AGE ARE ONLY GRADUALLY ACHIEVING SOME DEGREE OF DECENTRATION AND ARE SLOWLY BECOMING ABLE TO SEPARATE THE INFRALOGICAL FROM THE LOGICAL AS THEY MOVE TOWARD HIGHER LEVELS OF DECENTRATION AND COMPENSATION LEADING FINALLY TO OPERATIONAL THOUGHT. THIS GRADUAL AND STILL INCOMPLETE EMANCIPATION FROM THE SEDUCTIONS OF IMMEDIATE PERCEPTION MAY ACCOUNT FOR THE FACT THAT SOME CONTEXTS SEEM TO PROVIDE GREATER RESISTANCE TO THE DECENTERING PROCESS THAN OTHERS. THIS MAY EXPLAIN THE DECALAGE IN CONSERVATION.

B'S INDIVIDUAL PERFORMANCES ON THESE TASKS PROVIDE INTERESTING AND ILLUSTRATIVE EXAMPLES OF SEVERAL IMPEDIMENTS THAT STAND IN THE WAY OF THE ACHIEVEMENT OF CONSERVATION OF QUANTITY BY YOUNG CHILDREN.

ON THE CONSERVATION OF DISCRETE QUANTITY TASK, B WAS ABLE TO CONSTRUCT A SET WITH POKER CHIPS EQUIVALENT TO THE EXAMINER'S SET BY COUNTING THE NUMBER IN THE EXAMINER'S SET AND PUTTING DOWN THE SAME NUMBER IN HIS OWN. HOWEVER, EVEN THOUGH HE COUNTED, HE STILL PLACED EACH ELEMENT IN HIS SET EXACTLY BESIDE EACH ELEMENT IN THE EXAMINER'S SET USING ONE TO ONE CORRESPONDENCE.

WHEN THE CHIPS IN THE EXAMINER'S ROW WERE SPREAD APART, B SAID THAT, "YOUR'S HAS MORE BECAUSE IT'S LONGER."

After the chips were returned to their original positions, B thought that the sets again were equal. He said that "yes, they are the same because they are the same length."

When the examiner stacked one set vertically to see whether B would think that the sets now had the same quantity, B said that the set that was stacked was smaller "because it only had one chip in it."

B's responses on this task reveal several things about his present way of thinking. Although B can count, he has not yet learned to use counting as a thinking tool and, therefore, although he knows both rows of chips have the same amount originally, he does not use counting to check the quantity when the appearances are changed. Also, even though he used counting to make his original set, he also used one to one correspondence (matching his chips to the examiner's) as a more certain check on the equivalence of the sets.

The fact that B also said that there was only one chip in the set when the chips were stacked vertically attests to the fact that counting is in the service of the infralogical concepts relating to the set (length) rather than to the logical/mathematical relationships.

On the conservation of continuous quantity (substance) task, B said that when the examiner's ball of clay was flattened into a pancake, "the ball is bigger because your's is flat."

When the clay was returned to its original shape, B

SAID THAT THE CLAY BALLS "ARE THE SAME BECAUSE THEY LOOK LIKE TWO EYES," AGAIN REFLECTING A FOCUS ON APPEARANCES. AS A FINAL TEST OF CONSERVATION, THE CLAY IN ONE OF THE BALLS WAS THEN ROLLED INTO A SNAKE AND B SAID THAT "THE SNAKE HAS MORE CLAY BECAUSE IT IS LONGER."

B'S RESPONSES ON THE CONSERVATION OF QUANTITY TASKS REFLECT A CHILD WHO IS STILL PERCEPTION BOUND AND IS ABLE TO FOCUS ON ONLY ONE DIMENSION. HE HAS NOT YET MOVED INTO STAGE 3 WHEN HE WILL BE ABLE TO MAKE SUCCESSIVE CENTRATIONS AND TO FOCUS HIS ATTENTION ON MORE THAN ONE DIMENSION.

IN DESCRIBING THESE BEHAVIORS OF B, A FOUR-YEAR-OLD BOY IN THIS STUDY, THE WRITER HAS TRIED TO RELATE THE PERFORMANCES OF ONE REPRESENTATIVE SUBJECT IN AN ANECDOTAL WAY. THIS WAS DONE IN ORDER TO IMPART THE FLAVOR OF THE UNIQUE HUMAN RESPONSES THAT OCCUR IN ANY TESTING SITUATION AND PROVIDE AS MUCH INFORMATION AS THE MORE FORMAL DATA IF ALLOWED TO EMERGE AND BE VALIDATED AS AUTHENTIC.

SEVERAL INTERESTING AND RECURRING PATTERNS OF RESPONSE AMONG THE CHILDREN IN THE STUDY ALSO WERE NOTED AND SHOULD BE MENTIONED AS A PART OF THE QUALITATIVE DATA.

ONE OF THE MOST INTERESTING AND INTRIGUING OF THESE PATTERNS WAS OBSERVED DURING THE TESTS FOR HAPTIC PERCEPTION. IN THIS TESTING SITUATION, DESCRIBED IN THE PRECEDING SECTION, CHILDREN WERE PLACED BEFORE A BOX WITH ROUND HOLES ON EACH SIDE SO THAT THE CHILD'S HANDS COULD BE PLACED THROUGH THE HOLES. THE BOX WAS OPEN ON THE EXAMINER'S SIDE ONLY AND THE EXAMINER COULD HAND OBJECTS OR SHAPES TO THE CHILD AND OBSERVE

HOW THE CHILD EXAMINED THEM BY TOUCH WITHOUT THE CHILD HAVING ANY VISUAL CONTACT WITH THE ITEM. A DUPLICATE SET OF OBJECTS OR SHAPES WAS AVAILABLE TO THE CHILD FOR VISUAL EXAMINATION AND, AFTER FEELING THE PROFFERED ITEM, THE CHILD WAS ASKED TO POINT TO THE SAME ITEM IN THE VISUAL DISPLAY.

ADULTS WHO WERE GIVEN THIS TASK WOULD FEEL THE OBJECT, LOOK AT THE VISUAL ARRAY WHILE FEELING IT AGAIN, AND THEN COME TO A DECISION BASED ON A COORDINATION BETWEEN WHAT WAS SEEN VISUALLY AND WHAT WAS FELT KINESTHETICALLY. AT LEAST THAT IS THE PROCEDURE USED BY HALF A DOZEN ADULTS WHO WERE OBSERVED.

THE MAJORITY OF SUCCESSFUL CHILDREN IN THE STUDY, HOWEVER, DID NOT USE THIS PROCEDURE AT ALL, YET THEY IDENTIFIED THE OBJECTS. INSTEAD, THEY LOOKED AT THE VISUAL ARRAY ONCE AT THE BEGINNING OF THE TASK, THEN FELT EACH OBJECT OR SHAPE AS IT WAS PRESENTED, THEN QUICKLY TURNED AND, WITHOUT SEARCHING, POINTED DIRECTLY TO THE ITEM IN THE VISUAL ARRAY.

