

### Abstract

Research has shown that physical activity and sensory input can have positive effects on the behavior of children with an autism spectrum disorder (ASD). The current study sought to examine whether participation in a seven week alpine skiing program had an effect on behaviors of children with an ASD as well as to examine the family's perspective regarding their child's participation in the program. Participants were recruited through an adaptive ski program and included three children with an ASD and one of their parent's. The Sensory Processing Measure (SPM) was used to assess sensory-based behaviors. A questionnaire was developed to (1) examine parent-identified hopes for ski program participation and the extent the hopes were fulfilled and (2) describe the intensity of parent-identified challenging behaviors and the effect of the ski program on these behaviors. These measures were completed before and after the child's participation in the seven week ski program. Results indicated subtle changes in behaviors. Additionally, some associations were found between changes in behavior and the fulfillment of parent-identified hopes for ski program participation. Further studies should examine how occupational therapists can use recreational activities, such as alpine skiing, to complement treatment activities when working with children with an ASD.

**The Effect of Alpine Skiing on Behavior of Children with an  
Autism Spectrum Disorder as Viewed by their Parent**

In the United States, 228,497 children were living with a diagnosed Autism Spectrum Disorder (ASD) in 2008 (Data Accountability Center, 2009). Children with this disorder experience impaired social interaction and communication, and frequently exhibit repetitive and stereotyped patterns of behavior such as intense preoccupations, inflexibility with routine, and repetitive motor mannerisms (American Psychiatric Association [APA], 2000). Due to these behaviors, children with an ASD experience difficulty participating in daily life activities and their families can report a feeling of isolation (Woodgate, Ateah, & Secco, 2008). One way to increase participation in daily life activities and to decrease isolation may be through adaptive recreation programs that are designed for children with special needs. These programs may create an optimum environment for social interaction, exercise, recreational participation, and to address other therapeutic goals.

The focus of occupational therapy services is on functional activities and participation (American Occupational Therapy Association [AOTA], 2008). To address participation, occupational therapists not only teach skills for interaction, both in clinical and natural environments, but also work to decrease behaviors that interfere with participation (Roley & Jacobs, 2008). For children with an ASD, social skills may be addressed in order to enable participation in the classroom, at home, and in the community. These children can receive these services in clinics, schools and other settings, including the community (Barnes, Vogel, Beck, Schoenfeld, & Owen, 2008; Egilson & Traustadottir, 2009).

Recreation is one way in which an individual may participate in functional activities. For the purposes of this study, recreation is defined as an activity or set of activities that one engages

in for relaxation or amusement and to improve skills needed for that activity (Duvdevany, 2002; Fennick & Royle, 2003; Hurren, 1994; Kleiber, Ashton-Shaeffer, Malik, Lee, & Hood, 1990; Orsmond, Krauss, & Seltzer, 2004; Rose & Massey, 1993). Recreational activities can provide opportunities for social interaction for children and their families (Duvdevany, 2002; Orsmond et al., 2004; Rose & Massey, 1993) as well as physical exercise and sensory input (Bass, Duchowny, & Llabre, 2009; Silva, Schalock, Ayres, Bunse, & Budden, 2009) while participating in the activity. In some areas of the country, community recreational programs exist for people with disabilities. These programs may support participation in new recreational activities for children with disabilities including an ASD through positive recreational experiences and also while giving the parent some respite. This may lead to increased appreciation for life in general that then may contribute to resiliency for families with a child with an ASD (Bayat, 2007).

Recreation programs for adults and children with special needs exist in many forms across the country. Studying the effect these programs have on the behavior of children with an ASD will provide useful information regarding potential outcomes of participation in recreation programs, particularly those that provide increased sensory input. The current study sought to examine whether participation in a 7-week alpine skiing program had an effect on sensory-based behaviors of children with an ASD as well as to examine the family's perspective regarding their child's participation in the program.

### **Background and Significance**

**Autism spectrum disorders.** Autism spectrum disorders (ASD) are neurodevelopmental disorders that are referred to as pervasive developmental disorders and include diagnoses such as autistic disorder, pervasive developmental disorder not otherwise specified (PDD-NOS), and Asperger's syndrome (Watling, Tomchek, & LaVesser, 2005). ASDs are characterized by

difficulties with social interactions and communication skills as well as repetitive, stereotyped patterns of behavior (Tomchek & Case-Smith, 2009). According to the DSM-IV-TR, diagnostic criteria for autistic disorder include abnormalities of social interaction, and impairments in verbal (a delay or lack of the development of spoken language) and non-verbal (eye gaze, facial expression, body postures, and gestures) communication (APA, 2000). Criteria also include restricted and repetitive interests, behaviors, and activities which can manifest as preoccupations with parts of objects, inflexibility with routines, repetitive motor mannerisms, and/or preoccupation with a narrow interest that is encompassing and abnormal in intensity (APA, 2000). All of these traits must also be present in early childhood before the age of three (APA, 2000). Although children with an ASD exhibit a wide variety of these characteristics as well as experience a range in their severity, most children with an ASD experience difficulty participating in daily life activities due to challenges with social interactions paired with stereotyped patterns of behavior (Tomchek & Case-Smith, 2009).

