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AMONG CHILDREN DIAGNOSED WITH
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By

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ABSTRACT

LEARNING AS A FUNCTION OF EVENT PARTICIPATION AMONG CHILDREN DIAGNOSED WITH AUTISM SPECTRUM DISORDER

By

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Little empirical treatment outcome research exists for children diagnosed with Autism Spectrum Disorder (ASD). There is a critical need to understand the nature of learning in children diagnosed with ASD so effective treatments can be designed and implemented. This study demonstrated the differential effects of two intervention conditions on verbal and nonverbal learning within the context of a novel event structure. The two treatment conditions were labeled as the observation and the participation conditions. Thirty-four children, diagnosed with ASD, were matched and randomly assigned to one of two teaching conditions. The seventeen children assigned to the observation condition received visual and auditory input while observing a juice-making task. The seventeen children in the participation condition received visual, auditory, and tactual-kinesthetic input while they participated in making orange juice. Six measurements were used to evaluate participant learning. Four of them evaluated verbal learning and two evaluated nonverbal learning. The verbal measures, obtained at four different points in time, were comprised of three types of questions: (1) confrontational naming, (2) recognition, and (3) WH-questions. Two nonverbal measures, a nonverbal score and a nonverbal rating, were obtained at two points in time.

Significant differences found between the two treatment conditions were

observed on both the verbal and nonverbal measures. Analyses revealed that the participation group scores were significantly higher than the scores of the observation group on all four composite verbal measures across time. An item analysis revealed further that the participation group scored significantly higher than the observation group on every question type. Additionally, on both the nonverbal score and rating measures, significant differences were demonstrated, favoring the participation group.

It is concluded that the type of sensory input impacts both verbal and nonverbal learning for children with ASD. The findings suggest that one cannot dismiss the relevance of manually guided experiences for the child with ASD. These outcomes are promising for continuing to explore the possible learning gains that can result when children with ASD bodily participate in learning events.

To those who gave my journey a beginning:

My Parents, Blaine and Louise Olney

To those who gave my journey meaning:

Jay, Wilkin, and Hattie

And to those who have given my journey into autism a purpose:

All the Families of Children with Autism with Whom I have Worked

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CHAPTER 1

REVIEW OF THE LITERATURE AND STATEMENT OF THE PROBLEM FOR STUDY

Autism Spectrum Disorder (ASD) has captivated the attention of the world. The attention stems partly from human curiosity about something that does not appear to make sense with what is known about typical development and even some forms of atypical development. There is curiosity about individuals who are typical in physical appearance, yet impaired in global human functioning. Individuals with ASD move, see and hear; yet, ASD as a pervasive disorder affects every aspect of adaptive behavior.

Individuals with ASD do not present with symptoms that are consistent with what is known about atypical development in other clinical populations. In contrast to learning disability (LD) and specific language impairment (SLI), ASD is pervasive, affecting development globally, not just spoken language like SLI or written language like LD. Unlike other pervasive disorders, such as Down syndrome, individuals with ASD also have uneven skill profiles. That is, they are not simply delayed in development but may be skilled in areas which typically develop late for normal children and delayed in areas which typically develop early for normal children. Individuals with ASD are simply a puzzle, attracting the attention of society as a whole, and the scientific research community in particular.

Bruno Bettleheim (1967) and Leo Kanner (1943) emphasized the role of the social environment in the development of autism. However, research has provided beneficial descriptions of the disorder that recognize it as not simply due to social environment. Better diagnostic methods for early identification of the disorder have been provided by the research community. Symptoms appear before 36 months of age, thus rendering ASD a neurodevelopmental disability. Although there now are methods for identifying ASD and doing so at an early age, comparatively less is known about how to intervene to modify the developmental trajectory.

Interventions tend to be symptom driven, i.e., the tendency is to isolate a skill to be taught, and then use conventional teaching strategies to achieve behavioral change. Practitioners[1] work to modify behaviors without hypotheses about how learning may differ in this population. The most popular interventions rely mainly on auditory and visual perceptual input. Evidently, these conventional methods have not been effective enough, otherwise families and practitioners would not seek out new interventions. But there are little empirical data about effective interventions for children

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[1]The term, practitioners (after Stockman, 2004), refers in this dissertation to the range of professional service providers involved in the intervention for persons with ASD. They commonly include the speech-language, occupational and physical therapists, teachers, and psychologists.

with ASD. Dawson and Osterling (1997) reviewed "model" intervention programs and concluded that these programs were effective for no more than half of the children enrolled. Wetherby and Prizant (2000) charged the research community "to better understand which specific intervention methods work best to accomplish which goals for which children" (p.3). Given the severity of the disorder, it is critical to know how to intervene. Individuals with ASD do not respond to the usual sensory modalities for learning. For this reason, the modality to use during intervention becomes particularly important.

The present investigation was concerned with intervention efficacy, particularly the efficacy of using unconventional treatments that cater to somatosensory input in efforts to modify behavior. This chapter will provide more background information about ASD. It will focus specifically on what ASD is **and** why it should be investigated, in addition to identifying the unconventional approaches to intervention, which motivated the current study.

Characteristics of the Population

Issues in Defining the Population

Home caregivers, practitioners, and the general public can be confused about who is autistic. This confusion results partly from the changing definition of autism across time. Even today, when there is so much public awareness of the disorder, various professional organizations use different definitions. For example, medical and educational professionals use different definitions to identify individuals with autism. See Appendix A for the educational definition of ASD and the *Diagnostic and Statistical Manual of Mental Disorders (4th edition,*

1994) (*DSM-IV*) for diagnostic criteria. Refer to the *International Classification of Diseases* by the World Health Organization (1990) and to Simpson and Myles (1998) for a discussion of definitions. Despite the differences in definition, three core features have been used consistently across professional boundaries to describe the autism population: (1) impaired social interaction, (2) impaired verbal and nonverbal communication, and (3) restricted, repetitive behaviors (American Psychiatric Association, 1994).

The meaning of the term, ASD, also can be elusive because of the different ways in which it has been used. It has been used to describe the individual variability among people diagnosed with autism. ASD can vary from the minimal requisite symptoms to many other symptoms. Alternatively, ASD has been used to describe the level of functioning, which can vary from low to high levels of functioning. The term also has been used to refer to the continuum or spectrum of symptomatology observed across various clinical subgroups that encompass the pervasive developmental disorders (PDDs). The Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV) identifies five disorders that fall under the broad rubric of PDD or ASD: Autism, Asperger Syndrome, Rett Syndrome, Pervasive Developmental Disorder- Not Otherwise Specified (PDD-NOS), and Childhood Disintegrative Disorder. The term, ASD, was used synonymously with the term PDD in the present research. Consequently, ASD is viewed here as a spectrum disorder based on the similarity of symptomatology across individuals, specifically the three core features as identified above. The commonality of the five categories of PDD disorders is that the deficits are pervasive. That is, ASD is manifested as multiple deficits across systems and skills, which affect the individual's adaptive function globally, and limit participation in many aspects of life. These individuals demonstrate deficits in both nonverbal and verbal functioning.

Symptoms

The symptomatology frequently associated with ASD includes unusual sensory responses, abnormalities in posture and motor behaviors, and abnormalities in the development of cognitive skills (Mesibov, 1991). Although these behaviors are not necessary for a diagnosis of ASD, they are important features to consider in treatment because they are commonly, although not universally, manifested.

Learning Ability

Individuals with ASD may have the ability to learn, i.e., they are not always intellectually disabled. Kanner's early descriptions of autism stated that these children were "cognitively well endowed" (Kanner, 1943). However, traditional IQ tests emphasize verbal ability as an index of intellectual ability, thus putting individuals diagnosed with ASD at a disadvantage. The view that individuals with autism are intellectually disabled is challenged by the research. Biklen (1990) demonstrated literacy skills with assisted-written communication, claiming that the behavior peculiarities are motor rather than cognitive impairments.

Uneven profiles of skills and deficits in this population are well documented (Frith & Baron-Cohen, 1987; Prior, 1979; Schuler, 1995; Affolter & Bischofberger, 2000). For example, a child with ASD can have exceptional abilities to see spatial relationships or comprehend numerical concepts but be unable to use these strengths in everyday tasks. Descriptions of skills of children with ASD include: excellent rote memory for both auditory and visual information as well as strengths in tasks demanding visual-spatial judgment and pattern recognition. For example, some children with ASD are proficient with recognition and production of melodic patterns; construction of visual-spatial arrays from samples (block construction), and completion of puzzles (Frith & Baron-Cohen, 1987; Affolter & Bischofberger, 2000). Children with ASD present with uneven profiles when comparing the outcomes of standardized tests and natural observations. Children with ASD demonstrate greater cognitive competence during everyday activities than during cognitive tasks (DeLoache, 1980; Donaldson, 1978; Gelman, 1978; Nelson, 1977). Clearly, this is a challenge for practitioners, who use decontextualized tasks for instruction. These children can learn. But how do caregivers and practitioners tap a child's learning ability and knowledge?

Sensorimotor Symptoms

Sensory disturbances in this population are well documented (Ornitz, 1989; Yeung-Courchesne & Courchesne, 1997; Baranek, 1999; Kientz & Dunn, 1997). In fact, O'Neill and Jones (1997) suggested that unusual sensory responses may be present in most children with ASD. The range of sensory disturbance includes: tactile, auditory, visual, olfactory, and gustatory hypersensitivities and hyposensitivities. Issues with tactile defensiveness, or hypersensitivity to touch, are often cited in the literature. For example, individuals may display sensitivity to tags in clothing, walking barefoot on grass, or touching certain consistencies, such as shaving cream or finger paint. The tactile defensive person will not tolerate great variation in pressure or temperature.

Thus, many individuals with autism consider sensory issues as a primary problem (Gerland, 1997; Grandin, 1995; Grandin and Scariano, 1986; Lawson, 1998; O'Neill, 1999; Willey, 1999; Williams, 1992). Van Dalen (1995) proposed that the cause of autism is of a perceptual nature and needs to be viewed above all else as a perceptual deficit. Grandin (1995), an individual with the diagnosis, described her own sensory aversions to touch, and how she created a "squeeze machine" to provide firm and consistent pressure to her body, which she paradoxically craved. This inconsistent reaction to sensory input is commonly described among the symptoms of individuals with ASD. Others have hyposensitivities to touch. Some individuals have decreased sensitivity to pain. Children are commonly reported to bang their heads against brick walls or cement flooring with no reaction to pain. Others bite their bodies or pick at sores, never allowing the sore to heal.

Auditory defensiveness is manifested as an oversensitivity to sound. Reported examples include an over sensitivity to alarms, vacuum cleaners, air conditioners, and even some music. A person with auditory defensiveness has difficulty sleeping through noise that most individuals ignore. Electrical devices, with high-pitched sounds, which are not heard by individuals with normal hearing, attract the attention of individuals with ASD. In contrast, the person with hyposensitivity to sound may press his or her ears against vibrating and noisy surfaces, such as dishwashers, vacuum cleaners, or tape recorders. Such individuals with reduced sensitivity to sound may fail to recognize when their name has been called or to react to another person's loud screams. Despite such concerns about hearing perception, hearing acuity is reported to be within normal limits when it is tested (Affolter & Bischofberger, 2000).

Visual defensiveness can be manifested as a squinting of the eyes in response to bright lights. Other individuals with ASD have been reported to be discomforted by fluorescent lighting. The visually hypersensitive individual watches dust in the air, picks lint from the carpet, or may watch his or her spit falling in the air for hours, if allowed. These individuals are reported to be preoccupied with visual designs and patterns, and anything with turning parts that create a design when in motion. In contrast, the visually hyposensitive individual will rock back and forth while viewing an object or moving the object in and out of sight. These individuals reportedly view objects at close range and stare intently at objects and light sources. Visually hyposensitive individuals also are attracted to mirrors, and shiny objects, and they may stare at them for hours.

Abnormal olfactory and gustatory sensitivities are inferred from observing the eating habits of individuals with ASD. Commonly reported food aversions may be related to taste, odor, or texture. Some individuals eat only "orange" foods or black olives, for example. They may smell everything in their environment before touching it. Individuals with hypersensitive taste are regarded as "picky eaters" while those with hyposensitive taste, who eats everything, may be given the diagnosis of Pica.

In addition, individuals with ASD may not be able to integrate multiple sensory modalities. Temple Grandin (1995) reported difficulty speaking to audiences when background noises are present. Paris (2000) concluded that sensory issues may result in impaired gross motor control, hand control, oral motor control, and other physical problems. Baranek (1999) suggested that both motor and sensory problems are evident early in life (i.e., 9-12 months). Motor deficits can affect a child's exploration of the environment, thus impacting overall cognitive development (Anzalone & Williamson, 2000; Huebner & Kraemer, 2001).

Motor problems are well documented in the literature for individuals with ASD (Teitelbaum, Teitelbaum, Nye, Fryman & Mauer, 1998). Both fine and gross motor abilities are affected. Reports include postural problems, clumsiness, low tone, decreased complex motor skills, balance issues, speech difficulties, apraxia, and impaired goal formulation, planning and execution (Murray-Slutsky, 2000).

Cognitive Symptoms

The cognitive profile of individuals with ASD is mixed. They present with deficits in metacognitive abilities, abstract thinking, problem-solving skills, knowledge of others and self, understanding emotions and complex memory (Millward, Powell, Messer & Jordan, 2000; Waterhouse, 2000; Kasari, Chamberlain, & Bauminger, 2001). Their cognitive strengths include: pattern discrimination, rote memory, attention, visual-spatial perception, and object knowledge (Mesibov, Adams, & Klinger, 1997; Pierce, Glad, & Schreibman, 1997; Goldstein, Johnson, & Minshew, 2001; Kanner, 1943). Children with ASD are not like other children with intellectual impairment because they are not simply delayed in overall development. They may have isolated areas of superior cognitive ability which demonstrate their ability to learn.

Language Symptoms

Language performance varies widely among those in the ASD population, although all have difficulty communicating. Sigman and Capps (1997) described the language deficits of the ASD as problems with words, grammar, pragmatics, conversational skills, perspective taking, and the use of narratives. Murray-Slutsky (2000) suggested that speech and language proficiency require an individual to register sensory information, formulate an idea, plan and sequence thoughts, and finally, speak. She described this process as the same process involved in motor planning and execution. It was hypothesized that motor planning and language share overlapping neural structures. Approximately 50% of autistic people do not develop meaningful communicative language (Wetherby, Prizant, & Schuler, 2000). Those who are verbal often communicate by using echolalia, a repetition of words spoken to them.

Social Symptoms

Social deficits are considered a defining characteristic of ASD. However, it is no longer believed that "refrigerator mothers" cause the disorder. Some children with ASD do become attached to their caregivers (Capps, Sigman, &

Mundy, 1994; Rogers, Ozonoff, & Maslin-Cole, 1991). However, social interactions are often limited in this population (Bailey, Philips, & Rutter, 1996). Volkmar, Cohen, and Paul (1986) examined fifty parental responses about their children's early social development. The children ranged in age from 28 months to 33 years and had a history of autism. The majority of the parental descriptions noted that the children were emotionally distant, i.e., they ignored people, displayed little affection, avoided eye contact, lacked interest in social interaction, ignored displays of affection or withdrew from affection, looked through people, and seemed to be unaware of their mothers.

The most commonly cited social deficit is in joint attentional skill. Joint attention refers to a child's ability to actively share attention and experiences with another individual. These skills involve the use of eye contact, affect and gestures. A child can share attention in several ways: declarative pointing, referential looking, looking where others look and point, and social referencing. Research has documented that joint attentional deficits show up early in (1) pointing responses (Baron-Cohen, 1989; Loveland & Landry, 1986; Wetherby & Prutting, 1984), (2) referential looking (Lewy & Dawson, 1992; Mundy, Sigmam, Ungerer, & Sherman, 1986; Wetherby, Prizant, & Hutchinson, 1998), (3) looking where others look and point (Leekman, Baron-Cohen, Perett, Milders, & Brown, 1997), and (4) social referencing (Sigman, Kasari, Kwon, & Yirmiya, 1992).

Later in development, children and adults are marked for pragmatic language deficits (Surian, Baron-Cohen, & Van der Lely, 1996; Tager-Flusberg, 1993; Happé, 1993). They have difficulty with appropriate social communication such turn-taking, topic maintenance, figures of speech, and prosody.

Importance of Studying ASD

The important work of understanding what an autism spectrum disorder is and how to treat it, is far from complete. While ASD is understood to be a neurobiological disorder (Bailey, LeCouteur, Gottesman, Bolton, Simonoff, Yuzda, & Rutter, 1995; Minshew, 1991), a genetic marker has not been identified and, 15 to 20 different genes are most likely involved. Therefore, professionals must rely on behavioral observations to guide diagnosis and remediation. Better descriptions of ASD are needed to establish standard diagnostic criteria, which provide information to families and practitioners about development and treatment. More and more individuals are being identified with ASD, and caregivers and professional service providers are at a loss for what to do.

Increased Incidence

ASD is no longer a rare disorder. Its incidence rate is estimated conservatively to be one child in 1,000 in the United States (U.S.) (Fombonne, 2002; Gilberg & Wing, 1999). The Centers for Disease Control and Prevention have reported rates between 2 and 6 per 1,000 individuals, thus providing the commonly cited statistic of 1 in 166 by the popular media (Autism Speaks, 2005). Charman and Baird (2002) reported the incidence to be as high as 4 to 6 per 1,000 individuals. It is more prevalent than Down syndrome, Fragile X, cystic fibrosis, or pediatric cancer (Bristol, 1996). The prevalence of ASD has increased dramatically from the 11 cases of Autism first described by Leo Kanner in 1943 and the early descriptions of Asperger Syndrome provided by German scientist, Dr. Hans Asperger.

Based on the incidence of autism at 2 to 6 per 1,000 persons (Centers for Disease Control and Prevention, 2001) and the 2000 U.S. census figure of 280 million Americans, 1 to 1.5 million Americans are diagnosed with Autism. During the 1990s, the number of persons with the autism diagnosis increased at a more rapid rate than did the U.S. population and the number of persons with other disabilities. That is, the U.S. population increased by 13% and persons with disabilities other than autism increased by 16%. But the autism population increased by 172% (U.S. Department of Education, 1999). The Autism Society of American estimates that the prevalence of Autism could reach 4 million Americans in the next decade.

The increased prevalence is due partly to better evaluation measures. Children can be reliably diagnosed before age three (Lord, 1995), and research suggests that effective screening and diagnostic methods can be developed for 18-month (Baron-Cohen, Allen & Gillberg, 1992) or even one-year old children (Osterling & Dawson, 1994). Currently, Lord and colleagues are developing assessment measures for infants as young as 6 months.

Another explanation for the increased ASD prevalence is the increased recognition of the heterogeneity of the diagnostic category. The current use of the spectrum term encompasses persons with minimal ASD symptomatology.

Provision of Resources and Legal Entitlement

The increased number of children diagnosed with ASD in public school systems adds to the perception that this disorder is now more prevalent than it used to be. In 1994, ASDs were the 10^{th} most common disability among the 6 to 21 year old children in special education. According to the Centers for Disease Control and Prevention (CDC), the number of children diagnosed with ASD increased six-fold from 22,664 to 141,022 between 1994 and 2003. Although more children are receiving special education services for ASD than ever before, this diagnostic classification was not added until the early 1990's. Therefore, the growth of children being serviced is partly due to the addition of the autism diagnostic category rather than the increased prevalence.

Historically, educators did not have children with ASD in their classrooms. In the early 1970s, schools even refused to enroll children with any disabilities, or if enrolled, they were placed in programs that segregated them from their nondisabled peers. When Congress amended the Education of the Handicapped Act (EHA) with Public Law 94-142 in 1975, it intended to include 1 million school-age children with disabilities without any educational placement, and 2 million children enrolled with inappropriate placements. Federal legislation (Individuals with Disabilities Act (IDEA) of 1990 (PL 101-476), its 1991 and 1997 amendments, and its most recently revised 2004 version, renamed the Individuals with Disabilities Education Improvement Act, mandates that a state provides all eligible children with a free and appropriate education (FAPE) that meets their unique individual needs in the least restrictive environment (LRE).

The IDEA emphasizes legal entitlement to early intervention services and provides more services for young children and families, who could not previously access them.

Educators do not have a choice about providing services for this difficult population. They are legally required to provide services and to do so at earlier ages than were required in the past. Any child younger than 3;0 years of age, who has a developmental delay, is eligible for the early intervention services provided through IDEA. This government legislation provides federal grants to individual states for their provision of early intervention services for children with disabilities. For some families, a diagnosis of autism means provision of services, whereas, other diagnoses may not result in intensive services. Thus, another basis for the increased number is the preference for this diagnosis over others by the family.

At age 3;0 years, IDEA requires states to provide special education services through local school districts. As previously stated, every child is entitled to be educated in the least restrictive environment. This means that children are placed in environments that provide the greatest potential to interact with non-disabled peers and to participate in the general education curriculum. More and more effort is being made to mainstream these children in regular education classrooms. This means that regular education teachers now have these children in their classrooms and are partly responsible for their learning, often with little preparation. So the important questions for the educators become: 1) How can I teach this child? and 2) What is the most effective way for this child to learn?

Cost of Intervention

The cost of intervention is an important issue because as stated previously, ASD is a pervasive disorder, often requiring clinical intervention beyond standard medical care. Several services are commonly prescribed. They include: physical therapy, occupational therapy, and speech and language therapy. Clinical intervention services are costly (Baum, 1998). Gantz (2006) estimated that direct medical cost, such as physician services and behavioral therapies, cost more than $29,000 per person per year. In addition to clinical and medical services, IDEA requires provision of special education services from birth. Direct non-medical costs, such as special education and child care are estimated to cost annually more than $38,000 per person for mild disability per year and more than $43,000 per person for more severe disability per year (Gantz, 2006).

In addition to direct costs, the cost of autism includes indirect costs. Indirect costs include the value of lost productivity for the person with autism as well as for caregivers. Examples of lost productivity include loss of income as a result of reduced work hours or the inability to work at all.

Factoring in both direct and indirect costs of autism, Gantz (2006) estimated that caring for an individual with autism over his or her lifetime can cost about $3.2 million and caring for all people with autism over their lifetimes costs an estimated $35 billion per year. The Autism Society of America (2003) predicts that in 10 years, the annual cost will be $200-400 billion.

