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# Comparative cognitive performance of orthopedic, delay, and intellectual disability cases: accommodations?

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Comparative Cognitive Performance of Orthopedic, Delay,  
and Intellectual Disability Cases: Accommodations?

By

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Presented to the Faculty of the  
Graduate Department of Clinical Psychology  
George Fox University  
in partial fulfillment  
of the requirements for the degree of  
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in Clinical Psychology

Newberg, Oregon

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at the

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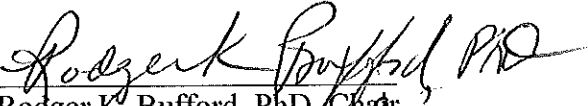
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and Intellectual Disability Cases: Accommodations?

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**Abstract**

Many clients who appear for psychological assessment are found to be struggling because of physical or motor performance disabilities in addition to developmental delays or cognitive-processing disabilities. The effects of orthopedic conditions on testing have been known for decades (e.g., Briggs, 1960). Despite the attention to physical disabilities, there are few currently published studies of how developmental delays or motor performance affect performance on cognitive and achievement batteries exclusive of the studies reported in test manuals (e.g., Roid, 2003, on the Stanford-Binet Intelligence Scales, Fifth Edition, [SB-5]). Often these groups are the smallest among the validation groups.

Participants for the current study included individuals aged 3 to 18 from samples collected during the standardization of the SB-5: (a) 22 individuals with orthopedic disabilities (9 with cerebral palsy, and 13 with other motor disabilities); (b) 54 individuals with developmental

delays; (c) 104 individuals with documented intellectual disabilities; and (d) 211 normative cases from a stratified random sample of the U.S. Instruments were the 10 subtests of the SB-5 (Roid, 2003). The SB-5 consists of 5 each Verbal and Nonverbal tests representing 5 cognitive factors. Performance of the 4 samples was compared on each of the SB-5 subtests.

The normative sample showed the highest level of performance on all subtests. The orthopedic cases showed higher levels of cognitive performance than the developmental delay and intellectual disability samples except on tasks requiring refined motor skills. These findings suggest that SB-5 subtests most clearly differentiate the orthopedic cases from Developmental Delay, Intellectual Disability, and Control when it involved the manipulation of forms. These included Nonverbal Visual-Spatial, involving the placement of pieces in a formboard or form completion using tanagram-style pieces, and the Nonverbal Working Memory, involving the tapping of blocks. Because response speed is scored for these subtests, it is concluded that standardized test procedures are biased against those whose motor skills are impaired.

The separation of speed from cognitive ability is crucial for the fair assessment of cognitive abilities among individuals with physical disabilities (Braden & Elliott, 2003). Appropriate accommodations are needed to fairly assess cognitive functioning for individuals with orthopedic disabilities.

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## **Chapter 1**

### **Introduction**

Cognitive assessment batteries such as those that measure intelligence are used in several areas of society to obtain information in diagnosing disabilities and to gain eligibility or access to resources the government provides. Many of these assessments have high stakes outcomes for the clients. The Wechsler Adult Intelligence Scale 3rd Edition, for example, is routinely given as part of many neuropsychological evaluations (Binder, 1987). IQ batteries often determine the type of accommodations a child will need to succeed in school, or whether a person is able to collect Social Security.

Assessments used for Social Security and workers compensation eligibility usually include cognitive and intellectual ability (IQ) batteries. These assessments often determine income supplementation, placements in community or school programs, and the type of accommodations needed. Therefore, many research studies have focused on the reliability and validity of IQ batteries for several clinical populations, including individuals with intellectual disabilities or learning disabilities.

Perhaps the most familiar assessments for special educators are the measures given to students for eligibility and placement. Students are tested to see if they are eligible for remedial or special education. Although this type of assessment is important, it does not connect with or count in state and district accountability systems. Researchers have found evidence that

students with physical disabilities have largely been excluded from both assessment and accountability in schools, especially when reports are released to the public (Elliott, Ysseldyke, Thurlow, & Erickson, 1998).