**Sensory processing and ASD.** Sensory processing refers to the “reception, modulation, integration and organization of sensory stimuli, including behavioral responses to sensory input” (Miller & Lane, 2000, p. 2). Children with developmental disabilities have been shown to have significantly more sensory processing difficulties than children without disabilities (Cheung & Siu, 2009). Specifically, research has shown high rates of reported difficulties with sensory processing in individuals with an ASD (Kern et al., 2007; Rogers, Hepburn, & Wehner, 2003; Wiggins, Robins, Bakeman, & Adamson, 2009). Dawson and Watling (2000) conducted a literature review of studies on the prevalence of abnormal responses to sensory stimuli among individuals with autism. Four studies were included and the authors estimated that 30-100% of individuals with autism exhibit some degree of abnormal responding to sensory stimuli and that

two groups may exist in this population – those who are hypo-responsive and those who are hyper-responsive (Dawson and Watling, 2000). Studies by Ornitz et al. in 1977, Volkmar, Cohen, and Paul in 1986, LeCouter et al. in 1989, and Kientz and Dunn in 1997 (as cited in Baranek, 2002) reported percentages ranging from 42-88% of children with autism displaying unusual sensory responses. More recently, one study indicated that over 90% of children with autism have sensory abnormalities (Leekam, Nieto, Libby, Wing, & Gould, 2007), and another study found that 95% of the sample of children with an ASD displayed difficulties with sensory processing (Tomchek & Dunn, 2007).

The nature of sensory processing difficulties is widely varied among children with an ASD, such that a child can exhibit both hypo- and hyper- responsiveness as well as patterns of both under- and over- arousal (Baranek, 2002). Despite the high variance of sensory processing difficulties among children with an ASD, an individual with sensory processing difficulties of any kind will likely have challenges with the organization of purposeful behaviors that enable effective navigation of and engagement with the environment (Ayres, 1972).

Children with an ASD experience difficulties participating in daily life activities (Hilton, Crouch, & Israel, 2008) which may in part be due to these sensory processing difficulties that influence stereotyped patterns of behavior. One study found that among 29 children with high functioning autism, the amount of restricted and repetitive behaviors reported by their parents was highly correlated with degree of sensory abnormalities as measured by the Short Sensory Profile (Chen, Rodgers, and McConachie, 2009). Sensory processing difficulties have also been shown to be related to social, emotional, and behavioral function among children with autistic disorder (Baker, Lane, Angley, & Young, 2008). In this study, parents of 22 children with autistic disorder completed the Short Sensory Profile and Developmental Behavior Checklist and

provided information in an interview guided by the Vineland Adaptive Behavior Scales. Results showed that poor sensory processing abilities (present in 82% of their sample) were strongly associated with more behavioral and/or emotional problems as well as with decreased functioning in their daily living skills. These sensory processing difficulties that affect children with an ASD can be addressed with occupational therapy services in order to minimize their impact on functioning.

### **Occupational therapy.**

*Occupational therapy and ASD.* Occupational therapists evaluate and provide intervention for individuals with an ASD in order to achieve a variety of outcomes. These outcomes include participation at home, school, and in the community; occupational performance, adaptation, health and wellness, role competence, and quality of life (Watling, Tomchek, & LaVesser, 2005; AOTA, 2008). Occupational therapy services are provided to those who are experiencing difficulty with any of these areas due to a limitation within the person or the environment. For an individual with an ASD, these limitations to occupational performance may be due to movement impairments, sensory processing difficulties, difficulties with adaptive behavior, or other factors (Tomchek & Case-Smith, 2009).

To evaluate an individual with an ASD, occupational therapists use standardized tests as well as skilled observation of the individual's typical behaviors and plan interventions based on evaluation results in a collaborative effort with the client (Watling, Tomchek, & LaVesser, 2005). Intervention plans are influenced by

“(1) the client's goals, values, and beliefs; (2) client's health and well-being; (3) client's performance skills and performance patterns; (4) collective influence of activity demands, client factors, and the context, which includes the environment, on the client; (5) context of service delivery in which the intervention is provided; and (6) best available evidence” (Tomchek & Case-Smith, 2009).

The focus of intervention approaches for an individual with an ASD may include but are not limited to sensory integration, sensory-based, relationship-based interactive, developmental/skill-based, social skills (social groups and social stories), and behavioral (Watling et al., 2005; Tomchek & Case-Smith, 2009). Forty-nine studies surrounding interventions within these categories were investigated in an evidence-based review by Case-Smith and Arbesman (2008). The results of this review indicate that although the domain and process of occupational therapy is consistent with current treatment approaches for individuals with an ASD, more participation and leadership by occupational therapists is needed to increase occupational therapy's contributions to the continual development of effective treatments. Occupational therapy interventions for these individuals are designed to address participation and increase functional outcomes in the classroom, at home, and in the community by teaching skills for interaction as well as decreasing behaviors that interfere with participation (Law, Missiuna, Pollock, & Stewart, 2005; Rogers, 2005).

***Occupational therapy and participation.*** Occupational therapists support the outcome of “health and participation in life through engagement in occupation” (AOTA, 2008, p. 660). For all people, participation is essential for self-expression, developing skills and competencies, growing in mental and physical health, experiencing meaning in life, and forming friendships (Law & King, 2000). Participation is defined as “engagement in desired occupations in ways that are personally satisfying and congruent with expectations within the culture” (AOTA, 2008, p. 662). For children with an ASD, participation in daily life may be significantly impeded by undesired behaviors.

Hilton, Crouch, and Israel (2008) found that a significant difference existed between the out-of-school participation patterns of children with a high-functioning autism spectrum disorder

and their typically developing peers. Children with an ASD participated in fewer social activities, recreational activities (however, reported enjoyment of these activities was higher than their typical peers), and physical activities.

When a child exhibits sensory processing difficulties, the ability to participate in daily life is often compromised (Bundy & Murray, 2002; Roley, 2006). Ashburner, Ziviani, & Rodger (2008) investigated the association between sensory processing and classroom emotional, behavioral, and educational outcomes of children with an ASD. They found that academic underachievement was associated with a pattern of auditory filtering difficulties, sensory underresponsiveness, and sensory seeking behavior. They concluded that this may be associated with deficits in learning and attention that leads to difficulty processing verbal instructions in busy classroom environments. These difficulties may also lead children with an ASD to feel overwhelmed and thus seek repetitive and predictable sensory input that they can control, which interferes with their ability to participate in educational activities (Ashburner, Ziviani, & Rodger).