Practitioners are pressured by insurance companies to demonstrate improvement quickly. Sometimes insurance companies provide funding for a limited number of therapy sessions and require demonstrated improvement before allocating more funds for treatment. Insurance companies have been hesitant to provide funding at all because individuals with ASD require sustained financial support, and will never be completely "cured."

Issues with funding the treatment of ASD bring to the foreground the importance of establishing clinical efficacy. There are limited resources in autism prevention and treatment. Gantz (2006) reported that the federal autism research budget is historically less than $100 million per year, and the research budgets for other conditions with similar incidence figures are much higher. Given the limited funds relative to the numbers of individuals with the disorder, it makes sense to spend funds on treatments that have been demonstrated to work.

Intervention Models

Teaching individuals diagnosed with ASD can be challenging for the caregivers and professionals involved in their development. Failures arise when educators try to accommodate the individual by redesigning the general education curriculum into skill sets, rather than considering how the individual learns through natural interactions in his or her environment. Most, who take on this challenge, do so with a clear vision of what they want to accomplish, i.e., what they want to teach an individual, or want an individual to learn, but they are less clear on how to reach these goals (Brown, et al, 1989; Lave & Wenger, 1991). The design of educational curricula is often far removed from the goal of achieving functional outcomes (Bricker, 1993).

This dissertation focused on treatment models that cater to the unusual and uneven skill profile of individuals who do not seem to learn with the usual approaches. Broadly speaking, there are both indirect and direct treatment approaches, as described next.

Indirect Treatments

Indirect treatments focus on changing the way the body responds to a particular treatment, which then impacts behavior indirectly. Therefore, indirect treatments focus directly on the body system that impacts behavior. They include the biomedical interventions, e.g., pharmacological (Cook & Leventhal, 1995), hormonal (Beck, Beck & Rimland, 1998), immunologic (Fudenberg, 1996), dietary (Reiten, 1987) and megavitamin (Rimland, Callaway, & Dreyfus, 1978; Dolske, Spollen, McKay, Lancashire, & Tolbert, 1993).

Ninety-nine articles were reviewed in a New York technical report (1999) which examined the efficacy of pharmacological treatments. The report concluded that some medications may be effective, but have high rates of side effects. Some case studies suggested that hormone therapies (secretin) reduced autistic symptoms (Kaminska, Czaja, Kozielska, Mazur & Korzon, 2002), but other clinical trials have refuted this claim (Coniglio, et al, 2001; Corbett, et al, 2001; Dunn-Geier, et al, 2000; Lightdale, et al, 2001; Owley, et al, 2001; Roberts, et al, 2001). Immunologic treatments have been supported by a pilot study (Fudenberg, 1996), but other studies have not found significant improvement (DelGiudice-Asch, Simon, Schmeidler, Cunningham-Rundles, & Hollander, 1999; Plioplys, 1998). The New York technical report (1999) concluded that there are no known advantages for using diet therapies for children with ASD. Although Rimland, Callaway, and Dreyfus (1978) observed improvements in the behavior of autistic children who received vitamin therapy, others have not (Findling, Maxwell, Scotese-Wojtila, Huang, Yamashita, & Wiznitzer, 1997).

Direct Treatments

This dissertation is concerned with direct treatments. Unlike the indirect ones, direct treatments focus on behavioral interventions that aim to explicitly modify particular behaviors. There are both conventional and unconventional methods for doing so. Conventional methods have received peer support and are considered as best treatment practices. Unconventional treatments are not established as best practices and may be generally unknown to the public.

Conventional Methods

Conventional teaching methods facilitate learning by targeting specific behaviors for remediation. Long term goals and behavioral objectives are proposed. This process often involves a task analysis in which a behavioral goal is decomposed into all the prerequisite and necessary steps needed to achieve it. Then, the intervention approach is selected to establish or modify the missing behavior.

Fey (1986) described interventions as falling on a "continuum of naturalness." Clinician-directed approaches and client-centered approaches represent the end points of Fey's continuum. The use of clinician-directed drills is the least natural approach on the continuum. When using this approach, a practitioner selects the training stimuli, identifies the target response, presents the stimuli in a predetermined order, and reinforces the expected behavior. Functional therapy is at the other end of the naturalness continuum. It incorporates activities of daily living into the therapy. A child engages in these activities with professional support.

Traditionally, clinicians have taught the desired behavior by shaping it in small chunks until the more complex behavior is learned. They teach these behaviors using conventional clinician-directed approaches in which stimuli are presented either aurally and/or visually. The clinician reasons that if the child could do the task, then he or she would demonstrate this knowledge by actually "doing" it. If instruction is needed on how to do a task, it takes the form of verbally telling the child what to do, or visually showing a child what to do by using picture schedules to complete tasks. Clinicians assume that the distance senses are adequate channels for receiving instructional input.

Conventional behavioral methods include such approaches as Applied Behavior Analysis (ABA) (Lovaas, 1987), Division TEACCH (Treatment and Education of Autistic and related Communication Handicapped Children) (Schopler & Mesibov, 1988), DIR (Developmental, Individual Differences, Relationship-based Approach) (Greenspan & Wieder, 1998), and augmentative and alternative communication training, such as visual mediated strategies (Hodgdon, 1996) and Picture Exchange Communication System (PECS) (Bondy & Frost, 1994).

Applied Behavior Analysis (ABA). ABA methods focus on teaching small units of behavior systematically. Skills that have not been acquired are broken down into small measurable steps, and then taught by presenting a specific cue, typically an auditory-verbal or visual cue. Appropriate responses are followed by a reinforcer. Teaching trials are repeated frequently until the child performs accurately. Responses are graphed and evaluated. As skills emerge, they are practiced in less structured environments (Harris and Handleman, 1994; Koegel & Koegel, 1995). The premise of an ABA method is that children with ASD will learn from an exaggerated, intensive, and slowed presentation.

Treatment and Education of Autistic and related Communication-Handicapped Children (TEACCH). Project TEACCH (Schopler, Mesibov & Hearsey, 1995) at the University of North Carolina in Chapel Hill is similar to ABA. It claims to exploit the strengths of individuals with ASD by creating structured teaching procedures. The procedures provide for instruction that is systematic and predictable in organizational and temporal structure. However, unlike ABA, there is not constant instructional control. Less redirection and fewer prompts at predetermined levels are provided in TEACCH than in ABA. The child is given the opportunity to problem-solve through a task. Visual schedules and workstations in which the child has a set number of tasks to complete are integral aspects of the model. The premise of TEACCH is that the weaknesses of a child with ASD are in social, language, attention, organization, transitioning, and auditory processing. The TEACCH intervention is designed to build on strengths in visual processing and routine-based learning.

Developmental, Individual Differences, Relationship-based Approach (DIR). DIR, sometimes referred to as "floortime", is an intensive, one-on-one period in which the caregiver gets down on the floor and interacts with the child. The premise of this intervention is that human relationships are critical to child development. The home caregiver is expected to "follow the child's lead and play at whatever captures her interest, but to do it in a way that encourages the child to interact with you" (Greenspan & Wieder, p. 123-124). The goal of this intervention is the mastery of emotional milestones in a sequential order. The premise is that emotion regulates interaction, and that ASD is a multisystem developmental disorder (MSDD) affecting interpersonal relating, communication, and overall adaptation, among many others. Intervention is expected to enhance engagement and attention towards increased reciprocal communication.

Picture Exchange Communication System (PECS). PECS (Bondy & Frost, 1994), which employs augmentative and alternative communication techniques, is a structured behavioral program that uses symbols to teach individuals to exchange the symbol for a "real" item. After the individual can complete this exchange with different people and under different conditions, then other functions, such as labeling, are taught. The visual symbols are used to augment receptive and expressive language.

While all four approaches described above differ in their goals and clinical strategies or assumptions, they commonly share a reliance on the auditory and visual modality for input. They do not focus on the sensory channel over which input is received. They appear instead to focus only on the material stimuli presented to the child.

Unconventional Methods

Unlike the accepted conventional methods, unconventional methods are largely unknown to the public and are not widely used in clinical practice. This study specifically focused on those unconventional methods that claim to enhance the tactile-kinesthetic perception associated with purposeful bodily movement. They include four types of action-based therapies. Two of them are well known, viz., sensory integration (SI) (Ayres, 1972; Ayres, 1979; Fisher, Murry & Bundy, 1991; Cook and Dunn, 1998; Schneck, 2001) and Facilitated Communication (Biklen, 1993). Two others are less well known, viz., Guided Interaction Therapy (GIT) (Affolter, 1991; Affolter & Bischofberger, 2000), and Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT) (Hayden, 1999; Hayden, 2004; Rogers et al, 2005).

Sensory integration (SI). This therapy, which was developed by occupational therapist, Jean Ayres (1979), is perhaps the best known of the four interventions cited above. It focuses on organizing the whole sensory system so that an individual with ASD and sensory integration difficulty can increase his or her alertness to stimulus input. The premise of sensory integration is that people affected by ASD have impaired abilities to take in, organize, and react to sensory stimuli effectively. The goals of SI therapy are to improve one's ability to process complex sensory information automatically, improve motor coordination, and reduce over- or under-reactivity so that better social and emotional adjustment can be achieved.

SI therapy is administered by using special equipment in a controlled therapy environment. Physical exercises with various equipment, such as a scooter board or bolster swing aim to promote motor development by facilitating the processing and organizing of tactile, proprioceptive, and vestibular systems. Ayres (1979) stated that, "Doing purposeful physical activities- rather than thinking or talking about them - is the best way to improve human functioning when the problem lies in the way the brain is working"(p.151).

Facilitated communication. Facilitated Communication was developed by Rosemary Crossley in Australia and promoted in the United States by Douglas Biklen (Biklen, 1990; Biklen, Morton, Gold, Berrigan, & Swaminathan, 1992). Facilitated Communication aims to help an individual with autism to use a visual-motor system for communicative expression. Physical support is provided at the hand, wrist, elbow or shoulder. The premise of facilitated communication is that ASD results from a neuromotor impairment that prevents communication skills from being expressed. This premise is supported by other scholars who have proposed that an underlying motor dysfunction exists in individuals with autism (Rogers, 1996; Teitelbaum, Maurer, Fryman, Teitelbaum, Vilensky, & Creedon, 1996; Donnellan & Leary, 1995).

Prompts for Restructuring Oral Muscular Phonetic Targets (PROMPT). The PROMPT therapy framework was developed by Deborah Hayden in Canada (Chumpelik [Hayden] & Sherman, 1980; Chumpelik [Hayden] & Sherman, 1982, Chumpelik [Hayden], 1984; Hayden, 1999). It is an intervention model for speech production disorders. It aims to develop (1) an interactive awareness of oral communication; 2) an integrated multisensory associative mapping for cognitive and linguistic concepts; and 3) balance or reorganize speech subsystems at the motor-phoneme, word, and phrase level in order to optimize speech production (Hayden, 2003).

This model of therapy is distinguished by its emphasis on enhancing tactual input for remediating speech production disorders in addition to auditory and visual cues. Touch is viewed "as the single most connecting and organizing factor in human development" (Hayden, 2004, p.260). Thus, PROMPT, as a clinical technique, helps clinicians to manually apply tactual cues that provide strategic postural support and cues for mapping the articulatory place, manner, and voicing of speech sounds as well as their sequential and temporal organization. Therapy is done in functional contexts that require social interaction and meaningful use of language. Although speech production is its primary focus, PROMPT's aims to foster social communication and conceptual development generally.

Guided Interaction Therapy (GIT). This intervention was developed in St. Gallen, Switzerland by Felicie Affolter (Affolter, 1991; Affolter & Bischofberger, 2000; Affolter and Bischofberger, 2000). It is a nonverbal perceptual-cognitive approach to intervention. Like PROMPT, it assumes that tactual perception is critical to normal perceptual development and provides clinical techniques for enhancing such input. While expressive communication is central to PROMPT intervention, GIT's focus on expressive communication is secondary to the more *primary goal of providing experiences with the nonverbal, problem-solving experiences of daily life events*. The multisensory experiences associated with spontaneous daily experiences include the tactual-kinesthetic information arising from one's movement interactions in the world in addition to the information from vision, audition, and other senses. GIT's premise is that such holistic sensory experiences are needed in order for people to perceive their nonverbal physical, mental and social worlds as familiar and to function adaptively within them. Holistic nonverbal experiences that include the somatosensory input are assumed to provide the conceptual basis for the meaning of words and other symbols used to communicate.

Thus, the nonverbal interaction between individuals and their environments is presumed to be the source of learning both nonverbal and verbal skills. The premise is that some children along the autism spectrum may fail to develop normally because of a perceptual disorder that either prevents the central nervous system from adequately processing tactual-kinesthetic input or connecting such input to other sensory information such as vision and audition. Their nonverbal and verbal behaviors can appear to be so delayed and deviant because most human actions, particularly those involving complex skills, rely on integrated sensory experiences that include the tactual-kinesthetic experiences.

The intervention goal is to enhance a child's perceptual experiences during ordinary problem-solving events of daily life in ways that include the somatosensory input. This is done by enabling a child to physically participate in nonverbal, problem-solving activities. A clinician physically guides a child's hands, limbs or torso to act in a purposive or goal directed way. Alternatively, the physical environment may be modified to enable a child to do a task on his/her own. For example, a chair may be lowered so that a child's feet touches the floor in order to gauge where the body is in space; objects may be selectively chosen to offer more or less resistance to movement patterns during an event. During the nonverbal event, whether physically guided or not, talking is not done or encouraged. This practice is expected to minimize distractions from the task at hand and decrease processing load. After the nonverbal event, words, or other communicative forms are used to represent the event just experienced, i.e., if a child is on the level of using words or other symbols, e.g., pictures, to communicate.

Expanding the repertoire of such experiences is expected to improve a child's ability to perceive environmental events as familiar and to predict and execute causative sequences of actions that are meaningful for his/her life experiences. It also is expected that comprehension or understanding of how events occur will serve the meaningful use of language forms.

Issues in Clinical Efficacy

An important question to raise is how efficacious are any clinical interventions for children with autism. Clinical efficacy is a judgment about the validity of an intervention (Stockman, 2004). Does the intervention yield the outcomes that it claims to yield? As stated earlier, Wetherby and Prizant (2000) have charged the research community "to better understand which specific intervention methods work best to accomplish which goals for which children (p.3)." In other words, which interventions are efficacious?

Efficacy should be generally important for all practitioners, given the value being placed currently on evidence-based practice (EBP) in health care and education (Dollaghan, 2004; Drake, Rosenberg, Teague, Bartels, & Torrey, 2003; Geyman, 2000; Gray, 1997; Lohr, Eleaser, & Mauskopf, 1998; and Straus, Richardson, Glaszio, & Haynes, 2005). EBP refers to the integration of scientific evidence with clinical expertise, client values, and circumstances (Robey, 2006).

EBP is likely to be a particularly critical issue for the unconventional, sensorimotor-based interventions, which were the focus of the current research. They are not well known and are not used as widely as conventional methods. Some of these interventions have already been discredited for lack of adequate empirical support. For example, in the case of the facilitated communication intervention identified above, controlled experimental studies failed to demonstrate that a written message originated in the individual with autism as oppose to the facilitator or they failed to isolate the observed effect from the literacy level of the participants (Wheeler, Jacobson, Paglieri, & Schwartz, 1993; Eberlin, McConnachie, Ibel, & Volpe, 1993; Bligh & Kupperman, 1993; Smith & Belcher, 1993).

Baranek (2002) reviewed 29 studies published between 1974-2001 that focused specifically on sensory and motor interventions for children with Autism. The meta-analysis included such interventions as sensory integration, sensory stimulation, auditory integration training, prism lenses, and physical exercise. Some of them focused on the distant senses, namely, the auditory (auditory integration training) and visual (prism lenses) intervention paradigms. Others can be regarded as somatosensory approaches, which ranged along the continuum from sensory stimulation (sensory diets) to those with a motor component (physical exercise). Although positive, but modest outcomes were reported for some interventions, Baranek (2002) expressed concern about the functional utility of the sensory and motor interventions reviewed, It was concluded that, "without direct practice in generalizing to functional tasks and in naturalistic environments, the effects of therapeutic gains in sensory processing or motor components may be limited" (p. 417).

However, Baranek's (2002) review of the sensory and motor therapies did not include two unconventional therapies, which may be regarded as sensorimotor approaches to intervention with autism: namely, the GIT and PROMPT interventions. These two approaches were of particular interest to the present study for two reasons. First, they emphasize human actions and communication in the kind of functional contexts that Baranek's review referred to as being ideal.

Second, GIT and PROMPT offer unique therapeutic strategies for facilitating one's ability to function in such contexts. Both interventions commonly emphasize augmented tactual-kinesthetic input for clients who do not adequately respond to the visual and auditory instruction so frequently used in clinical interventions with autism. Although other therapeutic approaches do emphasize authentic settings, they may not stress the importance of tactual input or provide ways to facilitate meaningful action. For example, Facilitative play is such a commonly used child directed approach (Hubbel, 1981; Shriberg & Kwiatkowski, 1982) used to facilitate language. It relies on auditory and visual input. That is, the clinician may expand, extend, and recast a child's utterance (auditory verbal input) while also encouraging visual modeling of actions during shared play activity (visual input). Even when functional therapies capitalize on natural interactions involving communicative activities of daily living, practitioners do not deliberately enhance tactual input for learning to participate in such events.

Nevertheless, it is important to seek evidence for innovative procedures such as those used in GIT and PROMPT. However, Stockman (2004, Ch.11) suggested that some therapies may be ignored when the evidence for their efficacy is limited to just one type of efficacy. She described four types of evidence: 1) grounded efficacy, 2) theoretical efficacy, 3) empirical efficacy, and 4) ecological efficacy. In the review to follow, it is shown that the unconventional therapies that augment tactual input may be clinically valued on some level of efficacy but not others.

Grounded or Situational Efficacy

Grounded efficacy refers to an intervention effect that can be observed during an intervention session, which could not be witnessed immediately before the intervention. Stockman (2004) stated, "The word grounded is intended to focus attention on the behavioral changes that clinicians and families can actually witness when they intervene **in a given moment to help a child** to solve a problem in therapy or in daily life (p.305)." The evidence is particularly valuable when the change occurs. The interventions singled out already are likely to have some impact on a child's performance, otherwise people would not apply them. Stockman (2004) stated that different sources of input may affect behavior, as practitioners and caregivers probably observe routinely. The important evidence for tactual-kinesthetic input is achieved when behaviors change following some modified input, but have failed to be achieved with auditory or visual input in the context of the therapy event or learning event in the moments before. The efficacy of some interventions may include only grounded evidence of efficacy. That is, the practitioner does something with the goal of modifying a particular behavior (e.g., provide a tactual cue) and immediately afterwards, a child generates the desired behavior. Such a change is likely to be viewed as the consequence of the intervention. This interpretation will be validated if a clinician repeatedly observes repeated instances of the same kind of events in different sessions for the same child and for different children.

It has been relatively easy to demonstrate this kind of grounded efficacy for using tactually enhanced input, particularly when behavioral changes occur after auditory and visual inputs have not been successful. Archived video records provide anecdotal evidence for the effectiveness of therapy sessions when using GIT and PROMPT. While it is important to demonstrate grounded efficacy for the reality of clinical use, it alone is not adequate evidence of efficacy to stop here. Without controlled observation however, one would not know for certain that the behavioral change was due to the intervention strategy employed. It is possible that some other factor caused the observed change.

Theoretical Efficacy

According to Stockman (2004), "Theoretical efficacy refers to the fit between clinical observations and the body of empirically derived knowledge about how people learn and develop" (p.307). Theory provides us with the understanding of how we learn, but it can be only an indirect source of evidence for treatment efficacy because the research observations are not designed to test directly the validity of an approach.

There is indirect theoretical justification for believing that intervention models that cater to enhance somatosensory input are likely to be useful for treating autism. Both GIT and PROMPT draw on a rich scholarly literature on the role of action as purposeful movement activity in cognitive, motor, perceptual and language development. More than a half century ago, classic Piagetian theory asserted that the sensory-motor system was important to early cognitive development. Piaget (1952) described the child's stages of sensory-motor intelligence in the first 2 years of life as foundational for cognitive development.

A body of knowledge on the sensory and motor foundations of learning now extends beyond Piagetian theory. Neopiagetian scholars have investigated the role of action as sensorimotor activity in the process of constructing knowledge in real time and space. Their views broadly reflect an embodied constructivist view of knowledge acquisition (Stockman, 2004). They have shown that motor behavior is not merely a display of what is already learned, but it is also a part of the input experience needed to acquire new conceptual knowledge (Thelen & Smith, 1994). Studies of the psychophysical and perceptual properties of the haptic modality suggest it is not inferior for learning about the world as is often asserted. It is important for learning about the material properties of objects (e.g., weight, texture) in addition to their size and shape (Jones & Lederman, 2006; Lederman & Klatzky, 1987; Lederman, Klatzky, Chataway, & Summers, 1990; Kilgour and Lederman, 2002; Lederman, 1981; Magee & Kennedy, 1980). Other research has called attention to the unique role of tactual experiences in learning about the nonverbal cause-effect relationships of actions and interactions with objects and events (Affolter & Bischofberger, 2000; Affolter, 2004; Nelson, 1986; Nelson, 2004). Action/interaction experiences arguably grounds even visual perception (Noë, 2005) and language in its oral (Bloom, Tinker, & Marqulis, 1994) and written forms (Glenberg & Kaschak, 2002). Bloom (2000) concluded from her work that learning a language requires a child's *engagement* in a world of persons, objects, and events."

Although these theoretical formulations offer important theoretical justification for focusing on action in an intervention framework, they do not provide direct evidence for the effectiveness of a therapy regimen in which perceptual-motor activity plays a central role. Therefore, they provide only indirect support for the principles of interventions such as GIT and PROMPT, which exploit the movement senses in efforts to modify behavior. Such theoretical support, although necessary, is not enough to justify the clinical efficacy of intervention like GIT and PROMPT. What GIT and PROMPT have demonstrated clinically are differences in performances between children with tactual problems and those without it in their responding to intervention.