IT WAS AS THOUGH THEY HAD A PHOTOGRAPH OF THE WHOLE ARRAY IN THEIR HEADS WHERE THEY COULD USE IT FOR COMPARISON WITH THE "FELT" ITEM AND ALSO USE IT TO GUIDE THEIR HAND WHEN THEY WERE READY TO POINT TO THE SPECIFIC ITEM THAT HAD BEEN FELT. THE MOST INTRIGUING THING ABOUT THIS WAS THAT AS THE CHILD MOVED THROUGH THE TASK, THE ITEMS PRESENTED BECAME LESS FAMILIAR (IRREGULAR SHAPES, DIFFERENT TYPES OF CROSSES IN THE SAME ARRAY, ETC.), AND IT WAS DIFFICULT TO SEE HOW THE CHILD COULD USE ANY TYPE OF VERBAL LABEL AS A MEMORY DEVICE. PERHAPS IT IS TRUE THAT MANY CHILDREN DO HAVE EIDETIC IMAGERY AND THIS PARTICULAR TASK HAPPENED TO REVEAL ITS PRESENCE.

A SECOND INTERESTING ASPECT OF THE TESTING INVOLVED A PORTION OF THE LINEAR ORDER TASK. IN THE THIRD PART OF THIS TASK, THE CHILD WAS ASKED TO PUT CUT-OUT PAPER CLOTHES ON A CLOTHES LINE THAT HAS BEEN DRAWN ON PAPER, AND TO PUT THEM ON THE LINE IN EXACTLY THE SAME ORDER AS THE CLOTHES ON A MODEL LINE ABOVE.

THE CHILD THEN WAS ASKED TO REMOVE THE CLOTHES FROM THE LOWER LINE IN THE REVERSE ORDER FROM WHICH THEY HAD BEEN PLACED ON THE LINE AND TO PILE THE CLOTHES IN A MINIATURE WASH BASKET SO THAT EACH PIECE WAS PLACED ON TOP OF THE PREVIOUS ONE. THE CHILD THEN WAS ASKED TO TELL THE EXAMINER WHICH PIECE WAS ON THE BOTTOM OF THE BASKET, WHICH PIECE WAS NEXT, ETC. ALTHOUGH THE UPPER CLOTHES LINE PROVIDED A PERFECT MODEL OF THE ORDER FOR THE CHILD, THE YOUNGER CHILDREN NEVER THOUGHT OF LOOKING AT IT AND EITHER TRIED TO REMEMBER THE ORDER OR ATTEMPTED TO PEEK INTO THE WASH BASKET TO SEE THE ORDER, AND, IN BOTH INSTANCES, THEY WERE UNSUCCESSFUL.

WHAT WAS INTERESTING TO OBSERVE WERE THOSE CHILDREN WHO RECOGNIZED THE UTILITY OF THE MODEL BUT FELT THAT SOMEHOW IT WAS WRONG TO USE IT. THEY WOULD CAST SURREPTITIOUS GLANCES TOWARD IT WHEN THEY THOUGHT THAT THE EXAMINER WAS NOT LOOKING OR WOULD ACT LIKE THEY WERE LOOKING INTO THE BASKET WHILE GLANCING FURTIVELY AT THE MODEL. ONLY ONE CHILD LOOKED DIRECTLY AT THE MODEL AND VERBALIZED THE FACT THAT THE MODEL GAVE THE CLUE TO THE ORDER. SINCE THESE CHILDREN ARE IN A SCHOOL SETTING WHERE CHILDREN ARE FREE TO GET INFORMATION FROM A VARIETY OF SOURCES, INCLUDING OTHER CHILDREN, TEACHERS,

VISITORS, ETC., IT SEEMED SURPRISING TO THIS OBSERVER THAT THIS REACTION OCCURRED IN THE MAJORITY OF CHILDREN WHO UNDERSTOOD THE VALUE OF THE MODEL. MAYBE IT WAS AS ONE CHILD SAID WHO, AFTER THE TESTING WAS OVER, "CONFESSED" TO LOOKING AT THE MODEL, "IT JUST SEEMED TOO EASY THAT WAY TO BE RIGHT." THE PURITAN ETHIC STILL LIVES!

ANOTHER OBSERVATION CONCERNS THE CHILD'S ABILITY TO DRAW A PICTURE AT A MOMENT'S NOTICE. IN THE PROTOWRITING TASKS THE CHILDREN ARE GIVEN A MAGIC MARKER AND A LARGE SHEET OF WATER COLOR PAPER AND ASKED TO DRAW A PICTURE FOR THE EXAMINER. MOST CHILDREN WOULD CHOOSE A MARKER AND BEGIN IMMEDIATELY AND THE EXAMINER WOULD STOP THEM JUST BEFORE THEY PUT MARKER TO PAPER AND ASK IF THEY KNEW WHAT THEY WERE GOING TO DRAW OR IF THEY WERE GOING TO DECIDE AFTER THEY BEGAN. MANY OF THE YOUNGER CHILDREN SAID THAT THEY WOULD DECIDE AFTER THEY BEGAN DRAWING, SOME CHILDREN SAID THAT THEY KNEW BUT THEY WOULD NOT TELL, AND OTHERS IMMEDIATELY SAID WHAT THEIR PICTURES WERE TO BE. WHAT SURPRISED THIS OBSERVER WAS THE ALACRITY WITH WHICH THE CHILDREN ENTERED INTO THE PROCESS OF DRAWING A PICTURE. ONLY ONE OR TWO OF THE OLDEST CHILDREN REFLECTED FOR A FEW MINUTES BEFORE THEY BEGAN. FOR THE REST, IT WAS AS THOUGH THEIR MINDS WERE BURSTING WITH IDEAS TO PUT ON PAPER, AND THEY WERE DELIGHTED WITH THE OPPORTUNITY TO CREATE. THIS OBSERVER ALSO WAS SURPRISED AT HOW SUCCESSFUL THE CHILDREN WERE IN THINKING OF APPROPRIATE TITLES FOR THEIR PICTURES AFTER THEY WERE COMPLETED. TITLES LIKE "SPRNG" AND "PCNC" NOT ONLY REFLECTED THE CHILD'S PROTOWRITING ABILITY,

BUT ALSO REFLECTED THE ABILITY TO DEPICT AN IDEA OR CONCEPT RATHER THAN JUST NAMING AN OBJECT OR A PERSON.

AFTER THE TESTING WAS COMPLETED, THE RESEARCHER INTERVIEWED CHILDREN AND ASKED THEM HOW THEY KNEW WHAT LETTERS TO USE WHEN THEY WERE WRITING. THE ANSWERS WERE INTERESTING AND REVEALING BECAUSE THEY DEMONSTRATED AGAIN THE LACK OF CONSCIOUSNESS ON THE PART OF MOST YOUNG CHILDREN REGARDING ACTIVITIES IN WHICH THEY ARE INVOLVED.

