Validity of the Postrotary Nystagmus Test for Measuring Vestibular Function

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key words: sensory integration, evaluation, vestibular

ABSTRACT

This study examined the validity of the Postrotary Nystagmus (PRN) test as a measure of vestibular functioning by examining the relations of scores from the PRN test with those from other variables measuring similar functions and through conducting a group comparison study. The PRN test is one of 17 tests included in the Sensory Integration and Praxis Tests (SIPT). Using SIPT scores from 575 children, sensory motor performance among children with depressed, average duration, and prolonged nystagmus was compared. The results indicated that children with low-duration postrotary nystagmus scored more poorly than children with average or prolonged postrotary nystagmus on other SIPT tests measuring aspects of vestibular function. Statistically significant, although weak correlation, coefficients were also obtained, demonstrating low-duration postrotary nystagmus may be associated with sensory motor deficits. The results of this study contribute to evidence supporting the PRN test's validity as a measure of some aspects of vestibular functioning.

The vestibular system in humans supports several important functions related to balance, postural control, and mobility, thereby affecting one's ability to successfully engage in daily life activities. Occupational therapists have an important role in the evaluation and treatment of individuals with vestibular disorders. In her theory of sensory integration, Ayres (1972, 2005) described the vestibular system as being closely linked to the visual and proprioceptive sensory systems. With the integration of sensory input from these systems, she described vestibular processing as being essential for coordinating eye movements, for postural control including muscle tone and balance, and for contributing to one's gravitational security or comfort with movement. These body functions provide a foundation for smooth, coordinated movement, and allow children in the context of their daily lives to explore, play, develop fine and gross motor skills, and move efficiently within their multiple environments.

Vestibular processing problems are commonly reported in children with neurodevelopmental disorders, such as developmental coordination disorder (Przysucha, Taylor, & Weber, 2008), autism (Molloy, Dietrich, & Bhattacharya, 2003; Noterdaeme, Mildenberger, Minow, & Amorosa, 2002), attention disorders (Mangeot et al., 2001; Mulligan, 1996), and learning disorders (Ayres, 1978; Mulligan, 1998). Children described as having sensory integration dysfunction commonly experience occupational performance problems believed to originate within the vestibular system or with the integration of vestibular sensory input with visual and proprioceptive input. For example, Miller, Anzalone, Lane, Cermak, and Olsten (2007) described some children with sensory modulation difficulties as being either over- or under-responsive to vestibular sensory input. White, Mulligan, Merrill, and Wright (2007) found that vestibular processing difficulties in children with sensory processing disorders were associated with dif-

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ficulties performing some daily living tasks, such as dressing and simple snack preparation. Ayres (1972) described a specific sensory integration problem as being gravitational insecurity or a discomfort or fear with movement in some children with learning disorders, which she believed originated from difficulties with vestibular processing. Such children might be uncomfortable climbing stairs, avoid playground swings, or be fearful of carnival rides. Therefore, pediatric occupational therapists commonly use measures of vestibular functioning as part their evaluations and for examining the effects of interventions aimed at improving vestibular processes impacting occupational performance.

Unfortunately, few easily administered, psychometrically sound, standardized evaluation tools are available for assessing vestibular function in children, and therapists often rely on their clinical observations of the child's movement and gross motor performance to infer vestibular functioning. Common evaluation activities include asking children to walk on a line, stand on their toes, maintain their balance while standing on one foot, or walk on a balance beam (Bundy, 2002). More formal clinical assessment procedures might include placing a child on a tilt board to examine how well the child adjusts his or her body position when the center of gravity is displaced to maintain balance, assessing righting and equilibrium reactions (Bundy, 2002; Steindl, Kunz, Schrott-Fischer, & Scholt, 2006).

Asking the child to assume antigravity postures, such as a prone extension posture, is also believed to provide information about vestibular processing (Ayres, 2005; Wilson, Pollock, Kaplan, & Law, 2000). The Sensory Organization Test using posturography (Forssberg & Nasher, 1982) and the Pediatric Clinical Test of Sensory Interaction for Balance (Crowe, Dietz, Richardson, & Atwater, 1990) both measure specifically balance and postural sway and the contributions of visual, proprioceptive, and vestibular sensory input on postural sway and ability to maintain balance. Some standardized tools designed to measure gross motor skills, such as the Peabody Developmental Motor Scale-2 (Folio & Fewell, 2000), the Miller Function and Participation Scales (Miller, 2006), and the Bruininks-Oseretsky Test of Motor Proficiency-2 (Bruininks & Bruininks, 2005), provide information about postural control and balance, but they are not designed to comprehensively measure vestibular function.