Empirical Efficacy

Empirical evidence is direct evidence based on controlled observation. Stockman (2004) observed that controlled clinical trials are often viewed as the gold standard for determining clinical efficacy. This is because they attempt to test if and how a particular intervention may cause the desired behavioral changes by ruling out the potential effect of extraneous factors on intervention outcomes. Although clinical controlled trials are the gold standard for determining efficacy, they are not easy to do in a rigorous experimental way for persons with autism. First, there is difficulty in equating the experimental groups. Individuals diagnosed with ASD present varied profiles of strengths and weaknesses as well as varied histories of exposures to clinical interventions.

Second, it can be difficult to identify and control for all the relevant extraneous variables in research studies. This is because research participants may learn from experiences that are external to an intervention, which could impact the outcomes of the study.

To date, the empirical evidence for the use of GIT and PROMPT with ASD populations has taken the form of case studies. This is the weakest form of empirical evidence by some standards. Individual clinical cases can differ on factors that influence the severity of a disorder and the progress made with an intervention. Therefore generalizations across clinical cases about clinical efficacy can be difficult to make. Single subject designs have led to more promising outcomes, particularly when controlled, multiple baseline controlled studies are not done as proponents of PROMPT are beginning to do.

Ecological Efficacy

Stockman (2004) stated that ecological efficacy "refers to consumer satisfaction or to what others refer to as social validity (Goldstein 1990)" (p.312). Therefore, it is a subjective evaluation of the validity of an intervention by observers who may not be clinically trained or informed. Guiding ought to be viewed positively by caregivers because it gives them a way to intervene with children who do not respond to visual and auditory-verbal instruction. In fact, Affolter and colleagues have reported that caregivers view GIT intervention as helpful, but such anecdotal reports do not replace the need for studies that apply objective measures of consumer satisfaction. Such studies do not appear to have been done.

Statement of the Problem

This dissertation was concerned generally with the efficacy of nonmainstream or unconventional approaches, specifically the efficacy of such approaches that claim to provide enhanced or guided tactual input for stimulating learning, namely GIT and PROMPT. These two interventions were regarded as promising because they promote holistic functioning in the real world environments. Their emphasis on enhancing tactual input also offers an alternative to treating persons with autism who do not respond well to just visual and/or auditory-verbal instruction. Nevertheless, the above discussion revealed that so far, the efficacy of GIT and PROMPT interventions rests mainly on (1) informal grounded evidence of behavior changes as can be documented in therapy sessions, (2) empirical and theoretical evidence supporting the importance of action and the somatosensory senses for human development, and (3) nonexperimentally controlled case studies of patients with a favorable response to tactually-enhanced therapy. So rigorous empirical research is needed to demonstrate whether these tactually-based interventions are clinically efficacious, and if they are comparatively more effective than either the conventional or unconventional methods that cater primarily to visual and auditory input for learning. Such empirical evidence can serve two purposes. First, it establishes the validity of an intervention when desired behavioral outcomes have been documented. Second, it serves as a guide to defensible clinical practices.

The efficacy of interventions like GIT and PROMPT rests not only on future controlled clinical trials that document effective outcomes when these therapies are implemented as recommended by their founders; it also rests on evidence that shows if and how learning is affected by the use of any type of manually guided input. Affolter and colleagues have argued that when children fail to nonverbally interact with the environment on their own, they can be manually guided to experience directly the causative events created by their own actions. Children even report that they have done the actions themselves.

If tactual processing deficits exist and tactual-kinesthetic perception is important to normal development, then we need ways to provide such perceptual input. But delivering manually guided instruction pose obvious problems for caregivers and practitioners. They may present visual and auditory stimuli easily, but obviously cannot feel for the child. Nonetheless, the notion that manually-guided input can provide tactual experiences well enough to promote learning is likely to be controversial. This is because such externally guided actions/interactions are viewed as passive activity (Lederman, 1997). Lederman (1997) defines passive touch as the "Mode of tactual perception in which the observer has no voluntary control over the receipt of sensory information" (p.49). The corresponding assumption is that such actions may not get the attention of the nervous system well enough to support the learning of complex human skills. This assumption can be tested with controlled empirical observations of children's learned responses to novel events in different sensory modality conditions, as was done in this dissertation research. Fortunately, a small number of studies have been done to address this question and they provided a template for the current work. They suggest that different populations of typical and atypical learners do benefit from tactually enhanced input during novel learning tasks, as summarized below.

Seminal Research in a New Paradigm

Seminal research in which one principle, manually guided input, made a difference in the performance of the individual is reviewed. The research participants included adults and children, both typically and atypically developing.

The research demonstrated that the tactual system is not inferior to the visual and auditory systems. The overarching paradigm in this seminal research was to manipulate learning by augmenting the tactual input. Control groups were employed as well as different populations of learners. A review of these studies follows.

Within the last 15 years, six studies have served as the building blocks for developing an experimental intervention protocol that demonstrates learning from active participation in events. Taken together, they show that the addition of tactual input to visual and auditory input is helpful to verbal and nonverbal learning. All of these studies aimed to show whether manually-guided instruction made a difference in performance outcomes. Some of them focused on typical learners (Mitchell-Futrell, 1992; Rowe, 2003; Luce, 2004; Stockman & Latham, 2002) and others focused on abnormal learners (Beretta, 1999; Latham & Stockman, 2002). Most focused on children (Mitchell-Futrell, 1992; Luce, 2004; Stockman & Latham, 2002; Beretta, 1999; Latham & Stockman, 2002). Just one focused on adults (Rowe, 2003). None of the abnormal studies recruited well-defined participants from the ASD population.

Mitchell-Futrell's study (1992) included 10 male and 10 female participants with normal language development. The participants' mean age was 3:6 years, and their mean language age was 4:3 years as measured by the *Preschool Language Scale-3*. All participants were taught novel action words under two different teaching conditions: an observational learning condition and a manipulation condition. During the observation condition, children were deprived of tactual-kinesthetic information about the word's referent. During the manipulation condition, children were deprived of visual information by blindfolds. Each participant learned two words, one in each teaching condition. Ten participants were taught a nonsense word in the observation condition and then taught a second nonsense word in the manipulation condition. For the other ten participants, the first nonsense word was taught in the manipulation condition, and the second nonsense word was taught in the observation condition.

Following the teaching conditions, three tasks were used to assess retention of the newly learned word: (1) word recall, (2) action re-enactment, and (3) visual recognition. The word recall task required participants to produce the novel nonsense word. The action re-enactment task required that the participant perform the action associated with the novel nonsense word. The visual recognition task required the participant to watch three people performing actions and point to the person performing the action that corresponded to the word learned. Responses to each task were obtained at two time intervals: 5 minutes after the teaching condition and 5 minutes after the initial testing procedure.

The results revealed the children in the manipulation condition, that is, those children who were blindfolded, performed better than the children who were not blindfolded on the visual recognition task. This unexpected result was explained by the blindfolded children's limited attention to the specific action performed. A multitude of stimuli could have been attended to during the teaching event rather than the action specifically.

The investigators also concluded that for actions already known to the children, both the manipulation and observation teaching conditions were equally effective for reproducing the action in response to the novel label. While it has been easier to accept younger children's dependency on "hands-on" learning that necessarily includes tactual kinesthetic input, it has been less often assumed that adult learners need such input. In other words, they are expected to learn as well from visual or auditory verbal instruction. Therefore, Rowe (2003) conducted a study in which normal adults were recruited as participants to learn a novel task.

Rowe (2003) demonstrated that auditory and/or visual input alone was not sufficient for normal adults on a novel procedural task involving the construction of a novel object using origami craft. The 21 male participants between the ages of 18 and 21 attended Michigan State University. Participants leaned an origami task under one of three input conditions: auditory verbal instructions only, auditory verbal plus visual demonstration only, and auditory verbal, visual demonstration and tactually-mediated or "hands-on" input. Participant learning was assessed immediately after completion of the initial instructions for the origami task and after a 20-minute time interval. Participants were judged on their ability to non-verbally reproduce the origami task and their ability to verbally describe the procedures for doing the task.

The participants, who received only auditory-verbal input, performed the least well on both nonverbal and verbal performance measures. The participants who received the hands-on experience with its access to tactual-kinesthetic input in addition to the auditory and visual input performed the best on some verbal measures, specifically after a 20-minute interval between the teaching and testing conditions. It was concluded that when learning a novel procedural task, multiple sensory input that includes tactual-kinesthetic experience does matter to both verbal and nonverbal performance even in normal adults, and that auditory verbal input alone is not enough.

To show that manually guided input is an active process that gets the attention of the Central Nervous System (CNS), Beretta (1999) used EEG measures. She studied three children (6 to 10 years of age) with a moderately-severe to severe autism diagnosis. They were exposed to both novel and familiar tasks while EEG recordings were made. The EEG measure of brain activity used was contingent negative variation (CNV), which has been correlated with attention in learning. Task exposure involved controlled learning tasks that provided the child with enhanced manual input on some tasks and not on others. The tasks included: pushing a button, squeezing soft and hard balls, and picking up light and heavy glasses.

Responses were compared under identical or similar task conditions. The researcher compared picking up a light glass to that of picking up a heavy glass while being guided in the task and while completing the task independently as well as squeezing a ball while being guided and squeezing the same ball independently.

The most severe participant recorded a strong CNV response to the condition providing the tactual-kinesthetic input. This response suggested that sensory input associated with manual guiding can elicit the attention of the nervous system during exposure to novel tasks.

Research (Stockman & Latham,2002; Latham & Stockman, 2002) used an orange juice-making task to study children without and those with special needs, some of whom were labeled as ASD by their respective school districts and serviced in Speech-Language Impaired/ Autistic Impaired (SLI-AI) classrooms. Research (Stockman & Latham, 2002) showed that even typically developing children profited verbally and nonverbally from participation in an event, especially after the opportunity to do it more than once. Participants in the first pilot research included 15 children (mean age = 5; 1) without a special needs history. Standard conditions were used to expose the children to a juice-making task. The children were randomly assigned to an observation or participation condition. The children were asked a series of WH-questions about the task (Verbal 1 score). Then, each child was asked to reproduce the juice-making task independently. Afterwards, the WH-questions were repeated to give the child another verbal score (Verbal 2 score).

The two verbal scores were compared for the participation and observation conditions. Analysis of Variance (ANOVA) revealed significantly higher scores for the participation group than the observation groups on both verbal tasks 1 and 2 with no significant group-by-task interaction.

A second pilot study included 12 children with special needs (mean age = 6; 4). They were tested under the same conditions as the typically developing children. Their performances, scored by the same judges, were compared to those observed for the typically developing children. Within the special needs group, differences on Verbal tasks 1 and 2 were also observed. The observation and participation groups each improved their scores from Verbal task 1 (initial sensory input) to verbal task 2 (re-enacted input). Analysis of Variance revealed a significant task main effect with no significant task-by-group interaction, as was observed for typically developing children. This result indicated that the children with special needs in the observation group profited even from one participation experience, unlike the typically developing group, which did not.

There were no significant differences between the special needs observation and participation groups in their ability to reenact the nonverbal task. However, the qualitative ratings showed that the participation group performed the task with better motor dexterity, as measured by execution and rate of completing the task, than did the observation group. When compared to the normal counterpart for both groups, the nonverbal scores were lower for the special needs children. In addition, the ratings were poorer for the special needs children, regardless of group assignment. Luce (2004) used the same paradigm to investigate further the issue of passive versus active participation by comparing real and simulated actions during the juice-making task used in the earlier research.

Luce (2004) observed that typically developing preschoolers, who received enhanced tactual-kinesthetic input during a real juice-making novel task, performed better than their age-matched peers who participated in a pretend version of the same task. The 14 participants included 8 females and 6 males between 3; 7 and 4; 8 years. Participants were assigned to either the group using a real juice press or the group using a visual replica. The scores of the group using the real juice press were significantly higher than those of the representational group on the direct questions asked about the juice-making event. Analysis of the nonverbal scores also revealed a significant group difference that showed the best performance for the group that used the real juice press.

It was concluded that although the children, who performed the pretend task, did indeed perform an action, their actions did not have the effect of changing the environment in a salient way. The results exposed the inadequacy of traditional teaching practices, which claim that a child actively participates in an event just because he/she "does" or "touches" something.

The Need for Further Research

The previous work demonstrated that there is enough bias to favor the positive effects of enhanced tactual input that it cannot be dismissed as irrelevant to acquiring new knowledge. All of the prior studies confirmed the relevancy of manually-guided input for both verbal and nonverbal learning. They suggest that such input, whether labeled as passive or not, is able to facilitate learning. Nevertheless, more research is needed. The earlier work provided a working protocol that could be used, namely, a functional task of making orange juice with an unfamiliar juice press. But several issues still need to be addressed to determine whether this paradigm can be useful for studying children diagnosed with ASD.

First, an ASD sample of participants needs to be studied before making claims about the relevancy of a particular research paradigm for them. Previous studies recruited either typically developing children or a mixed group of children with special needs that was not clearly defined as ASD (Latham and Stockman, 2002). Beretta (1999) was the only study to include participants with ASD, and the sample of three children with the diagnosis was very small. Thus, there is little data so far about how well children with autism may respond to the structured protocol used to pilot the nonverbal and verbal learning tasks that were used in the earlier studies.

A second reason to undertake the current research is that previous studies did not reveal how stable the learning was over time. To address learning retention, outcome measures need to be taken at different intervals across time. It may be that the differences between children, who received and those who did not receive enhanced tactual input on certain tasks, may be time dependent.

Finally, the research protocol used in earlier pilot studies was not successful in eliciting children's production of novel words. For example, Latham and Stockman (2002), neither the atypical nor the typically developing children were successful on confrontational naming tasks that required them to recall the novel words to which they had been exposed, regardless of whether they received manually-guided instructions for learning the juice making task or not. It is possible that success in recalling and naming the novel words can be increased by using oral tactual prompts. They offer cues about the articulatory features of novel words in addition to visual and auditory ones used in earlier studies, as provided by PROMPT therapy (Hayden, 2004).

Purpose of Investigation

This study broadly aimed to demonstrate whether the differential effects of two intervention conditions on verbal and nonverbal learning within the context of a novel event structure existed.

Research Hypotheses

1. Children diagnosed with ASD who bodily participate in a novel event will perform better than those who only observe an event visually and aurally on verbal and nonverbal tasks.
2. Children diagnosed with ASD who bodily participate in a novel event will perform better than those who observe events visually and aurally on verbal and nonverbal tasks when measured 24 to 48 hours afterwards.

CHAPTER 2

RESEARCH DESIGN AND METHODS

In this study, the investigator examined the differential effects of two treatment conditions on verbal and nonverbal learning within the context of a novel event structure. The two treatment conditions were labeled as the observation condition and the participation condition. The children assigned to the observation condition received visual and auditory input while observing a juice-making task. The children in the participation condition received visual, auditory, and tactual kinesthetic input while they participated in making orange juice. The general methodology for this study was developed and applied in a previous study (Stockman & Latham, 2002; Latham & Stockman, 2002).

Participants

Description of Participants

With human subjects approval (Appendix B), informed consent was obtained (Appendix C) from the parents of 34 children who participated in the study. Although 36 persons agreed to participate, two were excluded because they did not meet the eligibility requirements. The participants included 5 females and 29 males between the ages of 4; 4 years and 14; 4 years. All participants met the Michigan State Board of Education Administrative Rules for determining autism or ASD. See Appendix A. Thirty-two of the participants were enrolled in speech and language therapy; 1 participant was receiving speech and language consultative services; and 1 participant had been dismissed from speech and language services and was in the referral process to resume these services.

The 34 participants were enrolled in nineteen different classrooms in Berrien County, Michigan. Twelve participants were enrolled in Autistic Impaired (AI) classrooms administered by the Berrien County Intermediate School District; 6 participants were enrolled in AI early intervention programs; 1 participant attended a Charter school and received regular education services with accommodations and resource room services; 3 participants were enrolled in a Pre-Primary Impaired (PPI) program; 4 participants were enrolled in full time special education classrooms; 5 participants were enrolled in regular education classrooms and received accommodations and resource room services; 1 participant was enrolled in a private school and had a full time speech and language pathologist assisting him 100% of the school day; and 2 participants were enrolled in regular education classrooms and received accommodations without resource room services.

Participant Selection Criteria

Thirty participants were sought initially to participate in the study. All had to be diagnosed with autism or ASD according to the Michigan State Board of Education Administrative Rules and be at least 4 years of age. In addition to meeting the Autism/ASD criteria, participants also met the following inclusionary criteria:

1. They had hearing and vision within normal limits (aided or unaided)
2. They had no physical impairments that might decrease motor abilities

3. American English was the primary language spoken in the home

Participant Selection Procedures

Recruitment procedures

Participants were recruited from every public and private school in Berrien County, Michigan. After receiving consent from the Berrien County Intermediate School District (Appendix D) and the local school districts, the parent consent forms for eligible participants were sent through the schools to the parents. In Berrien County, there are 16 local districts. Twelve districts agreed to participate. Three local districts did not have any children with the ASD diagnosis enrolled in their schools, and one local district did not want to participate in the study. Of the 12 districts that agreed to participate, only 10 received completed consent forms from the parents. In addition to the 10 local school districts, 1 private school, and the Berrien County Intermediate School District programs participated in the study. Once parent consent was obtained, child screening was scheduled.

Screening procedures

Information regarding whether a child fit the selection criteria was obtained from the completed teacher questionnaires (Appendix E) and parent questionnaires (Appendix F). In addition, screening procedures required a review of the child's performance on language and cognitive measures. Given the variability of the ASD population, it is not always easy to obtain representative language and cognitive data. Equally important, the test scores alone provided little information about the underlying processes the child may have used. Therefore, a general review of language and cognitive functioning was followed by extensive interviews. These interviews were conducted with the speech and language pathologist, school psychologist, regular education teacher, special education teacher, and the caregivers. This comprehensive review aimed to verify the information about the child's inability to comprehend and produce language at an age appropriate level and the need for intervention services. The most recently reported receptive and expressive language scores were used, which had to be greater than 1.5 standard deviations below the mean score of a standardized test population. This review also revealed whether the child was cognitively able to complete the treatment conditions based on reported cognitive test scores that did not exceed more than 2.0 standard deviations below the mean of a standardized test sample.

Other screening measures consisted of the *Oral Speech Mechanism Screening Examination-Revised* (St. Louis & Ruscello, 1987). The speech mechanism screening was performed by the investigator to rule out any gross abnormalities in oral structure or functioning that might compromise a child's participation in the research tasks.

A broad screening of motor performance was obtained from the teacher questionnaire (Appendix E) and the parent questionnaire (Appendix F). The teachers were asked to rate the motor abilities of a child using a 5-point scale. The scale ranged from a rating of one to indicate below average performance to a score of 5 to indicate above average performance. A paired samples t-test revealed no significant differences between the observation and the participation groups on motor performance as rated by the teachers ($t=1.29$, $p<.216$). Parents also were asked to describe their child's motor development as: good/normal, questionable, or poor, and they provided comments regarding their description. Sixteen of the 17 pairs were matched with the same description provided by the parents. The remaining pair consisted of one child described by the parents as "good" and the other child was described by the parents as "questionable".

After receiving the completed parent questionnaire, the investigator verified that a child had never participated in a juice-making task by directly asking parents during the interview. This procedure was intended to ensure that the experimental learning task would be novel for participants. The investigator asked caregivers to describe any tasks the child routinely did in the kitchen, such as washing dishes or preparing food. No family reported that its child had experienced making juice or using an antique juice press.

Human participant assurances.

The study was approved by the University Committee on Research Involving Human Subjects. See Appendix B. The parents of the participants all provided informed written consent before beginning the study. See Appendix C. The participants were informed that their participation was completely voluntary and that they could withdraw from the study at any time. The participants provided verbal assent to participate in the study if they were able to communicate verbally. Each participant was assigned a number and pseudonym that was used for purposes of data collection and analysis.

Participant Assignment to Treatment Conditions

Among the children who met participant selection criteria, each one was matched to another child in the group in chronological age, educational placement, ratings of motor performance obtained from the teacher and parent questionnaires, and scores on available standardized language and cognitive measures. The matching procedure resulted in 17 matched pairs. Then the children in each participant pair were randomly assigned to either an observation or participation condition. The two resulting groups overall did not differ significantly in their mean chronological ages or mean motor ratings. The mean age of participants in the observation condition was 8.69 years (*SD*= 3.0), and it was 8.36 (*SD*= 2.6) for those in the participation condition. The mean motor rating by the teachers for those in the participation condition was 2.53 (*SD* = 1.0) and 2.29 (*SD* = 1.05) for those in the observation group. Both groups included approximately the same ratio of males to females, i.e., a ratio of 8:2. Every child in each of the two groups was confirmed with a language delay of 1.5 standard deviations or greater on a standardized test or qualified for an AI placement for language delays and development. In addition, every child in each of the two groups was within 2.0 standard deviations of the mean on a standardized cognitive test or did not meet qualifications for a mentally impaired classroom.

The participants learned the task of making orange juice under one of the two conditions. Those in the observation condition watched and heard the investigator during the event of making orange juice. Those in the participation condition watched, heard, and were physically guided by the investigator during the orange juice making event.

Description of Experimental Procedures

The teaching event involved making orange juice using an antique juice press. This event provided the context in which to facilitate the children's learning of a novel noun, novel verb, and the steps to complete a novel procedural task.

Task Selection

The task of making orange juice using an antique juice press was chosen for several reasons. The nature of the task allowed observation of how a child problem solves while doing a novel procedural task. The task was done in a natural and functional context following the methodological framework presented in Affolter and Bischofberger (2000). The juice-making task required the child to interact with real objects, which involved eliciting changes of topological relationships between the body and the environment in order to reach a functional problem-solving goal. This task also was chosen because it was an activity of daily living, but was likely to be novel to the participants. Screening procedures ensured that no child had previous experience making orange juice using an antique juice press.

Furthermore, the selected task required completion of a contingency of steps. It was predetermined that such a task would require the sequencing of five steps. This was judged to be a reasonable level of task difficulty, given the participant population and previous research data (Latham & Stockman, 2002).

Previous research (Latham & Stockman, 2002) indicated that the task was not too complicated or too simplistic for child participants to learn.