#### **Current recreation for children with an ASD.**

*Activity patterns of children with an ASD.* Although numerous benefits to recreation and leisure exist, participation can be difficult for children with an ASD and their families. One study found that children with an ASD were less active than their peers without disabilities during free play (Pan & Frey, 2006), and overall physical activity decreased as children with an ASD progressed from elementary-ages to adolescence.

Pan (2008) compared physical activity patterns between children with an ASD and children without disabilities during recess and lunchtime and found that children with an ASD were significantly less active during these times than their peers. During inclusive free play

times, the participation of children with an ASD was hindered by high social demands, pressure to perform, and competition. Thus, the ideal recreational setting, according to Pan, would include decreased social demands, minimal or no competition, and no performance expectations. When comparing these characteristics to many current integrated and adapted sports programs that offer physical activity to people with disabilities, a contrast is found as these programs often include performance expectations and competition. Individual recreational activities may be a better option for providing the context described by Pan as optimal for facilitating recreation participation.

***Recreation possibilities.*** While participation in integrated recreational activities can provide social opportunities for children with and without disabilities, recreation can also offer children with an ASD the opportunity to benefit from and enjoy an individual, non-competitive activity (Fennick & Royle, 2003; Mactavish & Schleien, 2000). Adaptive recreation programs that are designed for children with special needs and their families may provide an optimum environment for recreation participation as well as offer social connection and familial support. These programs can enhance enjoyment of activities, build recreational skills, improve self-efficacy, and provide opportunity for improving social skills (Kleiber, Ashton-Shaeffer, Malik, Lee, & Hood, 1990). Until recreational skills are built, many children with a profound ASD may have difficulty engaging in integrated programs due to being overwhelmed by a new activity and the demands of functioning in a busy group setting. A child with an ASD can be better equipped to participate successfully in an integrated recreational setting after skill building has occurred. Creating and maintaining choices in recreational activities for youth with developmental disabilities allows the participant to enjoy activities at individually appropriate levels (Fennick & Royle, 2003) as well as in team activities once skills have been built.

A few aspects of outdoor recreation set it apart from team activities and from physical exercise. Outdoor recreation can be informal and spontaneous, and individuals can experience the activity at their own skill levels, an advantage for any participant (Rose & Massey, 1993). Many outdoor sports, such as alpine skiing, can be enjoyed individually as the participants complete the activity at their own pace and create their own challenges. In addition, recreational activities can be more meaningful than simply exercising for physical benefits. An individual may choose to hike to enjoy a mountain view, walk with a friend to engage in conversation, or ski to take in fresh air and obtain a break from normal life routines. Recreation is an important aspect of life for many people, and participating in outdoor recreation can be a meaningful experience. People with disabilities experience limitations in many aspects of their lives and this often includes recreation participation.

***Recreation Effects on Children with an ASD.*** Recreational activities frequently include physical components that benefit all people regardless of disability by increasing physical, mental, and emotional health (Centers for Disease Control and Prevention [CDC], 2009). Studies show that physical activity can have positive effects on the stereotypical behaviors associated with ASD. Kern, Koegel, Dyer, Blew, and Fenton (1982), introduced an aerobic exercise routine into the school day for seven children with autism who exhibited exceptionally high levels of self-stimulatory behavior. The routine consisted of stretching and mildly strenuous jogging each morning. The results included a significant decrease in self-stimulatory behavior for the children immediately following the intervention. In a similar study Rosenthal-Malek and Mitchell (1997) introduced brief jogging sessions throughout the school day and found an immediate decrease in self-stimulatory behavior for five adolescent males with an ASD. For a group of six adults with both autism and mental retardation, vigorous exercise

decreased stereotypic behavior that inhibited community participation (Elliott, Dobbin, Rose, & Soper, 1994). The results of these studies demonstrate that strenuous activity can have an immediate effect on behavior. Although desirable behaviors increased and disruptive behaviors decreased, these studies did not address long term effects or examine whether participant fatigue had an effect on behaviors.

Providing choice in recreation has been shown to lessen stereotypical and self-stimulatory behaviors (Bambara & Ager, 1992), and activity preference indication is an important aspect of participation in recreational activities. In a case study of a 21-year-old male with an autism diagnosis, a 75% reduction of self-injurious behavior prior to and during engagement in leisure activities occurred over a period of two years when a communication book was used to indicate the participant's leisure needs and preferences (Schneiter & Devine, 2001). Another case study demonstrated that the provision of structured opportunities to select preferred leisure activities decreased obsessive behaviors, increased appropriate material use, and improved tolerance for social interaction in a 15-year-old male with autism (Sigafos, Green, Paynes, O'Reilly, & Lancioni, 2009). Providing choice allows the child to indicate their preferences as well as have some control over how their leisure time is used. Schleien, Mustonen, Rynders, and Fox (1990) conducted an integrated recreation program in which children without disabilities received training in the methods that their peers with autism use to communicate. In integrated play activities, the children with autism exhibited more appropriate play activity with their nondisabled peers than when in isolated play activities (Schleien, Mustonen, Rynders, & Fox). Integrated recreation programs may allow for interaction among peers with and without disabilities when communication methods are established and understood.

In addition to lessening stereotypical behaviors, participation in recreational activities has been shown to result in increased engagement in daily occupations among children with an ASD. Rosenthal-Malek and Mitchell (1997) found that not only did exercise decrease self-stimulatory behavior for five males with autism, but also increased academic responsiveness and work completed in a classroom. Kern, et al. (1982) also found that following aerobic exercise, seven children with autism demonstrated increased participation in a subsequent ball playing game as well as increased academic responsiveness. These findings indicate that engaging in recreational activities, particularly those with an element of exercise, can result in benefits such as an increase in participation at school and in play activities which may contribute to improved social skills and quality of life.