THE YOUNGEST WRITERS WHO WERE INTERVIEWED SAID THAT "THEY JUST KNEW" WHAT LETTERS TO USE IN WRITING A WORD. TWO CHILDREN AT A MORE ADVANCED WRITING LEVEL SAID THAT THEY LISTENED FOR THE SOUNDS AND THEN WROTE THE LETTERS FOR THESE SOUNDS; HOWEVER, WHEN THEY WERE ASKED HOW THEY HAD LEARNED WHICH LETTERS STOOD FOR WHICH SOUNDS, THEY EITHER SAID "MY MOTHER TOLD ME" OR THEY DID NOT KNOW HOW THEY HAD LEARNED, EVEN THOUGH THERE ARE MANY ACTIVITIES FOR THAT PURPOSE IN THEIR SCHOOL.

A SIX-YEAR-OLD BOY SAID THAT BEFORE HE WROTE, HE THOUGHT OF AN IDEA THAT HE WANTED TO WRITE ABOUT, THEN HE THOUGHT OF THE WORD TO USE, THEN THE LETTERS TO MAKE THE WORDS. HOWEVER, HE WAS AS UNCERTAIN AS THE OTHERS ABOUT HOW HE HAD LEARNED HIS SKILLS AND SAID THAT HE THOUGHT HE HAD LEARNED WHEN HE WAS VERY LITTLE AND SO HE COULDN'T REMEMBER.

ALL THESE OBSERVATIONS INDICATE THAT TO EVALUATE TESTING OF CHILDREN ADEQUATELY IT IS AS IMPORTANT TO UNDERSTAND WHAT THEY ARE THINKING AS TO RECORD HOW THEY RESPOND.

CHAPTER IV

DISCUSSION

The results of this study suggest that the progression of stages of development in protowriting (invented spelling) provides an analogue model of the historical development of writing in humans. This spontaneous replay of an historical invention is not presumed to be the result of a predetermined behavioral program. Rather, protowriting occurs in response to environmental input as an adaptive behavior created from two previously adaptive behaviors, spoken language and graphic representation. This scenario, it appears, is very similar to one that initially led our ancestors into writing.

The plasticity of behavior, which is characteristic of modern humans and which allows for a wide range of diverse outcomes, is an adaptive response that seems to have evolved at least 1,000,000 years ago. In a sense, human infants are born very much unfinished. It has been pointed out by anthropologists that since pelvic size has been limited in human evolution to accommodate upright stance and bipedal locomotion, much brain development must occur after birth. The human brain at birth has reached less than one-quarter

OF ITS EVENTUAL SIZE WHEREAS MONKEYS ARE BORN WITH THREE QUARTERS OF THEIR TOTAL BRAIN VOLUME ALREADY DEVELOPED. THE BABY'S BRAIN IS A FETAL BRAIN AND ITS CONTINUING DEVELOPMENT MUST OCCUR AFTER BIRTH THROUGH INTERACTIONS WITH THE ENVIRONMENT.

JEAN PIAGET HAS CHRONICLED THE INTELLECTUAL DEVELOPMENT OF THE CHILD FROM BIRTH THROUGH ADOLESCENCE AND HAS GIVEN AN ACCOUNT OF THE RESPONSE OF THE DEVELOPING HUMAN ORGANISM TO INTERACTIONS WITH THE HIGH PROBABILITY ENVIRONMENT THAT WILL BE ENCOUNTERED. THIS ENVIRONMENT, THOUGH APPEARING IN OUTWARDLY DIVERSE FORMS, WILL PROVIDE GENERAL TYPES OF EXPERIENCES REQUIRED BY THE CHILD FOR CONTINUING DEVELOPMENT. JEAN PIAGET, BASING HIS IDEAS UPON FIFTY YEARS OF OBSERVATION AND RESEARCH, HAS CONCLUDED THAT THE CHILD ORGANIZES EXPERIENCES THROUGH COGNITIVE STRUCTURES THAT CHANGE AND DEVELOP AS THE CHILD MATURES AND INTERACTS WITH THE WORLD. THESE ORGANIZING STRUCTURES DEVELOP OUT OF THE CHILD'S OWN ACTIONS AND BECOME INTERNALIZED SYSTEMS OF THINKING AND BEHAVING. SUCH COGNITIVE STRUCTURES, BECAUSE THEY ARE ADAPTATIONS OF THE ORGANISM, CANNOT BE PRESENTED TO THE CHILD READY-MADE THROUGH LANGUAGE OR ANY OTHER MEANS, BUT MUST BE CONSTRUCTED BY THE CHILD THROUGH HIS OWN ACTIVITIES. THE STRUCTURES CREATED ESSENTIALLY INVOLVE LOGICAL-MATHEMATICAL RELATIONS OF INCLUSION, ORDER, AND CORRESPONDENCE, AND INFRALOGICAL RELATIONS DEALING WITH SPACE AND TIME.

ANTHROPOLOGIST SUE PARKER (1981), WHO HAS STUDIED

CHILDHOOD DEVELOPMENT EXTENSIVELY, HAS CONCLUDED THAT THE HUMAN ORGANISM IS VERY ACTIVE IN EVOKING INPUTS FROM THE ENVIRONMENT THAT ARE ESSENTIAL FOR ITS OWN TRANSFORMATIONS. PARKER FINDS IT DIFFICULT TO BELIEVE THAT SUCH COMPLEX, HIGHLY ELABORATED SYSTEMS AS LANGUAGE OR INTELLIGENCE COULD HAVE RISEN BY CHANCE IN ANY INDIVIDUAL OR IN ANY SPECIES. RATHER, PARKER BELIEVES THAT COMPLEX ADAPTIVE STRUCTURES ARE ALWAYS THE PRODUCT OF DIRECTIONAL SELECTION ACTING OVER MANY GENERATIONS. NO HIGHLY ORGANIZED SYSTEM CAN EXIST AGAINST RANDOM DISORGANIZING FORCES, ACCORDING TO PARKER, UNLESS IT IS MAINTAINED BY SOME CONSISTENT FORCE.

PARKER BELIEVES THAT SUCH A CONSISTENT FORCE IS BUILT INTO EACH MEMBER OF THE SPECIES MAKING THE CHILD AN ACTIVE PARTICIPANT IN GENERATING AND PROVOKING THE INPUTS NECESSARY FOR ITS OWN DEVELOPMENTAL TRANSFORMATIONS. THE CHILD, ACCORDING TO PARKER, NOT ONLY IS GENETICALLY PRIMED TO ELICIT AND EVOKE NECESSARY INPUT FROM THE ENVIRONMENT, BUT, RECENT RESEARCH SUGGESTS, THAT COOPERATING ADULTS ARE ALSO GENETICALLY PRIMED TO RESPOND TO THE CHILD'S BEHAVIORS IN PARTICULAR WAYS THAT PROVIDE STRUCTURE AND PATTERN TO THE INTERCHANGE.

