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ACTION WORD LEARNING IN OBSERVATIONAL AND OBJECT-MANIPULATION CONTEXTS

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By

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ABSTRACT

ACTION WORD LEARNING IN OBSERVATIONAL AND OBJECT-MANIPULATION CONTEXTS

By

Kellie Mitchell-Fucile

A multitude of sensory information is available during language acquisition. Whereas the auditory and visual sensory systems have received attention in language research, input through the tactile-kinesthetic sensory systems has not. The possibility that action patterns may facilitate language learning requires examination. The effectiveness of two teaching conditions was studied. Subjects were taught nonsense words under observational and object-manipulation teaching conditions. The results indicated that, overall, both conditions were effective. The object-manipulation condition was superior when taking word order and task into consideration. Additional research examining the clinical importance of object manipulation and how the tactile-kinesthetic systems contribute to language learning is needed.

Thesis adviser: Dr. Ida Stockman

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For Frank. Your enthusiasm and unconditional support and love convinced me I could accomplish anything. While I dedicate this to you, which represents my greatest achievement, it pales in comparison to what you have given me.

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CHAPTER I

BACKGROUND OF THE STUDY

Language is an essential aspect of human existence. It is not surprising that understanding its acquisition is of primary concern to scholars in the language sciences. Considering the complex and dynamic processes associated with mastering a conventional spoken language, it seems almost miraculous that children are able to learn this symbolic system. Understanding how spoken language is acquired not only expands our knowledge of normal child development, it also allows us to assist children with language impairment.

The Mapping Problem

Language exists as a series of symbols that come to represent objects and events in the environment. For children to learn language, they must acquire knowledge about its forms and the environment that is represented by these forms. Therefore, learning a language means that from the outset children are faced with the fundamental problem of mapping. Mapping refers to the connection between the linguistic form (i.e., a word or sentence) and the objects and events in the nonlinguistic world. As Nelson (1985) pointed out, the infant is not born with a shared meaning system fully intact; rather, the child invests years of gathering knowledge concerning various aspects of language structures (morphologic, syntactic, and phonological) that signify the shared referential distinctions (i.e., semantics and pragmatics).

The mapping problem is complicated by the fact that a one-to-one relationship between our range of experience and the symbols that a particular language may use to represent them does not exist. The complexity of the mapping problem can also be recognized when we consider that children chance among a series of ongoing events that offer multi-modal sensory input, some of which are relevant to the language code, and others that are not. At birth, the human neonate has the opportunity to experience visual, auditory, tactile, olfactory, and gustatory stimulation (Fantz, 1963; Haith, 1966; Mendelson & Haith, 1976; Nemanova, cited in Pick, 1961; Rovee, Cohen, & Shlapack, 1976; Sherman & Sherman, 1925).

Gleitman (1990) stated that:

> The very richness of perceptions guarantees multiple interpretive possibilities at many levels of abstraction for single scenes; but the problem for word learning is to select from among these options the single interpretation that is to map onto a particular lexical item. (p. 13)

Considering the learner (the child) is in an environment that offers continuous and varied stimulation (Affolter & Stricker, 1980), it is not difficult to imagine that mother and child may not be focused on the same thing (Bruner, 1974, 1975; Nelson, 1985). It is possible to assume that the mother may have different aims in mind when she tells her child to "look at," "hold," or "touch" an object. Gleitman gave a clear example of a mother and child interaction and explained the mismatches that can occur.

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> What is the likelihood, given that an event of /opening/ is in view and has captured the child's attention, that /open/ (rather than some other verb) will be uttered? Can one doubt that this relationship will turn out muddy in the extreme? For an ideal case, suppose the door to Alfred's house squeaks loudly, so his attention is invariably captured by the noise as it opens, and he invariably looks up and attends whenever it opens. When, every evening, Mother opens the door upon returning from work, what does he hear? I would venture that he rarely hears her say, "Hello, Alfred, I am opening the door!" but very often hears, "Hello, Alfred, whatcha been doing all day?" (p. 21)

The question of what factors constrain the kinds of interpretations children learn to map onto spoken linguistic forms still remains to be answered. Researchers have focused on the mapping problem from many angles. Some have examined the role of joint attention in caregiver interactions (Bruner, 1975; Butterworth, 1983; Collins, 1977; Phillips, 1973; Schaffer, 1977; Snow, 1972). Others have investigated the multiple perceptions present during interactions (Affolter & Stricker, 1980) and demonstrated the difficulties faced during mapping (Gleitman, 1990).

The present study focused on the role sensory modalities play in delivering information about the referents to be associated with words. Although all learning profits from multi-modal input, the present study was motivated by the possibility that the sensory channels may not contribute equally to a given aspect of learning language. The spoken form of the code is restricted mainly to auditory input (some visual information is present), while the meaning associated with the spoken form is far less circumscribed. Learning and discovering referents can involve smell, touch, vision, and audition. Nonetheless, one or more of these sensory inputs may be more critical than others for solving the mapping problem in learning language. This is not a new idea. Despite the multi-modal nature of the learning event, researchers and clinicians have identified audition and vision as the most critical links to cognitive and language learning as considered below.

Sensory Input for Language Development

Auditory Modality and Language Acquisition

It is not surprising that research and clinical practice focusing on spoken language have constantly centered on auditory input. The auditory modality allows the spoken or oral form of language (i.e., the speech sounds in words) to be perceived, and it offers important information about the world, as well. For example, we know birds from just hearing their calls, and in some environments the sound from a siren can signify danger. Theoretical models of spoken language-processing components of Aram and Nation (1984) imply that auditory input is even primary for language learning because other modalities are not represented in their model. In fact, Aram and Nation claimed that the auditory-oral modalities will have the most specific application for diagnosticians.

Our clinical practice makes use of auditory repetition and bombardment in order to give the language learner many models of the correct form to be learned. Children's use of stressed syllables to call attention to particular syntactic constructions also has been noted (Blasdell & Jenson, 1970). Along with repetition and varying stress patterns, the rate at which auditory information should be presented has been examined as a clinical tool. It even has been argued that hearing and the development of speech are necessary precursors to the cerebral specialization for language (McKeever, Hoemann, Florian, & VanDeventer, 1976).

Further evidence of the role audition plays in spoken language is attested to by the speech difficulties of individuals who are deaf. Moreover, some individuals who have learned language with an intact auditory system can experience speech deterioration later on if acuity is reduced.

The importance of auditory information extends beyond sensory acuity to auditory processing. Researchers have attempted to show a causal link between auditory-processing problems and difficulties in learning language (Eisenson, 1972; Tallal & Piercy, 1973, 1974, 1978). They have also attempted to separate the various levels involved in auditory processing (e.g., sequential memory, attention, temporal processing) and to demonstrate that inferior performances, at any of these levels, may cause language-learning problems. Although the hypothesis that auditory input is essential for language acquisition is firmly entrenched in research and in therapy procedures, the supporting evidence is ambiguous (Cromer, 1978; Rees, 1973).

Visual Modality and Language Acquisition

The importance of the visual system to cognitive development and language acquisition has been stressed, as well. The concept of observational learning, which is defined as learning that results from watching the behaviors of others (Shaffer, 1985), implicitly recognizes the importance of the visual modality. The relationship between perceiving visual input and learning seems well entrenched in the child-development literature. For example, Clark's (1973) Semantic Feature Hypothesis puts forth the idea that children first visually perceive the physical features of objects in the environment. More specifically,

> word meaning is acquired through a process involving the gradual accumulation of semantic features, with initial feature acquisition being governed by formal or perceptual phenomena (primarily shape, secondary size, texture, movement, sound). (Smith, 1978, p. 950)

In addition, evidence from children's semantic errors (e.g., calling the moon an orange) reflects an implicit assumption that visual input is important to early meaning acquisition (Anglin, 1977; Bloom, 1973; Bowerman, 1976; Clark, 1973; Dewey, 1894; Rescorla, 1980).

The emphasis placed on the visual sensory system for language acquisition also can be seen in clinical practices for testing and teaching individuals with speech and language pathologies. Visual information has taken the form of relatively static spatial representations of pictures or other graphic symbols corresponding to the words being taught. Static representation refers to the concept defined as "not moving or progressing; at rest; inactive; stationary" (<u>Webster's New Twentieth Century Dictionary</u>, 1983). For example, in comprehension testing and teaching, the learner is required to point to pictures in response to a model utterance (Connell, 1987). This procedure has been particularly popular for teaching words or vocabularies (Paluszek & Feintuch, 1979; Ruder, Smith, & Herman, 1974). Overall, relative to the other sensory modalities, vision has received much attention in both learning and teaching language.

Limitations of the Auditory and Visual Systems for Language

Although the literature has stressed the visual and auditory modalities for language learning, it is unlikely that a child acquires all the referential distinctions needed for language acquisition through these sensory systems alone (Bruner, 1964; Piaget, 1952, 1954; Zaporozhets, 1965, 1973). Studies on blind children's spoken language suggest that vision is not necessary for language learning to occur. Although blind children may acquire word meaning at a somewhat slower rate, their language acquisition is not deviant or abnormal, when compared to that of sighted children (Gleitman, 1990).

It also should be considered that, if the auditory modality is essential to learning language, then children who are deaf should not acquire language. However, it is known that, while deaf children do not perceive the aural/oral forms of spoken language, they are still capable of learning language by mapping manual symbols onto objects and events (Bellugi, Poizner, & Klima, 1989). Deaf children learn sign language very rapidly and master the same kinds of developmental milestones observed among hearing children.

Under some circumstances, deaf children are able to acquire oral language as well as sign language.

Thus, both the deaf and blind populations are able to acquire meaningful language despite the lack of visual and/or auditory information. On the other hand, there exist language-impaired children who have both sight and hearing. Their difficulties cannot be explained by the usual etiologies. In some cases, the language deficit is associated with failure on nonverbal tasks, which include symbolic play (Rom & Bliss, 1983; Roth & Clark, 1987; Terrell, Schwartz, Prelock, & Messick, 1984), motor skills (Affolter, Brubaker, & Bischofberger, 1974; King, Jones, & Lansky, 1982), and tactile perception (Affolter & Stricker, 1980; Kamhi, 1981, 1984; Tallal, Stark, & Mellits, 1985a). This group includes children known as specifically language impaired (SLI). These children present normal physical appearance and do not appear to be retarded on standard intelligence tests. However, little is known about the true nature or cause of impairment. Their primary characteristic is an inability to acquire language naturally like other children (Stark & Tallal, 1981) even though they have visual and auditory acuity.

At the same time, the evidence that links auditory-processing difficulties (e.g., sequential memory, attention, temporal processing) to the language-learning difficulties of the SLI population also is equivocal. For example, studies dealing with auditory memory have shown that children with language-learning difficulties have reduced auditory memory capacity (Eisenson, 1968; Masland & Case, 1968; Wepman & Moreney, 1973) and generally recall fewer digits and words in sequential order than age-matched peers (Katz, Healy, & Shankweiler, 1983; Mahecha, 1981; Masland & Case, 1968; Stark, Poppen, & May, 1967; Torgesen, 1985). However, the presence of such reduced performances does not automatically warrant the conclusion that deficiencies in the reproduction of auditory sequences are the cause of a language disorder (Lahey, 1988).

Moreover, it is unlikely that sequential memory is totally driven by auditory stimuli. Lahey (1988) reported that three-year-old children are able to produce and comprehend long sentences, while only repeating two to three unrelated words. She offered the explanation that semantic relationships between the words in the sentence aid the children in comprehending. That is, it is the child's knowledge of the language that increases auditory sequential memory.

Memory is a second component of auditory processing that researchers have linked to language-learning impairment. Evidence that meaningful words are recalled better than nonsense words (Brenner, 1940) and that linguistic familiarity increases recall shows that linguistic knowledge affects memory span. Therefore, poor memory capacity may not be the cause of depressed language skills, but it may be explained by the language disorder.