This study explored the construct validity of the Postrotary Nystagmus (PRN) test as a measure of vestibular functioning. The PRN test is one of 17 tests included as part of the Sensory Integration and Praxis Tests (SIPT; Ayres, 1989), which is a standardized measure of sensory integration and praxis functions in children ages 4 to 8 years, 11 months. Ayres (1975) first published the PRN test as a separate test, the Southern California Postrotary Nystagmus Test, and it was later included as part of the SIPT in 1989.

Validity as it relates to the properties of a standardized test is currently viewed as a unitary concept whereby all previously understood types of validity evidence can be thought of as construct validity (Fromme, Karani, & Downing, 2009). Validity relates directly to score meaning, and the newest edition of the Standards for Educational and Psychological Testing (American Educational Research Association [AERA], American Psychological Association [APA], and National Council on Measurement in Education [NCME], 1999) describes validity as, "the degree to which evidence and theory support the interpretations of the test scores entailed by proposed uses of the tests" (p. 9). Furthermore, a measure of a test's validity is described as being on a continuum rather than an absolute, reflecting the degree to which all of the accumulated evidence supports the intended interpretations and purposes of test scores.

The Standards introduced five different sources of validity evidence: evidence based on test content, on response processes (by examinees), on the test's internal structure, on relations to other variables, and on the consequences of testing (AERA, APA, & NCME, 1999). This study considered one of these sources of validity evidence by examining the PRN test's relations with other variables. In addition, content evidence based on information from the test manual and a review of previous studies is addressed as part of this literature review.

In consideration of test content, the PRN test specifically measures the vestibular-ocular reflex through the elicitation of postrotary nystagmus. The vestibular-ocular reflex is compensatory eye movements that are made through the interaction of the visual and vestibular systems as they strive to maintain visual clarity of objects during locomotion and other head movement. Corrective eye movements following body rotation are known as nystagmus and consist of a series of automatic, back-and-forth eye movements with a slow phase and a quick phase (Fetter, 2000). The vestibular-ocular reflex can be easily elicited using rotary stimulation, and the duration, velocity, and regularity of postrotary nystagmus are believed to be indicators of vestibular system functioning.

The PRN test is administered by passive, rotational stimulation. The child sits on a board with the head positioned in 30° of flexion to stimulate the endolymphatic fluid within the semicircular ear canals during movement. The board is then rotated by the administrator for 10 rotations in 20 seconds, followed by an abrupt stop. The child then lifts his or her head and is directed to look straight ahead, and then the duration of the child's nystagmus is measured by the test administrator using a stop watch (Ayres, 2004).

In a research context and clinical settings specifically designed for evaluating peripheral and central vestibular disorders, the rotational chair rather than a rotating board has been used for assessing the vestibular-ocular reflex (Fife et al., 2000). Rotational chair testing has undergone numerous changes over time and, with electronystagmographic readings, currently has additional applications, including testing of visual-vestibular interaction, optokinetic after-nystagmus, high-velocity sinusoidal testing, and off-vertical axis rotation testing (Schmal, Glitz, Thiede, & Stoll, 2005). Rotational chair testing is usually conducted in a lightproof booth with some form of a head restraint, an infrared camera, and a two-way communication system (Hain, 2009). Although rotational chair testing procedures with electronystagmographic recordings are conducted under more controlled conditions than the PRN test, these sophisticated procedures would typically not be practical for occupational therapists evaluating children due to the cost of the equipment, the training and time needed, and the potential discomfort involved for the child. Nonetheless, the idea of using the vestibular-ocular reflex as a measure of vestibular functioning is not new or unique to occupational therapy.

Ayres (1989, 2004) had support from experts from the field of occupational therapy for including the PRN test as part of the SIPT. Ayres acknowledged that our understanding of how vestibular processing difficulties affect learning and behavior lacks clarity, despite an abundance of data suggesting that children with learning disorders commonly exhibit vestibular processing problems. She considered the PRN test to be one method to assess functioning of the vestibular system and interaction of the visual and vestibular systems, and suggested that comprehensive testing of vestibular function should include other clinical observations of postural control and balance to augment the information obtained from the SIPT (Ayres, 1989, 2004; Wiss & Clark, 1990).