PARKER'S IDEAS SEEM TO BE CONSONANT WITH ELIZABETH BATES' VIEW THAT NEW SYSTEMS OF HUMAN BEHAVIOR CAN OCCUR AND REOCCUR OUT OF THE FORTUITOUS COMBINATIONS OF OLD SYSTEMS UNDER SIMILAR ENVIRONMENTAL CONSTRAINTS WHILE REQUIRING LITTLE GENETIC CHANGE.

Parker and Bates both stress the active involvement of the child in generating the developmental transformations that lead the child to reinvent such important adaptations as language. It is the belief of the present writer, based upon the results of this study, that protowriting (invented spelling) is an example of just such a transformation. Here the child, by utilizing available inputs from the environment, brings together previously well-practiced behaviors into a new configuration and creates a new and more complex adaptation, written language.

It is this writer's conclusion that the construction process involved in the child's creation of the written linguistic code of the culture is the same process that Piaget has noted in following the development of the logical-mathematical structures. Piaget has described this development in terms of the child's interactions with objects or persons in the physical world and the relations among these objects or persons that the child creates through his own actions. This researcher contends that the analysis which the child performs on the spoken language of the culture and the transformations involved in the ultimate mapping of this language onto the written cultural code calls into play the same relationships that Piaget has described in the child's interactions with the world of objects and people.

Although Piaget has said little about the development of literacy in children, the implication in several of

HIS WRITINGS (1967, 1974) HAS BEEN THAT LANGUAGE, PRIOR TO THE BEGINNING OF FORMAL THOUGHT IN ADOLESCENCE, IS PRIMARILY FIGURATIVE RATHER THAN OPERATIVE IN NATURE; THAT IS, LANGUAGE REPRESENTS (OR RE-PRESENTS) REALITY IN A STATIC WAY RATHER THAN BEING AN INSTRUMENT THROUGH WHICH THE CHILD CAN TRANSFORM REALITY, IN A DYNAMIC WAY, THUS LEADING TO THE CONSTRUCTION OF ESSENTIAL COGNITIVE STRUCTURES.

PIAGET (1969) HAS NOTED THAT THE CHILD'S LANGUAGE USAGE REFLECTS HIS PRESENT LEVEL OF COGNITIVE FUNCTIONING, BUT HE CITES EVIDENCE BY PSYCHOLINGUIST, HERMINE SINCLAIR, DEMONSTRATING THAT TRAINING THE CHILD THROUGH LANGUAGE, CONTRARY TO PREVALENT OPINION, DOES NOT ALTER THE CHILD'S UNDERLYING COGNITIVE STRUCTURES.

HANS FURTH (1970), AN AMERICAN COLLEAGUE OF PIAGET'S, HAS EXPRESSED THE VIEW, SEEMINGLY CONSONANT WITH PIAGET'S OWN, THAT IT IS VERY DIFFICULT IN THE CHILD'S EARLY YEARS TO MAKE READING AND WRITING AN ACTIVITY THAT WILL CHALLENGE THE OPERATIVE CAPACITY OF THE CHILD. INSTEAD, ACCORDING TO FURTH, EARLY EDUCATION USUALLY EMPHASIZES FIGURATIVE, LOW-LEVEL, ASSOCIATIVE KNOWING.

THIS RESEARCHER AGREES WITH PIAGET'S AND FURTH'S ASSUMPTIONS THAT THE ASSOCIATIVE TASKS UTILIZED IN TRADITIONAL LANGUAGE INSTRUCTION AND IN EARLY READING AND WRITING METHODS ARE BASICALLY FIGURATIVE IN NATURE AND DO NOT UTILIZE THE CHILD'S GROWING OPERATIVE CAPACITIES. WHETHER THE APPROACH IS LETTER TO SOUND (PHONICS METHOD), OR WRITTEN WORD TO

SPOKEN WORD (SIGHT WORD METHOD), THE TASK IS PRIMARILY ONE OF ASSOCIATION AND MEMORIZATION RATHER THAN OF CONSTRUCTION.

IT IS THE CONCLUSION OF THIS WRITER THAT THE YOUNG CHILD WHO IS ENGAGED IN PROTOWRITING IS INVOLVED IN A CREATIVE PROCESS OF CONSTRUCTION AND TRANSFORMATION JUST AS SURELY AS IF THE CHILD WERE INVOLVED IN ORDERING AND COMPARING OBJECTS OR PARTICIPATING IN ANY OF THE OTHER ACTIVITIES RECOGNIZED AS OPERATIVE, ACTIVE LEARNING IN THE PIAGETIAN SENSE.

THE PRESENT RESEARCH HAS SOUGHT TO TEST BOTH THE ASSUMPTION THAT PROTOWRITING IS A NEW BEHAVIOR CREATED BY THE CHILD FROM TWO PREVIOUSLY WELL-PRACTICED BEHAVIORS, SPOKEN LANGUAGE AND GRAPHIC REPRESENTATION (DRAWING), AND THAT PROTOWRITING IS A CONSTRUCTIVE PROCESS ANALOGOUS TO THE CONSTRUCTIVE PROCESSES OBSERVED BY PIAGET IN THE INFRALOGICAL AND LOGICAL DEVELOPMENT OF THE CHILD AND IS ORGANIZED BY THE SAME UNDERLYING COGNITIVE STRUCTURES.

TWO HYPOTHESES OR PREDICTIONS GENERATED BY THESE ASSUMPTIONS WERE TESTED IN THIS STUDY. THE FIRST WAS THAT THRESHOLD LEVELS IN EACH OF THE TWO PREREQUISITE BEHAVIORS, SPOKEN LANGUAGE AND GRAPHIC REPRESENTATION, MUST BE ATTAINED BEFORE PROTOWRITING COULD OCCUR. THESE THRESHOLD LEVELS WERE DERIVED FROM DATA OBTAINED FROM RESEARCH ON CHILDREN'S DRAWINGS AND ON LINGUISTIC DEVELOPMENT.

THE DATA GENERATED BY THE RESEARCH SUPPORTED THIS PREDICTION. ALL SUBJECTS, WITH A SINGLE EXCEPTION, WHO WERE AT THE THRESHOLD LEVEL OR BELOW IN PROTOWRITING (STAGES I OR

2) scored above the protowriting level in linguistic development (segmentation) and in drawing. In this one case, the subject scored above protowriting in linguistic development but at the same stage as protowriting in drawing.

In the multiple regression analysis, linguistic development (segmentation) and drawing were the two independent variables that were most predictive of the dependent variable, protowriting, again attesting to the strong relationship between the predicted prerequisite behaviors and protowriting.

The second prediction tested in this study was that the appearance and sequence of stages in protowriting should coincide with the appearance and sequence of stages evidenced in Piaget's infralogical and logical tasks since the different behavioral competencies are assumed to share underlying cognitive structures.