A study completed by Mahecha (1981) demonstrated this point. Differences in memory capacity were observed between specifically language impaired (SLI) children and non-language-impaired (NLI) children when meaningful linguistic stimuli were used. These differences disappeared when both sets of children were given nonsense syllables that contained non-English initial phonemes. In other words, when the familiarity of the linguistic stimuli was reduced, no significant differences existed between the two groups. While other researchers have looked at other factors of auditory processing (Eisenson, 1972; Mann, 1986; Tallal, 1976; Tallal & Piercy, 1973a, 1973b, 1974, 1975; Stark, Poppen, & May, 1967), it is not clear whether these measures can be separated from the child's knowledge of language.

The hypothesis that language-learning problems are due to auditory-processing deficits ignores the multisensory nature of language learning. The processing of multiple inputs, including visual and tactile-kinesthetic features, is essential for language learning. Coding the relationship between meaning and sound depends on experience with objects and events that are not restricted to auditory information (Lahey, 1988). On the other hand, it is plausible that, if a child has difficulties processing all of the inputs involved in language learning, auditory input may be a factor. But to search for a single auditory skill, or a set of auditory abilities, essential to language learning seems futile (Rees, 1983).

If visual and/or auditory deprivation need not keep one from learning language, and language can be absent when these two sensory systems are intact, then it is reasonable to hypothesize that some other sensory mechanism must drive the acquisitional process.

Tactile-Kinesthetic Modalities and Language Acquisition

This study was motivated by a specific hypothesis put forth by Affolter (1991) and Affolter and Stricker (1980), which asserts that tactile-kinesthetic sensory input is the most critical link to language acquisition (see Stockman, 1986, for a critical overview of this framework). Taction is the sensory modality involved with the perception of touch. Kinesis is the sensation of movement, position, and tension perceived through nerves, tendons, muscles, and joints (Webster's New Twentieth Century Dictionary, 1983). The combined tactile-kinesthetic modalities have been described as a multi-modal input (Gibson, 1966) that is capable of offering different information about the world than is provided by the visual and auditory systems.

Affolter and colleagues argued that tactile-kinesthetic information processing is essential not only for adapting movements to spatial conditions of the environment, "but also for establishing fundamental cognitive and emotional causality" (Affolter & Stricker, 1980, p. 11). Causality refers to the cause-effect relationships among objects that form the "meaning" base of language development. In this sense, language is viewed not in terms of linguistic forms (i.e., morphology, phonology, syntax), but on a more basic level as it relates to referential distinctions. The few studies on the tactile-kinesthetic system, furthermore, have revealed that tactile short-term memory is remarkably strong and that it is a superior "expert system," which appears to be unaffected by variables that normally produce decrements in the short-term memory for visual and auditory stimuli (Kiphart, Auday, & Cross, 1988; Klatzky, 1980; Klatzky, Lederman, & Metzger, 1985; Reed, Durlach, & Braider, 1982).

Unfortunately, research that documents the role of the tactile-kinesthetic systems in language acquisition is relatively sparse when compared with studies about the role of vision or audition in this process. Theoretically, tactile-kinesthetic modalities offer a unique contribution to language learning. These sensory systems offer the individual direct information about objects and causal relationships present in the environment. That is, unlike visual information, which provides a more static picture of objects and events, tactile-kinesthetic input offers the opportunity to experience the three dimensionality of objects and the sensory information involved in causing change to the world. For example, when a child pushes a ball, the input he or she receives when actually performing the movement is different from that of a child who only observes the movement. In the latter example, the child merely witnesses the result, whereas the tactile-kinesthetic systems allow one to experience what it means to cause change to the world.

Taylor et al. (1973) strengthened the case for the importance of the tactile-kinesthetic system by arguing that "it is this multi-modal nature of touching which gives touch the feeling of providing substance and reality to the perceived world" (p. 262). Some scholars have agreed that reality cannot come from visual input alone but must derive from "action," "activity," and "manipulation"

(Bruner, 1964; Bruner, Oliver, & Greenfield, 1966; Piaget, 1952, 1954; Piaget & Inhelder, 1956; Zaporozhets, 1965, 1973).

The argument used to explain why vision cannot be considered the most essential input for language learning is relevant to auditory input. Of course, auditory input is necessary for acquiring the spoken form of language symbols, but it cannot be the most critical input for learning about the cause-effect referential distinctions of a shared-meaning system. It is obvious that one cannot fully experience the action of pushing a ball from auditory input, or for that matter, by relying just on visual input. Although the previous example is a simple one, it is important to realize that individuals cannot take one step, touch any object, or turn their heads without receiving tactile-kinesthetic information. These modalities provide a sense of how the body can move in the physical world and the opportunity to obtain information about the cause-and-effect relationships of objects. While the importance of tactile-kinesthetic input for the learning of motor skills is readily acknowledged, Affolter and Stricker (1980) suggested that this sensory input is essential for learning complex cognitive performances, including language. As Affolter and Stricker stated, "acquisition, learning, development--these processes appear to evolve as a result of continuous interaction between environment and individual" (p. 11). Being in touch or in contact with the environment can only be realized through the tactile-kinesthetic sensory system.

It is generally accepted that language learning--in particular, meaning acquisition--is motivated by understanding cause-and-effect relationships and by "acting" on the environment. This correlation between action and early meaning acquisition (sustained by the tactile-kinesthetic senses) has been recognized from a theoretical point of view (Bruner et al., 1966; Piaget, 1952, 1954; Piaget & Inhelder, 1956; Zaporozhets, 1965, 1973). The importance of action, translated into object manipulation, also has been acknowledged in other studies (Butter, 1979; Connell, 1987; Huttenlocher, Smiley, & Charney, 1983; Kamhi, 1982; Olswang, Bain, Dunn, & Cooper, 1983). The results of these studies have revealed that children use action to develop early semantic relations (Huttenlocher et al., 1983). Children learn as well or better when receiving tactile-kinesthetic input as when receiving visual input (Butter, 1979; Oswang et al., 1983). Such findings support the hypothesis that tactile-kinesthetic input is critical to children's development.

In clinical terms, "acting on" is described under the rubric of haptic training. Researchers have studied the advantages of using haptic training with individuals who are learning disabled (LD) (Butter, 1979; Locher, 1985). One study demonstrated that because haptic training allowed the perceiver to focus his or her attention on features of stimuli one at a time, it was a superior learning condition (Locher, 1985). Butter (1979) explained that the characteristics of haptic perception induced a more thorough and reflective analysis of stimuli and resulted in greater effectiveness for haptic training as compared to visual training.

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Although these studies focused on the LD population, a number of these children experience language difficulties. At times, the terms "learning disabled" and "language delayed" are used interchangeably (Kirk & Kirk, 1971). In addition, Locher (1985) pointed out that, by using haptic exploration, the teacher could directly observe the encoding process and provide immediate and continuous nonverbal feedback by manipulating the child's hand. This approach has the potential to offer language-impaired children critical information about objects and events without relying on verbal input.

Evidence from children's early language usage also supports the importance of action and language learning. Children refer to actions and locative actions earlier than verbs encoding state. Children also are more apt to speak about what they are doing or what they are going to do (Bloom, 1973). A study completed by Huttenlocher et al. (1983) demonstrated that children first talk about actions they perform themselves, before they speak about actions they observe others doing. Moreover, action patterns coupled with location have been at the root of the semantic-bootstrapping theories about early language. The grammatical system may be extended by relying on early action and location sentences (Jackendoff, 1983).

Given the dominant role that action and movement play in early language learning, it should not be surprising to discover that some language-impaired children with intact visual and auditory systems

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have demonstrated problems with movement and taction (Affolter & Stricker, 1980; Affolter et al., 1974; Kamhi, 1981, 1984; King et al., 1982).

Affolter and Stricker (1980) described a longitudinal study of language-delayed children. Many of these children did not use speech sounds. They also did not perform sequences that were goal oriented, such as dressing. In addition, symbolic performances, production of events, and imitation were not observed in the language-delayed group.

Because language learning is multi-modal in nature, the contributions of audition and vision to language acquisition must not be ignored. It is generally accepted that audition, vision, and tactile-kinesthetics all are involved in meaning acquisition. Yet it is unfortunate that the link between tactile-kinesthetic information and language acquisition has received little attention in the literature. The quantity of information that the tactile-kinesthetic systems can provide for language acquisition is relatively unknown when compared to the well-studied visual and auditory modalities.

Statement of the Problem

The possibility that action patterns may facilitate language learning has not gone unrecognized. The few studies that have focused on children's object-manipulation strategies offer some insight into the relative contribution of the tactile-kinesthetic modality to language learning (Connell, 1987; Kamhi, 1981; Olswang

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et al., 1983). These studies have shown that children in the manipulation conditions learned as well as or better than children in conditions that offered visual information alone. However, manipulation is a multi-modal action event involving vision, taction, and kinesis. It is not known whether all modalities contribute equally to success on this kind of task. Unfortunately, researchers have failed to separate the modality input in object-manipulation learning conditions. For example, during object manipulation, the children also have watched what they were doing. Thus, the contribution of tactile-kinesthetic input to task success was not isolated from the visual input. Therefore, it is not clear whether one sensory input or multiple inputs account for the learning success that results from object manipulation.

If the differential contribution of sensory modalities is to be empirically tested, efforts must be made to separate the inputs. In effect, researchers who compare learning via object manipulation with learning via observation focus on the relative effectiveness of tactile-kinesthetic and visual inputs. Although natural learning conditions include a combination of vision and tactile-kinesthetic input, the relative contributions of the different sensory inputs can be determined only by separating the inputs. Separation of inputs does not imply that no other information is being perceived by other sensory systems. For example, during object manipulation and visual observation, some auditory and/or olfactory information may be generated by the objects acted on. In addition, there is no denying that during visual observation of action events, some tactile-kinesthetic information may be perceived through eye movement. But verb-learning studies, which compare observation with object manipulation, are concerned with the tactile-kinesthetic information as it relates to action in the sense of cause-effect relations among objects. Neither auditory, olfactory, nor kinetic feedback from eye movement directly causes change in the environment.

Purpose of the Study

This study focused on the conditions under which children map new words onto action referents. Specifically, the purpose was to determine whether object manipulation without vision would better facilitate word-to-action mapping than observation of the action without tactile-kinesthetic input. Because verbs carry essential information about action and movement in English syntax, the contribution of tactile-kinesthetic input is assumed to be more critical than that of visual input in action-word learning.

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CHAPTER II

LITERATURE REVIEW

The concept that object manipulation has cognitive and adaptive functions has been investigated in past research. The primary goal in this literature review was to critically review the object-manipulation research as it relates to language learning. However, the literature is sparse relative to research on object manipulation as it relates to infant exploratory behaviors (Fenson & Schell, 1985; Power, Chapieski, & McGrath, 1985; Rochat, 1989; Ruff, 1982, 1984, 1989; Ruddy & Bornstein, 1982).

How infants explore the environment through manipulation has been researched from different perspectives. For example, Ruff (1984) studied the durations and types of exploratory behaviors of 6-to-9-month-old and 12-month-old infants. Results indicated that the behaviors investigated (e.g., looking, handling, mouthing, banging, turning, alternating, and fingering) changed with age. For example, as age increased, mouthing decreased while fingering increased. The haptic behaviors of the infants also changed as a result of object properties. In other words, infants adjusted or varied the distribution of investigative and manipulative behaviors according to the nature of the specific object being explored (Ruff, 1984).

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Other researchers have addressed whether infants used visual or haptic consequences of their manipulation in learning about object properties (Ruff, 1982). The results suggested that manipulation augments recognition of the structural properties of objects. Ruff concluded that manipulative exploration involves constant interactions, which cannot occur with visual inspection of static objects or pictures.

In addition to identifying the stimulus attributes that influence manipulation, or describing developmental changes, researchers have attempted to establish the link between object manipulation and cognitive development (Ruddy & Bornstein, 1982). For example, 4-month-old infants, who either vocalized more or manipulated objects more frequently, spoke more words at 12 months than infants who vocalized or manipulated objects less frequently (Ruddy & Bornstein, 1982).