Stimulus Description

Nonverbal stimuli and task.

The materials used in the nonverbal teaching event were the same for both the observation and participation conditions. The following materials were used:

1. An antique juice press (Figure 1). The press is made out of metal and has one operating lever.
2. Two oranges per teaching trial. For the participation group, this meant each child used a total of 6 oranges; for the observation group, this meant each child used 4 oranges and the examiner used 2 oranges.
3. A child-safe knife to cut the oranges. The knife had a serrated edge to allow the child to cut through the orange, but not to harm her or himself.
4. A glass measuring cup to collect the orange juice from under the press.
5. A clear plastic glass
6. A plastic storage container that housed all the materials necessary to carry out the task of making orange juice. The participants could not see the contents of the container.

Figure 1. *Picture of antique juicer*

The teaching event consisted of the following sequences of actions leading to the goal of making orange juice:

1. Reaching for, and grasping the knife in one hand and one orange in the other hand. Repeating the procedure for the second orange.
2. Cutting the two oranges into halves.
3. Placing a half orange on the antique manually operated juice press.
4. Placing the glass measuring cup at the base of the juice press.
5. Pulling down on the handle of the juice press to squeeze the juice from the first half of the orange into the measuring cup below.

6. Repeating steps 3 and 5 for the remaining 3 halves.
7. Pouring the juice into the glass.
8. Drinking the juice.

Verbal stimuli and task

The same stimuli were used in both the participation and observation teaching conditions. The verbal stimuli to be learned were embedded in the task. Two strategically spoken, nonsense words were spoken during the teaching condition. They were /pak/, which referred to the antique juice press, and /kaIp/, which referred to the action of pulling the lever of the juice press. The words were chosen because of their similar phonetic composition. Both words are monosyllabic and contain the same consonant phonemes. Both /p/ and /k/ are voiceless stop consonants. The /p/ sound is one of the earliest sounds to appear in children's speech (Sander, 1972; Smit, Hand, Freilinger, Bernthal, and Bird, 1990). About 90 % use the /p/ consonant in the initial and final positions of words at 3; 0 years of age and the /k/ consonant by age 3;6 years (Smit et al,1990) or 4; 0 years (Sander,1972).

The /a/ vowel sound in /pak/ is among the first vowels to appear in children's speech and is the most common vowel in the languages of the world (Ladefoged, 2001). Most children have mastery by age 3; 0 years. The tongue height for this sound is low, and the tongue position is retracted. The /aI/ vowel sound in /kaIp/ begins in the low back portion of the mouth and glides to the high front position. It is the most frequently occurring diphthong in English (Ladefoged, 2001) and is mastered by 90% of children by age 4; 0 years. Therefore, all phonemes used in the nonsense words should be developed by 4; 0 years of age for 90% of children.

The nonsense words were each spoken four times during the juice-making learning event. No other words were spoken. The purposeful reduction of linguistic input follows Affolter and Bischofberger's (2000) therapeutic approach. GIT prescribes that talking is done before or after, but not during the guided activity. This approach posits that linguistic forms should be added after a child experienced an event to reduce the information complexity for the child.

The nonsense word, /pak/, was spoken after the investigator set the juicer on the table, pointed to the object, and then stopped pointing. Then, the investigator again pointed to the object, stopped pointing, and spoke the nonsense word, /pak/. This procedure was repeated two more times, for a total of four presentations.

The second nonsense word, /kaIp/, referring to the action of pulling the lever of the juicer, was spoken following the action four times. This meant that after the first spoken trial, the word preceded and followed the action. The word was never spoken during the action experience. The spoken words were delivered right after the guided action.

Participant's verbal learning was assessed at four time intervals: immediately after completing the initial learning instruction (verbal composite 1), after completing the task a second time on day 1 on his or her own without instructional support (verbal composite 2), after completing the task a second time without instructional support at 24 to 48 hour post-initial instruction (verbal composite 3), and after immediately repeating the task again (verbal composite 4).

Participants' nonverbal learning was assessed at two time intervals: once during the nonverbal task of making orange juice on day one (Nonverbal Rating 1/ Nonverbal Score 1) and once during the nonverbal task of making orange juice on day two (Nonverbal Rating 2/ Nonverbal Score 2).

Data Collection Procedures

Overview

Once assigned to a treatment condition, the children were individually instructed and tested in a designated room on their school premises. Each child was exposed to a single treatment condition. The investigator administered treatment conditions using a standard set of instructions and procedures. A testing room was chosen which had the least amount of distraction possible. The data collection took place on two separate days for each child. The second day of data collection for each child was completed after 24 hours and within 48 of the initial teaching condition. Data were collected for all the children over a three month time period. The investigator administered all tasks to every child in each condition. However, the children's performances were scored by four other people, who were blind to the study's goals and participants' group assignment.

Task Administration

The Observation Group

Prior to entering the testing room, the child was read a standard script of what to expect. The child was told, "Today you are going to watch me make something. After you watch me, you are going to make something. Then, I am going to ask you some questions." The child was familiar with the investigator from the screening procedures. The child indicated his or her willingness to participate by either verbally stating, "okay", or by non-verbally nodding his or her head "yes".

After the instructions were given, the child entered the room and was seated beside the investigator. The child observed the investigator making orange juice using the antique press. Observing the investigator provided the child with auditory, visual, and olfactory input. No words were spoken during the task except for the two strategically delivered nonsense words: /pak/, which referred to the antique juice press, and /kaɪp/, which referred to the action of pulling the lever of the juice press.

After the teaching trial, the child was asked a series of questions to evaluate what could be verbally expressed about the event (verbal composite 1). See Appendix G. Next, the child was instructed to replicate the task on his or her own. The investigator told the child, "Now it's your turn." They used the same materials that had been used by the investigator with the expectation that the child would repeat what had been observed. The investigator did not help the child in any way to complete the task unless the child asked for help or repeatedly struggled with a particular step in completing the task.

Following self-replication of the task, the child was again asked the same set of questions that followed the initial teaching condition (verbal composite 2). See Appendix G. Between 24 hours and 48 hours later, the child responded to the set of questions for a third time without any new intervening self-experience with the task (verbal composite 3). See Appendix G. The child was then instructed to replicate the task nonverbally on his or her own. Once the child replicated the task for a second time, the investigator asked for the fourth and final time the child the same set of questions that followed the initial teaching event (verbal composite 4). See Appendix G.

The Participation Group

Prior to entering the testing room, the child was read a standard script of what to expect. The child was told,

> "Today you are going to make something. Then, I am going to ask you some questions." The child was familiar with the investigator from the screening procedures. The child indicated his or her willingness to participate by either verbally stating, "okay", or by non-verbally nodding his or her head "yes".

After the instructions were given, the child entered the testing room and was seated directly in front of the investigator. The child was manually guided by the investigator to complete the task, thus receiving tactual-kinesthetic input in addition to the visual, auditory, and olfactory input. No words were spoken during the task except for the two strategically delivered nonsense words: /pak/, which referred to the antique juice press, and /kaIp/, which referred to the action of pulling the lever of the juice press in a downward motion. The procedures for auditory delivery of the nonsense words were the same as those used with the observation group. In addition to just hearing and seeing the production of the nonsense words, the participation group was guided physically for the novel word production using tactual prompts (Hayden, 1999). Specifically surface prompts for each phoneme in the nonsense word were used. Surface prompts are intended to provide information to a child about place, timing, and movement transitions for phoneme production in coarticulated contexts (Hayden, 1999). Hayden (1999) differentiated tactile input by the amount and type of support provided. That is, surface prompts provide the "most critical but least information necessary for the neuromotor system to recognize or produce a phoneme and maintain its essence throughout coarticulated movement transitions," (p.275-276).

After the teaching trial, the child was asked a series of questions to evaluate what he or she had just learned (verbal composite 1). See Appendix G. Next, the child was instructed to replicate the nonverbal task alone. The child was told, "Now it's your turn." The child was given the same materials used during the manual guiding. The investigator did not help the child in anyway to complete the task unless he or she requested help, or if the child was repeatedly struggling with a particular step in the task.

After replicating the nonverbal juice-making task, the child again was asked the same set of questions that followed the initial teaching condition (verbal composite 2). See Appendix G. After 24 hours and within 48 hours, the child was asked for a third time the same set of questions with no intervening teaching or self-reproduction of the juice-making event (verbal composite 3). See Appendix G. Immediately following this inquiry, the child was instructed to replicate the nonverbal task alone. After doing so, the investigator asked for the fourth and final time the same set of questions that followed the initial teaching event (verbal composite 4). See Appendix G.

Recording the Data

Each participant had a data checklist form with his or her identification number and pseudonym (Appendix H). Attached to this form were four copies of the verbal measure (Appendix G). As the child answered the questions, the investigator scored his or her responses on-line.

A SONY 360x video (Model # CCD-TRV67) handy-cam camera was used to record each child receiving his/her assigned teaching condition and the evaluation procedures that followed the treatment condition. A trained operator facilitated the recording of each child. The video camera was positioned on a tripod directly in front of the child at a distance of approximately 10 feet to ensure the highest quality of taping. Each child was recorded on a separately assigned 8mm high quality videotape. The tape was labeled with the child's assigned number and pseudonym. A microphone, which fed directly into the video camera, amplified the child's verbal output for taping purposes.

Measuring Learning Effects

Six measures were used to evaluate participant learning. Four measures evaluated verbal performances and two evaluated non verbal performances. The verbal measures reflected the participants' performance on 11 questions, which were asked at four different time points. The nonverbal measures were based upon the participants' event reenactment of the juice-making task at different points across time.

Description of Verbal Measures

The verbal measure (Appendix G) consisted of the same questions that were administered to the participants in both the observation and participation treatment conditions. It included 11 items distributed across three categories of tasks: (1) confrontational naming, (2) recognition, and (3) WH-Questions. Administration of the verbal protocol required the investigator to elicit responses in the following order: confrontational naming, recognition, and WH-Questions. The order of tasks and the questions used to elicit responses within a task were the same across all participants.

Confrontational Naming Task

The confrontational naming questions comprised three items. They prompted a participant to name an object or action as the investigator pointed to the referent object or performed the action by pulling down the lever of the juice press. The participants were asked to name two objects, an orange (familiar object), and the juice press, labeled as /pak/ (an unfamiliar object). Then the participants were asked to name the action of pulling down the lever of the press (/kaIp/).

Each question was spoken with the same carrier phrase, "What is ____?" immediately before the investigator pointed to the object, or performed the action. The first item required a child to name the orange. The investigator retrieved the orange from the storage container, spoke the carrier phrase, "What is _____?", and then presented the orange. No grammatical articles were used in the carrier phrase. This was done to ensure that the child retrieved the label independently of syntactic cues. Next, the investigator returned the orange to the storage container and placed the antique juice press on the table. After placing the juice press on the table, the research spoke the carrier phrase, "What is ____?", and pointed to the juice press. Finally, the investigator delivered the carrier phrase, "What is _____?", and performed the action of pulling down the lever of the juice press.

Scoring procedures for the responses are detailed on the verbal measure recording sheet (Appendix G). The investigator recorded the child's responses on site. In some cases, a participant was asked to repeat his or her response when speech was unclear. The investigator also repeated a child's responses in some cases to support for later transcription of the words spoken. Scoring procedures allowed for self-correction of responses. That is, if the child changed his or her response, the last response was recorded.

Recognition Task

The recognition task comprised three questions, items 4-6 of the verbal measure. The recognition questions required the child to point to the randomly ordered novel object or action on a TV monitor that displayed the object/action. A professionally produced videotape displayed dynamic recordings of the object and action, as well as foils of common household objects and the action produced to use the objects. The objects included a saw, garden shears, and a hand mixer. The dynamic images were displayed in four quadrants of the TV screen. The four recorded images were randomly ordered in the display of the objects/actions. A participant was shown the first of three sets of recorded images. It displayed four different actions being performed by the investigator without the use of objects in the action sequence. The images looked like pantomimed actions. The investigator observed a participant's eye tracking to ensure that he or she visually scanned the set options. In some cases, the investigator had to nonverbally instruct a participant to look at each quadrant on the TV monitor. This was done by pointing to each quadrant while observing the participants' eye tracking. Next, the participant was asked, "Which is /kaIp/," while still viewing the four actions being performed by the investigator without objects. Once the participant's response was recorded, the recording for the second item was shown.

The second recording displayed four object images on the TV screen, one of which was the antique-juice press. The same eye tracking procedures were implemented for this task as described above for the first item. The participant was then asked, "Which is /pak/?" The participant's response was recorded.

The third and last recording was presented to the participant. It displayed the same four actions that were shown in the first recording, however, this time the four actions were performed with the objects acted on. The same eye scanning procedures were used for this task. Then, the participant was instructed, "Which is /kaIp/?" The participant's response was then recorded.

WH-questions Task

The WH-Questions comprised questions 7-11 of the verbal measure (Appendix G). These questions required the participant to answer questions that were presumed to vary in level of difficulty. Answers to the questions provided the investigator with information about each child's ability to understand and produce various syntactic-semantic structures. The answers to the questions were scored according to a point scale that was developed in previous research (Stockman & Latham, 2002; Latham & Stockman, 2002). Verbal and nonverbal responses were scored.

Description of Nonverbal Measures

The nonverbal performance measures were based on a child's ability to reenact the juice-making event. Two performance measures were used for participants in both the first (day 1) and second (day 2) treatment conditions: (1) a nonverbal performance score and, (2) a nonverbal rating. The nonverbal performance measure was obtained following the teaching event on day 1 (nonverbal score 1) and again on the second day, following verbal measure 3 (nonverbal score 2).

The nonverbal score reflected a child's ability to do the steps needed to achieve the action goal (logical aspect). The nonverbal rating reflected a child's ability to efficiently execute the actions (sensory-motor aspect). To reenact the juice-making event, the children were given the same stimuli used by the investigator during the teaching trial. The child was instructed to repeat exactly what the examiner had done. All behaviors were video recorded for analysis.

Nonverbal Score

The nonverbal score was a quantitative measure based on a child's ability to replicate global steps in the event sequence of making orange juice (Appendix I). Scoring was based on whether a child replicated the five steps of the event in the correct order, and whether assistance was needed to complete any step. Each step had a point range of 0-2 points and yielded an overall score range of 0-10. For each step, a child was given a score of "2" if he or she completed the step unassisted. If a child needed assistance after self-initiated attempts, he or she was given a score of "1". A score of "0" was given if a child made no attempt to initiate the step and required the investigator to initiate and assist during the step.

Nonverbal Rating

The nonverbal rating was a qualitative score that reflected a child's perceived confidence and comfort level with performing the task independently, the speed in which the child completed the task, and the need for assistance in completing the sequence. The rating scale (Appendix J) used a 5-point scale with a score of "1" representing competent execution and smooth transition. A score of "5" indicated that the nonverbal task was extremely difficult, time consuming, and required help from the investigator repeatedly. In addition to the 5-point scale, the raters were asked to provide a rationale for the score given to a child.

Data Analysis

Raters

The Rating Task

Four female SLP's, who hold the American Speech Language Hearing Association's Certificate of Clinical Competence (CCC), judged the performances of both groups of children. The raters were naïve to the study's goals to minimize scoring biases. They applied standard evaluation criteria to randomly-ordered, video records of the children's responses to the experimental tasks. Raters individually watched the video records on a TV/VRC in the Communicative Disorders Department on the campus of Saint Mary's College, Notre Dame, Indiana.

Training the Raters

Prior to rating the video records, each rater attended an individual training session. It familiarized her with the protocol scoring sheets (Appendices G, I and J). Raters were given a three-ring binder that included the prepared forms and instructions for making and recording their judgments (Appendix K). Each binder contained every participant's assigned pseudonym on a tab, so the rater could easily access a child's score sheets.

Scoring Verbal Performance

During the training session, each rater was instructed to write down exactly what the child said or did for each question on the verbal scoring form's designated space. If a rater did not understand what a child said, she was instructed to indicate this on the verbal scoring form. If the investigator asked a child a question for the second time after receiving no response from the child, the raters were instructed to score the second trial. They were also instructed to score each response according to the point values given in Appendix K. For example, on question 1, "What is (point to orange)," raters were instructed to judge a child's response as follows: If the child responded verbally by saying the word, "orange", the performance was given two points. If the child gave a similar response by referring to another type of fruit or by saying, orange juice, the performance was given one point. If a child gave no response or an incorrect response, the performance was given zero points.

Assigning weighted scores to the responses allowed for the expected variability of children's responses. Some responses were more sophisticated than were others, even when they were not optimal. For example, one child responded to question 3, "What is (press on juicer)?" by stating, "That's pressing down to get juice." Although this was not the response that the investigator was aiming to get (/kaIp/), partial credit was given because it showed some understanding of the object's function even if the name of action was not given. Finally, the raters were instructed to total all points and record this total on the form as designated. Raters were instructed to use these same procedures for all four verbal measures obtained for each participant.

Scoring Nonverbal Performance

Nonverbal Scoring and Analysis Procedures

Following instruction on the verbal measures, the raters were given directions for scoring the nonverbal measures. First, the raters were instructed on how to obtain the nonverbal score (Appendix I). The raters were instructed to score each step of the task according to the point values provided by placing a check mark in the appropriate box for each step of the task. If unassisted in completing a step, a child was given 2 points. If the child initiated the step on his or her own, but required assistance during the task, he or she was given 1 point. If the investigator was required to initiate the step and assist the child during the step, 0 points were given for the step. Raters were then instructed to record the chronological order in which a child performed each step of the task. To do this, they were instructed to number a child's performance for each step next to the box containing the step description.

Nonverbal Rating and Analysis Procedures

Next, the investigator instructed the raters on the nonverbal ratings. The investigator played a videotape of herself performing the task of making orange juice. Each rater was instructed to use this example as a prototypical comparison for rating of the child. Specifically, each rater was asked to judge how close a child came to replicating the investigator's performance. To assign the nonverbal rating, the rater was instructed to subjectively rate the child's performance (Appendix J) according to a 5-point scale, that varied on a continuum from 1 (perfect execution) to 5 (very poor execution). If a child replicated the task with smooth transitions and competent execution, like the investigator had illustrated, they were to rate the child as 1. A child's replication was rated as 5 if the task seemed extremely difficult for the child to do and time consuming, or the child required help many times.

A composite mean nonverbal score for each child was computed from each rater's scores for each of the two nonverbal scores. A paired samples t-test was used to determine whether statistically significant differences existed between the two groups for each of the nonverbal scores, NV score 1 and NV score 2. In addition to comparing the mean scores for the two groups, each one was compared to itself over time. Nonparametric measures, namely the

Friedman's rank test for *k* correlated samples, were used to demonstrate significance.

A composite mean nonverbal rating for each child was computed from each rater's scores for each of the two nonverbal rating scores. Paired samples t-tests were used to determine whether the participant and observation groups differed significantly at day one and day. Within group comparisons were made using nonparametric measures.

Statistical Analysis

Computation of Scores

The scores of the raters were averaged to produce a verbal composite score for each child in each treatment condition for each of the four verbal measures. An Analysis of Variance (ANOVA) was done on each composite verbal score to evaluate whether the raters' mean scores differed significantly.

Statistical Tests

The SPSS software was used for the statistical analysis of the data. An Analysis of Variance (ANOVA) was performed on the raters' scores for verbal performance among the participants for each composite verbal score. The two treatment groups were compared statistically using paired samples t-tests for each composite verbal score. The Cohen's d statistic was calculated to determine the magnitude of the difference between the treatment conditions. Each treatment group was compared to itself using a one-way ANOVA.

An item analysis was done on the verbal questions using means, standard deviations, and paired-samples t-tests to determine whether differences exist between the observation and participation groups. Between-group comparisons were made on nonverbal scores using paired samples t-tests. Within-group comparisons were made using the Friedman's rank test for *k* correlated samples.

CHAPTER 3

RESULTS

This study investigated the effect of sensory input modality on verbal and nonverbal learning of children with ASD. It aimed to determine if such children who bodily participated (hands-on learning) in a novel event differed on verbal and nonverbal tasks from their matched ASD-diagnosed peers who just observed the same events visually and aurally. The assumption was that the participation group who received tactile-kinesthetic input through hands-on experience would be given an advantage in learning a verbal and nonverbal task. Additionally, the study aimed to determine whether group differences show up in the retention of both verbal and nonverbal learning over time, specifically after a latency of 24 to 48 hours.

The 34 participants were taught two novel words, one noun and one verb, within the context of performing a novel orange juice-making task. Learning effects were measured by scores obtained on verbal and nonverbal measures. In analyzing the results, the null hypothesis was set at $p=.10$ or less instead of $p=.05$ or less, the customary p value. The use of a more lenient p value was justified by the exploratory nature of the study. It allowed the investigator to identify significant trends in the data that could lead to further research.

Verbal Performances

Reliability of Individual Raters

The data consisted of each child's composite verbal score, as averaged across each of the four raters for all verbal performance measures observed at each of four successive times following the initial learning event. Table 1 displays the means and standard deviations for each rater on each verbal measure.

The four composite verbal scores obtained for each of the four individual raters were compared in a univariate Analysis of Variance (ANOVA). Raters were compared on each of the four verbal scores obtained at times 1 through 4. Their means ranged from 6.85 to 7.47 for Verbal Measure 1; 6.53 to 7.29 for Verbal Measure 2; 6.76 to 7.56 for Verbal Measure 3; and 6.71 to 7.09 for Verbal Measure 4 (Table 1). Among the raters, differences between the largest and smallest mean did not exceed .80, which occurred on Verbal 3.

The F test results, which also are shown in Table 1, revealed no significant differences among the four raters. Therefore, the scores for the raters were averaged to yield a single composite verbal score as shown in Table 2.

Table 1
Composite Verbal Score by Rater Conflated Across Observation Conditions

Task		Rater 1	Rater 2	Rater 3	Rater 4	*F*	*df*	*p*
Verbal 1								
	M	7.47	6.85	7.00	6.91	.090	3,132	.966
	SD	5.68	5.43	5.40	5.38			
Verbal 2								
	M	7.29	6.59	6.53	6.59	.147	3,132	.931
	SD	5.78	5.33	5.34	5.64			
Verbal 3								
	M	7.56	7.12	6.76	7.18	.133	3,132	.940
	SD	5.32	5.36	4.81	5.29			
Verbal 4								
	M	7.03	6.91	6.71	7.09	.032	3,132	.992
	SD	5.70	5.33	5.18	5.76			

Note. The four verbal tasks correspond to successive performances observed across time.