### **Occupational therapy interventions.**

*Recreation interventions.* Believing that participation in daily life activities can positively impact all aspects of well being, occupational therapists work to diminish the behaviors that inhibit participation in daily life. If participation in recreational activities is an effective way to reduce behaviors that interfere with daily life participation, occupational therapists can use recreation as both a means and an end to achieve the outcome of increased participation in various contexts.

*Sensory-based interventions.* Interventions that aim to affect processing sensory information have been shown to positively affect behavior and social participation for children with an ASD (Stephenson & Carter, 2009). Lopez and Swinth (2008) found that a proprioception-based group exercise program that included prolonged muscle contraction against gravity significantly decreased aggressive behavior and increased attention of three boys with sensory processing disorders. Therapeutic horseback riding, which provides a multi-sensory

environment and introduces stimulation through the horse's physical presence and natural movement, was shown to improve social motivation and sensory sensitivity as well as decrease inattention and distractibility among 34 children diagnosed with an ASD (Bass, Duchowny, & Llabre, 2009). As reported by their teachers, 46 children with an ASD exhibited significant improvement in their social and language skills in the classroom and reduced autistic behavior following a Qigong Sensory Training (QST) massage intervention (Silva, Schalock, Ayres, Bunse, & Budden, 2009). A sensory-integration approach that included a strategic mixture of tactile, vestibular, and proprioceptive input (based on each child's sensory needs) was used in occupational therapy sessions with seven children with pervasive developmental delay, leading to a significant reduction in self-stimulating behaviors one hour after intervention (Smith, Press, Koenig, & Kinnealey, 2005). Based on these studies, intervention activities that provide sensory input can have a powerful effect on behavior and social participation for children with an ASD, which may, in turn, contribute to increased participation in daily life activities.

*Alpine skiing as possible intervention.* Alpine skiing is a recreational activity that incorporates elements of both physical activity and leisure. It is an individual sport in which the participant can create their own challenges and control the level of intensity at which they participate. While skiing downhill, one must stay balanced and mobile in order to control the movement down the mountain. This requires the integration of a variety of rapidly changing and occasionally unpredictable sensory stimuli from the environment, including tactile, vestibular, and proprioceptive inputs. Alpine skiing is also a multi-sensory experience and its merit as an intervention for children with behavior and social participation challenges should be explored.

Tactile input includes wearing ski gear and experiencing cold air blowing against the skin. Proprioceptive input is provided through pressure from the ski boots around one's calves

and ankles, awareness of one's body position while moving downhill as well as while getting onto and off of the ski lift, changing postures and coordinating movement. Vestibular input comes from rapid movement downhill and a changing visual environment. The skier must then respond to these inputs and make postural adjustments in order to keep an upright position and maintain balance, coordinate the body to control the position of one's skis, coordinate eye movements, and discriminate tactile information. Tactile, vestibular, and proprioceptive inputs are the primary sensory modalities emphasized in strategic intervention planning by occupational therapists using a sensory integration approach to treatment (Roley & Jacobs, 2008).

In addition to the physical and sensory aspects of skiing down the mountain, the ski experience also includes a ride on the ski lift after each ski run downhill. The ski lift provides another opportunity to address challenging areas for children with an ASD: motor planning, sensory processing, and social interaction. Mounting and dismounting from the ski lift requires motor planning, sequencing, and timing to coordinate and time one's body to get on and off of the lift. The stop and start of the moving ski lift chairs provide vestibular input. Typically, a skier rides the ski lift with one or more other skiers. This affords several minutes of time for potential social interaction.

Alpine skiing may be an effective context for occupational therapy intervention for individuals with an ASD. Its sensory elements can be used strategically as a sensory-based therapy while a child learns to process and integrate sensory stimuli from their environment. The rides on the ski lift can be a time to develop motor and praxis skills and foster social interaction among a child and his or her peers as well as with ski instructors. The effect of participation in an individualized, physically challenging, sensory rich, and functional outdoor recreational sport

on the behavior of children with an ASD should be explored to better understand these relationships.

### **Purpose**

Research has shown that physical activity and sensory input can have positive effects on the behavior of children with an ASD. The current study sought to examine whether participation in a 7-week alpine skiing program had an effect on sensory-based behaviors of children with an ASD as well as to examine the family's perspective regarding their child's participation in the program. This study aimed to investigate (1) if sensory-based behaviors and (2) intensity of parent-identified challenging behaviors that interfere with participation at home among children with an ASD decrease when enrolled in a weekly alpine skiing program and (3) whether an association exists between reported behavioral changes and reported fulfillment of parent-identified hopes for ski program participation.

### **Method**

#### **Research Design**

This exploratory study used a mixed-methods approach. A one-group pretest-posttest design was used to examine behavioral changes of children with an ASD participating in an alpine skiing program run by the Outdoors for All Foundation. The Outdoors for All (OFA) Foundation (<http://outdoorsforall.org>) is a Seattle-based non-profit organization that is committed to providing instruction in outdoor activities such as cycling, hiking, kayaking, and skiing to children and adults with disabilities. The organization's largest programs are winter activities, including snowboarding, snowshoeing, cross-country and alpine skiing. The focus of the alpine skiing program run by OFA is to help the participant have fun while making improvements in their ability to ski (Outdoors for All Foundation, 2009). Participating in OFA's

alpine skiing lessons includes instruction in elements of weight shifting and balance, proper use and maintenance of ski equipment, and response to instruction. Alpine skiing provides vast amounts of sensory input such as vestibular and proprioceptive input, changing temperatures, a variety of clothing textures, and verbal and physical cues from the instructors. This alpine skiing program pairs each participant with an instructor for a weekly 2-hour or 4-hour alpine skiing session.