### **Neglected Areas of Research**

One of the most neglected areas in the documentation of the intellectual abilities of special populations is the study of individuals with physical disabilities such as cerebral palsy and muscular dystrophy. There has been an abundance of research focused on IQ assessment reliability and validity for several populations such as intellectual disabilities, developmental delay, gifted, and English language learners (Roid, 2003). It is often true that children with physical disabilities have mental disabilities as well. But this is not always true. The effects of orthopedic conditions on testing have been known for decades (e.g., Briggs, 1960), especially in neuropsychological assessment. Federal legislation such as the Americans with Disabilities Act (Phillips, 1994) and the new Individuals with Disabilities Educational Improvement Act (2004) have highlighted the need for sensitivity to the motor demands of assessments as well as the possibility of testing accommodations (Braden & Elliott, 2003). Yet few studies have addressed this concern.

### **Few Physically Disabled Participants in Standardization Samples**

Many IQ assessments rely on timed tests. Some require only rapid cognitive responses, while others require rapid physical responding as well. Familiar timed subtests that require rapid physical responses include Block Tapping, Block Design and Coding. These are core subtests on which examinees often earn extra points for faster performances. It might be expected that individual who have movement limitations would perform differently than persons who do not

have those limitations; however this norm group is often the smallest of the standardization groups. Despite the current attention to physical disabilities, few published studies have been conducted to document the affect of physical limitations on the most widely used cognitive and achievement batteries, exclusive of the studies reported in test manuals such as, the Leiter-R, (Roid & Miller, 1997), or Stanford-Binet Fifth Edition (SB-5; Roid, 2003). There were 61 participants with motor disabilities in the validation studies of the nonverbal Leiter-R and 19 in the SB-5 studies, but no orthopedic or developmental delay samples were included in validation studies of the Woodcock-Johnson 3<sup>rd</sup> Edition, (McGrew & Woodcock, 2001) Cognitive Assessment System (CAS; Naglieri, 1997) or Differential Ability Scales (DAS; Elliott, 1990).

In the real world of assessment, many of the clients struggling in school or at work have both learning, or processing, disabilities, and a physical disability; some have exclusively physical disabilities. Little to no research has been conducted on the effects of the timed tests on full scale IQ for participants with physical handicaps or those in multiply handicapped groups. Physically handicapped clients may not be receiving accurate scores on assessments, which can affect important aspects of their lives and development.

Briggs (1960) examined the effect of the hand (dominant and non-dominant) a client used on the scores they earned on performance subtests on the WAIS. “This investigation simply considers the degree to which a patient is handicapped by having had available only the dominant or non-dominant hand” (p. 318). Briggs (1960) found that only the digit symbol subtest was affected, by about 3 points. However, Briggs only used non-handicapped participants in this study. It is hard to generalize Briggs’ findings to a physically handicapped individual due to the

fact that they do not always have two hands, may not have a dominant hand, or whose impairment may adversely affect use of both hands.

The Americans with Disabilities Act of 2004 has helped to create this focus on providing assessments to each client to determine what will help him or her to succeed best in society. “Although a major focus of the new legislation is the removal of physical barriers in building construction, there are also provisions that prohibit discrimination against the disabled in employment and education” (Phillips, 1994, p. 94). Requiring a client with a physical disability to move as fast as those with normal ability to gain points on a high stakes assessment violates this principle. Therefore, it is crucial we determine how much the time affects the full scale IQ so that we can begin to make appropriate accommodations for clients with physical disabilities. Accurately appraising the role of time limits will enable us to provide more accurate assessments that will better help clients to succeed.

### **Importance of Appropriate Accommodations**

Additional studies of test performance by individuals with physical disabilities are crucial, as well as details of methods for providing appropriate accommodations for these groups. Also, the divergent validity of intelligence tests must be established by demonstrating each test’s ability to distinguishing among intellectual disabilities, developmental disabilities, and orthopedic disabilities. Such knowledge is especially important where motor delays or impairments are combined with cognitive delays.

Knowing which subtests pose the greatest disadvantage for individuals with physical disabilities also would help to determine modifications that would provide more accurate testing as well as which IQ assessments are better designed to be used with physically disabled clients.

This knowledge could lead to valid testing accommodations. The need to appraise the affects of physical disabilities on IQ scores provides valid reasons to look at a larger norm group with physical disabilities so they are no longer underrepresented in standardization procedures.