The validity of the PRN test has been questioned for several reasons (Cohen, 1989; Polatajko, 1985; Wiss & Clark, 1990). First, it is administered with the child's eyes open in lighted conditions allowing for visual fixation, which has been shown to inhibit or shorten the duration of the nystagmus (Bundy, 2002; Cohen, 1989). The child is told "look at the wall" when stopped, and although the wall should be blank, the child may find a spot on which to focus or even imagine a spot on the wall. Therefore, the influence of the visual system has been reported as a confounding factor (Cohen, 1989; Polatajko, 1985). Second, because it is manually administered, slight variations in the speed of the rotation and the child's ability to maintain the exact, desired head position during the testing procedure present challenges. Third, the duration of nystagmus as a parameter for measuring the vestibular-ocular reflex is not overly sensitive and, because the measurement relies on direct observation by the administrator (rather than electronystagmography) and manual use of a stopwatch, the measurement is subject to human error. Given these limitations, it is not surprising that the psychometrics, as reported in the SIPT manual for postrotary nystagmus, are relatively weak.

The test–retest reliability coefficient for a combined sample of learning disabled and normal children (n = 51) was reported as being r = .48 (Ayres, 1989). It is suspected that this weak result may reflect the instability of the vestibular-ocular reflex with children with vestibular problems or the relatively small sample used in the study. Based on a review of four earlier test–retest studies, Dutton (1985) reported more favorable results with r = .79 to .81 for typical children ages 4 to 11 years. Inter-rater reliability data reported in the SIPT manual is strong (n = 63; r = .98), indicating that human error can be minimized with adequately trained therapists.

The validity of the PRN test has also been addressed through factor and cluster analyses examining relations among the 17 SIPT tests, and fairly consistent patterns of dysfunction have been identified (Ayres, 1989; Mulligan, 1998). Cluster analyses by Ayres (1989) and Mulligan (2000) demonstrated a relation between moderately high PRN test scores and low performance on the Praxis on Verbal Command (PrVC), a test measuring a child's ability to assume a body posture or position following a verbal direction. However, factor analyses have not revealed consistent relations between PRN test scores and the other SIPT tests, and PRN test scores have not correlated significantly with any of the other SIPT tests believed to measure aspects of vestibular functioning. Ayres suggested that such relations are difficult to demonstrate statistically because both unusually high and low PRN test scores are indicative of dysfunction. In addition, she suggested that the PRN test may be measuring a different aspect of vestibular functioning than processes that influence balance and postural control. Earlier studies of the Southern California Postrotary Nystagmus Test suggested that low postrotary nystagmus is associated with visual-spatial and other learning problems (Ayres, 1978; Morrison, Hinshaw & Carte, 1985; Ottenbacher, 1978, 1980) and motor difficulties (Fisher, Mixon, & Herman, 1986).

The purpose of this study was to investigate the construct validity of the PRN test as a measure of vestibular function using a large data set of children tested with the SIPT by examining the relations of scores from the PRN test with those from other variables measuring similar functions. Currently, children with depressed or significantly lower duration postrotary nystagmus than average (z-scores of -1 or lower) are thought to have vestibular dysfunction that may be contributing to difficulties with balance, postural control, and motor performance (Ayres, 1989, 2004). High-duration nystagmus (z-scores of 1 or higher) is interpreted as vestibular dysfunction that may be associated with a lack of higher cortical inhibition, or over-responsiveness to the rotational movement (Ayres, 1989, 2004).

The SIPT selected for the analyses were those that also assess aspects of vestibular function or functions that are believed to result from the integration of vestibular input with other forms of sensory input, including Standing and Walking Balance, Bilateral Motor Coordination, Motor Accuracy, and Kinesthesia, which are briefly described below.

Standing and Walking Balance consists of items that examine static and dynamic balance with eyes open and with eyes closed. Ayres (2004) described Standing and Walking Balance as a test measuring vestibular functions that examines the contributions of visual and somatosensory input in maintaining balance.

Bilateral Motor Coordination requires the child to smoothly coordinate and sequence arm, hand, and foot movements following demonstration. It is primarily a measure of bilateral integration, sequencing, and motor coordination. Bilateral Motor Coordination has loaded strongly and consistently on a vestibular-bilateral integration pattern of dysfunction (Ayres, 2004; Mulligan, 1998), along with Standing and Walking Balance and motor sequencing measures. This evidence suggests that Bilateral Motor Coordination addresses an aspect of vestibular processing (Ayres, 1989, 2004, 2005), and therefore it was included.