Table 2 Mean Composite Verbal Scores obtained for the Participation Group and the Observation group plus t Statistic Outcomes Over Time

Measure		Participation	Observation	*t*	*df*	*p*
Day 1						
Verbal 1						
	M	8.12	6.00			
	SD	5.52	5.20			
	Cohen's *d*	.395		2.22	(3,16)	.041**
Verbal 2						
	M	7.76	5.74			
	SD	5.51	5.41			
	Cohen's *d*	.370		1.98	(3,16)	.065*
Day 2						
Verbal 3						
	M	8.25	6.06			
	SD	5.39	4.76			
	Cohen's *d*	.431		2.36	(3,16)	.031**
Verbal 4						
	M	8.25	5.62			
	SD	5.66	5.02			
	Cohen's *d*	.492		2.65	(3,16)	.017**
		$F(3,48) = .69$, $p<.56$	$F(3,48)=.72$.$p<.54$			

Note. *$p< .10$, **$p<.05$, ***$p<.005$

Composite Verbal Total Scores Analysis

Table 2 displays composite mean verbal scores computed separately for the participation and observation groups at each of the four time intervals, i.e., Verbal 1 through Verbal 4. The composite verbal scores tapped: (1) confrontational naming, (2) recognition of the novel noun and verb, and (3) elicited responses to WH-questions about the juice-making task.

Between-Group Comparison

The two groups were compared statistically on each composite verbal score using paired samples t-tests. The results of the t-tests for this between-group comparison are displayed in Table 2. The mean scores were consistently higher for the participation (hands-on) than the observation (nonhands-on) group on all four composite verbal scores. As shown, the mean scores across tasks varied from 7.76 to 8.25 in the participation group and they ranged from 5.62 to 6.06 in the observation group.

A paired samples t-test yielded statistically significant differences between the two groups at p values ranging from p=.017 (Verbal 4) to p=.065 (Verbal 2). To determine the magnitude of the difference, or the effect size, the Cohen's d statistic was calculated. The d values, ranging from .370 (Verbal 2) to .492 (Verbal 4), yielded moderate effect sizes.

Within-Group Comparison

A within-group analysis was done to reveal if the mean scores changed over time for each group (i.e., for each of the four successive elicitations of responses following the learning input condition). A One-Way ANOVA was performed on each treatment group to statistically measure whether differences occurred from the first to the fourth composite verbal score. Table 2 reveals mean scores that varied from 7.76 (Verbal 2) to 8.25 (Verbal 3 & 4) for the participation group and 5.62 (Verbal 4) to 6.06 (Verbal 3) for the observation group. A one-way ANOVA revealed no significant differences among the four composite scores for neither the participation group nor the observation group. Although no score shifts over time were statistically significant, it is worth noting one consistent data trend for both groups, namely, the mean score decrease from Verbal 1 (Time 1) to Verbal 2 (Time 2). The mean scores decreased from 8.12 to 7.76 and from 6.00 to 5.74 for the participation and observation groups, respectively (Table 2). A subsequent increase from Verbal 2 (Time 2) to Verbal 3 (Time 3) was followed by either a score decrease (observation group) or maintenance (participation group) from Verbal 3 (Time 3) to Verbal 4 (Time 4).

Verbal Task Analysis

The previous analysis focused on composite verbal scores, which conflated scores for three different types of tasks: (1) confrontational naming, (2) word recognition, and (3) WH-questions. A separate analysis of each of these tasks was done to determine if some verbal tasks contributed more than others to the composite score differences observed between and within groups. Table 3 displays the means, standard deviations, and the paired samples *t*-statistic for the three tasks by treatment group.

The confrontational naming task required participants to spontaneously generate the name of the object or action upon physical presentation by the examiner. The word recognition questions required the participants to point to a dynamic video image of the novel noun and novel verb upon request. The WH-Questions task required the participants to answer questions about the event, reflecting the participant's understanding of the question form and knowledge of the event.

Table 3 shows significantly higher mean scores for the participation than the observation group on each task. The means, ranged from 2.54 to 3.97 for the participation group and from 1.59 to 2.99 for the observation group. For both groups, the mean scores were the highest on the confrontational naming tasks, followed in order by the recognition and WH-Questions tasks. The paired t-test yielded significant group differences for each task. These differences were associated with moderate to robust effect sizes, as shown. The Cohen's *d* statistic ranged from *d* =.574 for the confrontational naming task to *d*=.838 for the WH-Questions task.

Table 3
Means, Standard Deviations, & Effect Size on Verbal Tasks for the Participation Group and Observation Group

Task	Participation	Observation	*t*	*p*	*d*
Confrontational Naming					
M	3.97	2.99			
SD	1.76	1.65	4.66	.001***	.574
Recognition					
M	3.10	2.45			
SD	1.21	.55	1.79	.101*	.692
WH-Questions					
M	2.54	1.59			
SD	1.04	1.22	9.27	.0001***	.838

Note. *p<.10, **p<.05, ***p,.005

Task-by-Time Analysis

While the previous analysis revealed a participation group advantage on composite scores for each of the three types of tasks that comprised the verbal measure, this analysis focused on trial-by-task effects.

Table 4 displays the mean scores of the two treatment groups on each of the four performance trials. It shows that the mean scores for the participation group were higher than the observation group on all four performance trials for all three tasks. However, the differences were not significant for every task.

Table 4
Verbal Task Type Across Time for the Participation Group and Observation Group

Task Type		Participation	Observation	Difference	*t*	*p*
Confrontational Naming						
Time 1	M	4.20	3.88			
	SD	3.51	3.55	.32	.82	.417
Time 2	M	3.16	2.50			
	SD	3.04	2.98	.66	2.65	.011**
Time 3	M	4.18	2.74			
	SD	3.33	3.08	1.47	3.61	.001***
Time 4	M	4.33	2.84			
	SD	3.33	3.19	1.49	3.10	.003***
Recognition						
Time 1	M	2.57	2.29			
	SD	2.71	2.63	.28	.60	.553
Time 2	M	3.02	2.29			
	SD	2.89	2.79	.73	1.38	.174
Time 3	M	2.88	2.84			
	SD	2.78	2.90	.04	.10	.921
Time 4	M	2.59	2.37			
	SD	2.75	2.66	.22	.51	.612
WH-Questions						
Time 1	M	2.76	1.75			
	SD	3.34	2.82	1.01	2.91	.005***
Time 2	M	2.58	1.73			
	SD	3.42	2.93	.85	2.45	.016**
Time 3	M	2.36	1.51			
	SD	3.08	2.64	.85	2.46	.016**
Time 4	M	2.45	1.36			
	SD	3.17	2.76	1.09	3.37	.001***

Note. * $p < .10$; ** $p < .05$; *** $p < .005$

The confrontational naming task group yielded significantly higher scores for the participation than observation group for all trials except Time 1. The differences were more robust for trials 3 and 4 than 2. On the recognition task, none of the group differences in mean scores was significant across time despite the bias toward higher mean scores for the participation compared to observation group. The WH-Questions yielded the largest and most robust differences as shown across all trials. The participation and observation groups differed significantly on the WH-Questions task at every time interval.

Item-by-Item Analysis

Whereas the previous item analyses of question types conflated the outcomes for individual items within a question category, a narrower analysis was done to determine whether some of the individual items within each category of verbal tasks contributed more than others to the group differences observed.

Confrontational Naming Questions

The results of the item analyses are displayed in Figures 1.1 to 1.3. for the items in the confrontational naming task. Paired sample t-tests revealed significant differences between the treatment groups across time on two confrontational naming questions, "What is orange?" at times 2 and 3, and "What is /pak/?" at times 2,3, and 4. There were no significant group differences for the question, "What is /kaIp/?" during any of the four performance trials, even though the means were highest for the participation group on three of the four trials. See raw score data for Figures 1.1 to 1.3 in Appendix L.

The within-group analysis revealed that both groups fluctuated in their performances across trials. At the second performance trial, the mean scores for both groups decreased relative to the first time probe. The score depression is especially marked for naming the novel object, "/pak/." (Figure 1.2) The participation group differed from the observation group in that it increased its scores across time on two of the confrontational naming questions, "What is orange?" and "What is /kaIp/?". The participation group scored higher than the observation group at almost every point across time and across performance task. Thus the score distance between the two treatment group means increased across trials. This trend suggested greater retention of verbal learning by the participation than the observation group. The decreased means across trials for the observation group suggested reduced retention.

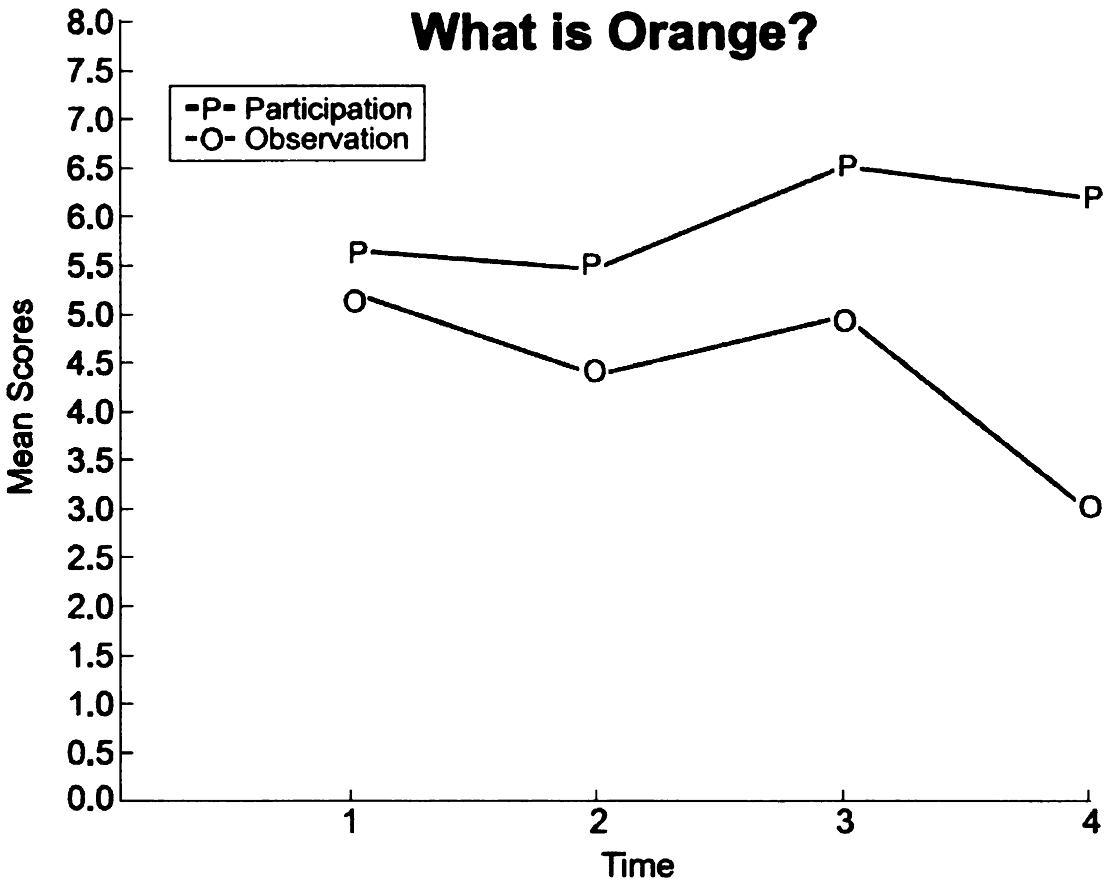

Figure 1.1
Mean Scores for the Participation and Observation Groups Across Time on the Confrontational Naming Question, "What is Orange"

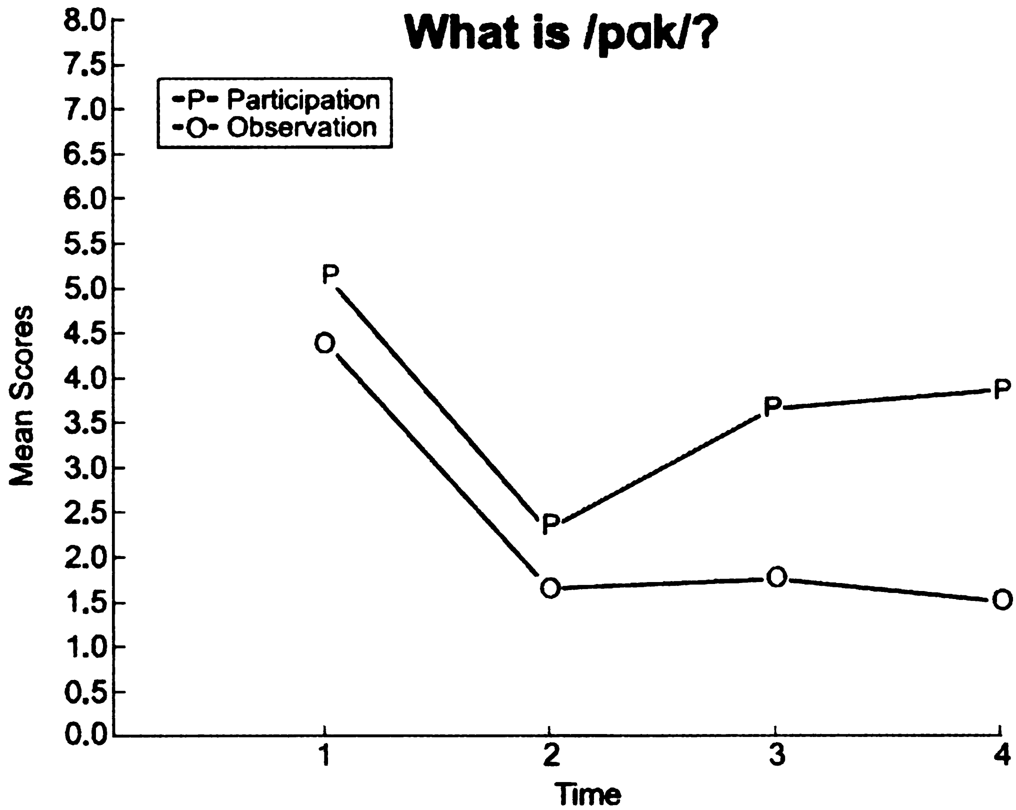

Figure 1.2
Mean Scores for the Participation and Observation Groups Across Time on the Confrontational Naming Question, "What is /pak/"

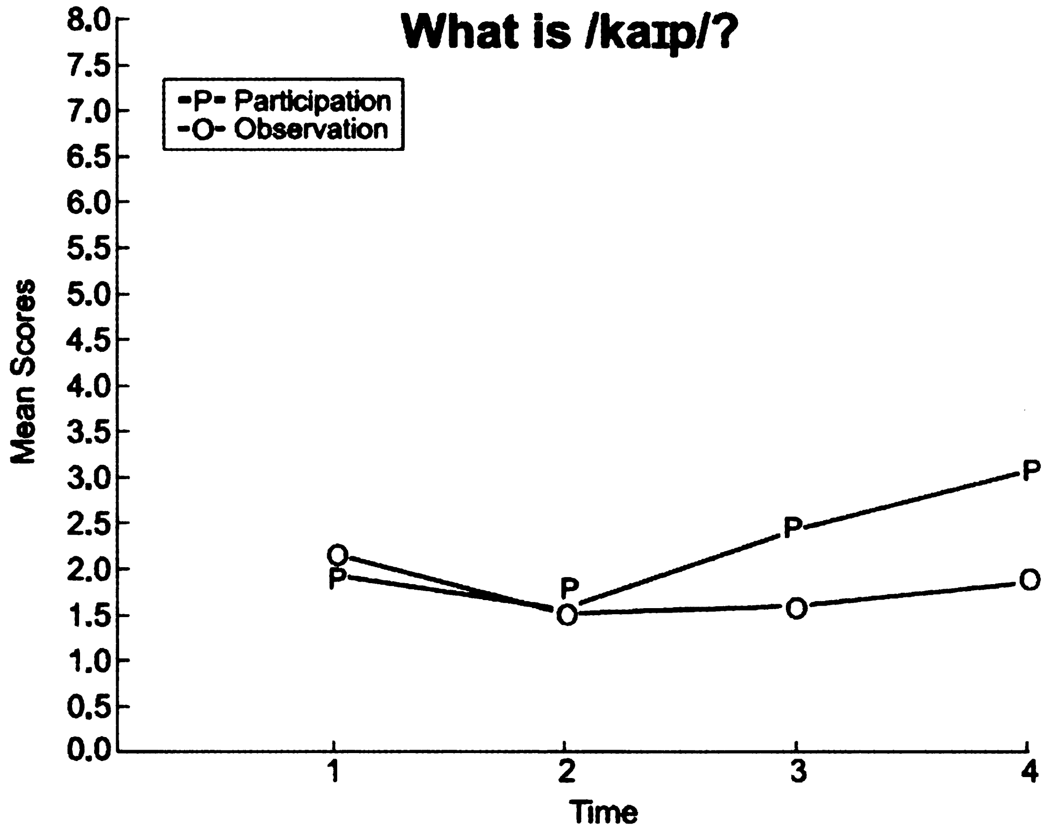

Figure 1.3
Mean Scores for the Participation and Observation Groups Across Time on the Confrontational Naming Question, "What is /kaIp/"

Recognition Questions

Figures 2.1 to 2.3 display the comparison of the treatment groups on the recognition task. See raw score data for Figures 2.1 to 2.3 in Appendix M. Only one recognition question (/kaIp/ without object) contributed to the group difference displayed in Table 4. Paired sample t-tests revealed significantly higher mean scores for the participation than the observation group across time on the item, "Which is /kaIp/" with object at time one (Figure 2.2). On the two remaining items, the performance of the two groups overlapped (Figures 2.1 and 2.3). The overlapping performance indicated that the participation group was not consistently better than the observation group for each performance trial. As a result, no statistical differences between the groups were found on the recognition task.

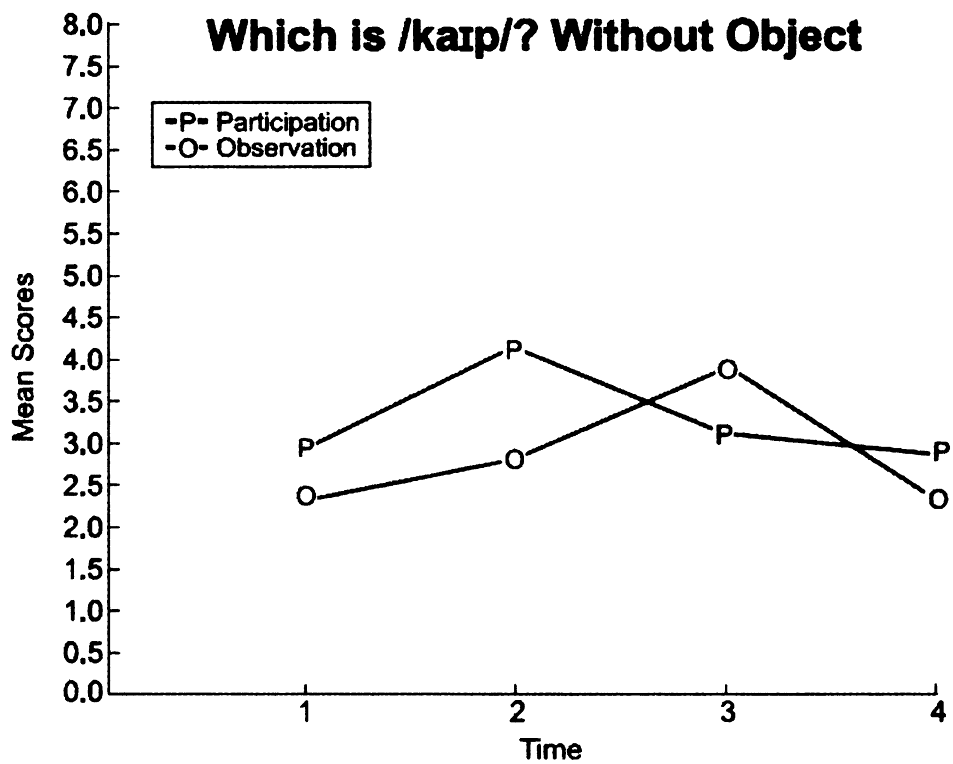

Figure 2.1
Without Object Mean Scores for the Participation and Observation Groups Across Time on the Recognition Question, "Which is /kaIp/"

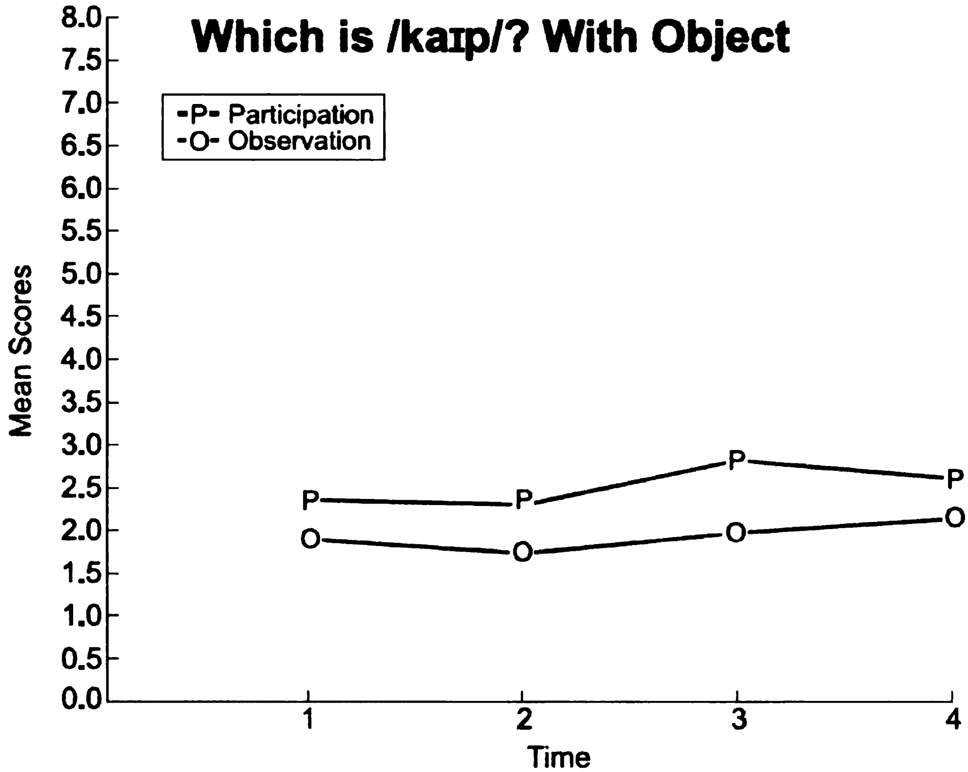

Figure 2.2
Mean Scores for the Participation and Observation Groups Across Time on the Recognition Question, "Which is /kaIp/" With Object