### **Research Questions of the Study**

The present study was conducted to determine the magnitude of differences between various disability groups on the scores from a prominent cognitive-ability test battery, with the purpose of establishing possible needs for test accommodations. The study examined the 10 subtests, indexes, and IQ measures from the *Stanford Binet Intelligence Scale, Fifth Edition* to identify differences in the cognitive profiles of individuals with orthopedic or intellectual disabilities as well as those with developmental delays in cognitive function. The main research question was, “To what degree do individuals with orthopedic disabilities score lower on tests that require rapid, and precise motor responses subtests (e.g., completion of puzzles with time limits) as compared to other disability groups and control participants?” Also, the study investigated the degree to which subtests in this major battery could differentiate between orthopedic cases and the DD or ID and control cases. Finally, the study was designed to demonstrate the validity of the SB-5 in effectively separating control participants from more severe conditions of developmental disabilities.

## Chapter 2

### Method

This chapter describes methods for the study. Participants, the instrument used, procedures, and methods of data analysis will be reported in turn.

#### Participants

The archival data for this study consisted of 391 participants who served as participants in the norming of the SB-5 (Roid, 2003). These participants were selected to represent variance in values, backgrounds, ages, socioeconomic status, level of parental education, and number of hours spent in special education each week. The participants were male and female and were between the ages of 3 and 19 years old as shown in Table 1. The participants represented four types of subgroups within the sample collected during the norming of the SB-5. The groups included: (a) 22 individuals with documented orthopedic disabilities (9 with cerebral palsy, and 13 with other motor disabilities, identified by physicians), (b) 54 individuals with developmental delays, (c) 104 individuals with documented intellectual disabilities, and (d) 211 normative cases from a stratified random sample of the U.S. selected from the 4,800 cases in the SB-5 standardization sample to match the disability samples for age, gender, ethnicity, and parental education level. There were more males (63%) than females, more individuals of non-majority ethnic origins (60% versus about 40% in the U.S. population), and fewer individuals whose parents had college-level education (35% as compared to the U.S. population rate of about 55%).

The Stanford Binet standardization sample was stratified into three categories; (a) Ethnicity: Hispanic, African American, Caucasian, and Other; (b) Parents Education Level: No high school, High school/GED, and 1+ Years of College, and (c) Sex: Male, and Female.

Table 1

*Demographics of the Four Contrasting Samples*

	Control Group	Orthopedic Impairment	Develop-Delay	Intellectual Disability
<i>Ethnicity</i>				
African American	29.6%	5.3%	20.6%	37.2%
Hispanic	19.5%	31.6%	31.7%	15.5%
White/Caucasian	43.8%	57.9%	33.3%	40.3%
Other	7.1%	5.3%	14.3%	7.0%
<i>Educational Level of Parents</i>				
No High School	25.2%	10.5%	19.0%	25.6%
HS or GED	36.3%	31.6%	38.1%	41.1%
1+ yrs College	38.5%	57.9%	42.9%	24.8%
<i>Sex</i>				
Female	37.6%	47.4%	23.8%	41.9%
Male	62.6%	52.6%	76.2%	58.1%
Average Age	8.4 yrs	9.9 yrs	3.7 yrs	11.2 yrs
Group Size	211	22	54	104

**Instrument**

The SB-5 (Roid, 2003). The SB-5 was developed to assess full scale IQ from age 2 to 85+ years. It also is used to assess fluid reasoning, crystallized knowledge, quantitative reasoning, visual-spatial processing, and working memory for both nonverbal IQ and verbal IQ.



It was normed on 4,800 participants. It consists of the five above domains, which are assessed by asking cognitive questions and requiring participants to complete puzzles and processing speed tasks. All questions were designed to tap into a general intelligence factor, *g*. The SB-5 takes two to three hours to complete and must be administered by trained examiners. Internal consistency reliability of the subtests ranged from .84 to .89, averaged across age levels. Extensive validity studies including correlations in the .80 to .90 range for Full Scale IQ with other prominent IQ batteries, including SB-5 Wechsler Intelligence Scale for Children III, and WAIS-III, were reported in Roid (2003).