In general, the research data also support this second prediction. Correlations among all seven variables were substantial, and, with one exception, performance score means for all groups and on all tasks were approximately equal to or above performance score means on protowriting/invented spelling, supporting the researcher's contention that common cognitive structures underlie performance on these diverse tasks.

The performance score means of four-year-old females, however, did not support the prediction. Performance score means on the conservation of discrete quantity were at

APPROXIMATELY THE SAME LEVEL AS PERFORMANCE SCORE MEANS FOR PROTOWRITING/INVENTED SPELLING FOR THIS GROUP. SCORES FOR CONSERVATION OF CONTINUOUS QUANTITY WERE WELL BELOW THOSE FOR PROTOWRITING/INVENTED SPELLING, HOWEVER, AND THE TWO CONSERVATION SCORES WERE SUBSTANTIALLY BELOW ALL TASK SCORES EXCEPT PROTOWRITING/INVENTED SPELLING FOR FOUR-YEAR-OLD FEMALES.

THIS EXCEPTION MAY INDICATE EXPERIMENTAL ERROR OR IT MAY REFLECT SEX-RELATED DIFFERENCES LEADING TO AN ACCELERATION OF DEVELOPMENT IN TASKS RELATED TO CERTAIN MODALITIES AND UTILIZING PARTICULAR CONTEXTS POSSIBLY MORE FAVORABLE TO YOUNG FEMALES' INTERESTS THAN TO MALES. WHATEVER THE REASON, THE RESEARCHER DOES NOT BELIEVE THAT THIS EXCEPTION NEGATES THE HYPOTHESIS THAT PROTOWRITING/INVENTED SPELLING AND THE INFRALOGICAL AND LOGICAL TASKS USED IN THIS STUDY ARE DEPENDENT UPON THE SAME UNDERLYING COGNITIVE STRUCTURES.

THE PRESENCE OF SUCH UNDERLYING COGNITIVE STRUCTURES THAT ARE REQUIRED FOR PERFORMANCE AT PARALLEL LEVELS OF DEVELOPMENT ON THE VARIOUS TASKS IN THIS STUDY MAY OFFER THE POSSIBILITY BUT NOT YET THE NECESSITY FOR THIS PERFORMANCE.

SUBJECTS MAY NOT ALWAYS PERFORM AT THEIR HIGHEST POTENTIAL ON PARTICULAR TASKS OR, CONVERSELY, SUBJECTS MAY APPEAR TO PERFORM AT HIGHER LEVELS THAN THEIR ACTUAL COGNITIVE DEVELOPMENT THROUGH EFFICIENT USE OF LOWER LEVEL CONCEPTS (FOR INSTANCE, GIVING THE APPEARANCE OF CONSERVATION OF NUMBER THROUGH THE EFFICIENT USE OF ONE-TO-ONE CORRESPONDENCE). THESE POSSIBILITIES MUST ALWAYS BE CONSIDERED IN EVALUATING YOUNG CHILDREN'S PERFORMANCES.

Educational Implications

The view that protowriting is a spontaneous, operative activity that leads young children to construct or invent the culture specific written code for themselves rather than learning it only ready-made as an associative, figurative activity has many implications. One is that each young protowriter becomes a lexicographer and proceeds through the progressive historical stages from writing with pictures to the use of the complete phonetic and semantic rules and devices contained in the written code of the culture.

A second implication is that the underlying cognitive structures necessary for this behavior to occur as well as the range of responses needed to meet environmental demands are available to all humans. Lack of literacy occurs, according to this model, when (1) the task of translating the spoken code into a written code has not been demanded by the needs of a culture, or (2) the "invention" process has not been completed by a particular individual in a culture with a written code. This latter possibility has important ramifications for education.

In a recent book which is a chronicle of her young son's writing and reading development over a seven year span, Glenda Bissex (1980) tells us that Paul at age six thought up a chicken and egg question. "Which comes first, writing or reading?" Paul, an inveterate invented speller, who was,

BY THEN, READING, DECIDED THAT WRITING CAME FIRST BECAUSE HE SAID, "YOU HAVE TO HAVE LETTERS OR EVEN A PICTURE BEFORE YOU CAN READ IT."

ONE WONDERS, HOWEVER, IF CHILDREN WHO HAVE NEVER HAD THE EXPERIENCE OF WRITING BEFORE READING WOULD HAVE GIVEN THE SAME ANSWER OR EVEN BEEN ABLE TO FORMULATE THE QUESTION. IN TWO STUDIES REPORTED BY JOHN DOWNING (1973), ONE IN WALES AND A SECOND IN ENGLAND, RESEARCHERS FOUND THAT KINDERGARTEN AGE CHILDREN, WHEN QUESTIONED ABOUT THEIR UNDERSTANDING OF SUCH IMPORTANT COMPONENTS OF READING AS WORDS AND SOUNDS, HAD LITTLE AWARENESS OF THE MEANING OF THESE CONCEPTS AND EVIDENCED A GENERAL LACK OF ANY SPECIFIC EXPECTANCIES OF WHAT READING WAS GOING TO BE LIKE, WHAT THE ACTIVITY CONSISTED OF, OR ITS PURPOSE.

IN A RELATED AREA, DOWNING, IN REPORTING ON A SURVEY OF READING DISABILITY RESEARCH BY MAGDALEN VERNON, NOTES VERNON'S CONCLUSION THAT THE BASIC CHARACTERISTIC OF READING DISABILITY APPEARS TO BE COGNITIVE CONFUSION. ACCORDING TO VERNON, THE CHILD WITH REAL LEARNING DISABILITY APPEARS HOPELESSLY UNCERTAIN AND CONFUSED AS TO WHY CERTAIN SUCCESSIONS OF PRINTED LETTERS SHOULD CORRESPOND TO CERTAIN PHONETIC SOUNDS IN WORDS. (DOWNING, 1973)

FOR THE CHILD WHO HAS COME TO READING THROUGH WRITING, IT SEEMS UNLIKELY THAT SUCH COGNITIVE CONFUSION WOULD EXIST.

BUT CAN ALL CHILDREN COME TO READING THROUGH

SPONTANEOUS WRITING? OR IS IT JUST THOSE CHILDREN WHO WOULD LEARN TO READ EASILY ANYWAY WHO ENJOY PARTICIPATING IN THIS CONSTRUCTIVE ACTIVITY?

SEVERAL RECENT ANECDOTAL ACCOUNTS GIVE US HOPE THAT ALL CHILDREN, IF ENCOURAGED, CAN COME TO WRITING AND TO READING IN THIS WAY.