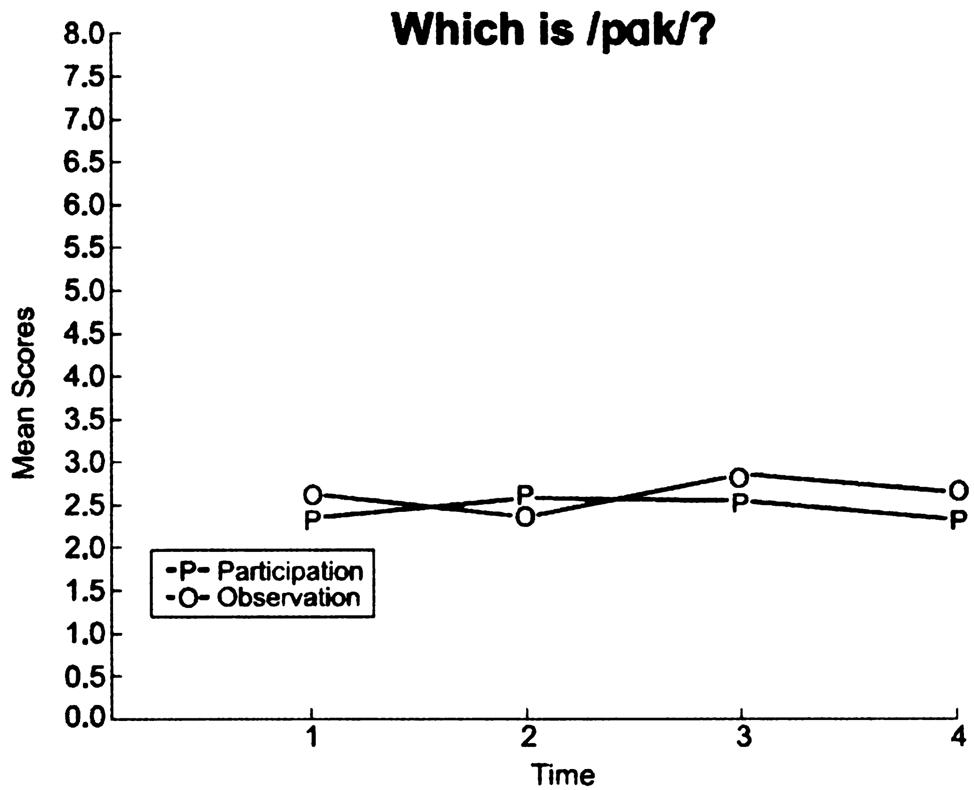

Figure 2.3
Mean Scores for the Participation and Observation Groups Across Time on the Recognition Question, "Which is /pak/"

Wh-Questions

Figures 3.1-3.3 display the mean scores for the two treatment groups on the WH-Questions. Paired sample t-tests revealed robust significant group differences ($p < .001$ to $.016$) on one or more trials for each of the following questions: *how*, *why*, and *when*. The significant differences across time were observed on the *how* question at times 1 and 2, the *why* question at times 1, 2, 3, and 4, and the *when* question at time 3.

The scores on the *who* and *where* questions also were consistently ranked higher for the participation than the observation group although the differences were not large enough to reach significance on any of the performance trials, with one exception, the *where* question at time 3. See raw score data for Figures 3.1 to 3.3c in Appendix N.

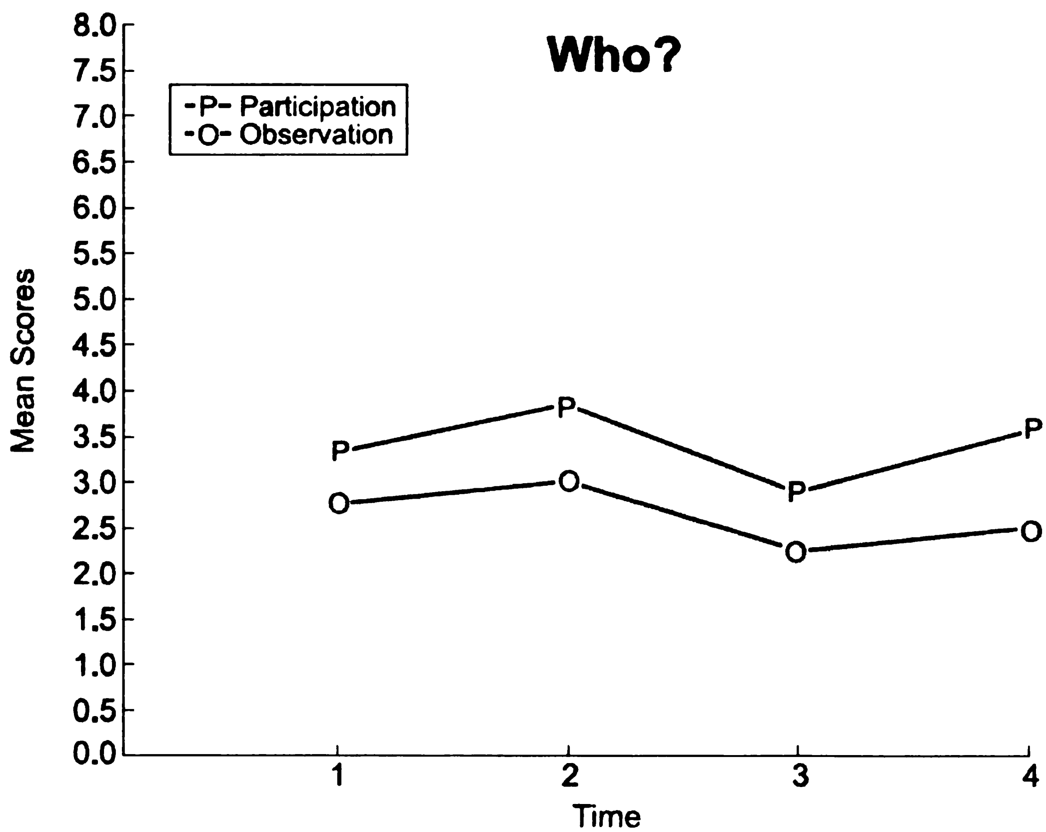

Figure 3.1
Mean Scores for the Participation and Observation Groups Across Time on the WH-Question," Who"

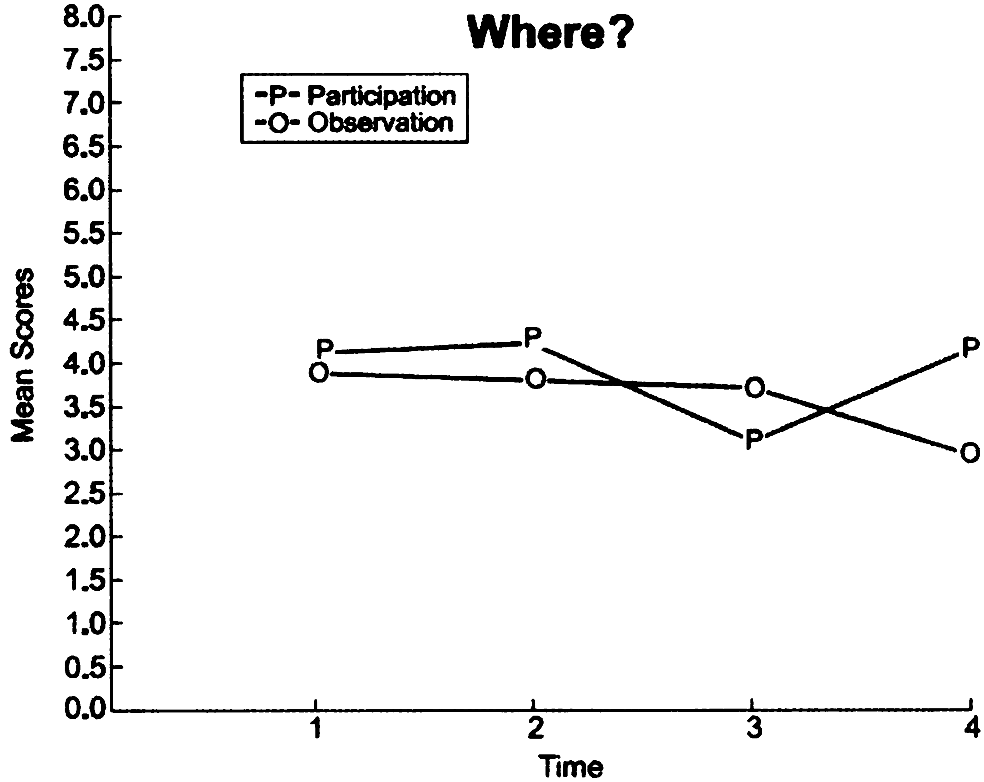

Figure 3.2
Mean Scores for the Participation and Observation Groups Across Time on the Wh-Question, "Where"

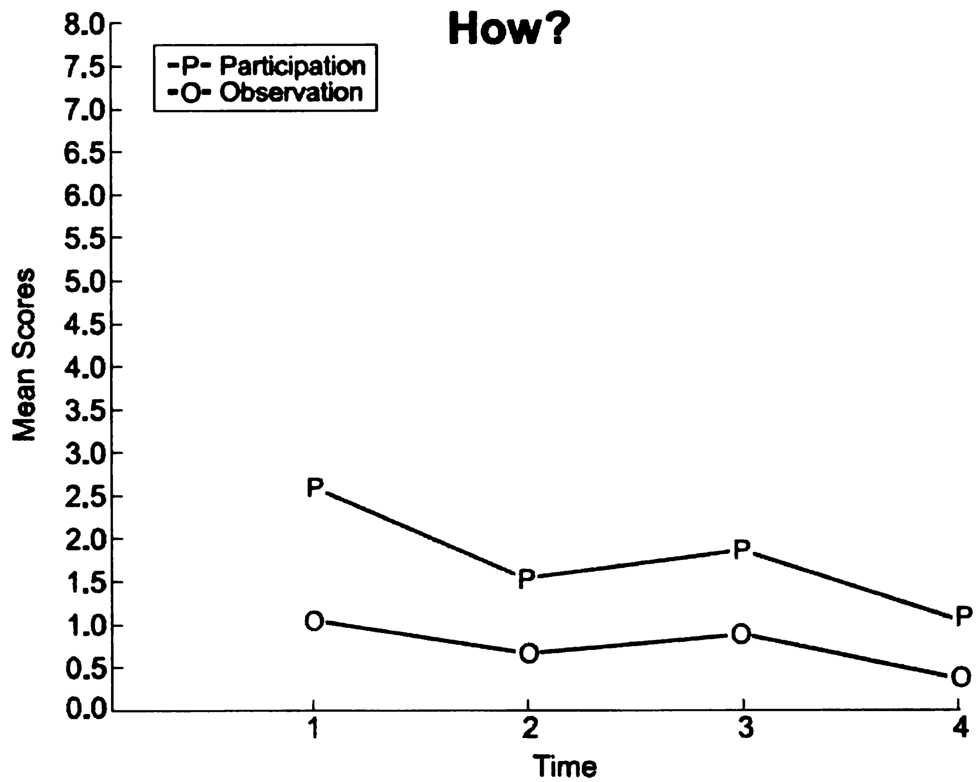

Figure 3.3a

Mean Scores for the Participation and Observation Groups Across Time on the WH-Question, "How"

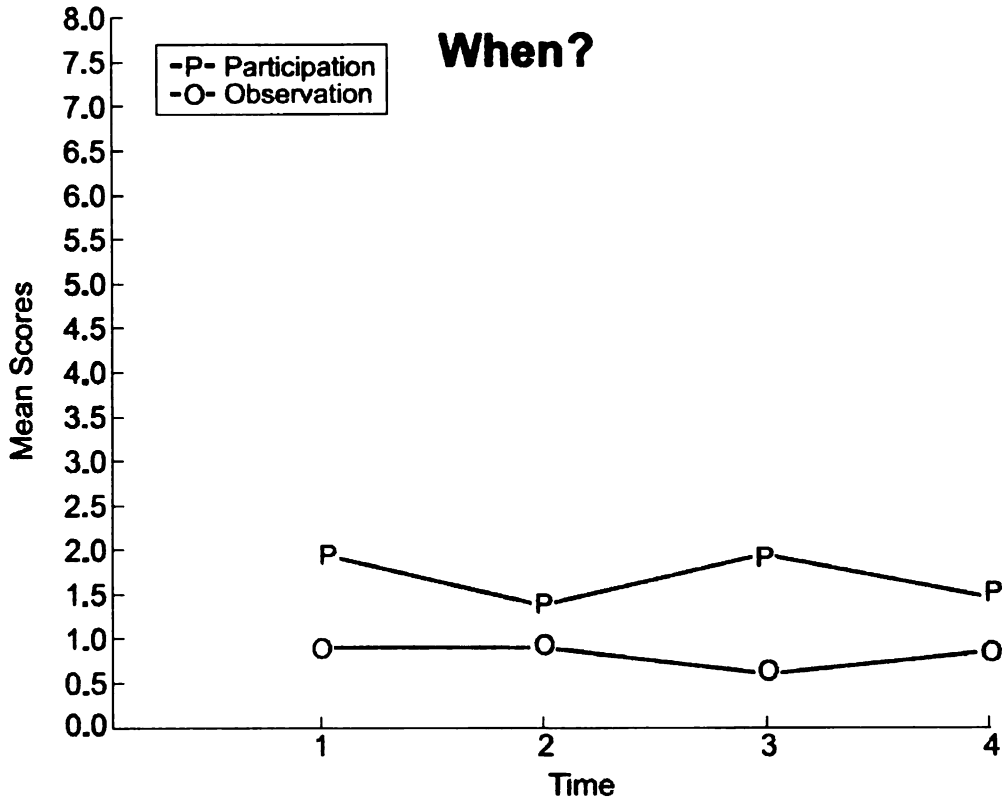

Figure 3.3b
Mean Scores for the Participation and Observation Groups Across Time on the *WH-Question, "When"*

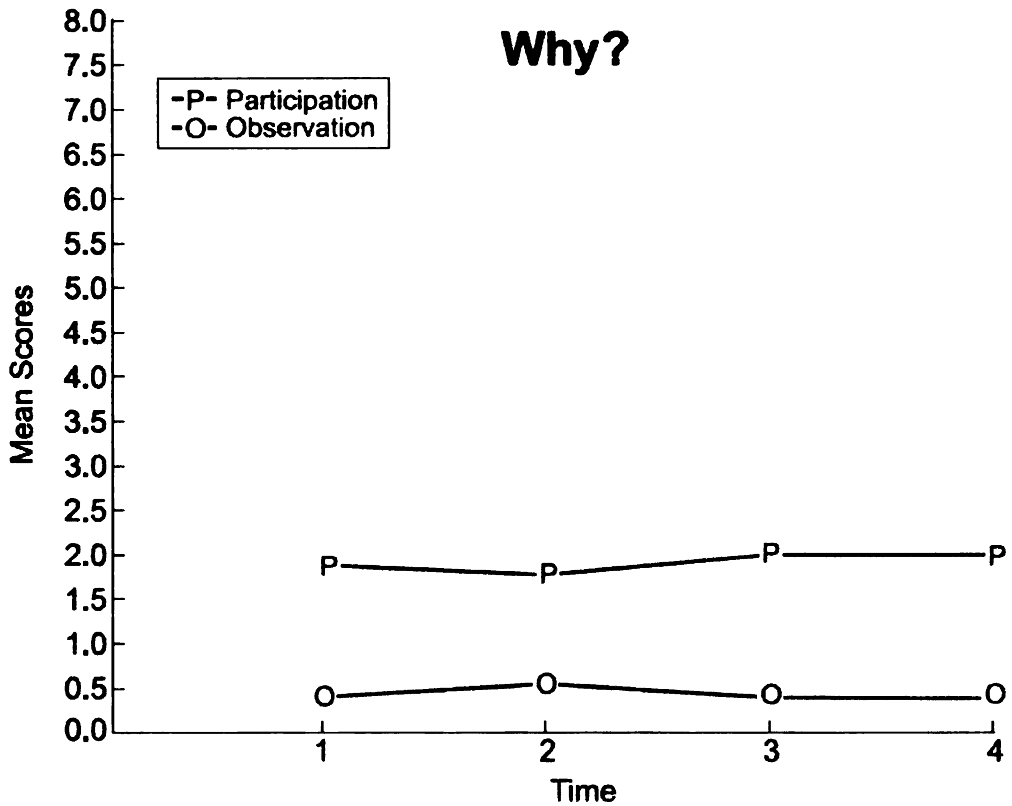

Figure 3.3c
Mean Scores for the Participation and Observation Groups Across Time on the WH-Question, "Why

Summary of Verbal Performance

The results for the verbal performances revealed that children with ASD who bodily participated in a novel event differed from their age-matched ASD peers, who observed an event just visually and aurally. In general, the children in the participation group scored significantly higher on each of three types of verbal tasks: Confrontational Naming, Recognition, and WH-Questions, and on the items within these tasks. Over time, the differences between the participation and observation groups increased on the confrontational naming task and WH-Questions task. The performance on the recognition task overlapped between the two groups, given that neither group performed consistently better than the other across all the trials.

Nonverbal Performance

Composite Nonverbal Score

Two non-verbal scores were used to determine if the children diagnosed with ASD who bodily participated in a novel event differed from those who observed an event visually and aurally. The nonverbal score reflected the child's ability to replicate the logical steps of making orange juice as outlined in the non-verbal scoring procedures. Table 5 displays the nonverbal scores of the participation and observation groups.

Table 5
Nonverbal Scores

Day	Measure		Participation	Observation	*t*	*p*	*d*
1							
	NV Score 1						
		M	8.10	4.60			
		SD	1.97	3.42	3.88	.001***	1.254
2							
	NV Score 2						
		M	8.35	6.13			
		SD	1.66	3.47	2.92	.010**	.816
		p=	.366	.021**			

Note. **p*<.10, ***p*<.05, ****p*<.005

Between-Group Comparisons

The participation group scored higher than the observation group on both day 1 and day 2. A paired samples t-test revealed a significant group difference for nonverbal 1 at the p=.001 level. Another paired samples t-test, which compared the two groups on the second nonverbal score, revealed a significant difference at the p=.010 level. Therefore, children diagnosed with ASD who bodily participated in a novel event did differ from those who observed the nonverbal event. The Cohen's d=1.254 indicated an extremely large effect size at time 1. At time 2, Cohen's d=.816, which also indicated a large effect size.

Within-Group Comparisons

Within group comparisons also are displayed in Table 5. In addition to comparing the two treatment groups with each other, each group was compared to itself over time with the goal of determining if nonverbal performance was affected by group assignment over time. The participation group slightly increased its mean score from Time 1 (M= 8.10) to Time 2 (M= 8.35). This difference was not statistically significant. But the observation group's increased mean score from Time 1 (M=4.60) to Time 2 (M=6.13) was statistically significant. Using nonparametric measures, specifically the Friedman's rank test for k correlated samples, a statistically significant difference was obtained (p =.021) for the observation group. This outcome demonstrated that by interacting tactually with objects, a child can improve his/her performance over time even if the original learning trial did not include manually guided procedures.

Composite Nonverbal Rating

Two non-verbal ratings were obtained to determine if the children who bodily participate in a novel event differed qualitatively from those who observed an event visually and aurally on non-verbal tasks. The two treatment groups can be compared in Table 6.

Table 6
Mean Non-Verbal Ratings and Standard Deviations for the Participation and Observation Groups

Day	Measure		Participation	Observation	*t*	*p*	*d*
1							
	NV Rating 1						
		M	2.95	3.90			
		SD	1.08	1.16	-2.94	.010**	-.848
2							
	NV Rating 2						
		M	2.88	3.57			
		SD	.96	1.23	-2.59	.020**	-.625

Note. *p<.10, **p<.05

Lower ratings corresponded to better performance while higher ratings corresponded to poorer performance. A rating of "1" reflected the rater's judgment that the task replication was competently executed and done with smooth transitions. The "5" reflected the rater's judgment that the task replication was extremely difficult, time consuming, and required the child to ask for help many times. Mean nonverbal ratings are shown for Day 1 and Day 2 of the testing in Table 6.

Between-Group Comparisons

The mean scores were lower for the participation than the observation group at both times, i.e., Day 1 and Day 2. This meant that the participation group was judged to be qualitatively better at executing the juice-making task at both sampling times. A paired samples t-test revealed statistically significant group differences at the p=.01 level. Another paired samples t-test, compared the two groups at day 2 and revealed statistically significant differences at the p= .02 level. These findings suggested that although the children in the observation condition may have improved with their nonverbal performance from day 1 to day 2, they were rated qualitatively different from the children who received the tactual-kinesthetic input in addition to the visual and auditory input during the teaching trial.

Within-Group Comparisons

Table 6 also displays the within group non-verbal ratings. The participation group's nonverbal rating improved from day 1 (M=2.95) to day 2 (M=2.88) as did the observation group (cf. M=3.90 on day 1 and M=3.57 on day 2). Neither the participation group nor the observation group demonstrated statistically significant differences over time.