Kinesthesia examines the ability to interpret and recall sensory input from the joint and muscle receptors and has been associated with motor performance and somatosensory processing. Although this test primarily measures kinesthetic awareness, vestibular processing to detect and analyze movement and arm position is also addressed. Kinesthesia has also correlated with Standing and Walking Balance (Ayres, 1989). In a more recent factor analysis, the PRN test loaded on a factor combining vestibular and bilateral integration sequencing functions including Standing and Walking Balance, Bilateral Motor Coordination, Kinesthesia, and Motor Accuracy (Mailloux et al., in press).

Motor Accuracy is primarily a visuomotor test requiring the child to trace over a path using a marker. The child completes the task with both dominant and non-dominant hands and is required to cross the midline while tracing. Data suggest that performance on this test relies on vestibular, visual, and somatic sensory processing, and Motor Accuracy has correlated significantly with Standing and Walking Balance in previous studies (Ayres, 1989).

The PrVC, although a test of motor planning rather than a measure of vestibular function, is the only SIPT test that has shown relations with higher duration postrotary nystagmus (Ayres, 1989; Mulligan, 2000). Ayres hypothesized that abnormally high postrotary nystagmus may reflect a left hemisphere vulnerability impacting some aspects of auditory processing and motor planning. Further examination of the relations of postrotary nystagmus with the PrVC in this study aims to inform our ability to make interpretations regarding high-duration postrotary nystagmus.

Inter-rater reliability of these SIPT measures is reported to be strong (correlations of .96 and above; Ayres, 2004). Test–retest reliability data (n = 51) indicate adequate stability for all of the measures with coefficients ranging from r = .82 to r = .88 except for the PRN test (r = .48) and Kinesthesia (r = .50). More information on the psychometrics of these SIPT measures, including an abundance of data supporting the validity of the measures, is provided in the test manual (Ayres, 2004).

Based on previous research, it was hypothesized that: (1) there would be significant positive correlation coefficients between the PRN test, Standing and Walking Balance, and Bilateral Motor Coordination, and negative correlations between the PRN test, Kinesthesia, and Motor Accuracy, indicating that lower PRN test scores are associated with poorer performance in sensory motor measures addressing aspects of vestibular functioning; (2) children with depressed postrotary nystagmus would score more poorly on Standing and Walking Balance, Kinesthesia, Bilateral Motor Coordination, and Motor Accuracy than children with normal or high postrotary nystagmus; and (3) children with prolonged postrotary nystagmus would score lower on the PrVC compared with those with average or low postrotary nystagmus, and there would be a negative, significant correlation between the PRN test and the PrVC.

Methods

Sample

The SIPT raw scores of 575 children who were assessed due to suspected sensory integration problems were extracted from a data set of 1,000 cases compiled by Western Psychological Services, the publisher of the test. Detailed diagnostic information of the children in the sample was not available, but children with (or suspected of having) sensory processing disorders and/or conditions, such as developmental coordination disorder, learning and attention disorders, and autism spectrum disorders, are commonly administered the SIPT. The SIPT scores were submitted by therapists who were trained and certified to administer the SIPT, which includes more than 10 days of training and peer reviewed test administration. Permission to use the data set for the purposes of this study was obtained from the institutional review board for the protection of human subjects of the researcher's academic institution prior to data analysis. To obtain the sample from the set of 1,000 cases, cases with missing data were omitted first, including all children 4 years of age because they are not administered Part 2 of the Bilateral Motor Coordination Test (the feet items), leaving 608 cases.

These cases were then divided into three groups based on PRN test scores. PRN-Low included children with PRN test scores more than 1 standard deviation below the PRN mean of the sample; PRN-Average included children with PRN test scores within 1 standard deviation from the mean; and PRN-High included children with PRN test scores more than 1 standard deviation above the mean. Because both age and gender influence performance on the measures analyzed (Ayres, 1989), the final step was to achieve equality on the variables of age and gender across groups. This was accomplished through random elimination of cases that were over-represented across groups so that equivalency in the proportions of females and males and children of the various ages across groups was achieved, while leaving the maximum number of cases possible. A description of the final sample of 575 cases and mean SIPT raw scores by group are included in Table 1.