For this study, parents rated their children's behavior prior to and immediately following participation in the ski program for pre- and post- program measures. An exploratory questionnaire was used to help parents identify the hopes they had for their child's participation in the ski program, to determine the extent to which these hopes were fulfilled, and to identify and rate the intensity of participants' challenging behaviors.

### **Participants**

Participants were a convenience sample ( $n = 3$ ) of children ages 5-12 diagnosed with an ASD who were enrolled in the 7-week alpine skiing program at a ski area in Washington through OFA, and their parents. The OFA program was chosen due to its proximity to the researcher's university as well as the researcher's volunteer experience with the program.

### **Recruitment**

A flier with information about the study was created by the researcher and sent electronically from OFA to all families who registered a child for the alpine skiing program who was reported to have a diagnosis of developmental delay, autism, pervasive developmental delay – not otherwise specified, or Asperger's syndrome. Allowing families to initiate contact with the researcher if they were interested in the study decreased the possibility of coercion. Inclusion criteria for participants in the study were: between the ages of 5 and 12, had a diagnosis of an

autism spectrum disorder and a parent with regular access to telephone and/or email. Previous years of participation with OFA and comorbid diagnoses varied and were recorded on the demographics questionnaire.

### **Instrumentation**

Autism spectrum disorder diagnosis for each participant was confirmed using the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). The SRS is a 65-item rating scale which measures the severity of symptoms characteristic of autism spectrum disorders. It uses a Likert scale response format to assess interpersonal behavior, communication, and repetitive/stereotypic behavior. The SRS is norm-referenced for children or adolescents aged 4 to 18 years and is completed by a teacher, parent, or caretaker who is familiar with the child's current behavior as well as their developmental history. Interrater reliability between mother and father is  $r=.91$ . The test-retest reliability is  $r=.85$  for males and  $r=.77$  for females. The SRS has shown strong to moderate ability to identify autistic-spectrum disorders in school-age children with special needs (Charman et al., 2007). It has also been determined to be a valid quantitative measure of autistic traits (Constantino et al., 2003). When completed by a child's mother, the SRS and the Autism Diagnostic Interview-Revised (ADI-R) showed correlations between  $r=.65$  and  $r=.77$  for the various subsections of these measures (Constantino et al., 2003).

The Sensory Processing Measure Home Form (SPM; Parham & Ecker, 2007; Parham, Ecker, Miller Kuhaneck, Henry, & Glennon, 2007) was used to rate pre- and post-program sensory-based behaviors. The SPM Home Form is a 75-item rating scale used to assess sensory processing, praxis, and social participation in children ages 5 through 12. It is completed by the child's parent or caretaker. Eight norm-referenced standard scores are obtained from the SPM Home Form: Social Participation, Vision, Hearing, Touch, Body Awareness, Balance and

Motion, Planning and Ideas, and Total Sensory Systems. For each of these domains a child's functioning can be classified as typical, some problems, or definite dysfunction. The SPM is intended for use with children with sensory processing difficulties, such as those documented in persons with an ASD (Wiggins, Robins, Bakeman, & Adamson, 2009). Internal consistency for the SPM Home Form ranges from .77 to .95 (median = .86), and test-retest reliability ranges from .94 to .98 (median = .97). A timeframe for testing and retesting a child using this measure is not addressed in the SPM manual. Therefore it was determined to be an appropriate tool for investigating sensory-based behaviors for children in this study. The SPM is a relatively new tool, thus few published studies report using this measure. However, its strong psychometric properties and thorough assessment of sensory processing and its impact on social participation deemed the SPM to be useful for this study.

A pre-program questionnaire was developed specifically for this study. This questionnaire collected demographic information and asked parents to identify in their own words three hopes for their child's participation in the OFA program for the child and three hopes for the family, for a total of six identified hopes for participating in the ski program. Parents also identified three challenging behaviors, observed at home or in the community, and rated their intensity on a 10-point scale. The identified hopes and challenging behaviors were used to customize the post-program questionnaire on which parents were asked to rate on a scale of one to ten the extent to which each of the hopes identified on the initial demographics cover sheet were fulfilled. The intensity of each challenging behavior that was identified on the pre-program questionnaire was rated again and a general question asked parents to reflect on any behavioral changes that they witnessed during the program. Each participating family received a

customized post-program questionnaire that was based on information provided in the pre-program questionnaire.

### **Procedure**

The University of Puget Sound Institutional Review Board approved all proposed methods for this study. The recruitment flier was sent to families via email by OFA two weeks before the start of the ski program. Parents of ski program participants who were interested in this study contacted the researcher via e-mail. Upon receipt of the email, the researcher responded by thanking them for their interest and asking the parent to provide an address for sending the pre-program packet. Once the researcher received the address, the initial study packet was mailed to the parent. This packet included a cover letter with instructions, consent form, assent form, the pre-program questionnaire, the SRS assessment, the SPM Home Form, and a return envelope. The researcher sent an email to the parent four days after the mailing to verify receipt and to offer to discuss the study (including informed consent), answer any questions, and to explain procedures for completing the SRS and the SPM Home Form. No parents sought further clarification on any elements of the study. Once parents completed the questionnaires and assessments, the packets were mailed back to the researcher and the SRS and SPM were scored. The children of all the families that completed the packet met the inclusion criteria of autism spectrum disorder diagnosis based on SRS score and were enrolled in the study.

Between pre- and post-program mailings, the children completed the 7-week alpine skiing program through OFA. They participated in four-hour ski lessons each Saturday or Sunday during which they were paired with a volunteer ski instructor for one-on-one lessons. A one-hour lunch break occurred after the first two hours of the program to rest, eat, and take a

break from the cold weather. Then, participants returned to the slopes for the remainder of their lesson. The researcher was not involved with the participants' lessons in any way. In the original study design, data were to be collected on each day in order to document how the lesson went, what was addressed, how the child responded to instruction, and to rate the child's behavior that day. However, these data were not collected due to the increased time and effort this would demand from volunteer ski instructors and parents participating in this study.