Although the above-cited research on infant exploratory behaviors and object manipulation did not address the involvement of the tactile-kinesthetic sensory systems, it did shed some light on the importance that object-manipulation input may have in early language development. However, the literature documenting how object manipulation may be linked to language acquisition is sparse. The limited research that does exist encourages the exploration of object manipulation and the role of the tactile-kinesthetic sensory systems in language development. The remaining discussion reviews the research on object manipulation and language learning for both normally developing children and for clinical populations.

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Action and Normal Language Acquisition

A study completed by Huttenlocher et al. (1983) suggested a link between action experience and verb learning. The authors investigated the types of action verbs children use and whether the emergence of action categories was affected by observed action or by self-action. Observed action was based primarily on receiving visual information, whereas self-action was an index of tactile-kinesthetic and visual information. Overall, the results suggested that self-action plays an important role in verb acquisition. This study was motivated by Strawson (cited in Huttenlocher et al., 1983), who claimed that there are no differences between self-action and observed action because both are produced by the same being. To investigate some of the issues concerning verb learning, the Huttenlocher et al. (1983) study was subdivided into three parts.

The first study attempted to answer whether children apply observed actions first to movement verbs (e.g., bounce, jump) or to verbs that encode change (e.g., cut, draw). Data were collected from 69 middle-class preschoolers. Each subject observed two films, presented side by side, displaying two verbs. One verb was chosen from the "movements" list (e.g., jump), whereas the other included verbs from the "change" list (e.g., cut). The child observed the two films simultaneously, while the investigator named both actions and asked for the target action (e.g., One is cutting and one is jumping. Which one is cutting?). After the investigator asked the question, the subject was asked to point to the correct film displaying the target action.

The verbs were presented in pairs, which were randomized across subjects. Each subject viewed 10 pairs. To evaluate comprehension, the child was presented with the 10 verb sequences four times. The criterion for comprehension was choosing the target verb correctly all four times. The results showed a significant difference between responses to the two verb types. The children applied movement verbs to observed behavior more than change verbs.

The second study investigated whether children first produce verbs for actions of self or of others, and whether movement verbs are produced before change verbs. The spontaneous productions of 16 preschool children were collected over a 4-hour period. The results showed that 90% of the verbs used by the children were produced when they were participating in the action. The remaining productions were used to encode observed actions. The investigator concluded that when average 2 year olds observe other people's behavior, they do not categorize that behavior as goal-directed or causally efficacious.

The final study used longitudinal data from 10 children to investigate whether children produce verbs that encode characteristic motions (e.g., walking) first in relation to self-action, observed action, or both. A total of five verbs (e.g., sit, run, kick, jump, wave bye-bye) were tested at each visit. The data from this study showed two things. First, verbs for particular movements were acquired first for children's own actions. Second, chi

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children's verbs encoded their actions involving change before they encoded the actions of others that caused changed.

The fact that children comprehended and produced verbs they had physically performed, before they produced or comprehended verbs they had observed, highlighted the strength of the modalities involved in acting versus observing. Although the above-mentioned study was limited to verb acquisition, it seems reasonable to conclude that the perceptions received through self-action, which are primarily tactile-kinesthetic, are more relevant to early verb learning than the visual perceptions received through observation.

Although this interpretation of the Huttenlocher et al. (1983) research is plausible, it must be tempered by the fact that during self-action, perceptions are not solely perceived by the tactile-kinesthetic modalities. During self-action, the child also is observing what he or she is doing. That is, the modalities used in perceiving self-action events include both vision and tactile-kinesthesis. Therefore, with respect to perceptual processing, Huttenlocher et al. showed that verb learning was facilitated by the combination of visual and tactile-kinesthetic experiences present during self-action. Thus, this experiment did not demonstrate whether sensory input from one modality during self-action provided more information to the child than another, or whether it was the combination of the two that made self-action a better tool for learning.

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Differentiating Normal and Clinical Groups Using Tactile-Kinesthetic Tasks

Information with respect to how normally developing children differ from children who are language impaired provides insight into the specific areas that may cause the deficiencies. Researchers have demonstrated that tasks specific to the perception of tactile-kinesthetic information can be used to differentiate normal children from clinical groups, including language impaired. This is one reason why this modality should be given additional attention in research. The few research studies that have shown normal children and language-impaired children to differ on tactile-kinesthetic tasks represent significant first steps toward demonstrating the significance of the tactile-kinesthetic modalities.

One set of investigations, as summarized in Affolter and Stricker (1980), used 38 children diagnosed as language disturbed (LD). They were given Successive Pattern and Form Recognition tasks. Their performance was compared to that of a second clinical group of 13 hearing-impaired (HI) subjects and of a normal group consisting of 240 children. The results of each task will be discussed individually.

Successive Pattern Recognition tasks required children to compare two nonverbal stimuli. The study was designed to investigate whether modality condition and complexity of series affected performance. The subjects were presented analogous patterns under three modality conditions: visual, audition, and vibro-taction. Each modality condition contained four series of iter

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items, which included patterns with one element, two elements, three elements, and four elements, respectively. The presentation conditions of the stimuli remained constant across each series and modality condition.

The within-group analysis showed that each clinical group scored lower on Series 3 and 4 than on Series 1 and 2. The shift in error score as a function of modality condition was not as clear. The HI subjects' scores did not yield modality differences. In other words, these subjects did not consistently score lower in one modality condition compared to another. The LD subjects' scores produced a definite trend. The subjects always scored lower in the vibro-tactile modality than in the visual or auditory modalities.

The between-group analysis compared the scores of the two clinical groups with the scores from the normal group. In relation to the normal children, the HI children scored more like the normal group than the LD children on most series. Overall, the LD children scored higher in the visual and auditory modalities, and lowest on the vibro-tactile tasks.

In general, the results demonstrated that the LD children consistently scored lower than the normal children, and in some instances lower than the HI children, on tasks that required vibro-tactile perception. It should be noted that the LD children experienced difficulty in all three modality conditions, although the most pronounced difficulty was in the vibro-tactile conditions.

The second investigation used Form Recognition tasks. Each subject had to match forms under three modality conditions, across thr

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three series that increased in shape complexity (from simple to complex). The three modality conditions included: tactile (T) condition, visual (V) condition, and visual-tactile (M) condition. The tasks were developed to test the hypothesis that the two clinical groups' scores would decrease as form complexity increased, and, with respect to modality condition, scores would be highest for the visual condition followed in order by visual-tactile and tactile modalities, respectively. The second hypothesis stated that differences between normal children and the clinical children would vary with task complexity.

The results yielded score trends consistent with the hypothesis regarding modality condition. Both HI and LD children scored highest during the visual modality presentation and lower on visual-tactile and tactile. But the results expected for series complexity were not found. The between-group analysis revealed interesting results. The HI children performed appropriately on all series and in each modality condition. In contrast, the LD children scored lowest on visual-tactile and tactile tasks within each series. These results suggest that any series that included tactile-kinesthetic processing produced the greatest difficulty for the LD children.

Further evidence that normally developing children can be differentiated from language-impaired children comes from Kamhi (1981). This study compared the nonverbal performance of 10 language-impaired children with two groups: (1) mental age (MA) mat

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matched normal children and (2) mean length utterance (MLU) matched normal children. The study was driven by the assumption that a cognitive deficit may be the cause of language impairment (Morehead & Ingram, 1973; Rees, 1973) if a specific linguistic deficiency could not account for language delays and if difficulty in processing and integrating auditory information was not causing the impairments (Cromer, 1978; Rees, 1973; Tallal & Piercy, 1978).

To assess this hypothesis, six nonlinguistic symbolic tasks derived from the Piagetian literature were presented to subjects in alternating order. The tasks included Haptic Recognition, Water Level, Mental Displacement, Classification, Number Conservation, and Linear Order. The data revealed a significant difference between the language-impaired children and both MA and MLU matched groups on the Haptic Recognition task. No other task performances revealed significant differences between the language-impaired and the two matched groups.

The Haptic Recognition task was a cross-modal task, which involved exploring geometric shapes while blindfolded and visually recognizing the corresponding shape. Therefore, the subjects had to rely on their tactile-perception skills to be successful on this task.

Kamhi (1981) discussed these results in relation to what skills were necessary to perform the tasks. Originally, Kamhi hypothesized that the subjects would have to use nonlinguistic symbolic abilities, specifically imagery skills. According to Kamhi, a posthoc task comparison revealed that the formulation of an

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anticipatory symbolic images was necessary only for the Haptic Recognition task, and the children were able to use other strategies to be successful on the remaining tasks, for example, using drawn figures, matching stimulus feature to the figures in the response choices, and random response strategies. It was then hypothesized that the significant poor performance on the Haptic Recognition task exhibited by the language-impaired group was due to their symbolic deficiencies.

Although Kamhi (1981) demonstrated that normal children differed from language-impaired children on a task that relied on tactile-kinesthetic perception, the conclusion drawn did not focus on the sensory input required for the task. It focused instead on symbolic abilities. However, this study supports the present study's premise, namely, that tactile-kinesthetic processes are associated with language learning in some critical ways.

Although Kamhi's (1981) study lends support to the hypothesis of the present study, the results must be tempered by (a) the small sample size and (b) the fact that only one haptic task was used. Of course, the main purpose of Kamhi's study was not to concentrate on haptic manipulation; therefore, one must not be too zealous in interpreting the results. The author concluded that "further studies using other non-linguistic symbolic tasks for which solutions depend on anticipatory imagery abilities are clearly needed to substantiate these claims" (p. 451).

In subsequent research, Kamhi (1984) attempted to clarify the nature of the cognitive deficits of the language-impaired population. Once again, he compared language-impaired children to normal children. The basis for this study was taken from Morehead and Ingram's (1973) claim that "these children may have a pervasive symbolic deficit that affects non-linguistic as well as linguistic abilities" (p. 170).

Kamhi (1984) used 10 language-impaired and 10 normally developing children matched for mental age (MA). Each subject was given three standardized tests to measure expressive and receptive language skills (e.g., Peabody Picture Vocabulary Test [PPVT; Dunn, 1965], Northwest Syntax Screening Test [NSST; Lee, 1969], and Developmental Sentence Scoring Analysis [DSS; Lee, 1974]) and three cognitive tasks: concept formation, discrimination learning, and haptic recognition. The last task was used to corroborate Kamhi's (1981) earlier finding that haptic recognition was delayed in language-impaired children. The remaining two tasks assessed subjects' hypothesis-testing abilities. Hypothesis testing refers to a process involving formulating and testing hypotheses about specific conceptual domains (Slobin, 1979).

The results revealed that the between-group comparisons yielded no significant differences on the discrimination-learning or concept-formation tasks. But a significant group difference was again obtained for the haptic recognition task. The language-impaired group displayed significantly poorer haptic-recognition skills than MA matched subjects. A high correlation also was found between the language-impaired group's performance on haptic recognition and receptive language scores on the PPVT, and a moderately significant correlation was found on discrimination learning and PPVT scores.

Although no differences existed between the language-impaired and the normal children on the hypothesis-testing abilities, a strong difference was found on the haptic-recognition task. In other words, the language-impaired children performed significantly poorer on this task than did the MA matched controls. The author concluded that the visual information available during the concept-formation and discrimination-learning tasks aided the language-impaired children. The haptic-recognition task, which relied completely on tactile-kinesthetic input, clearly had a stronger symbolic component. Kamhi believed the dependence on symbolic representation caused the group's inferior performance.

Kamhi (1984) mentioned the sensory input that was not available (e.g., vision), but unfortunately he did not explore the inputs that were available (e.g., taction, kinesis). To be successful on the haptic task, the perception of tactile-kinesthetic input was necessary. Unfortunately, these sensory systems were not considered. Although it is conceivable that language-impaired children have problems in symbolic abilities, it seems essential to understand the abilities that precede symbolic functioning--especially, given the fact that language-impaired children do not perform poorly on all symbolic activities, and their deficiencies appeared to be specifically related to tasks requiring tactile-kinesthetic input.