DONALD GRAVES, WHOSE INTEREST IS TO TEACH YOUNG CHILDREN TO WRITE CREATIVELY RATHER THAN TO READ, HAS GIVEN US SOME INSIGHT INTO THE WILLINGNESS OF YOUNG CHILDREN TO ENTER INTO THE PROCESS. HE TELLS ABOUT TWENTY-TWO FIRST GRADE CHILDREN IN A VERMONT CLASSROOM WHO, ON THE FIRST DAY OF SCHOOL IN THE FALL, WERE GIVEN WRITING MATERIALS AND ASKED TO WRITE SOMETHING. ONLY TWO OF THEM SAID THAT THEY DID NOT KNOW HOW; THE REST SAT DOWN AND WROTE. THEY COULD NOT SPELL OR PUNCTUATE, ACCORDING TO GRAVES, AND SOME OF THEM WERE NOT SURE OF ALL OF THE LETTERS OF THE ALPHABET, BUT THEY ALL WROTE. THE CHILDREN'S TEACHER, MARY ELLEN GIACOBBE, BELIEVES THAT CHILDREN COME TO SCHOOL KNOWING A LOT MORE THAN WE THINK THAT THEY DO, AND SHE AGREES WITH GRAVES THAT MOST SCHOOL SYSTEMS UNDERCUT WHAT KIDS CAN DO. (BRANDT, 1982)

NANCY RAINEY, A FIRST GRADE TEACHER IN THE OKLAHOMA CITY PUBLIC SCHOOLS, HAS USED CHILDREN'S DAILY STORY WRITING IN HER CLASSROOM FOR SEVENTEEN YEARS AS A VEHICLE FOR LEARNING TO WRITE AND TO READ. RAINEY EACH YEAR HAS A WIDE RANGE OF ABILITIES IN HER CLASSROOM AND HER POPULATION INCLUDES

MANY CHILDREN WHO COULD BE TERMED DISADVANTAGED. SHE MAINTAINS THAT THROUGH WRITING ALL CHILDREN LEARN TO READ AND TO WRITE CREATIVELY BY YEAR'S END, AND SHE HAS THE TEST SCORES TO PROVE IT. HER CHILDREN'S READING SCORES CONSISTENTLY ARE AMONG THE HIGHEST IN THE CITY SYSTEM. (PERSONAL COMMUNICATION)

ALTHOUGH THESE SUCCESS STORIES PROVIDE SUPPORT FOR A BELIEF IN THE NATURAL PROGRESSION OF THE CHILD'S LANGUAGE DEVELOPMENT FROM SPEAKING TO WRITING TO READING, MUCH MORE RESEARCH NEEDS TO BE DONE BEFORE ANY DEFINITIVE ANSWER CAN BE GIVEN TO THE QUESTION OF WHETHER THIS PROCEDURE COULD BECOME THE BASIS FOR WRITING AND READING PROGRAMS IN SCHOOL SETTINGS ON ANY WIDE SCALE.

THE NOTION THAT IT MIGHT BE POSSIBLE TO HARNESS A NATURAL LEARNING PROCESS FOR EDUCATIONAL PURPOSES JUST AS THE NEW BIOTECHNOLOGY IS HARNESSING NATURAL BIOLOGICAL PROCESSES FOR MEDICAL AND COMMERCIAL PURPOSES SURELY DESERVES SERIOUS CONSIDERATION IN A CULTURE WHERE THE TREATMENT OF READING FAILURES IS AN EDUCATIONAL SPECIALTY AND WHERE HUGE SUMS OF MONEY ARE SPENT EACH YEAR ON REMEDIAL READING PROGRAMS.

DIRECTIONS FOR FUTURE RESEARCH

THE GOAL OF THIS RESEARCH HAS BEEN TO TEST SOME BASIC ASSUMPTIONS REGARDING THE GENESIS, SIGNIFICANCE, AND DEVELOPMENT OF THE PHENOMENON OF PROTOWRITING (INVENTED SPELLING) IN YOUNG CHILDREN.

THE STUDY IS SEEN AS AN IMPORTANT BUT INITIAL STEP IN EXAMINING NATURAL LEARNING PROCESSES OF CHILDREN FROM FOUR TO TWELVE YEARS OF AGE, AND TO INVESTIGATE WAYS IN WHICH THESE NATURAL PROCESSES MIGHT BE FOSTERED AND UTILIZED BY THE EDUCATIONAL NETWORK OF HOME AND SCHOOL.

ALTHOUGH VERBAL APPROVAL IS GIVEN TO THE IMPORTANCE OF INDIVIDUALIZING LEARNING EXPERIENCES FOR CHILDREN, IN REALITY INDIVIDUALIZING USUALLY MEANS DIVIDING PRESELECTED CONTENT MATERIAL INTO BITE-SIZE UNITS SO THAT IT CAN BE SWALLOWED MORE EASILY AND LESS PAINFULLY BY CHILDREN.

JEAN PIAGET HAS GIVEN US AMAZING INSIGHTS INTO THE THOUGHT PROCESSES OF THE DEVELOPING CHILD FROM BIRTH TO ADOLESCENCE. HE HAS PROVIDED US WITH AN AERIAL MAP OF THE COGNITIVE TERRAIN AND WITH DETAILED LOCAL MAPS IN PARTICULAR AREAS. HE HAS NOT RELATED COGNITIVE DEVELOPMENT TO EDUCATION OR TO LEARNING EXPERIENCES, EXCEPT IN A VERY GENERAL WAY.

ALTHOUGH MANY EDUCATORS HAVE ATTEMPTED TO MAKE THE CONNECTION BETWEEN PIAGET'S EPIGENETIC THEORY OF INTELLECTUAL DEVELOPMENT AND EDUCATIONAL APPLICATIONS, THIS WRITER FEELS THAT IN MOST CASES THEY HAVE BEEN UNSUCCESSFUL. EITHER THEY HAVE FAILED TO UNDERSTAND PIAGET'S REVOLUTIONARY THESIS AND HAVE SOUGHT, UNSUCCESSFULLY, TO FORCE HIS IDEAS INTO A BEHAVIORIST/LEARNING MODE, OR THEY HAVE RECOGNIZED THE VALIDITY OF PIAGET'S DEVELOPMENTAL PROGRESSION BUT HAVE TAKEN A NATIVIST/MATURATIONAL VIEW AND HAVE NOT RECOGNIZED THE

IMPORTANCE OF THE RECIPROCAL INTERACTIONS BETWEEN THE CHILD AND THE ENVIRONMENT. IN EITHER CASE, THEY HAVE FAILED TO SEE THE SIGNIFICANCE OF THE CHILD AS CONSTRUCTOR AND THE IMPORTANCE OF THE ENVIRONMENT AND ITS COMPONENTS IN THIS SELF-CONSTRUCTION PROCESS.

IT IS THE CONTENTION OF THIS RESEARCHER THAT AN ANTHROPOLOGICAL PERSPECTIVE THAT SEARCHES OUT ANALOGIES BETWEEN HUMAN EVOLUTION AND THE DEVELOPMENT OF THE INDIVIDUAL CHILD OFFERS A PRODUCTIVE METHOD BY WHICH A PARTICULAR BEHAVIOR CAN BE EXAMINED AND THE DEVELOPMENTAL PROCESSES AND ENVIRONMENTAL DYNAMICS LEADING TO THIS BEHAVIOR CAN BE UNDERSTOOD MORE FULLY.