Summary of Non-Verbal Performance

The results from this study revealed significant verbal and nonverbal differences between children with ASD who had hands-on participation in the novel juice-making and those who just experienced the same visually and aurally. The hands-on group obtained significantly higher verbal and nonverbal scores. They demonstrated these higher nonverbal scores not only initially, but also maintained their differences across a 24-48 hour time span. Therefore, the initial intervention was adequate enough to stimulate learning that could be detected in the children's performance beyond the initial learning trials.

The results did not reveal significant score increases for either group over time. While the observation group benefited from interacting with the materials, it did so to less extent than did the participation group.

The raters subjectively assigned better ratings to the participation group than the observation group at both time 1 and time 2. The raters did not score the participation group or the observation group as being subjectively different from time 1 to time 2.

General Conclusion

The results revealed an empirical bias in the data that favored better verbal and nonverbal performance for the participation than the observation group with ASD on novel tasks. Given these results, it can be concluded that both verbal and nonverbal learning are likely to be facilitated when children diagnosed with ASD are manually instructed to do a task or say a new word.

CHAPTER 4

DISCUSSION

This dissertation investigated the effect of using different sensory modalities on learning novel verbal and nonverbal tasks among children with ASD, and whether such learning effects are sustained across time. It was hypothesized that the children who manually participated in a novel juice-making event would receive more effective input than the children who only watched and heard the same event. Consequently, they were expected to better store and retrieve novel words and their meanings as well as nonverbally reenact the newly learned functional event when compared to children who just observed the same event visually and aurally. In addition, it was hypothesized that the differential learning effects for the two groups would be sustained after a latency of 24 to 48 hours.

The results generally confirmed the expected outcomes. Manual participation in a novel event resulted in not only significantly higher nonverbal performance, but also significantly higher verbal performance when compared to the performance of participants in the visual and auditory observation condition. These findings suggested that even brief exposure to the hands-on intervention led to a significant shift in both nonverbal and verbal learning for some children. The practical implication is that enhanced somatosensory perception via manual guiding allows professional service providers and caregivers to effectively intervene when a child does not respond to auditory and visual instruction. The theoretical implication is that manually guided input should not be viewed as a passive source of perceptual input for acquiring knowledge. If anything, this study, like earlier pilot research, suggests that such input may be even more effective than just providing auditory, visual, and olfactory experiences. Adding the tactual systems seems to be helpful. The purpose of this chapter is to discuss the possible reasons for the observed outcomes in this study and their implications for clinical and research work.

Study Outcomes and Explanatory Factors

Verbal Learning

The verbal tasks entailed asking the participants a series of probe questions in three broad categories of tasks: (1) confrontational naming, (2) word recognition, and (3) Wh-Question responses following the event of making orange juice. The composite mean verbal score, which included all three tasks, was significantly higher for the participation than the observation group. This finding was supported by robust statistical outcomes that exceeded the conventional .05 level of probability for determining statistical significance.

This predicted outcome was consistent with earlier studies, which have shown manually guided, nonverbal interaction experience to be a more effective instructional strategy than just watching and listening when learning novel word meaning and nonverbal tasks (Mitchell-Futrell, 1992; Rowe, 2003; Beretta, 1999; Luce, 2004; Stockman & Latham, 2002; Latham & Stockman, 2002). However, every task did not contribute equally to the strength of this outcome. The verbal composite score pooled outcomes from different tasks with different processing and retrieval demands. The discussion to follow, examines the contribution of individual items to the group differences observed on the three types of tasks.

Confrontational Naming

Task description. The confrontational naming task consisted of three questions: (1) What is (orange)?, (2) What is /pak/?, and (3) What is /kaɪp/? To answer these questions, a child had to know the name or verbal form for the object or action in the orange juice-making event and know what the word referred to, i.e., the semantics or the meaning of the word. This naming task had complex requirements for success. It required the child to have stored the word in memory and to have created an oral motor map for articulating the speech sounds in the novel words so that they could be understood.

Expected performance. We expected the participation group to perform better than the observation group on each item probe, and especially on recalling the action, /kaIp/. It was reasoned that the observation group would have had less information about the action word, /kaIp/, because it did not perform the action during the learning trial. Visual and auditory information were accessible but not the experience of tactually interacting with the objects to gain important information about the action meaning for this novel verb. In addition, the participation group received oral tactual prompting that ought to have helped them to create an oral motor map to guide productions. If there were going to be any group difference that favored the observation group, it was expected to occur for the word /pak/. Its phonetic properties were visually salient, thus matching the initial input received by the observation group during the learning trial. It was reasoned that just seeing and hearing the stimuli may have been enough to retrieve the name of this object. In contrast, the participation group interacted with the object. As a result, learning the novel object name as part of an action could have made the novel noun word less salient for the participation group than the observation group.

Overall outcomes. Although differences between the two groups on the confrontational naming tasks were observed as expected, the results were surprising. The group differences that favored the participation group were significant for only the object words (i.e., the familiar word, orange, and the unfamiliar word /pak/), and not for the action word /kaɪp/, as was predicted. That is, the participation group performed better than the observation group even on the word, /pak/, which was expected to favor the observation group, given the visually salient phonetic properties for the /p/ and /a/ sounds. This outcome differs from the earlier pilot studies, which revealed significantly higher scores for the participation than observation group on all verbal items (Stockman & Latham, 2002; Latham & Stockman, 2002).

Several factors could have contributed to the observed confrontational-naming results. They relate to phonetic and semantic differences between the requirements for learning the noun object word used in this study as opposed to the action word. These two words differed both in their phonetic and semantic properties.

Phonetic explanation. Regarding phonetic properties, better object word naming by the participation than the observation group could be explained by its exposure to oral tactual surface prompts during the learning trial for the word /pak/. The participation group was required to actually articulate the word while surface prompts were given to guide the production efforts. That is, the investigator provided the children in the participation group with auditory, visual and tactual input. Surface prompts provided information about the place, manner, voicing, and the sequential and temporal organization of the speech sounds in the novel words. The observation group was not provided with the same information for learning the same word.

Although PROMPT cues were used for both the novel object word, /pak/, and the novel action word, /kaIp/, significant group differences were not observed for both. Perhaps it was the phonetic complexity of the stimulus that led to significant group differences on /pak/. The first sound, /p/, in the name of the object word was both visually and tactually salient as was the open mouth posture for the vowel /a/. In contrast, the first sound, /k/, in /kaIp/ was not visually salient although it may have been tactually salient.

The complexity of the phonetic form, however, cannot completely account for the observed group differences because both groups produced the word *orange*, more often than either of the novel words, /pak/ and /kaIp/. Yet it arguably required the most phonetically complex production and it was not tactually prompted for either group. The word *orange* has two syllables, unlike the novel object and action words, and it includes, for example, two later developing consonants, a liquid and an affricate.

However, any explanation based on prompt cueing does not account for why the participation and observation groups differed on /pak/ and /kaIp/, but not the familiar word, *orange*. Recall that PROMPT cues were not provided for the word, *orange,* for either group and children in both groups were required to know the word, *orange*, as a condition for their participation in the study. The observed differences between the two groups for the word, *orange,* may be explained by other factors. The participation group may have had better recall of the familiar word because it handled the oranges in addition to seeing and smelling them during the initial teaching condition. That is, multimodal input with handling the oranges may have stimulated better recall of known information than did just seeing and smelling the oranges.

Semantic explanations. The most surprising results of the confrontational naming task involved verb learning. It had been hypothesized that because the children in the participation condition actually performed the action that they would more easily map the targeted novel word to the action performed during the initial learning event. But, there were no significant group differences in naming the action /kaɪp/ on any of the four trials, despite the bias toward higher scores for the participation group. The PROMPT cues that presumably helped the recall of the novel object word, /pak/, did not have the same effect for the novel verb word, /kaIp/. Thus, action verb word learning may have differed from object word learning. It is already known that acquiring the meaning of an action verb word may require attention to multiple aspects of an event. For example, one must figure out whether meaning refers to the instrument involved; the action performed, or the result of the action (Talmy, 1985; Gentner, 1982). So it is possible some of the children in the observation group responded incorrectly to the action question with the object name /pak/ because they mapped the meaning in terms of the visually observed instrument used. The participation group could have relied on other available properties such as tactual-kinesthetic input.

The different outcomes observed for verb and action learning reinforced the idea that verb and noun learning differ. Verb learning poses several problems for children. One problem is that adults do not label actions frequently for children (Tomasello, 1995). In fact, verbs cannot be labeled for children in the same way that a noun can be labeled. In most cases the referent action is not perceptually available to the child before, during, and after the label is provided, as is the case with causative action. For example, the verb "disappear" would not be labeled following the event of hiding a teddy bear as "I disappeared the teddy bear." This is contrary to object labeling. If one were teaching the word, "teddy bear," it would always be labeled as such. So part of the problem is the transient nature of action verb referents whereas objects can have a static reality. Many children with autism have difficulties effectively processing transient information (Hodgdon, 1996).

Regarding differences in semantic properties, noun object words and action verb words may involve different processes (Tomasello & Farrar, 1984; Gopnik & Meltzoff, 1987; Adamson & Tomasello, 1984; Gopnik, 1988; Tomasello & Farrar, 1986). Other factors may have been previous event experience

(Nelson, 1986), event knowledge (Slackman, 1985), and input modality (Stockman & Latham, 2002; Latham & Stockman, 2002).

Syntactic explanation. Another possible explanation for the difference between the object and verb labeling performances is that syntactic cues were not available. The theory of syntactic bootstrapping (Landau & Gleitman, 1985) proposed that syntactic cues surrounding verbs reduce possible word meanings, thereby helping a child to determine that a referent is a verb. In this study, only the stimulus word was presented, e.g., "/kaɪp/" or "/pak/". So the participants could not use syntactic cues to help figure out whether the stimulus word was a verb or noun.

Recognition Task

Task description. The recognition task required the child to point to a dynamic visual display of the novel object or of the examiner performing the novel action in a field of four stimulus acts. The child had to look at the video screen and perceptually process the multiple images before choosing a response to the verbal stimulus. The child had to associate the novel object or action with a visual referent. This task also required the child to translate the real-life event experienced in real time to a video image in the here and now on a TV screen.

Expected performance. The participation group was expected to have significantly higher mean scores than the observation group on the recognition task attributed to group differences on the confrontational naming tasks above.

Outcomes. The significant overall differences observed between the two groups favored the participation group, as expected. However, the group differences on the recognition task were weak (p=.10) relative to the confrontational naming and Wh-question tasks. The only significant between-group difference observed was on /kaIp/ with the object at time 1, which yielded the better performance for the participation group. The observation group did this task as well as the participation group even though no tactual input had been given during the teaching trial.

Explanations for this observed outcome can appeal to the nature of the input stimulus presentations during the teaching trial. That is, this task was likely to be easier for the observation than the participation group, as predicted, because its input training task resembled the task used to judge the learning outcome. The inputs for both the learning and evaluation tasks were similar in that they both involved experience with predominantly visual and auditory events.

Another expected outcome was that the participation group had higher mean scores than the observation group for the recognition item probes that evaluated verb understanding. For /kaIp/ with and without the object, the participation group had higher mean scores on 7 of the 8 opportunities across time. The verb/action versus noun/object outcomes were in the expected direction despite the lack of significance difference. That is, the object item, /pak/, was most successful for the observation group, while the verb/action item was the most successful for the participation group. It is inferred that information about object properties (e.g., shape, size, color) were more readily available via vision to which the observation group had access while information about transformative properties of action were more readily available to the participation group.

WH-Question Task

Task description. The WH-Questions task required a child to understand both the form and meaning of the question asked. That is, a child had to know the form, connect it to meaning, and then generate a spontaneous response. The questions were open-ended, although "who" and "where" were much less open-ended than "how", "why" and "when". Accurate responses to the questions "how", "why" and "when" required an understanding of causative relationships among objects and the actions performed on the objects. The "who" question required an understanding of person, and the "where" question required the understanding of content related to the location of objects and the sequences of actions.

Expected performance. The participation group was expected to have higher mean scores than the observation group on the WH-Questions task relative to the confrontational naming and recognition tasks just described. The largest group differences were expected on the "how," "why," and "when" questions because they required integration of event knowledge and action sequences.

Outcomes. The significant overall differences observed between the two groups on the WH-Questions supported the hypothesis that children's ability to describe an event may be enhanced by participation in an event, as opposed to just visually and aurally observing it. But the five questions did not contribute equally to this effect as discussed below.

Two of the WH-Questions, *who* (object) and *where* (object place), did not yield statistical significances between the two groups, as predicted. It is likely that these questions could be answered correctly based on object knowledge alone, which the observation group had available from just the distant senses (i.e., audition, vision, olfaction) during its learning trial. However, the participation group was not at a disadvantage by having tactual-kinesthetic input. In fact, the participation group was favored on all but one question (*where* at time 3) at one or another point in time.

The WH-Questions for which significant group differences were observed included *how, why,* and *when.* When comparing the two treatment groups by mean scores, the participation group's mean scores were ranked higher than the observation group on each of the three questions at times 1, 2, 3, and 4. It is inferred that having access to multimodal input with tactual information aided the ability to describe the cause and effect relationship during the event as Slackman (1985) also inferred from a study of the role of action in children's learning of an unfamiliar event. The test questions in the current study required children to comprehend the goal and temporally organize the juice-making event. Having interacted with the objects during the learning trial, the children in the participation group were likely to have gained better understanding of the causative relationships among the objects than did the children in the observation group. Recall that the latter group experienced the same event via just the distance senses, namely, vision, audition, and olfaction. Therefore its cause-effect information had to be based inferences from the auditory and visual information given. Affolter and Bischofberger (2000) argued that "tactually anchored input is more critical than is vision for acquiring conceptual knowledge about causes and effects underlying a sentence grammar," (p.210).

The importance of the initial input for learning an event was evident, given that the performance of the observation group continued to lag behind the participation group even after being given the opportunity to do the task on its own. But it never reached the performance level of the participation group.

Nonverbal Learning

Nonverbal Score and Rating

Task description. The nonverbal measures required a child to independently reenact the juice-making event. The task of making orange juice required the child to interact with real objects that included an antique juice press. The task required a contingency of steps to be completed. Refer to Chapter 2 for a detailed description of the nonverbal task.

Expected performance. Affolter (1991) and Affolter & Bischofberger (2000) suggested that participation in everyday events provides a child with functional knowledge for concepts and language. Therefore, it was expected that the participation group would differ significantly from the observation group both qualitatively (nonverbal rating) and quantitatively (nonverbal score) on the nonverbal measures. Hands-on participation in the novel event was expected to provide multimodal input experience, namely, the integration of tactual-kinesthetic with auditory and visual sensory input.

Outcomes. The expected group differences in nonverbal performance were observed. The significant differences favored the participation group in both the nonverbal scores and ratings. The largest group discrepancy occurred in the first trial after the participation group had just received hands-on experience during the learning event while the observation group had received just auditory and visual exposure to the same event before replicating it for the first time. It is inferred that the participation group had received an integrated perceptual experience that included not only vision and audition but also relevant tactual-kinesthetic information while being manually guided to do the novel task. As a result the participation group was expected to gain better understanding about the relationship between self and the environment as well as cause-effect relationships within the event when compared to the observation group (Affolter, 1991; Slackman, 1985). They experienced what needed to be done to achieve task success. For example, if a child was not pulling down hard enough on the handle of the juice press, the examiner provided the resistance to extract the juice. The observation group did not benefit from such feedback during the learning cycle.

Therefore, some children may not have been able to grade the amount of resistance required to effectively carry out each action in the event when asked to replicate the task. Its poorer performance relative to the participation group suggests that it may have been helpful to have this kind of information during the learning cycle.

Time

The participation group was expected to have higher mean scores on every task over time, on the assumption that it received the more salient information. In general, this expectation was supported by the data. The results revealed two trends in the data. First, both groups had decreased mean scores at Verbal 2. Second, there was a widening gap between the two group's overall verbal scores at time 3 and 4.

The decreased mean scores at Verbal 2 can be explained by information processing load. Verbal 2 was the first time that children in both groups were expected to reenact the event independently. Task success required an increased information load. A child had to remember or recall the steps needed and then execute the steps while performing the task.

The second trend in the data was the widening performance gap between the two groups over time. Although both groups were expected to increase mean scores over time, given past research (Stockman & Latham, 2002; Latham & Stockman, 2002), this outcome was observed only for the participation group. One interpretation of this outcome is that the participation group received more salient information through manual input during the event and therefore retained the information over time while the observation group decreased retention over time.

Although no significant within group differences over time were observed for the participation group, it maintained a similar performance level over time. It is inferred that the multimodal input given during the learning cycle was enough to sustain learning over time.

Implications for Clinical Praxis

There is now greater public awareness of ASD, given the current national focus on "curing" autism. Even though research has focused on finding a "cure", both the public and research communities are likely to agree that efficacious interventions are needed for children with autism right now. Current, interventions typically do not focus on "real life" events. Isolated skills are taught in sterile environments (Applied Behavioral Analysis). Representations, usually in the form of pictures, are used to teach children about language. Practitioners rely on auditory-verbal and visual instruction as is done to teach typically developing children. "Real life" events are too "messy." Practitioners may assume from anecdotal evidence that it is too difficult for children with ASD to learn a new skill when there are competing stimuli commanding attention at the same time. A child may not be able to figure out what is most important to pay attention. It is, therefore, common practice to teach a child in an environment where "distractions" are removed. For example, potential visual distractions are removed from the walls of Autism Impaired (AI) rooms in educational settings. Children may be taught at individually partitioned worktables in rooms that look and feel like laboratories. However, teaching and learning in such an environment require a skill to be transferred to real life, once it is learned (Stockman, 2004).

The current study offered support for using another intervention approach to teach children with ASD. This approach emphasizes hands-on interaction experience during real events that are easily applicable to everyday real world experiences. By interacting with objects in the context of an event structure, the children appeared to learn some aspects of language better than did their age peers in the observation group.

This study's goal went beyond just suggesting that we should carry out treatment for children with ASD in real life events. It also revealed that in meaningful contexts, children can learn without being drilled on the correct sequential order of performing the task or on vocabulary comprehension or on correctly answering WH-Questions. Drilling procedures are likely to teach a child to produce certain linguistic forms without their meaning or appropriate contexts for their use. That is, form is stressed without meaning or functional use. This study suggested that holistic learning that combined action/interaction events with their representations required multiple subsystems that included somatosensory input. Knowledge appears to be gained from tactual-kinesthetic experiences, that is, not obtained from just vision and audition. Some practitioners may take this to mean that they should just provide opportunities for "hands on" learning experiences. However, results of this study suggested that while learning can still occur in the absence of somatosensory input, as was observed when the observation group replicated the juice-making event, this group did not seem to benefit to the same extent as the participation group. This observation suggests that practitioners should not just have real objects available for children to interact with, but they may also facilitate learning about object relationships by manually guiding them to interact with the environment during purposeful daily events. As a result, the opportunity to receive important tactual-kinesthetic input ought to be maximized. The model of intervention developed by Affolter (1991) is useful because it aims to combine nonverbal and verbal learning.

In addition to targeting both nonverbal and verbal learning experiences, this study revealed that even with *minimal* instructional input, the children learned and retained some aspects of the novel task, both verbally and nonverbally. This alone is important because it suggests the possibility that multiple exposures could solidify learning outcomes even more than the single exposure presented in this research study.

Implications for Future Research

This study provided some empirical support for interventions, like PROMPT and GIT, which assume that tactual-kinesthetic input is a primary source of learning about spoken verbal and nonverbal events for children with ASD. More research is needed on the efficacy of augmented tactual input for children with ASD. Specifically, research needs to determine which children on the autism spectrum can best profit from augmented tactual-kinesthetic input. The treatment goal for children with ASD is independent function in society like other children. There is limited empirically-based evidence that current interventions do support use of an augmented tactual-kinesthetic model. Future research should: 1) address the heterogeneous nature of the ASD population in research designs, 2) increase the number of participants in the ASD category, 3) extend the type teaching events studied to include tasks varying in sequential and complexity combinations of perceptual input, 4) track longitudinally the learning of children with ASD, and 5) extend the research to include clinical trials. Each potential area for future research is discussed below.

Differences Within the ASD Population

The current research study recruited a critical mass of individuals with ASD and employed a control matched-pair design. Still this study was conducted on an undifferentiated group of children with the ASD diagnosis. Future research needs to investigate if and how the interventions used in this study may apply to different disorders under the ASD category: Autism, Asperger Syndrome, Rett Syndrome, Pervasive Developmental Disorder-Non Otherwise Specified (PDD-NOS), and Childhood Disintegrative Disorder. Some sub-classifications may have more focal tactual deficits than others. Stockman (2000) argued that of the three clinical subgroups identified by Affolter & Bischofberger (2000), the one with primary tactual deficits appears to be fit the profile of PDD-NOS classification.

Increasing the Sample Size

Future research should use a larger number of participants in order to stabilize group trends so that they are less susceptible to individual fluctuations. The larger the population sample (n) the more likely the results will generalize to a specified population (N) as a whole and become more relevant for clinical practice.

Extending the Types of Events

The results of the present study, demonstrated learning outcomes for a single event, making orange juice. Thus we do not know whether the learning outcomes demonstrated in the current study would apply to other daily living tasks. Future research should expand the focus to varied types of tasks.

Altered Teaching Trial Schedules

An important question for this study was whether learning from enhanced tactual input was retained across time. Again, the participation group seemed to have a better retention rate than those who just received visual, auditory, and olfactory input. Therefore, given that this outcome was observed after just one teaching trial, the question can be raised whether performance could improve with multiple teaching trials.

Concluding Remarks

Children with ASD who manually participate in a novel event achieve better verbal and nonverbal outcomes than do those who just observe an event visually and aurally. While this study provided some clinical support for specific intervention methods such as, GIT and PROMPT, more research needs to be done on manually guided intervention strategies for individuals diagnosed with ASD.

APPENDICES

APPENDIX A

EDUCATIONAL DEFINITION OF ASD

R 340.1715 "Autism" defined; determination.

Rule 15. (1) "Autism" means a lifelong developmental disability which is typically manifested before 30 months of age. "Autism" is characterized by disturbances in the rates and sequences of cognitive, affective, psychomotor, language, and speech development.

(2) The manifestation of the characteristics specified in subrule (1) of this rule and all of the following characteristics shall determine if a person is autistic:

(a) Disturbance in the capacity to relate appropriately to people, events, and objects.