Given that language-impaired children differed significantly from normal children on the haptic task in Kamhi's (1981) first study, it is surprising that additional haptic tasks were not used in his second study. This could have revealed whether the poor performance of the language-impaired children was task specific or was indicative of a more general deficit in the area of tactile-kinesthetic perception.

In the final study reviewed here, Affolter et al. (1974) compared the performance of normally developing children with language-impaired children on input functions, general behavior, elaborative performance, and speech-sound production. The results demonstrated that the language-impaired group differed from the normal group on nonlinguistic abilities, which included attention span, hand-eye coordination, and imitation.

The research described by Affolter and Stricker (1980) and Kamhi (1981, 1984) highlighted the fact that normal children could be differentiated from language-impaired children on tasks requiring tactile-kinesthetic perception. Little documentation has directly demonstrated the problems that exist between tactile-kinesthetic perception and this population. Whereas Affolter and Stricker's (1980) studies have shown that LD children experienced the greatest difficulties on tasks that relied primarily on tactile-kinesthetic input, only Kamhi's studies separated the visual modality from the tactile-kinesthetic modality. Therefore, only one study exists that clearly demonstrates that the language-impaired population has difficulty perceiving tactile-kinesthetic input.

These two studies, combined with a growing awareness that the difficulties of the language impaired include more than just language (e.g., gross and fine motor coordination) (Affolter et al., 1974; Lahey, 1988), demonstrate the need for additional research.

Object Manipulation as a Teaching Strategy

The reason to look to the tactile-kinesthetic sensory systems for answers about language delay is supported not only by research on the relationship between poor haptic recognition and language impairment as described above; it also is supported by research on the use of object manipulation as a teaching strategy. Two studies exist (Butter, 1979; Olswang et al., 1983) that attempted to demonstrate to what extent tactile-kinesthetic input is involved in learning.

A study completed by Butter (1979) demonstrated that haptic training was more successful than visual training in teaching impulsive subjects to perform more reflectively. Past researchers have attempted to modify individuals' impulsive responses because reflective children perform better than impulsive children on inductive reasoning (Kagan, Pearson, & Welch, 1966), memory (Kagan, 1966), information-processing tasks (Egeland & Higgins, 1976; Neussle, 1972), and general school performance (Messer, 1970).

Two measures, the Matching Familiar Figures Test (MFF) and the Haptic Visual Matching Task (HVM), were used to assess the reflection-impulsivity dimension (R-I). The MFF is a visual match-to-sample task, and the HVM is a cross-modal match-to-sample task. The main objectives of the study were to (a) compare the error and latency performances in the two modalities and (b) assess the effectiveness of haptic and visual training in the same modality and in the other modality.

The HVM task required subjects to select the geometric form that corresponded to the form haptically explored. This represented a bimodal task because subjects first explored the form without vision and then had to visually choose the correct form from among five choices. The MFF was a unimodal task. Subjects had to select the line drawing from among six foil items that matched the drawing they were exposed to originally.

The 30 subjects chosen performed impulsively on both tasks. The "impulsives" were separated into three groups. One group received visual training, a second group received haptic training, and the third group acted as a control and received no training. The results demonstrated that both training methods produced significantly lower errors in the respective task modalities. In other words, subjects trained in the haptic modality improved their performance on the HVM, and subjects trained in the visual modality had lower error scores during MFF. In addition, an asymmetrical transfer of training occurred. Subjects who received haptic training produced fewer errors on the MFF than control subjects. This transfer was not found in the visually trained subjects. That is, subjects trained in the visual modality produced no decrease on the HVM. The effectiveness of haptic training was also revealed when haptic subjects performed significantly better on the HVM than the visual subjects, whereas visual subjects did not perform better than haptic subjects on the MFF.

These results suggested that the information provided during haptic teaching was more beneficial than the information provided during visual teaching. This was evidenced by the haptic group's improvement on both the HVM and the MFF. The haptic training could be described primarily as a tactile-kinesthetic task because it required subjects to explore objects void of any visual input. Butter (1979) concluded that haptic teaching was more effective than visual teaching because the haptic exploration allowed a more thorough analysis of the objects than did the visual teaching.

Although results from Butter's (1979) study lend support to the effectiveness of tactile-kinesthetic input, caution must be exercised in drawing conclusions from this study because of the dissimilarity that existed between the two tasks. The author admitted that the stimuli used in the two tasks differed. Therefore, differences between the teaching strategies could have resulted from task rather than sensory-input differences.

Regardless of the limitations of Butter's work, his research has put forth the idea that tactile-kinesthetic input can be effective in teaching. Unfortunately, there exists only one other study that has used tactile-kinesthetic information as a teaching strategy. This study, completed by Olswang et al. (1983), compared two modes of stimulus presentation, object manipulation and picture identification. The aim of this study was to show which presentation was most successful in teaching single-word productions to language-impaired subjects. This is the only study found that examined object manipulation as a teaching strategy for language learning. The data collected were used to answer two main questions: (1) Overall, were the target words produced more often than the control words? and (2) Did differences exist in the effectiveness of object- manipulation teaching versus picture-identification teaching?

Four language-impaired children, with ages ranging from 23 to 40 months, were observed. Several standardized tests (Sequenced Inventory of Communication Development, Boyd Developmental Progress Scale, and Uzgris and Hunt Ordinal Scales) and observations classified the subjects as having a moderate to severe language delay. The study employed a multiple-schedule design to assess the effects of object-manipulation and picture-identification procedures on performance.

The investigation targeted 20 words (10 nouns, 10 verbs) to receive treatment and 20 control words (10 nouns, 10 verbs) to receive no treatment. Each subject was taught five nouns and five verbs in a structured teaching program over approximately three sessions. The treatment conditions were counterbalanced across time periods to avoid biasing one condition.

It was shown that all of the children produced the target words more often than the control words. Therefore, the language-impaired subjects acquired more words after structured teaching than when left to natural maturational development.

The answer to the second question was not as clear. The analysis showed differential results across subjects. Subjects 1 and 2 learned better in the object-manipulation teaching condition than in the picture-identification condition. Subject 3 learned equally well in both conditions, whereas Subject 4 appeared to learn better in the picture-identification teaching condition.

The researchers discussed the results in terms of different language-learning styles. The first two subjects, who were also the most impaired, appeared to learn best through object manipulation. The fact that their language impairment was the most severe suggests that the information perceived through the object-manipulation condition offered them valuable information that they could not receive during the visual presentation of pictures.

Subject 3 appeared to have no preference, and both teaching conditions were equally as effective. The fact that this subject was the least impaired suggests that he had the capacity to perceive the appropriate stimuli from both presentations. This result highlights the fact that both modes of presentation can be effective for teaching the words.

Subject 4 was the only subject who learned better in the picture-identification condition. The researchers claimed that manipulating the objects may have caused interference. At times the subject refused to manipulate. Therefore, it was assumed that her style of learning was based on visually presented stimuli.

The conclusion that Subject 4 could be taught only with visual stimuli seems incomplete, at best. The fact that she refused to manipulate some objects indicates that she may have had difficulty perceiving the stimuli offered through the tactile-kinesthetic modalities. This possibility should not make clinicians ignore this type of input, as suggested by the researcher. On the contrary, if children have difficulty perceiving stimuli through a particular modality, teaching situations should incorporate methods that make this input less complex and more perceptible. For example, instead of having the child manipulate the objects and listen to the clinician, steps could be taken to decrease the amount of stimulus presented (e.g., no auditory information, dimming the lights) so that the child can focus on limited input.

The idea that children have a preference for one type of stimulus mode over another is possible. Yet, consistent reliance on the preferred input modality for interaction seems to be a faulty strategy. For example, Subject 4 had been diagnosed as moderately to severely language impaired. It therefore was reasonable to assume that she did not have some of the prerequisite skills necessary for language learning. If she was able to receive enough information from the visual presentation of pictures to learn vocabulary items, then visual perception may not be the area of concern. But the fact that she refused to manipulate objects may be a sign that she was deficient in perceiving the tactile-kinesthetic information offered through object manipulation. Instead of disregarding object-manipulation tasks, the experience could be modified so that tactile-kinesthetic information is more accessible.

Information concerning how the target words were chosen and the procedures involved in collecting baseline information was presented in sufficient detail, but information regarding the structured teaching session was nonexistent. In addition, facts regarding the number of teaching sessions and the basic session descriptions were given (e.g., two sessions were used actually to teach the target words, leaving the third session to probe for spontaneous productions). Yet there was no mention of how the pictures were presented and how object-manipulation teaching was done. Moreover, results of reliability measures concerning clinicians' competencies in performing the structured teaching programs (e.g., 4-week training period) were reported, but no description of the teaching program was provided. Given that the two teaching paradigms were compared in the study, detailed information regarding the teaching procedures should have been clearly outlined.

The final comments about this study pertain to the heterogeneity of the language-impaired population. The researchers suggested that each child be treated as an individual and that therapy procedures recognize the varied learning styles of each client. This is reasonable advice. However, it may also be the case that certain prerequisite skills essential for language acquisition do depend more critically on one type of sensory input than another. Therefore, it appears premature to ignore a particular modality condition on the assumption that the child can learn better through another.

Although it is encouraging to find that Olswang et al. (1983) explored the differential effectiveness of object-manipulation and visual-presentation strategies, they failed to examine why object manipulation may be a more effective tool for word learning than visual observation. Despite the researchers' admission that documentation regarding these two therapeutic methods was lacking and that a method for highlighting the critical features of objects and events was needed, no attempt was made to go beyond an analysis of the children's outputs. The researchers could have focused more on the nature of the stimulus input. If one systematically varies the stimulus input (i.e., object manipulation, picture identification), then it is sensible to examine its components. For example, what is involved in picture identification? If results showed that input (e.g., object manipulation) produced significant differences in the number of words produced, then it would be crucial to understand what elements involved in the input may have caused the differences.

Research is needed to examine further the role that object manipulation or "action" plays in language acquisition. Investigations should focus on what is perceived by the child during object manipulation to make it an effective language-learning strategy. Object manipulation implicitly involves the tactile-kinesthetic sensory systems. However, in Olswang et al. (1983), the manipulation condition offered both tactile-kinesthetic and visual information. Therefore, it is not known whether the effectiveness of object manipulation as a teaching strategy is due to either visual or tactile-kinesthetic input.

Conclusion

The literature reviewed in this chapter pointed to the need for additional research regarding the role that various sensory inputs play in language acquisition. The studies, which show that language-impaired children may have perceptual-processing difficulties (Affolter & Stricker, 1980; Kamhi, 1981, 1984) and may lack certain motor coordination skills (Affolter et al., 1974), suggest a tactile-kinesthetic deficit. The limited research completed on verb learning and object manipulation imply that the child's interaction with the environment may be one of the most powerful sources of information for learning language. It follows that if language-impaired children have tactile-kinesthetic perceptual difficulties, then they may be unable to perceive the critical information needed for interactions to occur. Thus, additional research that focuses on different sensory inputs is essential if questions are to be answered about the role of tactile-kinesthetic input in object-manipulation tasks.

CHAPTER III

METHOD

The present investigator attempted to demonstrate the effectiveness of two teaching conditions in learning action verbs. The two teaching conditions were object manipulation, devoid of any visual input, and visual observation, devoid of any tactile-kinesthetic input. The methodology was developed from pilot testing six children (four females and two males) in the age range of 3:5 to 6:2 years.

Subject Selection and Screening Criteria

Twenty children were chosen for this study from the Child Development Laboratories at Michigan State University and the surrounding East Lansing residential community. The subjects included 10 males and 10 females who met the following selection criteria: (a) within the age range from 3:0 to 4:0 years, (b) normal language development, (c) middle-class social-economic status, and (d) native speakers of English. The subjects' gender, age distribution, and language age as measured by the Preschool Language Scale (PLS) (Zimmerman, 1973) are displayed in Table 1. The subjects' mean age was 3:6 years, and their mean language age was 4:3 years.

Table 1. Subject characteristics.