USING THIS METHOD, THIS STUDY OF PROTOWRITING TENTATIVELY HAS IDENTIFIED SOME PREREQUISITE BEHAVIORS FOR ITS EMERGENCE, HAS SUGGESTED THAT PROTOWRITING IS AN OPERATIVE RATHER THAN A FIGURATIVE ACTIVITY, AND HAS SHOWN THAT ITS STAGES OF DEVELOPMENT ARE HIGHLY CORRELATED WITH STAGES OF DEVELOPMENT IN PIAGET'S LOGICO-MATHEMATICAL/SPATIO-TEMPORAL TASKS.

THE DATA GENERATED IN THIS STUDY PROVIDES IMPORTANT INFORMATION ABOUT THE CHARACTERISTICS AND FUNCTIONS OF PROTOWRITING AND SUGGESTS THAT THIS BEHAVIOR, BECAUSE OF ITS RELATIONSHIP TO UNIVERSAL STAGES OF COGNITIVE DEVELOPMENT, SHOULD BE UNIVERSAL IN CULTURES WHERE A WRITING SYSTEM EXISTS. SINCE THE PHENOMENON OF PROTOWRITING HAS BEEN OBSERVED AND REPORTED IN ONLY A FEW CULTURES, SEVERAL QUESTIONS ARISE:

1. Can protowriting behavior be evoked among children in any culture with a written language?
2. Would the sequential stages of protowriting observed in English be identical in all alphabetic languages?
3. Is there a difference in the cognitive processes involved in learning to use the written code in a highly phonetic language like Spanish, in a morpho-phonemic language like English, and in a logographic language like Chinese; and if so, what are these differences?

These questions require carefully documented answers if the process of learning to write and to read in any language is to be understood fully.

A second area of future research is to examine more fully the relationship of protowriting to reading. Although researchers and teachers have provided evidence that protowriting does appear to be a highly effective vehicle for carrying the child into reading, a more detailed analysis of the process is required.

An anthropological approach, whose purpose would be to tease out the social and cultural factors that affect the child and encourage or discourage protowriting's development, would seem appropriate for the task.

It seems to this writer that young children often are unsure of the proprieties and the conventions of the culture and are easily dissuaded from an activity if they

SENSE THAT IT MAKES THEM APPEAR FOOLISH OR IGNORANT.

YOUNG CHILDREN ALSO WRITE ABOUT WHAT THEY FEEL, AND IT OFTEN IS DIFFICULT FOR THEM TO SORT OUT THE DIFFERENCES BETWEEN CORRECTION OF THEIR WRITING SKILLS AND REJECTION OF THEIR IDEAS. TEACHERS WHO HAVE BEEN SUCCESSFUL IN FOSTERING PROTOWRITING HAVE BEEN SENSITIVE TO THIS NEED, BUT A MORE CAREFUL STUDY OF THIS FACTOR NEEDS TO BE MADE IF WE ARE TO BE SUCCESSFUL IN LEARNING HOW TO PIGGYBACK EDUCATIONAL GOALS ONTO THE CHILD'S NATURAL PROPENSITY FOR LEARNING.

A FINAL AREA FOR FUTURE RESEARCH OF INTEREST TO THIS WRITER WOULD BE A STUDY OF THE DEVELOPMENT OF COGNIZANCE OR CONSCIOUSNESS IN CHILDREN. ONE EVIDENCE OF THIS COGNIZANCE WOULD SEEM TO BE THE DEVELOPMENT OF LINGUISTIC AWARENESS. BUT IS LINGUISTIC AWARENESS THE PRODUCT OF A PHYSIOLOGICAL OR A COGNITIVE DEVELOPMENT? DOES IT COME ABOUT, USUALLY BETWEEN FOUR AND SIX YEARS OF AGE, BECAUSE THE CHILD HAS GRADUALLY DEVELOPED THE NECESSARY AUDITORY DISCRIMINATION TO BE ABLE TO HEAR DISCRETE SOUNDS IN HIS SPEECH? OR IS THIS A COGNITIVE ABILITY, THIS ABILITY TO STEP BACK FROM ONE'S OWN SPEECH AND ANALYZE IT? THE PRESENT STUDY CERTAINLY GIVES EVIDENCE THAT LINGUISTIC AWARENESS IS CLOSELY CORRELATED WITH THE LOGICO-MATHEMATICAL STRUCTURES OF THINKING MAKING IT UNLIKELY TO BE THE OUTCOME OF AUDITORY DISCRIMINATION ALONE. BUT IF COGNIZANCE, OF WHICH LINGUISTIC AWARENESS IS AN EXAMPLE, IS PART OF THE CHILD'S DEVELOPING COGNITIVE ABILITIES, IS IT EVIDENT IN OTHER AREAS OF THE CHILD'S

LIFE, AND WHAT FORMS DOES IT TAKE? IS GENDER IDENTITY (CULTURAL STEREOTYPES INCLUDED) A PART OF THE CHILD'S DEVELOPING COGNIZANCE OF SELF, OR THE ABILITY TO BE THE NARRATOR OF A STORY, OR THE ABILITY TO COMPARE TWO SETS OBJECTIVELY IN MATH. THIS CERTAINLY WOULD BE AN INTERESTING QUESTION TO PURSUE AND ONE THAT MIGHT GIVE US FURTHER INSIGHT INTO UNIVERSAL NATURAL LEARNING PROCESSES.

IN HER BOOK ABOUT HER YOUNG SON'S JOURNEY INTO LITERACY, GLENDA BISSEX WRITES,

> IN LOOKING AT AN INDIVIDUAL HUMAN BEING IN THE ACT OF LEARNING PARTICULAR THINGS, WE ARE ALSO SEEING BEYOND THAT INDIVIDUAL AND BEYOND THE PARTICULAR HE IS LEARNING. WHAT DOES PAUL'S LEARNING TO WRITE AND TO READ MEAN NOT JUST FOR CHILDREN'S LITERACY LEARNING, NOT JUST FOR EDUCATION, BUT FOR UNDERSTANDING OURSELVES AS HUMAN BEINGS? --- IN THE BROADEST SENSE OF THE WORDS, "WRITING" (INCLUDING DRAWING) AND "READING" (INCLUDING INTERPRETING VISUAL ASPECTS OF THE WORLD BESIDES PRINT) ARE UNIVERSAL; AND LEARNING TO WRITE AND READ SHARE IN THOSE BASIC PROCESSES BY WHICH WE GROW AS HUMAN BEINGS. (BISSEX, 1980, P. 200)

THE STUDY OF PROTOWRITING LIKE THE STUDY OF ANY HUMAN BEHAVIOR BRINGS US A LITTLE CLOSER TO UNDERSTANDING OURSELVES AND OTHERS. IF WE COULD ALLOW OURSELVES THE FREEDOM OF A CHILD TO "WRITE" IN BISSEX' SENSE, WHAT WE FEEL, AND TO "INVENT" WHAT NEEDS INVENTING, WE ALL MIGHT BE CONSIDERED GENIUSES.