(b) Absence, disorder, or delay of language, speech, or meaningful communication.

(c) Unusual, or inconsistent response to sensory stimuli in 1 or more of the following:

- (i) Sight.
- (ii) Hearing.
- (iii) Touch.
- (iv) Pain.
- (v) Balance.
- (vi) Smell.
- (vii) Taste.
- (viii) The way a child holds his or her body.

(d) Insistence on sameness as shown by stereotyped play patterns, repetitive movements, abnormal preoccupation, or resistance to change.

(3) To be eligible under this rule, there shall be an absence of the characteristics associated with schizophrenia, such as delusions, hallucinations, loosening of associations, and incoherence.

(4) A determination of impairment shall be based upon a comprehensive evaluation by a multidisciplinary evaluation team. The team shall include, at a minimum, a psychologist or psychiatrist, a teacher of speech and language impaired, and a school social worker.

(5) A determination of impairment shall not be based solely on, behaviors relating to environmental, cultural, or economic differences.

APPENDIX B

APPROVAL TO USE HUMAN PARTICIPANTS

MICHIGAN STATE
UNIVERSITY

February 11, 2004

TO: Ida STOCKMAN
378 Com. Arts and Sciences

RE: **IRB# 03-955** CATEGORY: EXPEDITED 2-6, 2-7

APPROVAL DATE: February 11, 2004
EXPIRATION DATE January 11, 2005

TITLE: LEARNING AS A FUNCTION OF EVENT PARTICIPATION AMONG AUTISM SPECTRUM DISORDER (ASD) CHILDREN

The University Committee on Research Involving Human Subjects' (UCRIHS) review of this project is complete and I am pleased to advise that the rights and welfare of the human subjects appear to be adequately protected and methods to obtain informed consent are appropriate. Therefore, the **UCRIHS approved this project.**

RENEWALS: UCRIHS approval is valid until the expiration date listed above. Projects continuing beyond this date must be renewed with the renewal form. A maximum of four such expedited renewals are possible. Investigators wishing to continue a project beyond that time need to submit a 5-year application for a complete review.

REVISIONS: UCRIHS must review any changes in procedures involving human subjects, prior to initiation of the change. If this is done at the time of renewal, please include a revision form with the renewal. To revise an approved protocol at any other time during the year, send your written request with an attached revision cover sheet to the UCRIHS Chair, requesting revised approval and referencing the project's IRB# and title. Include in your request a description of the change and any revised instruments, consent forms or advertisements that are applicable.

PROBLEMS/CHANGES: Should either of the following arise during the course of the work, notify UCRIHS promptly: 1) problems (unexpected side effects, complaints, etc.) involving human subjects or 2) changes in the research environment or new information indicating greater risk to the human subjects than existed when the protocol was previously reviewed and approved.

If we can be of further assistance, please contact us at (517) 355-2180 or via email: UCRIHS@msu.edu. Please note that all UCRIHS forms are located on the web: http://www.humanresearch.msu.edu

Sincerely,

Peter Vasilenko, Ph.D.
UCRIHS Chair

PV: rt

cc: Susan Latham
3459 Schmuhl Road
Benton Harbor, MI 49022

OFFICE OF
RESEARCH ETHICS AND STANDARDS

University Committee on Research Involving Human Subjects

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APPENDIX C

INFORMED CONSENT

Parent Consent for Participation in Study:
Learning as a Function of Event Participation Among Autism Spectrum Disorder (ASD) Children

Dear Parent,

My name is Susan Latham and I am a graduate student at Michigan State University. I am requesting permission to have your child participate in a research project on how children learn and use new words. I am specifically interested in knowing the best way to teach children new words. Participation in this study is voluntary and you can withdraw anytime without penalty.

If you agree to participate you and a member of your child's multidisciplinary team will be asked to fill out a brief questionnaire about your child's overall development and provide current levels of speech, language, and cognitive functioning. Upon completion of these tasks, your child will be given a free speech screening. I will videotape and audiotape two 20- to 25-minute sessions in which your child will be taught new words. These sessions will consist of either watching a person saying the new words or doing an activity in which the words are used. The tapes will be used to record your child's verbal and nonverbal responses. The tapes will be secured in a locked cabinet, only accessible to the researcher. The videotapes will be kept at the end of the study for analysis. The research study will take place during school hours at your child's school or at your child's place of speech and language services. The time that your child will be participating in the study will be arranged carefully with your child's teacher and multidisciplinary team so interference with your child's schoolwork will be kept to a minimum. Your child will be asked if he or she wants to participate. If your child does not want to participate, indicating this verbally or nonverbally, he or she will not be forced. All information about your child's identity will be kept confidential and will not be revealed in the results of the study.

If you are interested, your child may participate in my research project, by filling out the consent statement attached and return it to school with your child. Aside from filling out a brief questionnaire, there will not be any additional requirements of you. If you have any questions regarding this project, please call me at my home in Berrien County (269-927-1721). If you have questions or concerns regarding your rights as a study participant, or are dissatisfied at any time with any aspect of this study, you may contact – anonymously, if you wish- Peter Vasilenko, Ph.D., Chair of the University Committee on Research Involving Human Subjects (UCRIHS) by phone: (517) 355-2180, fax: (517) 432-4503, e-mail: ucrihs@msu.edu, or regular mail: 202 Olds Hall, East Lansing, MI 48824.

Page 1 of 2

Parent Consent Statement

Title of the Project: Learning as a Function of Event Participation among ASD Children
Investigator: Susan Latham
Michigan State University
Department of Audiology and Speech Sciences
East Lansing, MI 48824

Your child ______________________ CAN/CANNOT participate in the research project on children's word learning and use on a functional task.

Your child's participation is voluntary and your consent may be withdrawn at any time without penalty. The results of the study will be used for research purposes and NOT for educational placement. Report of these observations will respect your child's right to privacy by not revealing his/her identity. Your child's privacy will be protected to the maximum extent allowable by law. Your participation in this research project will not involve any additional costs to you or your health care insurer. Your signature below indicates your permission for your child to be a participant in this study.

____________________________________ ______________________

Caregiver's Signature Date of Signature

Page 2 of 2

APPENDIX D

BERRIEN COUNTY INTERMEDIATE SCHOOL DISTRICT APPROVAL

March 22, 2004

Susan Latham
3459 Schmuhl Road
Benton Harbor, Michigan 49022

Dear Ms. Latham:

I am in receipt of and have reviewed your letter dated March 3, 2004 requesting permission from Berrien County Intermediate School District to recruit participants for your dissertation research project. Your request as written is granted , per our Board Policy.

The procedure to follow would be for you to contact Jack Houser, Principal at Lighthouse Education Center and Mark Reigle, Supervisor of Early On Programs and request that your *Parent Consent for Participation in Study* be forwarded through the school to parents of eligible students. The forms will be returned back to the school and you may pick them up and arrange with the two program supervisors the dates/times the study will take place.

I wish you well in your endeavors in regards to increasing professional knowledge of teaching and learning process.

Sincerely,

Jeff Siegel, Superintendent

cc:

Jim Palm, Assistant Superintendent
Stephanie Mack, Director of Special Education
Jack Houser, Principal Lighthouse Education Center
Mark Reigle, Supervisor of Ancillary Programs and Services

APPENDIX E

TEACHER QUESTIONNAIRE

Teacher Questionnaire

Instructions: You are asked to provide information for the child listed below. Please use the following rating scale when appropriate: G/N = Good/Normal; Q= Questionable; P= Poor. If you are uncertain about how to judge a category, place a question mark (?) in the space. You may be assured that all information provided by you will be kept confidential. Thank you for your cooperation.

Child:____

Date: ________________ **Name of School:**__________________

Teacher:____________________________

Birthdate of child:______________________

Gender: M or F

1. **Hearing: G/N Q P**
2. **Vision (with or without glasses): G/N Q P**
3. **Social Interaction: G/N Q P**
4. **Behavior: G/N Q P**
5. **Communication Skills: G/N Q P**
6. **Has received or currently receiving speech and language therapy:**

   YES NO
   Comments:

7. **English spoken in home: YES NO**
8. **History of Developmental Difficulties: YES NO**
   Comments:

9. **History of Emotional Difficulties: YES NO**
   Comments:

10. **Physical Impairments: YES NO**
    Comments:

11. **Has received or currently receiving OT and/or PT? YES NO**
Comments:

12. **Mother's occupation:**

13. **Father's occupation:**

14. **Please provide two measures of Language:**

   A) **Name of Language Test:**
   Language Scores:

   Date Test Given:

   B) **Name of Language Test:**
   Language Scores:

   Date Test Given:

15. **Please provide one measure of Cognitive Functioning:**

   Name of Cognitive Test:
   Cognitive Scores:

   Date Test Given:

16. **Using the following scale, how would you rate the motor abilities of this child?**

1	2	3	4	5
Below Average		**Average**		**Above Average**

Thank you for your time and help on this research project. It is very much appreciated. If, at any time, you have questions about this questionnaire or any aspect of the research project, please feel free to call me at 269-927-1721. You may be assured that all information provided by you will be kept confidential. Please note that the child's name will be blocked out and a random number assignment will be used in its place.

Sincerely,

Susan Latham, M.A., CCC-SLP

APPENDIX F

PARENT QUESTIONNAIRE

Parent Questionnaire

First, I want to thank you for allowing your child to participate in this research project. I appreciate your cooperation and look forward to providing you with the results of this study. If, at any time, you have questions, please feel free to contact me at 269-927-1721.

<u>Instructions for completing Questionnaire:</u> You are asked to provide information on your child, which will help with the overall research project. If you are uncertain about how to answer a question, place a question mark in the space. You may be assured that all information provided by you will be kept confidential. Names will be blocked out and number assignments will be used it its place. Thank you for your time and help.

Child's Name: ______________________________

Name of School: ______________________________

Teacher: ____________________________________

Child's Date of Birth: ________________________

Your Phone Number: _____________________ Please provide your number if you want me to call you the night before I plan to work with your child. This will allow me to ensure your child plans to be in school the next day, and also allows you to know when I will be working with your child.

When was your child diagnosed with Autism Spectrum Disorder:

____

Is your child bilingual? YES NO

How would you describe your child's language development?

______Good/Normal _________ Questionable ________ Poor

Comments:

____

____

____

____

____

How would you describe your child's hearing?

______ Good/Normal _______Questionable _______ Poor

Comments:

____

____

____

____

____

How would you describe your child's motor development?

_____ Good/Normal ______ Questionable ______ Poor

Comments:

____

____

____

____

____

Sincerely,

Susan Latham
M.A., CCC-SLP, Speech and Language Pathologist

APPENDIX G

VERBAL MEASURE

Verbal Measures

WH-Questions

QUESTION	RESPONSE	2pt. RESPONSE	1pt. RESPONSE	0 pt. RESPONSE	SCORE
1. What is (point to orange)?		Orange	Similar	No Response	
2. What is (point to juicer?)		"[pak]"	Object	No Response	
3. What is (press on juicer)?		"[kaip]"	Function	No response	
4. Which is [kaip]? (video without object		Point to on screen		No response. Point to wrong portion of screen	
5. Which is [poc]? (video: object)			Point to on screen	No response. Point to wrong portion of screen.	
6. Which is [kaip]? (video action with object)			Point to on screen	No response. Point to wrong portion of screen.	
7. Who made the orange juice?		Indicates self (verbal correct, "I did", "me".	Indicates self (nonverbal correct – points to self)	No response. Incorrect response.	
8. How did you get the juice?		Semantic reference to process; must include action (squeeze) with object (pac)	Reference to action with another apparatus (i.e., squeeze with hands)	No response. No reference to action.	

QUESTION	RESPONSE	3 pt. RESPONSE	2 pt. RESPONSE	1pt. RESPONSE	0 pt. RESPONSE	Score
9. Where did the juice go?		Locative + serial content	Locative content correct	Nonverbal relevant response (point to some object connected to event)	No response. No locative content	
10. Why did you cut the orange?			Causal relationship expressed. Reference to specific action goal. Reference to fit.	Causal relationship. Reference to overall action goal.	No response. No causal relations.	
11. When did you drink the juice?			Temporal element (i.e., "finished") Specific	Temporal element General	No Response. No temporal element.	

Total Score	

APPENDIX H

CHECKLIST FORM

Child Checklist for Folder

Child # ____________

Age

Date of Testing

DOB

Consent Form __________

Teacher Checklist __________

Parent Checklist ___________

Language Scores

Cognitive Scores

Oral-Speech Screening

Experimental Design: **Observation ______** **Participation _____**

APPENDIX I

NONVERBAL SCORE

Nonverbal Score
Global/ Logical Steps and Scoring Procedures

STEP	2 Points	1 Point	O Points	Score
1. Make contact with knife and orange to start event; recognize need for both objects by touching each.				
2. Recognize need to cut orange – makes attempt to cut orange – separates orange into two parts with knife.				
3. Places orange segment in juicer correctly				
4. Puts measuring cup under juicer				
5. Pulls handle down to get juice out.				

Total Score	

2 Points = unassisted

1 point = Assisted after self-initiated attempts

0 points = Clinician initiated step and assisted

APPENDIX J

NONVERBAL RATING

Nonverbal Rating

Qualitative Rating Procedure

First you will observe an adult completing the sequence. You are asked to rate how close the child comes to repeating the adult.

Rating Scale

1	2	3	4	5
smooth transition competent execution				extremely difficult time consuming, struggling, ask for help many times.

Why did you judge the child to have this score?

Additional Comments:

APPENDIX K

RATING SCORING PROCEDURES

General Guidelines for Scoring Procedures

Verbal Measures

- In the response section, write down exactly what the child says or does for each of the eleven questions.
- If you cannot understand what the child says, indicate so on the form.
- If the examiner asks a question more than one time, give the child credit for the response that earns the most points. Indicate on the form that the child had more than one response by recording all responses. For example: Question 1: examiner: "What is (orange)?
  Child: no response
  Examiner: "What is (orange)?
  Child: "orange"
  Score: 2 points
- Pay attention to page 2 scoring – 4 levels rather than 3 on page 1. Make sure you look at the top of the column for appropriate scores.
- Specific scoring:
  - Question 1: "similar" refers to another type of fruit, orange juice, etc.
  - Question 2: "object" refers to any noun, even a nonsense noun. Anything close to "juice king", score as an object.
  - Question 3: "function" refers to any action, even a made up function, like "squasher"
  - Questions 4-6: If you cannot see where on the screen the child is pointing, indicate so on the form. If the examiner points to indicate where the child pointed, score as if the child pointed.
  - Question 7: Any verbal response indicating self, score as 2 points. Some children may say their own name, score as 2. If he or she points to himself or herself, score as 1. If the child says, "the juicer", "you did", or "we did", score as 0.
  - Question 8: If the child refers to the process of making OJ by including that he or she squeezed the oranges with the juicer, score 2 points. If he or she refers to squeezing the oranges, but does not refer to the juicer specifically, score as 1 point. Think of 2 points as referring to the action and the object, in some way verbally; one point referring only to the action; and 0 points for no response to action.
  - Question 9: If the child indicates a correct location and includes a serial order (child response: "in the measuring cup and in the glass"), he/she receives 3 points. If the child says a correct location ("in the cup"), he/she receives 2 points. If the child points to some

object connected to the event, like the juicer, measuring cup, or glass, he/she receives 1 point.

- Question 10: To receive 2 points, the child must indicate that he/she had to cut the orange to get the juice out/to make OJ, etc. He /she must also refer to an action – squeeze, kaip, to make OJ, etc. He/ she must also refer to the need to cut the orange in order for it to fit in the juicer. He /she would only receive 1 point if they do not include a reference to the orange only being able to fit into the juicer when cut, but they do include the other elements referred to above.
- Question 11: To receive 2 points, the child must state a specific temporal element. This could be something like "now", "when we are done". He or she only receives one point for a general temporal response, like "today", "yesterday".

<u>Nonverbal Measures</u>

Global / Logical Steps

- When the video begins, if for example, the measuring cup is under the juicer, assume that the child placed it there. Likewise, if the child is already holding the knife and orange, assume that he/she initiated the contact first.
- Record the chronological order of events by placing the numbers 1-5 in the left column next to each step.
- Score each step according to the point values given by placing a check mark in the appropriate box.

Qualitative Rating

- Measure each child against my performance. Do not take into account what you think the child's age, or cognitive level, etc. might be.
- If the child has smooth transitions and competent execution, he/ she receives a score of 1. If the task is extremely difficult, time consuming, effortful, and the child receives help many times, he/she receives a score of 5.
- Subjectively rate the child's performance based on this information only. It is your decision what constitutes a 2 versus a 3, etc. This will be reflected in the reasoning for the score given.

APPENDIX L

RAW SCORE DATA FOR FIGURES 1.1 TO 1.3

Table 7 Raw Score Data for Figures 1.1 to 1.3

Question		Participation	Observation	t	p	Cohen's d
1. What is (orange)?						
Time 1						
	M	5.59	5.24			
	SD	3.45	3.87	.56	.58	
Time 2						
	M	5.47	4.35			
	SD	3.24	4.01	2.56	.021*	.307
Time 3						
	M	6.53	4.94			
	SD	2.65	3.77	2.21	.042*	.488
Time 4						
	M	6.18	2.96			
	SD	5.24	3.60	1.26	.225	
Grand						
	M	5.94	4.94			
	SD	3.05	3.75	3.13	.003*	
2. What is (pak)?						
Time 1						
	M	5.18	4.35			
	SD	3.00	3.22	1.46	.163	
Time 2						
	M	2.41	1.59			
	SD	2.62	1.73	1.99	.064*	.369
Time 3						
	M	3.59	1.71			
	SD	3.22	1.61	3.05	.008*	.739
Time 4						
	M	3.76	1.47			
	SD	3.01	1.77	3.65	.002*	.927
Grand						
	M	3.74	2.23			
	SD	3.07	2.45	5.09	.000*	
3. What is (kaip)?						
Time 1						
	M	1.82	2.06			
	SD	2.92	2.90	-.30	.771	
Time 2						
	M	1.59	1.53			
	SD	1.62	1.77	.13	.896	
Time 3						
	M	2.41	1.59			
	SD	2.76	2.29	1.12	.278	
Time 4						
	M	3.06	1.82			
	SD	3.34	2.56	1.15	.266	
Grand						
	M	2.22	1.75			
	SD	2.74	2.37	1.20	.236	

APPENDIX M

RAW SCORE DATA FOR FIGURES 2.1 TO 2.3

Table 8 Raw Score Data for Figures 2.1 to 2.3

Question		Participation	Observation	t	p
4. Which is kaip? (without object)					
Time 1					
	M	2.94	2.35		
	SD	3.88	3.76	.48	.640
Time 2					
	M	4.12	2.82		
	SD	4.03	3.94	.94	.363
Time 3					
	M	3.29	3.76		
	SD	4.06	4.12	-.57	.579
Time 4					
	M	2.82	2.35		
	SD	3.94	3.76	.44	.668
Grand					
	M	3.29	2.82		
	SD	3.92	3.85	.83	.410
5. Which is pak?					
Time 1					
	M	2.35	2.65		
	SD	1.93	1.84	-.50	.623
Time 2					
	M	2.59	2.35		
	SD	1.97	2.03	.44	.668
Time 3					
	M	2.53	2.82		
	SD	1.94	1.88	-.46	.652
Time 4					
	M	2.35	2.59		
	SD	2.03	1.97	-.44	.668
Grand					
	M	2.46	2.60		
	SD	1.93	1.89	-.52	.606
6. Which is kaip? (with object)					
Time 1					
	M	2.41	1.88		
	SD	1.97	1.96	1.85	.083
	Cohen's d = .270				
Time 2					
	M	2.35	1.71		
	SD	2.03	1.99	1.08	.297
Time 3					
	M	2.82	1.94		
	SD	1.94	2.01	1.67	.114
Time 4					
	M	2.59	2.18		
	SD	1.97	2.01	.92	.370
Grand					
	M	2.54	1.93		
	SD	1.93	1.96	2.63	.011*

APPENDIX N

RAW SCORE DATA FOR FIGURES 3.1 TO 3.3C

Table 9 Raw Score Data for Figures 3.1 to 3.2

Question		Participation	Observation	t	p
7. Who?					
Time 1					
	M	3.29	2.71		
	SD	3.80	2.91	.77	.452
Time 2					
	M	3.76	2.94		
	SD	3.87	3.88	.84	.416
Time 3					
	M	2.94	2.24		
	SD	3.61	3.46	.71	.490
Time 4					
	M	3.59	2.47		
	SD	3.92	3.36	1.26	.228
9. Where?					
Time 1					
	M	4.06	3.65		
	SD	3.80	4.00	.49	.660
Time 2					
	M	4.41	3.59		
	SD	4.43	3.71	.81	.428
Time 3					
	M	3.24	3.41		
	SD	3.72	3.36	-.19	.851
Time 4					
	M	4.12	2.82		
	SD	3.60	3.97	1.41	.178

Table 10 Raw Score Data for Figures 3.3a to 3.3c

Question		Participation	Observation	t	p	d
8. How?						
Time 1						
	M	2.59	1.06			
	SD	3.39	1.60	2.34	.033	.577
Time 2						
	M	1.47	.71			
	SD	2.55	1.40	2.02	.061	.369
Time 3						
	M	1.76	.88			
	SD	2.73	2.03	1.36	.191	
Time 4						
	M	1.06	.35			
	SD	2.38	1.46	1.60	.131	
10. Why?						
Time 1						
	M	1.94	.41			
	SD	2.46	1.06	2.52	.023	.808
Time 2						
	M	1.82	.53			
	SD	2.07	1.23	2.60	.019	.758
Time 3						
	M	2.00	.41			
	SD	2.45	1.06	2.76	.014	.842
Time 4						
	M	2.00	.41			
	SD	2.52	1.06	2.62	.019	.822
11. When?						
Time 1						
	M	1.94	.94			
	SD	2.93	2.36	1.07	.303	
Time 2						
	M	1.41	.88			
	SD	2.74	2.06	.62	.544	
Time 3						
	M	1.88	.59			
	SD	2.76	1.12	1.86	.081	.612
Time 4						
	M	1.47	.76			
	SD	2.15	1.89	1.03	.318	

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