Subject	Gender	Age (Years:Months)	Language Age (PLS) (Years:Months)
1	M	3:2	3:3
2	M	3:0	3:4
3	M	4:2	4:10
4	M	4:0	4:9
5	F	3:7	4:11
6	M	3:7	5:3
7	M	3:8	4:6
8	F	3:8	4:0
9	F	3:5	3:8
10	F	3:6	4:0
11	M	3:0	4:0
12	M	3:7	4:11
13	M	3:3	4:0
14	F	3:7	4:5
15	M	3:10	5:0
16	F	3:6	5:0
17	F	3:6	5:1
18	M	3:7	5:3
19	F	3:7	4:4
20	F	3:8	4:0

Subjects at the preschool initially were screened by their preschool teachers, whereas neighborhood children were screened by at least one parent. The screener completed a standard form (see Appendix A). This form required yes/no answers to questions about physical growth, cognitive growth, visual acuity, hearing acuity, and social-emotional behavior.

The children who passed the initial screening were then given the Preschool Language Scale (PLS). This standardized test was designed to determine whether language skills were age appropriate. The auditory-comprehension section of the test examined the children's understanding of common vocabulary items, prepositions, and colors. The production section included items that could be used to assess children's expressive skills in terms of semantics, syntax, phoneme development, and memory of digits. The children were required to point to and/or label stimulus pictures, count blocks, recall colors, repeat numbers, and follow directions (e.g., "Give me just one block."). All subjects used in the study had age-appropriate performances.

These test outcomes were corroborated by the investigator's informal observations of the children's use of multiword utterances in a natural play environment. In addition, the investigator used two objects, a cotton ball and a wooden peg, to judge whether the subjects comprehended the words "rolling" and "squeezing," which coded the two actions targeted for study. During initial screening, subjects were given a cotton ball and were instructed to squeeze it. They then were given a wooden peg and asked to roll it. Only the children who were able to perform the action were chosen for the study.

Assignment of Subjects to Treatment Conditions

All 20 subjects were taught novel action words under two different teaching conditions: a visually observed condition and a manipulation condition. In the observational learning condition, the novel action word was paired with a visually represented action referent. In the manipulation condition, subjects were taught a novel action word while blindfolded. They were manually guided through the action that corresponded with the referent. Thus, in the observation condition, the children were deprived of tactile-kinesthetic sensory information about the word's referent, whereas in the manipulation condition, they were deprived of its visual information. The amount and type of auditory input remained the same across both conditions. Ten subjects were taught their first word in the observation condition and their second word in the manipulation condition. The order was reversed for the other 10 subjects. This counterbalanced order was achieved through random assignment. Each subject was exposed to a different word under the two different teaching conditions.

In each condition, the novel words taught were nonsense monosyllable words: "PIP" and "BUB." These words conformed to the phonotactic structure of English words but were completely unfamiliar to each subject. Thus, both PIP and BUB were taught in each modality condition, and each nonsense word was paired with each action (i.e., PIP-squeeze, PIP-roll, BUB-squeeze, BUB-roll). This created the possibility for the same-stimulus pairs within a teaching condition. Each of the four word-action pairs was represented at least four times within each teaching condition and was evenly distributed across conditions in counterbalanced order. In addition, each of the four word/action pairs was represented equally in terms of first and second words taught. In other words, each nonsense word/action pair received equal opportunity to be presented as the first and second word learned.

Each of the 20 subjects was randomly assigned to the counter-balanced stimulus conditions. Each subject learned two words, one in each teaching condition. For example, Subject 1, who was taught PIP (squeeze) in the manipulation condition, was the same person taught BUB (roll) in the observation condition. The stimulus conditions and subject assignment are displayed in Table 2. The success of the teaching trials was measured by multiple tasks, which included (a) Word Recall, (b) Action Re-enactment, and (c) Visual Recognition.

Table 2. Stimulus conditions.

Subject	First Word		Second Word	
	Manipulation	Observation	Manipulation	Observation
1	PIP(squeeze)	--	--	BUB(roll)
2	--	PIP(squeeze)	BUB(roll)	--
3	BUB(squeeze)	--	--	PIP(roll)
4	--	BUB(squeeze)	PIP(roll)	--
5	PIP(roll)	--	--	BUB(squeeze)
6	--	PIP(roll)	BUB(squeeze)	--
7	BUB(roll)	--	--	PIP(squeeze)
8	--	BUB(roll)	PIP(squeeze)	--
9	PIP(squeeze)	--	--	BUB(roll)
10	--	PIP(squeeze)	BUB(roll)	--
11	BUB(squeeze)	--	--	PIP(roll)
12	--	BUB(squeeze)	PIP(roll)	--
13	PIP(roll)	--	--	BUB(squeeze)
14	--	PIP(roll)	BUB(roll)	--
15	BUB(roll)	--	--	PIP(squeeze)
16	--	BUB(roll)	PIP(squeeze)	--
17	PIP(roll)	--	--	BUB(squeeze)
18	--	BUB(squeeze)	PIP(roll)	--
19	BUB(squeeze)	--	--	PIP(roll)
20	--	PIP(roll)	BUB(squeeze)	--

Teaching Procedures

Teaching trials were conducted in the Child Development Laboratories at Michigan State University. All teaching trials were conducted by the investigator as prescribed in Table 2. Each subject received teaching for one word in the first modality. After the teaching trial, the child was tested on the same day in that modality condition. Each subject received one teaching trial per treatment condition. The teaching trials for the first and second words learned were separated by one day. This was done to minimize the effect of learning the first word on learning the second word. The teaching and test time equaled approximately 20 minutes per word. Therefore, the total time each child spent as a subject in the experiment equaled no more than 45 minutes. To control practice effects, the words were taught according to the counterbalanced design shown in Table 2.

Description of Stimuli Used in Teaching Conditions

The same stimuli were used in both teaching conditions. The use of two nonsense words, PIP and BUB, aimed to rule out the chance of explaining the results in terms of a word rather than a treatment effect. These words were chosen because they have identical phonological shapes and were expected to be easy to say. Both are monosyllabic and contain stop consonants (/p/ and /b/) that should be developed at the 3-year age level.

The objects used to teach a word's referent remained the same across both teaching conditions. All materials were judged to be neutral with respect to olfactory and auditory information. During the teaching of PIP and BUB for the action of "roll," an apple was used with each subject. During the teaching of PIP and BUB for the action of "squeeze," a square sponge was used with each subject. These two actions, squeeze and roll, were chosen for the experiment because they could be done without special tools. For example, they are unlike the act of cutting, which requires the use of a tool (e.g., a knife).

Observational Teaching Condition

During the observational teaching condition, subjects were told that they were going to play a game that required listening to what the investigator said and watching what the investigator did. They were told further that the goal of the game was to learn a new word. Subjects were instructed not to touch anything on the table. While the subjects looked on, the investigator demonstrated the action of squeeze or roll associated with the verb being taught. The action was named at least 15 times during the teaching trial using the phrase, "I am (PIPPING or BUBBING)." The investigator labeled the word while the action was being performed. After labeling the novel word five times, the subject was asked to repeat the word once when given the instructions, "Can you say PIPPING/BUBBING?" This procedure ensured that the child was able to produce the nonsense word. Once the child had produced the word being taught, the investigator continued to perform the action and labeled it at least 10 more times. If the subject did not produce the nonsense word after the first five labels, the investigator continued to name the action.

Once the investigator finished, the child was asked to label the action a second time while the investigator performed it. The investigator said, "Now I want you to tell me what I am doing, using the new word." If the child did not produce the word, the investigator gave additional input to ensure that the child understood the action and could produce the word. The supplementary input was in the form of additional naming. The investigator attempted to label the nonsense words equally, which totaled 15 times for each subject. Extra input never exceeded 20 and was given only when judged necessary by the investigator. Once the child produced the nonsense word twice, he or she was escorted to the play area.

Object-Manipulation Teaching Condition

During the manipulation condition, the subject was blindfolded with a mask. With eyes covered, no visual information was received about the teaching materials or the action associated with the word learned. In reference to the game to be played, the subject was given the same instructions described in the observational teaching condition. The subjects were told not to be afraid when blindfolded and that the investigator would be behind them the entire time, guiding them through the actions of the game. During this teaching condition, the investigator was positioned behind the subject and guided him or her through the actions associated with the labeled word.

As with the observational condition, the investigator labeled the appropriate word at least 15 times, asking the subject to repeat the word once after the first five labels. Once the examiner labeled the word 15 times, the child was asked to produce the word associated with the action. If the child was able to produce the word, he or she was escorted from the teaching site, having received no visual information about the test materials or the action performed. If the subject was unable to produce the word, the investigator provided additional input as described in the observational teaching condition.

Description of the Test Tasks

The Child Development Laboratories were used for all testing. The test conditions, which included the types of test tasks, presentation order, time distribution, and scoring outcomes, were the same across all subjects in both teaching conditions. The testing was carried out by two testers who were naive to the goals of the study.

Recording the Data

To judge tester and score reliability, all testing trials were videotaped. A video camera was mounted over the test table, out of each subject's view. The camera could be mechanically rotated so that the entire test area was always in view. While the tester administered the test tasks, the investigator recorded the subjects' responses. All subject data were recorded on score forms designed by the investigator (see Appendix B).

Administration of Tests

Following each learning trial, a subject's retention of the new word was tested on three tasks in the following order: (a) Word Recall, (b) Action Re-enactment, and (c) Visual Recognition. The tasks were presented in this order for all subjects. The three tasks represented the different levels of performance that could result from learning. The stimuli used in each test condition were the same across all subjects, regardless of teaching condition.

The three test tasks were presented to each subject at two time intervals. The first trial was done 5 minutes after the teaching condition, to measure immediate learning effects. The second took place 5 minutes after the first testing was completed. Thus, 5-minute intervals separated the first and second test trials. If a subject was not able to perform correctly on any of the three test tasks, a second teaching trial took place. The second teaching trial followed the same procedures described for the first teaching trial.

The administration of test tasks, described below, was identical for both test trials. Between test trials, the subjects were engaged in controlled structured play activities that did not involve any of the stimuli from the teaching or test trials. The children were given toys and games from a large selection that included a sandbox with toys, dolls, kitchen set, toy animals, blocks, and dress-up clothes.

Word Recall

Word recall was the first test task administered. During this task, subjects were asked to produce the novel nonsense word just learned after the tester's instructions, "Please tell me the new word you have just learned." This task was expected to be the most difficult because the subject was given no information or cues about the word or its referent. Therefore, the subject was expected to retain information about the form of the word and possibly the experience associated with the word. No additional stimuli were used during this test condition.

Each subject was given at least two chances to produce the novel word. The child received two points for each production of the new word. Therefore, the maximum total score for the Word Recall test was four points. The subject also received credit if he or she produced a close phonetic representation (e.g., BIB for BUB). The child received no credit under the following conditions: (a) no word was produced, (b) subjects told the tester they did not remember, or (c) the conventional word associated with the action was produced. When the child was unable to recall the word, the tester reminded the child of the new word. Regardless of whether the child produced the word or not, each subject proceeded to the Action Re-enactment task.

Action Re-enactment

The Action Re-enactment test trial was presented second. This task determined whether the subject was able to perform the action associated with the novel nonsense word spoken by the tester. This task differed from the Word Recall task in that it involved comprehension of the nonsense word. The subject was not required to produce the word. Depending on the word being taught, the subject was told to PIP or BUB the two objects contained in a sack. The objects chosen were not the same as those used during the teaching trial, and they did not represent objects that were characteristic of the actions of roll or squeeze (e.g., a ball, sponge, or balloon). When testing the action of roll, a magic marker and a piece of play dough were used. For the action of squeeze, a pliable plastic container and an empty toilet paper roll were used.