The customized post-program rating forms were mailed to families so that they were received in the week following the end of the 7-week program. The mailing included a cover letter with instructions, the SPM Home Form, a post-program questionnaire, and a return envelope. Three of three post-program rating forms were returned to the researcher within one month of the OFA program's end.

### **Data Analysis**

Raw scores from the SPM Home Form for pre- and post-program data were converted into *T*-scores according to the SPM manual. The *T*-scores for each child in each domain were plotted onto line graphs and visually inspected to detect change.

All identified hopes and their fulfillment rating and identified challenging behaviors with their pre- and post-program intensity ratings were compiled into tables. Qualitative analysis was used to examine and describe any relationships between hopes for ski program participation, their fulfillment, intensity ratings of challenging behaviors pre- and post-program participation, as well as any links to demographic information for each participant.

## **Results**

### **Participants**

Eight families indicated interest in the study and were mailed an initial study packet. Of these eight families, three returned the packet for a response rate of 37.5%. The Social Responsiveness Scale (SRS) for each child was scored to determine eligibility for the study. The children of all the families who returned the study packets met inclusion criteria and were enrolled in the study. Participants were three boys and their parents. Table 1 provides demographic data for each participant as well as score on the Social Responsiveness Scale (SRS; Constantino & Gruber, 2005). No changes were reported in medications or special services for any of the participants from pre- to post-program measures. Each family was asked to identify the reason they chose to enroll their child in the OFA ski program. Reasons provided are listed in Table 2.

### **Sensory Processing Measure**

Pre- and post-program Sensory Processing Measure (SPM; Parham & Ecker, 2007; Parham, Ecker, Miller Kuhaneck, Henry, & Glennon, 2007) scores are presented in Table 3. Scores for each subtest (social participation, vision, hearing, touch, body awareness, balance and motion, and planning and ideas) as well as total SPM raw score and *T*-score are presented for each participant. The SPM manual (Parham, Ecker, Miller Kuhaneck, Henry, & Glennon, 2007) was used to convert raw scores into *T*-scores and subsequent interpretive ranges.

Changes in pre- and post-program SPM total scores and subtest scores were graphed and are visually represented in Figures 1 and 2. A decrease in score indicates lower rates of problem behaviors and improved functioning in the corresponding area, an increase in score signifies higher rates of problem behaviors and decreased functioning in the area.

### **Pre- and Post-Program Questionnaires**

Parent-identified hopes and their fulfillment ratings are presented in Table 4. One identified hope for Participant 2 was not given a fulfillment rating on the post-program questionnaire, which may be because the hope addresses future participation and the parent could not report on its fulfillment at this time. Pre- and post- program parent-identified challenging behaviors and parent-reported intensity ratings are presented in Table 5. The final question on the post-program questionnaire asked parents to reflect on their child's behavior throughout the ski program, describing any differences observed on ski days versus non-ski days. The following paragraphs in this section report the data provided in answer to this final question.

Participant 1 was not reported to show significant behavioral changes from the beginning to the end of the OFA program. However, his parent reported an overall positive and upbeat attitude at home and felt that this was due to being successful in an activity and potentially experiencing higher self-esteem.

Participant 2 was reported to show pride and enjoyment while skiing which his parent reported are not emotions that the child expresses often. The parent reported that the child expressed anxiety about trying the ski lift for the first time but enjoyed it when he rode it each week.

Participant 3 was reported to show an increase in independence throughout the OFA program, as perceived by his parent. The child was reported to be better able to function in crowded areas, such as while in lines for the ski lift or at school. In addition, the child originally required 1-2 full time aides in order to ski without endangering himself or others. At the end of this ski season, he required only the 1:1 instruction provided by Outdoors for All volunteers in order to be successful on the ski hill.

## **Discussion**

This study aimed to investigate (1) if sensory-based behaviors and (2) intensity of parent-identified challenging behaviors that interfere with participation at home among children with an ASD decrease when enrolled in a weekly alpine skiing program and (3) whether an association exists between reported behavioral changes and reported fulfillment of parent-identified hopes for ski program participation. The behaviors reflected in the study are interrelated, and are reflective of the diagnostic criteria for ASD (APA, 2000). Thus, each aim will be discussed separately as well as together to examine their interconnectedness.

### **Sensory-based Behaviors**

Sensory Processing Measure (SPM; Parham, Ecker, Miller Kuhaneck, Henry, & Glennon, 2007) scores did not show enough change to be considered significant for any of the participants. However when the small changes in the scores are analyzed within the context of all the data collected, it appears that sensory-based behaviors were in some way affected during participation in the OFA ski program. For example, small changes in score can be detected via visual inspection of the graphed SPM scores that indicate improved performance for all three participants in the area of body awareness. Body awareness is dependent upon integration of input from the proprioceptive system which allows the child to sense the position of the body parts in space (Parham, Ecker, Miller Kuhaneck, Henry, & Glennon, 2007). Many requirements of alpine skiing, such as postural adjustments and strategically moving one's body to control skis while traveling downhill, may have contributed to increasing the participants' proprioceptive processing and subsequent body awareness. These findings may help occupational therapists begin to conceptualize potential benefits of alpine skiing for children with an ASD.

Further areas of small improvement that may be a result of this program are the vision and touch scores. While these remained stable for Participants 1 and 2, they decreased for

Participant 3. Alpine skiing includes vestibular inputs, and the vestibular system is responsible for maintaining visual gaze with objects in the environment (Henderson, Pehoski, & Murray, 2002). Therefore, alpine skiing may have contributed to some improvement in processing visual stimuli and attending to the visual environment for Participant 3. The sensory integration theory recognizes that the interaction of multi-sensory inputs during dynamic activity can strengthen the neural processing sensation (Bundy & Murray, 2002). It is possible that the simultaneous processing of vestibular, proprioceptive, and tactile stimuli that necessarily occurs while skiing resulted in improved multi-sensory processing for Participant 3 and led to enhanced tactile awareness for this child.