Table 1
Subject Characteristics by Group[a]

Characteristic	Low PRN	Average PRN	High PRN	Total
Gender				
Male	72 (74%)	277 (71.5%)	62 (68%)	411 (71.5%)
Female	25 (26%)	110 (28.5%)	29 (31%)	165 (28.5%)
Age (y)				
5	20 (20%)	62 (16%)	17 (19%)	99 (17%)
6	30 (31%)	121 (31%)	24 (26%)	175 (30%)
7	28 (29%)	113 (29%)	28 (31%)	169 (29%)
8	20 (20%)	90 (23%)	22 (24%)	132 (23%)
Mean (*SD*)	6.7 (1.2)	6.8 (1.2)	6.8 (1.2)	6.8 (1.2)

PRN = postrotary nystagmus; SD = *standard deviation.*
[a]*No significant difference in frequencies across groups by gender* (X^2 = *.86,* p = *.65) or age* (X^2 = *5.8,* p = *.97).*

Procedures and Data Analysis

Relations between PRN test scores and Standing and Walking Balance, Bilateral Motor Coordination, Motor Accuracy, Kinesthesia, and PrVC scores were obtained by computing Pearson product moment correlations using SPSS version 17 (SPSS, Inc., Chicago, IL). For Standing and Walking Balance, Bilateral Motor Coordination, and the PrVC, higher raw scores represent better performance, whereas for Motor Accuracy and Kinesthesia, lower scores reflect better performance. To compare the performance of children with low, average, and high PRN test scores on the tests that measure aspects of vestibular functioning and the PrVC, analysis of variance was done. An alpha level with a *p* value of less than .05 was used to determine statistical significance for the omnibus test, and a more conservative *p* value of less than .01 was applied for Tukey's post-hoc comparisons.

Results

To test the first hypothesis, correlation coefficients between the PRN test and the other SIPT measures were obtained with values indicating statistically significant relations for all pairs ($p < .05$) as follows: r = -.16 (Kinesthesia), r = .25 (Bilateral Motor Coordination), r = .19 (Standing and Walking Balance), and r = -.19 (Motor Accuracy). Although the resulting coefficients indicated weak relations, they provide some evidence to suggest that children with lower postrotary nystagmus duration perform more poorly on measures of balance (Standing and Walking Balance) and other tests involving vestibular functioning (Bilateral Motor Coordination, Motor Accuracy, and Kinesthesia) than those with longer duration postrotary nystagmus, in support of the first hypothesis.

The second hypothesis was that children with depressed postrotary nystagmus would score more poorly on Standing and Walking Balance, Kinesthesia, Bilateral Motor Coordination, and Motor Accuracy than children with normal or high postrotary

Table 2
Mean SIPT Raw Scores by Group

SIPT Measure	Low PRN[a]	Average PRN[a]	High PRN[a]	Total[a]	*F*	*p*
PRN	1.4 (.9)	8.1 (2.7)	15.9 (6.4)	8.1 (5)	791	< .001
SWB	74.8 (24.2)	89.8 (21.6)	93.9 (20.5)	77.8 (25.1)	10.9	< .001
Kinesthesia[b]	34.9 (15)	34.3 (11.0)	32.1 (10.4)	39.6 (14.5)	8.8	< .001
Motor Accuracy[b]	112.0 (37)	92.0 (30.4)	82.3 (22)	108 (30.6)	7.9	< .001
BMC	13.9 (8.4)	17.3 (6.7)	20.5 (6.3)	17.2 (7.1)	9.3	< .001
PrVC	18.2 (5.7)	21.0 (3.1)	21.5 (2.5)	19.0 (4.9)	9.8	< .001

SIPT = Sensory Integration and Praxis Tests; PRN = Postrotary Nystgamus; SWB = Standing and Walking Balance; BMC = Bilateral Motor Coordination; PrVC = Praxis on Verbal Command.
[a]Values given as mean (standard deviation).
[b]Higher scores indicate lower performance.

nystagmus. Examination of group differences indicated significant differences in mean scores among the groups for all measures at a *p* value of less than .001 (Table 2). Post-hoc comparisons revealed that the PRN-Low group scored more poorly than the PRN-High group on all measures ($p < .01$). The PRN-Low group also scored more poorly that the PRN-Average group on all measures with the exception of Bilateral Motor Coordination, which approached statistical significance ($p = .02$). No differences were noted between the PRN-High group and the PRN-Average group. These results suggest that children with depressed postrotary nystagmus do more poorly than children with average or high postrotary nystagmus on a variety of sensory motor measures.