To determine whether the child remembered the action associated with the word, the subject had to perform the action with the two objects. The child was instructed to reach into the sack and pull out one of the two objects. Once the object was revealed, the tester instructed the child to PIP/BUB the object. Whether or not the child performed the correct action on the first object, the tester instructed the child to pull out the second object in the sack. Once the child pulled out the second object, the tester again asked the child to PIP/BUB the object. The subject was credited with two points for each correct action performed. If the subject was able to perform the action on both objects, he or she received a total of four points. The subject also received credit if the action came within a close approximation as judged by the investigator. The subject received no credit under the following conditions: (a) when no action was attempted and (b) when the action was different from the target action. If subjects were unable to perform the action, they were praised for their efforts but were not given additional information about the target action.

For subjects who were exposed to the novel word in the observational teaching condition, the Action Re-enactment task represented a bimodal test condition because they would not have performed the action before, but merely watched the examiner do it. This task also represented a bimodal task for the manipulation group because, although they experienced the action previously, they received no visual input. Performance on this task was expected to show differential results for the two teaching conditions. That is, subjects in the manipulation teaching condition were expected to perform better on this task than subjects in the observation teaching condition because they had previously performed the action. Regardless of whether subjects were able to reproduce the action, they moved on to the third task, Visual Recognition.

Visual Recognition

Visual Recognition was the third test task administered. During this task, the child was required to look at three other people performing actions and point to the one that corresponded to the word learned. Two females (the investigator and one helper) and one male (the second tester) participated in this test task. Each person simultaneously performed a different action with identical yellow Nerf balls. The actions performed included (a) the target action (roll or squeeze), (b) hitting the ball, and (c) throwing the ball in the air. To prevent bias in the subject's attention, all of the stimuli were identical, and the tester instructed the subject to watch each person first, before pointing to who was PIPPING/BUBBING. The investigator never performed the correct action.

After the subject pointed to his or her choice, the tester told the child that they were going to play the game a second time. The subject was instructed to look again and point to who was PIPPING/BUBBING. During the second game, the helper, who during the first game performed the correct action on the Nerf ball, now produced a foil action (hitting the ball or throwing it in the air), whereas the second helper, who performed the foil item during the first game, now produced the correct action. Playing the game a second time helped determine the reliability of the subject's response by revealing whether the child was possibly biased toward a particular action or person. By creating a situation with three choices and two trials, the likelihood that the subjects would be correct due to chance was decreased.

If the subject pointed to the person who performed the appropriate action associated with the novel word, he or she received credit for making the correct response and was given a score of two points. Correct responses on both trials yielded a total of four points. If the subject did not choose the correct action, no credits were given.

This task differed from the two previous tasks in that it did not require word production or performing the action. This task required comprehension like the Action Re-enactment task, but it was considered less difficult because it involved visually recognizing the action associated with the nonsense word. This task focused on visual representation, and although it was hypothesized that the subjects taught in the manipulation condition would perform better than those in the observation condition, the difference in performance was not expected to be as great as found in the Action Re-enactment task.

For subjects in the observational teaching condition, this final test task required them to perform in the same modality in which the word was taught. Therefore, it represented a unimodal test task. The subjects who were exposed to the novel word in the manipulation condition never received visual representation; therefore, this task represented a bimodal test task.

Parent Instruction

After the teaching and test trials, the subjects' parents were not given specific instructions regarding practicing the words at home.

Reliability Judgments

From the video documentation, a random sample of 10 subjects was selected, and their responses to the test tasks were judged by three unbiased individuals. The individuals also judged the consistency of the testers' instructions by rating them as (a) highly consistent, (b) consistent, or (c) not consistent. After viewing an edited videotape of 10 children, the three judges scored each subject according to the instructions given by the investigator. The scores then were compared to the raw data. The judges' scoring of the 10 subjects matched the data collected by the investigator, for 100% reliability. The judges also were asked to assess the consistency of the testers' instructions. Two judges rated the testers as highly consistent, whereas one judge rated them as consistent.

Data Analysis

Each subject was able to receive a total of four points for each test task; therefore, the maximum score a subject could obtain equaled 12 points. Because the subjects of this experiment were matched in terms of age, social-economic status, and language development, it was possible to use statistical measurements for correlated groups. Before pooling the data for the between-treatment analysis, a Student's t-test for correlated groups was completed to determine within-group treatment differences. The between-group treatment effects were analyzed using a three-way analysis of variance (ANOVA) to determine whether any main effects existed for the variables of (a) modality condition (observation versus manipulation), (b) first or second word taught, and (c) test task. Additional t-tests and honestly significant difference (HSD) values were completed to scrutinize further the significance of the interactions that existed among the three variables.

CHAPTER IV

RESULTS

In this study, children were required to learn novel verbs for familiar actions under two conditions. In one condition the subjects received information about a word's referent by visually observing an action; in the other condition, they received information from manipulation of objects without vision. The investigator aimed to determine whether one input condition was superior to the other for teaching children to map nonsense verbs onto action forms.

The 20 subjects were taught one of the four possible word/action sequences (PIP[roll], PIP[squeeze], BUB[roll], BUB[squeeze]) in each teaching condition. Therefore, each subject learned two new words, one being taught in the observation condition and the other in the manipulation condition. Each sequence was represented at least four times within a teaching condition. Learning effects were measured by scores obtained on three test tasks: Word Recall, Action Re-enactment, and Visual Recognition. The mean scores obtained for each word/action sequence across tasks and Word 1 and Word 2 are displayed in Table 3.

Table 3. Word/action sequences collapsed over first and second words.

Word/Action	Observation Condition (Mean)	Manipulation Condition (Mean)
PIP(roll)	7.2	7.2
PIP(squeeze)	5.5	7.0
BUB(roll)	7.8	7.3
BUB(squeeze)	7.3	6.0

To determine whether any within-treatment task effects were due to a specific word/action pair, a one-way ANOVA was completed. The results from the ANOVA for the word/action sequences for the visual and manipulation conditions (see Tables 4 and 5, respectively) showed no significant differences within the teaching conditions among the four word/action sequences. In other words, one word/action sequence was not learned significantly better than another within a modality teaching condition. Therefore, in the remaining analyses, the data were collapsed across the word/action sequences.

Table 4. ANOVA results for word/action sequences within the observation condition.

Source of Variation	Sum of Squares	df	Mean Square	F	p
Between words	12.08	3	4.03	.67	.60
Within words	97.92	16	6.12		

Table 5. ANOVA results for word/action sequences within the manipulation condition.

Source of Variation	Sum of Squares	df	Mean Square	F	p
Between words	6.78	3	2.36	.27	.85
Within words	126.30	15	8.43		

Each subject was taught two words in each modality condition. In Tables 6 and 7, the mean and standard deviation for each test task are shown for the first and second word learned, respectively. For the raw scores, refer to Appendix C.

Table 6. Mean and standard deviation for test tasks for Word 1.

Task	Observation Teaching		Manipulation Teaching	
	Mean	SD	Mean	SD
Word Recall	.60	1.78	.80	1.32
Action Re-enactment	3.80	.63	3.60	1.27
Visual Recognition	2.40	1.84	3.80	.63

Table 7. Mean and standard deviation for test tasks for Word 2.

Task	Observation Teaching		Manipulation Teaching	
	Mean	SD	Mean	SD
Word Recall	.80	.79	.22	.44
Action Re-enactment	2.80	1.93	2.67	2.00
Visual Recognition	3.60	.97	2.44	1.88

Visual inspection of the data revealed a strong test-task effect in the same direction within each treatment condition (observation and manipulation). Regardless of first or second word taught, lower mean scores were found for the Word Recall test task than for the Action Re-enactment and Visual Recognition tasks. The means for the latter two tasks were similar within and across teaching treatment conditions. Closer examination revealed that the rank order of mean scores for the Action Re-enactment and Visual Recognition tasks varied with first and second word taught and teaching condition.

In Table 6, for the first word learned, subjects in the observational teaching condition scored slightly higher on the Action Re-enactment task than subjects in the manipulation teaching condition. However, for Visual Recognition, the manipulation condition was superior to the observation condition. As shown in Table 7, for the second word learned, the means for the observation condition were greater for both Action Re-enactment and Visual Recognition tasks. Thus, it seems that scores were influenced by (a) teaching condition, (b) test task, and (c) first or second word taught.

A Word x Teaching Condition x Task ANOVA was used to test the statistical significance of these trends using the first and second words taught, the two teaching conditions, and the three test tasks as main effects. The ANOVA summary can be seen in Table 8.

Table 8. Results from the three-way ANOVA.

Source of Variation	Sum of Squares	df	Mean Square	F	p
Main effects	172.67	4	43.17	24.72	.000
Word	4.59	1	14.59	2.63	.108
Teaching	.12	1	.12	.17	.797
Task	168.00	2	84.00	48.09	.000
2-way interaction	14.16	5	2.83	1.62	.161
Word x Teaching	8.65	1	8.65	4.95	.028
Word x Task	4.85	2	22.43	1.39	.254
Teaching x Task	.72	2	.35	.20	.817
3-way interaction	8.72	2	4.36	2.49	.087
Word x Teaching x Task	8.72	2	24.36	2.49	.087
Explained	195.54	11	17.77	10.18	.000
Residual	183.38	105	1.75		
Total	378.92	116	3.27		

Significant Main Effects

From the three sources of variation--teaching condition, first and second word taught, and test task--a significant main effect was hypothesized for test task and, more important, for teaching condition. No significant main effects were found for teaching condition or word order. As expected, a significant main effect was found for test task (Word Recall, Action Re-enactment, Visual Recognition). These results support the hypothesis that the three test tasks measured different types of performance. Each task required different information to be recalled.

A posthoc comparison of task means was done using the HSD value, as shown in Table 9. The results from this analysis demonstrated that the main effect found among test tasks was due to lower scores on the Word Recall tasks than on the Action Re-enactment or the Visual Recognition tasks. This result coincided with the expectation that Word Recall would be the most difficult test task. It was considered the most difficult task because no additional information was offered during this test task and subjects had to recall both the linguistic form (word) and its referent (action).

Table 9. Within-task analysis.

Task	Overall Mean	Mean Task Difference		
		T1	T2	T3
Word Recall (T1)	.61	--	2.62*	2.45
Action Re-enactment (T2)	3.22	--	--	.16
Visual Recognition (T3)	3.06	--	--	--

*Value significant beyond the HSD value of 1.54.

Significant Interaction Effects

The lack of a significant two-way or three-way interaction involving test tasks and first and second word indicated that the significant main task effect was independent of first or second word taught and of teaching condition. The two-way interaction of Word x Teaching Condition was the only significant effect at conventional levels (p < .05 level). Additional t-test comparisons of teaching conditions showed that the source of interaction between first and second word taught was found in the manipulation teaching condition (see Table 10). That is, subjects taught Word 1 in the manipulation condition had significantly higher mean scores than those who were taught Word 2 in the manipulation condition. No significant differences were found for subjects who learned Words 1 and 2 in the observation condition.

Table 10. Results from the t-test analysis.

Source of Variation	Mean	SD	df	t	p
Manipulation condition					
Word 1	8.00	1.25	10	2.69*	.023
Word 2	5.22	2.86			
Observation condition					
Word 1	6.80	2.10	17	-.28	.78
Word 2	7.10	2.69			

*Significant at p < .05.

Further scrutiny of the significant interaction of Word x Teaching Condition in the manipulation condition revealed that the significant variation found for teaching condition was not due to higher scores across all tasks. A task comparison across teaching conditions can be based on data displayed in Tables 11 and 12 for the first and second word learned, respectively. The analysis revealed that the manipulation teaching condition yielded significantly higher scores on the Visual Recognition task than did the observational teaching condition on the first word learned. That is, the manipulation teaching condition was superior to the observational teaching condition when the Visual Recognition task was used as the measure of performance.

Table 11. Task analysis across teaching condition for Word 1.

Variable	Mean	SD	df	t	p
Word Recall					
Observation	.60	.84	18	.41	.69
Manipulation	.80	1.34			
Action Re-enactment					
Observation	3.80	.63	18	.48	.66
Manipulation	3.60	1.27			
Visual Recognition					
Observation	2.40	1.84	18	2.28	.04*
Manipulation	3.80	.63			

*Significant at $p < .05$.