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A P P E N D I X

INVENTED SPELLING

J. J., 5YRS. 2 MOS., FEMALE - FIRST ATTEMPT

WS AP N ATIM	ONCE UPON A TIME
TWS A LT RABT	THERE WAS A LITTLE RABBIT
HTH LITL RABTH	THE LITTLE RABBIT
PLAS TH RAB IS AD	PLAYS THE RABBIT IS SAD

J. J., 5 YRS. 2 MOS., FEMALE - SECOND ATTEMPT

WASAPON A TIM TH WAS	ONCE UPON A TIME THERE WAS
A LE RABIT ANB	A LITTLE RABBIT AND
HE HABA	HE THOUGHT OF EVERYTHING.

L. N., 5 YRS. 9 MOS., FEMALE - FIRST ATTEMPT

IM GOE T YMCA	I'M GOING TO YMCA
N IGE SWME	AND I AM GOING SWIMMING
N IWGT GMN	AND I AM GOING TO GYMNASTICS

S. F., 6 YRS. 6 MOS., MALE

IT IS FUN TO PLA XIT	IT IS FUN TO PLAY EXIT
I L TO PLA SOR	I LOVE TO PLAY SOCCER

J. R., 5 YRS. 9 MOS., FEMALE

I WT FN SCAT	I WENT TO FUN SKATE

J. T., 6 YRS., FEMALE - FIRST ATTEMPT (READS BEAUTIFULLY)

I WINT TO THE ZOO	I WENT TO THE ZOO
AND WINT TO FID THE	AND WENT TO FIND THE
ANUMULS.	ANIMALS.

Directions for Haptic Perception Task

Materials Needed:

1. Duplicate sets of common objects that are assumed to be familiar by sight to the children and are present in the child's daily environment. The objects for this group include a pencil, key, scissors, spoon, comb, button thimble, and ring.

2. First set of shapes (with duplicates): triangle, circle, elipse, semi-circle, semi-circle with notched chord, ring, irregular shape with one hole, irregular shape with two holes.

3. Second set of shapes (with duplicates) square, rectangle,ring, intertwined rings, regular triangle, curved triangle, cross, 4 pointed star.

4. Third set of shapes (with duplicates); regular cross, Cross of Lorraine, 4 pointed star, 6 pointed star, right-angled trapezium, swastika, half-cross, half-swastika.

5. Box with holes at each end and an opening at the back so that the child can feel objects with both hands without seeing them, and the examiner can place and remove objects from the box and observe the child's method of feeling the objects.

Procedures:

Beginning with the first set of materials, each set of objects or shapes is presented to the child. One set of items is displayed for the child while the duplicate of each of the items is placed in the box, one at a time, by the examiner. The child then is asked to pick out the item that s/he has touched in the box from the array that is displayed.

In working with the array of familiar objects, the child is asked to point to each object in the array,as it is named, before any objects are placed in the box. If the child cannot find a particular object in the array when it is named, the examiner should point to the object for the child and name it.

If the child cannot identify any object when named,it should be noted.

Beginning with the first set of shapes, the child also is asked to draw the shape immediately after touching and choosing.

Children are presented with the materials in the order in which they are listed above, beginning with the set of familiar objects. If children are unable to recognize at least half of the items in any one category, no further items will be presented and the testing will end.

Directions for Linear Order Task

Materials Needed:

25 wooden beads of 4 colors and 3 shapes, selected so that 2 identical 9-bead-sequences can be constructed.

22 pieces of paper clothing (2-3 in. length) selected so that 2 identical 9 item "washing lines" can be made.

2 pieces of wire 15" long for stringing beads.

2 washing lines (a 12" black line drawn horizontally across a sheet of paper).

Procedures:

1. Reproduction of Simple Linear Order

   (a) The child is shown a model consisting of 7-9 vari-colored beads on a rod and is asked to place a similar set on another rod. Care should be taken to insure that the child can recognize the different colors and shapes of the beads by getting the child to sort by color and shape before beginning. More beads should be provided than needed so that the child must make a selection even on the final bead.

   (b) The child now is asked to reproduce the beads on a second rod in reverse order starting with the bead at the opposite end (as directed by the tester) and then proceeding until the reverse order is complete.

   (c) The child now is shown a new pattern on a circular model (beads on a heavy cord curved in a circle) and is asked to repeat this pattern on a straight rod as in (a).

2. Two washing lines are presented, one placed 2 or 3 inches above the other. Small pieces of washing are arranged to hang on the first line.

   (a) Loose pieces of the paper clothing are arranged in front of the child. The child then is asked to hand the tester each piece as it is called for, "Please give me the red dress, the green pants, etc." to assure that the child can distinguish between the pieces. After this is done, the child is asked to place the corresponding objects in the same order on the second washline which is directly below the first.

   (b) If the child is able to place the objects on the line in the exact order, the clothes then are removed from the two clothes lines, and the lower line is placed about six inches to the right of the upper line so that the two lines no longer are aligned with each other. A new "line of washing" then is placed on the upper line and the child is asked to make an identical line of clothes on the lower line. If the child attempts to move the lower line directly under the model, the child is asked if it is possible to place the clothes on the line without moving the line. If the child is unable to do so, permission

is given to move it and carry out the task as in (a).

(c) A third task asks the child to remove the clothes from the bottom line, in the reverse order from which they were placed, and to pile the clothes in a miniature wash basket so that each piece is placed on top of the previous one. The child then is asked to tell the tester whick piece is on the bottom, which piece is next, etc. The upper wash line provides a model for the child to refer to, but the child's level of development will determine if it is used for this purpose.

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Child's Name_____ Date_____

Age_____Examiner_____

Picture Drawing:

Did child name picture in advance? _____ If yes, what_____

If child did not name picture in advance, did child name picture while drawing?_____ If yes, what_____

Did child name picture after it was completed?_____If yes, what?_____

What grip did the child use in holding the marker?_____

Writing:

Could the child write his/her name on the picture?_____

Were all the letters used in the name?_____

Were the letters in correct sequence?_____

Did the child write first name only?_____

Could child name the letters in his/her name or give any sounds?_____

Could child write or point to any other letters that s/he knew the name of or the sound? List_____

When you asked child to label his/her picture what did s/he do?_____

Was child willing to try?_____

How successful was s/he?_____

Reproduce the child/s writing here_____

Could child write any other words with the movable letters?_____

What?_____

Grammar:	Drawing:	Protowriting:
1._____	1._____	1._____
2._____	2._____	2._____
3._____	3._____	3._____
4._____	4._____	4._____
5._____		
6._____		
7._____		
8._____