The third hypothesis is that children with prolonged postrotary nystagmus would score lower on the PrVC compared to those with average or low postrotary nystagmus. The results of the group comparison study indicated that this was not the case, with the children with prolonged postrotary nystagmus actually scoring higher on the PrVC than those in the PRN-Average and PRN-High groups ($F = 9.81$, $p < .001$). The correlation between postrotary nystagmus and the PrVC was weak, but indicated a significant positive relation ($r = .18$; $p < .05$). Interestingly, the negative relation between postrotary nystagmus and the PrVC was not found with this sample as it has been found in previous studies (Ayres, 1989; Mulligan, 2000), suggesting that prolonged duration postrotary nystagmus can be associated with stronger performance on tests measuring one's ability to assume a body posture following a verbal command.

Discussion

The PRN test as a test of the vestibular-ocular reflex does appear to be a meaningful index of some aspect of vestibular functioning. Validity evidence must address how test scores are interpreted, and for what purposes. The results of this study provide evidence to suggest that significantly low PRN test scores (reflecting low-duration postrotary nystagmus) can indicate a vestibular processing deficit and may relate to difficulties in balance, motor coordination, kinesthesia, praxis (body positioning following a verbal direction), and motor accuracy. Low PRN test scores have been shown in previous research (Ayres, 1989, 2004) to be most closely associated with central vestibular system difficulties, which often result in balance and motor coordination problems consistent with findings of this study. Such difficulties have the potential to impair a child's gross motor play and performance of functional activities.

However, the significant correlations between the PRN test and the other SIPT measures must be interpreted with caution because the relations between these variables were weak. In addition, all of the measures included as part of the SIPT battery are believed to assess aspects of sensory integration. Therefore, it is plausible that the relations identified between postrotary nystagmus and the sensory motor measures may have represented the relations or commonality they share as sensory integration functions, rather than more specifically because they all measure aspects of vestibular functioning. Abnormally high PRN test scores or prolonged postrotary nystagmus has also been interpreted as being an indicator of vestibular dysfunction, although the type of dysfunction and clinical problems associated with high postrotary nystagmus have not been clearly identified. The results of this study did not indicate that high PRN test scores were unfavorable. It may be that abnormally high or prolonged postrotary nystagmus is associated with vestibular functions other than those measured by the tests included in this study, such as over-sensitivity to movement or motion sickness. As suggested by Ayres (1989, 2004), prolonged postrotary nystagmus may be associated with difficulties in higher cortical functions, such as auditory processing and language functions.

The PRN test is a test that is fairly quick and easy to administer and test scores from the PRN test provide some objective data regarding the functioning of the vestibular system and interaction of the visual and vestibular systems. The weak correlations of postrotary nystagmus with measures of balance, kinesthesia, and motor coordination suggest that the PRN test most likely measures different aspects of vestibular functioning than balance and postural control, allowing it to be a useful addition to more commonly used measures. It is recommended that this test be used in conjunction with other observations and measures of vestibular functioning for a more comprehensive assessment. Finally, contrary to information reported in the test manual, the results of this study did not support the interpretation of prolonged postrotary nystagmus as representing dysfunctioning sensory motor performance, nor having an inverse relationship with the PrVC (Ayres, 1989, 2004).

It is important to address several limitations of the study. First, although the sample size was more than adequate, using an existing data set with limited demographic and medical background information about the subjects did not allow for examination of how such factors may have influenced the test scores. Second, it is difficult to know if the relations that were identified were present because all of the measures included in the study were testing underlying sensory integration functions or because they were measuring aspects of vestibular processing. Third, the subject pool was limited to children for whom the SIPT was normed, limiting generalizability to other age groups. Finally, the test–retest reliability of two of the measures used in the study, postrotary nystagmus and Kinesthesia, is low and the possible instability of these measures may have affected the scores that were obtained and analyzed. However, despite these limitations the clear differences in sensory motor performance across the groups of children with low-, average-, and high-duration nystagmus provide some evidence that low PRN test scores are associated with vestibular-based challenges.

Further study is needed to examine the functional implications of both low-duration nystagmus and abnormally high-duration nystagmus. Successful occupational performance in most daily life activities requires an intact vestibular-ocular reflex, adequate postural control, balance and postural awareness, coordination of eye movements, and eye–hand coordination (Parham & Mailloux, 2010). Therefore, these aspects of vestibular functioning including postrotary nystagmus are important to consider in the evaluation of children with neurodevelopmental disorders. Further study of the stability of the PRN test is recommended and alternative administrative procedures that would eliminate the confounding variable of visual input should be considered and tested. Finally, the study of individuals with prolonged nystagmus is needed so that valid interpretations of such findings can be made.

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