However, the significant treatment difference found on the Visual Recognition task for Word 1 was not observed for Word 2. Although the treatment differences approached significance for the Visual Recognition task for Word 2 ($p = .076$), it was in the opposite direction of that found in Word 1. Whereas the manipulation condition resulted in the best Visual Recognition scores for Word 1, the observation condition resulted in the best scores on this task for Word 2, although the difference was not significant.

The three-way interaction for Word x Teaching Condition x Task was not significant at conventional levels (t = .087).

Table 12. Task analysis across teaching condition for Word 2.

Variable	Mean	SD	df	t	p
Word Recall					
Observation	.80	.79	17	1.94	.07
Manipulation	.22	.44			
Action Re-enactment					
Observation	2.80	1.93	17	.15	.88
Manipulation	2.70	2.00			
Visual Recognition					
Observation	3.60	.96	17	1.98	.06
Manipulation	2.33	1.73			

Summary of Results

The results from this study did not demonstrate an overall difference between the two teaching conditions (i.e., observation versus manipulation). However, it was found that manipulation was superior to observation for certain conditions, namely, visual recognition, when unconfounded by first and second word taught. Regardless of teaching condition, lower scores were observed on Word Recall than on Action Re-enactment or Visual Recognition.

Although there were no overall main effects between teaching treatments, there was a significant Word x Teaching Condition interaction. When analyzing the first and second words separately, it was found that subjects in the manipulation condition had higher Visual Recognition scores than did subjects in the observation condition during the first word learned. However, this finding was tempered by the fact that the outcome was not repeated for the second word learned. The source of variation for word learned was due to higher mean scores on the first word learned in the manipulation condition than the second word learned in the same condition.

CHAPTER V

DISCUSSION

Revealing differences between treatment outcomes can be clinically useful if one treatment turns out to be more effective than another. This experiment concerned children's ability to map novel words onto familiar actions under two different teaching conditions. It was hypothesized that the children exposed to a new action word in the manipulation condition would receive more effective input, which in turn would allow them to map the new word onto the action referent better than the children who received visual input in the visual observation condition.

The analysis revealed no significant overall differences between the observation and manipulation teaching conditions. Thus, the results indicate that one treatment was not superior to the other. This finding should lead to the conclusion that visual input was just as effective as tactile-kinesthetic input for teaching a new action word. Yet, upon closer examination of the individual test tasks, it appears that important treatment differences are masked by combining scores on all test tasks. The differences found between the teaching conditions were highly task dependent when taking into account (a) first and second word taught and (b) the type of test task. During the teaching of Word 1, the manipulation condition was shown to be superior to the observation condition on the Visual Recognition task. This performance difference was not expected, considering that success on this task was judged to rely primarily on the processing of visual information. Although it was hypothesized that subjects in the manipulation condition would perform better than those in the observation condition on all tasks, the Visual Recognition task was expected to yield few, if any, differences between teaching conditions. Given that performance varied greatly among the tasks, the outcomes for each task are discussed separately.

Word Recall

The Word Recall task required the subjects to say the novel word to which they had been exposed when asked what new word had been learned. This task was expected to be the most difficult because word production normally develops after comprehension and no additional information about the word was given during this task. Regardless of the first or second word learned or the teaching condition, this first test task was always significantly more difficult than tasks 2 and 3. The significant task main effect was due solely to the difficulty the subjects experienced on the Word Recall task relative to the other two tasks.

It is important to speculate about why the scores on the Word Recall task were the lowest for every subject because fast mapping studies have shown that children require only one labeling of a word before it is mapped to a particular object or action. In the present study, all of the children heard the label at least 15 times and were required to repeat the word twice in a teaching trial. As well, the intervals between testing were set at 5 minutes and 10 minutes, respectively, to encourage short-term-memory recall. None of these factors appeared to help the subjects recall the novel word.

One explanation for the poor word recall is that the children were unable to map a new word onto a referential distinction for which there was an existing word. The subjects in this study already had knowledge of the conventional verb forms for the two actions focused on. The remapping of a nonsense word onto an already existing action may have caused more confusion than expected. The subjects first had to accept the idea that the action of squeeze was no longer called "squeeze" and that the action of roll was no longer called "roll." There is evidence that children resist assigning more than one word to the same referent (Clark, 1987). However, if this were indeed the reason for the difficulty experienced by the subjects, they ought to have produced the conventional word during the Word Recall task. Yet none of the subjects produced the already learned conventional word during this task, although it was known from baseline data that the subjects knew the conventional words.

A second reason for the poor performance on this task may be related to the novelty of the situation and environment. When exposed to new people and a novel game, the children's apprehension may have decreased their willingness to concentrate or cooperate.

It is reasonable to expect that such young (3 to 4 years) children may not be able to perform to the best of their abilities under such circumstances. Indeed, in some situations, the subjects produced the word only after encouragement from their mothers.

Still other factors may explain the low score on the Word Recall task for the second word learned. Long-term-memory interference seems relevant since some subjects recalled the first word learned when tested for recall of the second word learned. The likelihood of interference is discussed in more detail later. Overall, the performance on Word Recall was not surprising. From the outset, performance on this task was expected to yield the lowest performance of the three tasks, as discussed above (page 69).

Action Re-enactment

The second test task, Action Re-enactment, differed from the first task on many levels. First, the requirement for success on this task was not based on producing the novel word. It focused on performing the action that had been associated with the novel word. Second, the input received about the action during the teaching trial differed across treatment conditions. For subjects exposed to the new word in the observational teaching condition, the input was primarily visual; the subject was unable to experience the action directly through manipulation. Action Re-enactment represented a cross-modal test condition. For subjects exposed to the new word in the manipulation condition, the input was primarily tactile-kinesthetic; the subject was not able to form a visual representation of the action. The Action Re-enactment test condition involved the same kind of input experienced during the teaching. Therefore, it was hypothesized that this difference in sensory input would lead to marked differences between teaching conditions. Specifically, subjects who received teaching input through the tactile-kinesthetic modalities were expected to re-enact the actions better than subjects who received primarily visual information. This expectation was based on past research concerning self-action versus observed action. This research led to the belief that critical features of the action to be learned can be discerned when a person is able to self-act and thereby experience the movement goal and the resultant change that may take place in the environment. On the other hand, as a visual observer, the child can witness the temporary change in the movement, but this may be confined to a spatio-temporal relationship. Only the initiator can feel the power of causing change, and studies have demonstrated that children will speak first about their own actions before they speak about those produced by others (Huttenlocher et al., 1983).

Contrary to the above-mentioned study, the performances demonstrated in the present study appeared to show that the effect of receiving visual or tactile-kinesthetic information was equal. The subjects in both conditions were able to reproduce the actions equally well, as measured by the Action Re-enactment test task. The results were the same for both Word 1 and Word 2.

Successful performance on the Action Re-enactment task may have been due primarily to the fact that the actions were not novel to any subject, based on baseline data. Although the subjects had to perform an action that was mapped to a new nonsense word, the actions of roll and squeeze conceivably were already such strong and familiar mental representations for the subjects that they had no difficulty producing these actions regardless of input. Therefore, what can be concluded from the data is that for actions already established, both types of sensory input, vision and tactile-kinesthesis, are equally effective for reproducing an action in response to a new lexical label.

It is unfortunate that a novel action was not used in the present study. In most clinical situations, the concern is not with remapping. More commonly, clinicians teach children who do not map conventional words onto common actions and who, in some cases, cannot even perform the actions. For impaired children, the actions appear to be unfamiliar. The results of this study do not show whether the visual and tactile-kinesthetic modalities would be equally effective inputs for teaching unfamiliar or novel actions.

Visual Recognition

The results of the Visual Recognition task analysis were the most surprising. Originally, it was hypothesized that the subjects receiving visual input during the observational teaching trials would be able to formulate a clear visual representation of the action being performed and therefore would not experience any difficulty performing this test task. In fact, the differences between the manipulation condition and the observational condition on this task were expected to be small, if significant at all.

But, contrary to expectation, the difference between the two groups' performances was the largest on the Visual Recognition task. Moreover, this was the only task on which subjects in the manipulation group performed statistically better than did subjects in the observation group. In addition to quantitative performance differences, there also were qualitative differences. Nine of the 10 subjects in the manipulation condition showed no hesitation in recognizing the action form associated with the novel word learned. This was compared to only 5 of the 10 subjects from the observation group who did not hesitate in recognizing the actions. The superior performance on a visual task in the manipulation condition forces one to question why the observation group experienced so much difficulty on a task that, in principle, should have been easy. Two interpretations are considered.

First, it is instructive to consider what the subjects in the observation group may actually have perceived during the teaching trial. Although the intention of the teaching was to focus the subjects' attention on the action performed, no one can be sure about what visual information the child attended. A vast array of stimuli could have been attended to in the teaching event at any one moment. For example, the subjects may have focused on the investigator's body position or on some part of the object being acted upon. One can assume that even though the actions of squeeze and roll were familiar, the stimuli and the investigator were not. In fact, the child's attention may have been directed to the novel features of the situation and not the familiar action schemes.

Even if subjects focused on the intended action, what could have been experienced? It is possible that they formed a visual gestalt of the activity. A gestalt is used here to refer to an integrated structure that contains the total experience. It has specific properties that can neither be derived from the elements of the whole nor considered as simply the sum of these elements (Webster's New Twentieth Century Dictionary, 1983). In other words, the representation cannot be separated into smaller parts. The gestalt is viewed as a frozen or still pictorial mental representation, which is similar to what a camera captures.

If the subjects in the observation group formed some kind of static visual gestalt of the teaching situation, then the Visual Recognition task would have been difficult. Indeed, vast inconsistencies would have existed between their visual representations formed from the teaching trial and the three visual choices during the Visual Recognition task. For example, the investigator was never the person performing the correct action during the Visual Recognition task, but she did perform the action in the teaching trial. Second, three actions were being performed, whereas a single action took place during the teaching trial. As well, the stimuli chosen for the test trial differed from those used during teaching. All of these factors may have combined to create a very different picture from that visualized during the teaching trial. This may have created a large inconsistency for those who were taught in the observation condition because they had access to all of this information, whereas subjects in the manipulation condition did not. In fact, one subject who was in the observational teaching condition looked upset during this test task. Later, the child's mother reported that her daughter was confused during the Visual Recognition task because she had expected the investigator always to be performing the action. When this did not match up with her concept of the action, she became upset with the investigator. The tendency for confusion on this task appeared to be present for some subjects in the observation condition.

Of course, the same incongruities existed for the manipulation condition: different stimuli, different people, simultaneous events. Yet the subjects who received the tactile-kinesthetic input during the object manipulation experienced no difficulties with these changes. It is possible that subjects who were allowed to manipulate the objects were able to focus directly on the referent action associated with the word, and thereby gain a more flexible and less rigid representation of its meaning. Having a less rigid representation could have allowed the subjects to more readily tolerate the incongruities between teaching and testing conditions.

It is reasonable to assume that, during language learning, a flexible, nonrigid representation is almost essential for word learning. An event experienced on one occasion is likely to be altered in some way when it is experienced again (e.g., the location or the persons associated with it). Children learning word meanings must come to understand which factors of the event are critical to the word meaning. When considering action verb learning, one must become familiar with the primary elements of the action and not the objects or people associated with it. When trying to figure out the meaning of a new verb, children may well use their prior knowledge of action events to sift out the irrelevant observations for meaning. Prior action experiences could turn out to be as relevant to reducing the number of alternative semantic interpretations of words, as is the linguistic information that Gleitman (1990) argued is important. 1990).

The interpretation of the data in terms of "flexible representation" was clearly supported by the evidence for the first word learned. Had the same results been obtained for the teaching of the second word, there would be even stronger support for the importance of tactile-kinesthetic input, and thus teaching through manipulation. Yet the data for the second word learned did not coincide with those for the first word learned. This inconsistency led the investigator to question whether the flexible-representation hypothesis represents a complete explanation.