The SB-5 provides a profile of scores consisting of 10 subtest scaled scores. The subtests include five nonverbal scales and five verbal scales for each of the five cognitive domains: Fluid Reasoning, Knowledge, Quantitative Reasoning, Visual-Spatial Ability, and Working Memory. In addition, the SB-5 includes composite scores for each of the five domains, a Nonverbal IQ, Verbal IQ, and an Abbreviated IQ. The present study concentrated on the 10 subtests, with normalized scaled scores with mean 10 and standard deviation of 3 because the subtests provide the best differentiation of cognitive strengths and weaknesses in clinical groups.

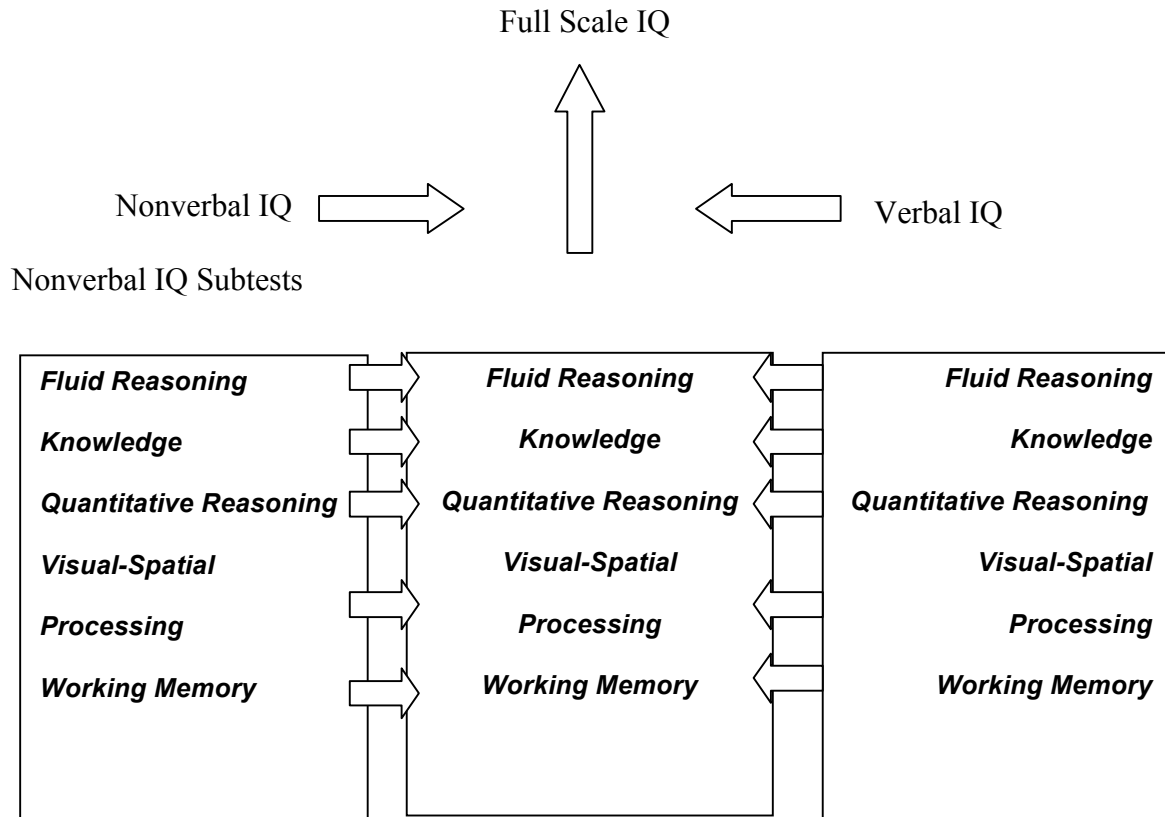


Figure 1. Description of Stanford Binet IQ Determinants. Adapted from Roid (2003).

**Procedure**

The procedures for collecting data on the SB-5 standardization study were described by Roid (2003). Procedurally, the tests were administered by trained, experienced school psychologists, clinical psychologists, and educational diagnosticians in all four geographic regions of the United States. Extensive quality control methods were used to select the random stratified national sample, monitor the field testing conditions, obtain informed consent, assure confidentiality, and to check the accuracy of computer data entry (Roid, 2003). For the analysis in the proposed study, the archival data included SB-5 subtest scores for individuals with motor

delays ( $n = 22$ ) developmental delays ( $n = 54$ ), intellectual disabilities ( $n = 104$ ), as well as a normative control group ( $n = 211$ ).