Overall total scores on the SPM (Parham, Ecker, Miller Kuhaneck, Henry, & Glennon, 2007) indicate small changes that suggest an overall trend toward improvement. Total scores decreased for Participant 1 and Participant 3, indicating that sensory-based behavior may have improved overall. Participant 2's total score remained constant from pre- to post- ski program. The small changes in SPM (Parham et al., 2007) data could be attributed to several factors. Sensory processing challenges for children with autism are complex and global and each sensory system is affected differently for each child (Kern et al., 2006). Behaviors that are linked to sensory processing are related to neurophysiological processes that are not prone to rapid change, though the neurological system is believed to be capable of change over time (Bundy & Murray, 2002). In one study, undesired behaviors and rates of engagement among four children with an ASD did not change immediately following sensory-based intervention but lab notes suggested these exhibited some change during intervention and parent report indicated change after a latency period (Watling & Dietz, 2007). Given that only 7 weeks elapsed between pre- and post-program measures in this study, change may have been in process when the study ended and may

have been too subtle to be detected with this standardized measure. The findings of this study indicate that participants may have begun to show changes in sensory processing as a result of participating in the alpine ski program, and that these changes may become more pronounced with continued participation in alpine skiing or other recreational activities.

### **Parent-identified Challenging Behaviors**

Parent report can be valuable in examining specific behavioral changes in an individualized manner. Challenging behaviors reported by the parent of Participant 1 were centered on him becoming frustrated at various times. For two of his three challenging behaviors, intensity ratings decreased from pre- to post- program, suggesting that his behavior improved throughout the 7-week ski program. Participant 2 was reported to show disengaging behaviors such as getting off task, asking rhetorical questions and having a very short attention span prior to the study. Like Participant 1, two of three challenging behaviors were rated as less intense following participation in the ski program. Challenging behaviors reported for Participant 3 seemed related to a lack of interaction with his surroundings. These were identified as self-stimulatory behaviors, not responding to instruction, and not communicating with others. All three of these behaviors were rated as more intense at post-program rating.

These parent-identified behaviors may be linked to each child's sensory processing abilities. For example, behaviors identified for Participant 1 indicate possible sensory modulation challenges. Participant 1's tendencies to have meltdowns, lack volume regulation when speaking, and give up when losing games are consistent with the definition of sensory modulation dysfunction in which a child has difficulty regulating the intensity of their response to sensory stimuli and difficulty with self-regulation (Roley & Schaaf, 2008). The behaviors

reported for Participant 2, a tendency toward isolation and a fleeting attention span, suggest avoidance of sensory input which may be due to sensory hypersensitivities. Children with hypersensitivities to sensory stimuli exhibit sensory defensiveness and display a fight-or-flight reaction to what are typically regarded as non-noxious stimuli (Bundy & Murray, 2002). The SPM score for Participant 2 indicates that his sensory processing abilities are in the typical interpretive range, so if hypersensitivities do exist they are likely mild in nature. Participant 3's non-verbal nature and difficulties following instructions behaviors indicate potential underresponsiveness to sensory input and consequently this child may seek sensation through self-stimulation (Lane, 2002). According to the literature, an underresponsive child requires higher degrees of stimulation to register input and activate the behavioral system (Lane, 2002). It is interesting to note that Participant 3's behavioral ratings increased in intensity while his SPM score showed a decrease from pre- to post- program. This participant also had the lowest SRS score and a profound ASD. This effect may indicate that for children with a profound ASD, overall sensory processing abilities may show marked overall improvement while continuing to display intense challenging behaviors periodically. This finding is also consistent with Ayres' (1972) early hypothesis that greater disorganization of behavior may precede increased organization of functional behavior in children with sensory processing dysfunction. The behaviors identified by the parents of the participants in this study as challenging in the home or the community are consistent with the SPM behaviors. The identified behaviors are focused on the child's social skills and participation, which are influenced by the child's sensory processing abilities. This study suggests that participation in an intense recreation activity may be effective in influencing sensory processing abilities, and subsequently influencing a child's social skills and overall participation.

### **Association between Behavior Changes and Hope Fulfillment**

Hopes identified for Participant 1 seemed to focus on quality of life themes including self-esteem, friendships, and coping skills and were reported to be highly fulfilled. Parent report for Participant 1 indicated an overall improvement in mood and attitude. Hopes for this family were centered on family interactions, and their reported fulfillment varied greatly. The parent's hope of spending time with another child while the participant skied was completely fulfilled, but those hopes involving the participant in interactions with family members were not rated as highly. Given this season was the fourth time that the child had participated in the ski program, his parent may have noticed changes in his affect in previous years and once again hoped that this would occur. Parent report revealed a decrease in intensity of the child's meltdowns when frustrated, and a somewhat fulfilled hope in progressing toward waiting in lines without melting down. Some association between parent hope fulfillment and behavior changes were found for Participant 1, indicating that the OFA ski program may have influenced this child's ability to regulate his behavior and interact more successfully with his family.

Parent report in an open-ended question regarding general behavior observations indicated that Participant 2 was able to successfully overcome his anxiety surrounding new activities (such as waiting in line and getting onto the ski lift) and participate in an activity valued by his family. This family hoped to gain an activity that the entire family could engage in after the ski lessons ended. Parent hopes for the child were rated as highly fulfilled in the child being able to feel comfortable and enjoy alpine skiing, and ski with his family. Overall, parent hope for his participation seemed to be more family oriented rather than focused on his behavior. No changes in medications or special services were reported by parents of Participant 2, and the parent emphasized that they could see improvement in their child's behavior while skiing was

the only change in his routine. The family's report that their hopes were highly fulfilled may be related to the reported decrease in intensity of challenging behaviors, suggesting an association between behavioral changes and hope fulfillment for Participant 2.