For the second word learned, there was no significant treatment difference. Moreover, there was even a tendency for the subjects in the observational teaching condition to score higher that those in the manipulation teaching condition on the Visual Recognition task, although differences were not significant. In other words, the first and second word learned yielded opposite effects. Therefore, the attempt to explain the superior performance of the subjects in the manipulation condition for the first word learned cannot be applied to the second word learned. Alternative interpretations of the second word performance are discussed below.

The Second Word Learned: Data Tendencies

Differences in learning were found not only within and between teaching treatments, but also between the first and second word taught. For the manipulation condition, none of the tendencies for the first word learned was repeated for the second word learned except for the subjects' continuing difficulty with the Word Recall task. However, mean scores were lower on the second than the first word learned for all three tasks. Thus, some of the depressed scores on the Word Recall task for the second word learned were not due to task difficulty but were a direct result of the subjects recalling the first word learned instead of the second. It was interesting to witness subjects recalling the first word they had learned, which had been taught to them on the previous day, rather than the word they had just heard. Some had not even said the first word during the testing on the previous day. In other words, they were not able to recall the first word during the first word testing, but they were able to recall it during the testing of the second word.

The fact that performances on the Action Re-enactment task also dropped for both observation and manipulation teaching conditions during the second word learned strengthens the interference explanation. Some subjects in both teaching conditions not only produced the first word learned during the second word testing, but they also performed the action associated with the first word they had learned. This was the case even though steps were taken to lessen the interference of the first word learned by having one day in between teaching trials. Apparently, the strength of the long-term memory for the first word learned was underestimated.

Another possible explanation for the drop in performance on the manipulation task for the second word learned is that the subjects in this group may have been poorer learners than those who were exposed to manipulation for the first word learned. Note that the group of subjects who learned the first word so well in the manipulation condition first were the same subjects who had the higher scores on the second word learned for the visual task. Conversely, the lower scores for the two treatment conditions were observed for the same subjects. However, it is unlikely that group learner differences were related to gender, age, socioeconomic status, or language skill level because these factors were randomly distributed across treatment groups.

Overall, then, the lack of consistent results for the first and second word learned limited the strength of the outcomes that favored object manipulation as a teaching strategy. The one definite conclusion reached in this study was that the input received from each teaching condition offered the subjects some level of information that allowed them to perform on each test task.

Statistically, there were no overall differences between the teaching treatments. The implication is that learning can occur as effectively with manipulation teaching as it can with teaching through visual observation. However, one cannot ignore the possibility that under some conditions, teaching by manipulation can yield better performance than teaching by visual observation. In this study, manipulation teaching resulted in the best performance on the visual recognition task for the first word learned. Moreover, the few studies that have examined manipulation have shown that it holds the child's interest in addition to focusing attention on the critical features of learning. Sometimes, discovering that two treatments are equally effective can be as useful as discovering that one is more effective than the other, particularly when dealing with clinical situations. The results from this study imply that clinicians have more choice; the results ought to at least open some clinicians' minds to the benefits of tactile-kinesthetic input.

Clinical Implications

Knowledge concerning the role of sensory systems in language acquisition can have significant practical implications for clinical intervention. Affolter and Stricker (1980) discussed the role of the therapist as a teacher, the role of the child as a learner, and the importance of the interaction with the environment. Clinicians need to come to a better understanding of what elements are operating during the interaction and what factors will make the interaction the most effective for language learning to take place.

More needs to be known about the contribution of the different sensory systems to this interaction process.

Intuitively, though, the therapeutic emphasis in language learning on visual input through observation and picture presentation has limited appeal. Although the visual information received during visual observation of an action is probably less static than that received from looking at a picture, neither type of visual input allows one to experience directly the cause-and-effect relationships among objects and actions. The increased use of computers as clinical tools does not enhance the input either, because this technology relies on the visual system as the primary input source as well. If research continues to show that manipulation has beneficial effects on word-meaning acquisition, clinical techniques will need to focus more on allowing children to take an active role in language learning.

An example of using the tactile-kinesthetic systems in therapy is emphasized in guided-movement therapy (Affolter & Stricker, 1980). See Stockman (1986) for an overview of this treatment approach with respect to clinical practices in the United States. This approach requires the clinician to take the hands of the patient and manually guide him or her to experience the actual cause-effect events. Using such an approach, one can be sure that some modality-specific tactile-kinesthetic information about cause-effect relationships among the objects of the environment and the patient's own body is received (Affolter & Stricker, 1980). During the exploration, it is important not to provide verbal stimulation.

The client must be allowed to concentrate solely on the exploration. The use of guided movement is one example of how the search for more effective therapeutic approaches continues and how researchers have begun to examine the role of tactile-kinesthetic input in clinical intervention.

In the field of speech-language pathology, one responsibility is to create a therapeutic environment that will be effective for teaching language to those who are not able to learn by conventional means. The researcher's role is to conduct valid and reliable studies so that intervention with such individuals can continually be upgraded. By challenging existing therapies and testing new procedures, researchers allow the profession to grow and be positively affected by new theories and advancing technologies.

The present investigator's main goal was not to discredit the effectiveness of visual input for language learning. Instead, the aim was to emphasize the idea that other modalities, specifically the tactile-kinesthetic ones, can contribute to language learning, particularly action-word learning. Studies conducted on deaf and blind populations overwhelmingly have demonstrated that vision and audition are not the most critical inputs for language learning to occur (Affolter & Bischofberger, 1982; Bellugi et al., 1989; Furth, 1966; Gleitman, 1990). Such observations alone should convince people that other sensory inputs are involved in successful language learning. In addition to the studies on language acquisition and sensory deprivation, we also know that some individuals, who are included in the heterogeneous population of language impairment, can see, hear, taste, and smell, but still are unable to master language. Furthermore, it appears that children first speak about actions they are able to perform before they speak about the actions of others (Huttenlocher et al., 1983), and some language-impaired children even show signs of receiving abnormal tactile-kinesthetic input (Affolter & Stricker, 1980; Affolter et al., 1974).

Yet despite such observations, a research focus on tactile-kinesthetic processes and learning remains sparse and clinically unaffected. The majority of clinicians still rely on visual representations for teaching action words. The vast array of picture cards, demonstrations performed by clinicians, and now videotapes, to name a few, are all stressed during therapeutic intervention. The results from this study, although not demonstrating the unquestionable superiority of manipulation teaching, definitely did not present this teaching condition as being inferior to the observational teaching condition. The fact that the subjects in the manipulation teaching condition were blindfolded, received no visual information, and yet performed as well as or in some cases better than the subjects in the observation condition should create at least a curiosity about this teaching method and the tactile-kinesthetic modality.

Future Research

The need for continued research in the area of tactile-kinesthesis and language acquisition is crucial. Countless individuals may not be receiving adequate intervention. Researchers must strive to discover more effective methods for teaching language. The present research, although completed as a pilot study, should be considered a small stepping stone that will lead to future research on the role that manipulation and tactile-kinesthetic input can play in language teaching.

To appreciate the importance of the tactile-kinesthetic modalities, it now seems apparent that, in subsequent studies, one should use actions that are not lexicalized in the language--that is, actions that do not have conventional words already attached to them. In doing this, it will not only demonstrate whether manipulation is more effective for learning, it also will come closer to representing the true clinical situation. Future researchers also should consider incorporating an evaluation of long-term memory. It may be that differences between manipulation and observation teaching strategies will show up in long-term retention of information. In addition to immediate testing, as was done in this study, subjects could be retested at least 1 month after initial teaching.

Clinical intervention generally relies on visual observation. When object manipulation is incorporated into clinical practices, it also includes input from visual observation as well as manipulation. Therefore, future research should include a third treatment group that receives both inputs at the same time. It is hypothesized that, when teaching novel action words, the manipulation condition will offer more effective input than the observation condition; and the combined condition of observation and manipulation will offer more effective input than either of the other two treatments. Again, the inclusion of a third treatment condition would more closely represent the real clinical situation.

In terms of testing, it may be beneficial to include a fourth test condition. This test condition would be patterned after the Visual Recognition test task, but it would involve action recognition while blindfolded. Creating this fourth test task would allow subjects to recognize the target action without visual information. Because subjects in the manipulation condition were instructed without visual input and had to perform on a task involving visual recognition, the fourth task would allow subjects taught in the observation condition to recognize the action without vision. Therefore, the primary goal of incorporating a fourth test task would be to better equate test conditions across teaching conditions.

The issue of using the same subjects for the different teaching conditions already has been discussed. Future researchers should try to create four groups of different subjects so that word-learning interference does not distort data interpretation.

The present study used children who did not experience difficulty with language acquisition; therefore, the results can be generalized only to children who acquire language normally. However, learning via the tactile-kinesthetic modalities also pertains to the language-impaired population. Affolter (1991) hypothesized that these sensory systems are used by all individuals and that the tactile-kinesthetic system is at the root of higher-order behavioral functioning, which incorporates language acquisition. If so, then individuals may experience difficulty with language learning because they receive abnormal tactile-kinesthetic input. In such cases, clinical intervention, which stresses visual input, may not be as effective as intervention that highlights tactile-kinesthetic input.

Therefore, research on the tactile-kinesthetic functions of the language-impaired population should be encouraged. One focus could be on delineating the object-manipulation characteristics of the impaired groups. Although the problems of trying to create a homogeneous subject population for research purposes from an extremely heterogeneous clinical group are recognized, such research is essential to understanding more fully the role of differential sensory input for language learning.

Obviously, more research is needed in order to understand the tactile-kinesthetic modalities and their relationship to cognitive and language learning. Even if researchers set out to show that some of the hypotheses put forth by this investigator and others are misguided, at least this kind of research focus would continue the process of discovery, which is so vital to any science.

APPENDICES

APPENDIX A

EXAMPLE OF SCREENING FORM

QUESTIONNAIRE

Instructions:

You are asked to provide information on the following categories on each child in your classroom. Please place a check (✓) in the appropriate space indicating your judgement in that category. If you are uncertain about how to judge a category, place a question mark (?) in the space instead of a check. Please identify each child by initials only. You may be assured that all information provided by you will be kept confidential. Thank you for your cooperation.

Teacher: ______________

Name of School: ______________

DATE: ______________

PUPIL IDENTITY	Age (in months)			[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]		[illegible]	
		M	F	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES	NO

APPENDIX B

EXAMPLE OF DATA-COLLECTION FORM

NAME	AGE	DATE	WORD	ACTION	COND	WORD PROD.	ACTION	RECOGNITION	SECOND TEACHING	WORD PROD.	ACTION	RECOGNITION

APPENDIX C

RAW DATA FOR WORD 1 AND WORD 2

Table 13. Raw data for Word 1.

Observation Teaching				Manipulation Teaching			
Subject	Task 1	Task 2	Task 3	Subject	Task 1	Task 1	Task 3
1	0	4	0	11	0	4	4
2	0	4	0	12	0	4	4
3	0	4	4	13	1	4	4
4	0	4	0	14	0	4	4
5	2	4	2	15	4	4	4
6	0	2	4	16	0	4	4
7	1	4	4	17	0	4	2
8	1	4	4	18	0	4	4
9	2	4	2	19	1	4	4
10	0	4	4	20	2	0	4
Mean	.60	3.80	2.40		.80	3.60	3.80
SD	1.78	.63	1.84		1.32	1.27	.63

Table 14. Raw data for Word 2.

Observation Teaching				Manipulation Teaching			
Subject	Task 1	Task 2	Task 3	Subject	Task 1	Task 1	Task 3
1	0	0	4	11	0	0	2
2	0	4	4	12	0	0	0
3	2	4	3	13	0	4	4
4	0	0	4	14	0	4	1
5	2	4	4	15	1	4	2
6	1	4	4	16	0	4	4
7	1	0	1	17	1	0	4
8	0	4	4	18	0	4	4
9	1	4	4	19	0	4	0
10	1	4	4	10	-	-	-
Mean	.80	2.80	3.60		.22	2.67	2.44
SD	.79	1.93	.97		.44	2.0	1.88

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