Participant 3 developed the ability to ski safely and with more independence through participating in the program, which was a hope that was rated as highly fulfilled. This child's pre-program SRS (Constantino & Gruber, 2005) score indicated severe impairment in social skills. The family did not rate their hopes for his increased interaction with others to be as highly fulfilled. While it is disappointing that a greater gain in this area was not observed, his lack of developing skill at interacting with others is not surprising since most of the ski program activities occur in a one-on-one interaction between the student and the ski instructor. However, the gains made in independence with alpine skiing as an activity indicate that the child was able to respond to instruction and experience in order to build skills needed for this activity. Both hopes identified for the family related to the family being able to collectively engage in an activity, and these were rated as highly fulfilled. It is likely that the child's gains in skiing ability allowed him to participate more fully in this family's desired activity. This finding supports the occupational therapy process of working with family members to identify priorities for intervention and the intervention emphasis of working to build skills that enable clients to more fully participate in desired activities (AOTA, 2008). Participant 3 showed change in his SPM score and it is possible that his behavioral changes, however small, may have contributed to his ability to ski more safely and that his progress in learning to ski may have led to improvements in behavior. This child was also reported to be better able to function in crowded spaces than before the ski program, which may help him to adapt to overwhelming environments and

participate in activities with his family. His tendency to be underresponsive to his environment may have been slightly decreased as he improved in skill building for a recreational activity.

### **Limitations**

This study had a very small sample size of all males ages 8-10, therefore generalization of results is limited. Research has suggested that changes in behavior for children with an ASD following sensory integration intervention has occurred immediately, lasting for about one hour (Smith, Press, Koenig, Kinnealey, 2005), while other work suggests the effects may be either concurrent or delayed (Watling, et al, 2007). The current study measured behaviors related to sensory processing over a period of time, rather than immediately following an alpine skiing lesson. Therefore changes occurring immediately following the alpine skiing lessons could not be determined. Due to the nature of this study, outside variables, such as participation in extracurricular activities and the extent and intensity of special services received, could not be controlled. Because these other variables can impact behavior for children with an ASD, it is not known whether the changes reported in behavior can be fully attributed to ski program participation. In addition, data were not collected regarding the skills addressed during each lesson, how the child responded to instruction, what was accomplished in each lesson, or whether challenging behaviors were addressed in any specific way. Such data would have added further depth to the interpretation of any behavioral changes.

### **Implications for Occupational Therapy**

Occupational therapists support participation in meaningful life activities by addressing factors within a person and their environment (AOTA, 2008). Occupational therapists work to address participation in various areas of occupation, including play, leisure, and social participation (AOTA, 2008) which are areas that were addressed through participation in an

adaptive alpine skiing program in this study. Alpine skiing is a recreational activity that involves physical activity and sensory inputs. The preliminary data from this study indicate that occupational therapists working with children with an ASD can potentially use alpine skiing and other recreational activities as a therapeutic modality to increase positive behaviors that may be influenced by sensory processing skills and thus encourage participation in daily life.

Occupational therapists can volunteer with, recommend, and use adaptive recreation organizations to address treatment goals with children with an ASD in a natural environment, away from the clinical setting. Many adaptive recreation organizations are community based and may provide an environment for children with an ASD to engage in functional tasks to overcome challenges and develop abilities alongside or in a fashion similar to that of their typical peers. Though there is much less control over features of the environment, natural settings can be used to deliberately incorporate sensory strategies into recreation experiences to encourage adaptive responses to unpredictable stimuli while engaging in activities such as skiing.

Alpine skiing is a complex sensory experience and can be used to challenge children with an ASD while providing a fun and meaningful recreational activity. Research has found that people with an ASD may be challenged in processing complex sensory stimuli and gravitate toward simple repetitive stimuli (Ashburner, Ziviani, & Roger, 2008). Reports from parents in this study show that when their child was challenged (such as by being in crowded lift lines) and they were able to adapt to the challenge, these skills transferred to other environments. Also, occupational therapists can recommend alpine skiing to families of children with an ASD to address both sensory processing and social participation which are primary areas of focus for occupational therapists when working with children with an ASD.

### **Future Research**

This study reveals promising trends that should be further examined by occupational therapists in order to better understand the possible ways that alpine skiing can affect behavior for children with an ASD. Any immediate responses to alpine skiing could be detected with daily observations and behavior tracking during ski program participation. This would be valuable for drawing comparisons in behavior between ski and non-ski days. Longitudinal research over multiple ski seasons could examine how a child with an ASD behaves throughout the year and compare behavior during the ski season to behavior during the off-season. This type of study could also examine a child's participation in various recreational activities and how behavior is affected during engagement in differing activities. The families in this study reported some changes that occurred in their children's behavior throughout the ski program that were not detected with a standardized measure. Qualitative research could take an in-depth look at the meaning of ski program participation for families of children with an ASD and its impact on family life and self-esteem for the child and their family members. The sensory aspects of alpine skiing and its merit as a sensory-based occupational therapy intervention should be investigated. A case study could be conducted using a sensory-based approach to intervention and working with OFA or a similar organization to address treatment goals surrounding participation for children with an ASD. Survey research could examine if occupational therapists are volunteering with recreational organizations, and identify why they are or are not involved.

## **Conclusions**

Results of this study indicated that though little change was detected with the SPM, change in sensory-based behavior for participants in this study trends toward improved functioning. Some benefits reported by families included less intense challenging behaviors, fulfilled hopes for their child and their family, increased self-esteem and positive affect, and

increased familial interaction and participation in recreational activities. Further research should investigate the merit of alpine skiing and other recreational activities as intervention tools for occupational therapists working with children with an ASD to address sensory processing, participation, and social skills.