### **Data Analysis**

The data analyses included multivariate analysis of variance employing the 10 subtest scaled scores across the four criterion groups. Also, graphic displays of group means for each of the four groups were generated. Multivariate analysis of variance was used on the 10 SB-5 subtest scaled scores to test for differences among groups and across subscales within groups while protecting the .05 level of significance and minimizing false positive outcomes for the multiple comparisons. A multiple discriminant function analysis was also completed in order to assess the degree of classification accuracy between the three clinical groups and the normative group. These analyses were used to discover which of the subtests of the SB-5 best differentiated between the four criterion groups. Special attention was given to the comparison of participants who had physical disabilities versus participants without physical disabilities.

## Chapter 3

### Results

This chapter presents the results of the targeted statistical analyses conducted on the Stanford-Binet (SB-5) data for each of the disability and control samples. First, the group means for all subtest, index, and IQ measures of the SB-5 are shown in Table 2. Immediately, the lower mean scores of the Developmental Delay and Intellectual Disability groups are apparent. Second, analyses are presented to verify some of the assumptions of multivariate analysis of variance (MANOVA) and to present the summary statistics (e.g., *F*-tests and significance) for differences between groups. Specifically, Table 3 shows the results of tests of homogeneity of variance (essentially equal standard deviations of test scores) across groups—one of the assumptions of most methods of analysis of variance—and Table 4 shows the summary *F*-tests for the MANOVA. Table 5 shows some differences between groups due to educational level, to explore possible rival hypotheses about the differences in mean scores between groups. Finally, a classification table from the discriminant function analysis shows the percentage of correct classification (group membership) possible if the SB-5 subtests are used to classify participants.

#### Mean Differences Between Groups

Table 2 shows the mean scores for each sample and the pattern of lower scores for the Developmental Delay and Intellectual Disability groups in particular.

Table 2

*Mean Group Differences Among Selected Sample on all Stanford Binet-5 Subtests and Indexes*

Subtest/indexes	Control	Orthopedic Impairment	Developmental Delay	Intellectual Disabilities
	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>	<i>M (SD)</i>
<b>Nonverbal Domain</b>				
Fluid Reasoning	9.5 (2.9)	7.8 (2.9)	7.4 (2.7)	3.7 (2.5)
Knowledge	9.8 (2.6)	7.3 (2.1)	6.5 (3.9)	3.9 (2.5)
Quantitative Reasoning	9.8 (3.0)	7.4 (2.0)	5.7 (3.9)	3.8 (2.3)
Visual-Spatial Ability	9.7 (2.8)	6.7 (2.5)	7.9 (3.2)	3.4 (2.3)
Working Memory	9.7 (3.1)	6.9 (2.9)	6.6 (2.6)	4.0 (2.5)
<b>Verbal Domain</b>				
Fluid Reasoning	9.2 (3.0)	7.8 (2.5)	5.8 (3.4)	3.7 (2.6)
Knowledge	9.6 (2.6)	8.7 (2.4)	6.7 (3.7)	3.2 (2.1)
Quantitative Reasoning	9.6 (3.0)	6.4 (2.0)	6.6 (4.2)	3.8 (2.4)
Visual-Spatial Ability	9.7 (3.0)	8.0 (2.1)	6.0 (3.1)	3.8 (2.5)
Working Memory	9.8 (2.6)	7.8 (2.5)	6.4 (3.2)	3.5 (2.7)
<b>Factor and IQ Indexes</b>				
Fluid Reasoning	18.7 (4.9)	15.7 (4.5)	13.2 (5.3)	7.5 (4.5)
Knowledge	19.4 (4.5)	16.0 (3.2)	13.2 (7.0)	7.1 (4.2)
Quantitative Reasoning	19.4 (5.3)	13.8 (3.4)	12.4 (7.5)	7.5 (4.4)
Visual-Spatial Ability	19.3 (4.9)	14.7 (3.8)	13.9 (5.4)	7.2 (4.1)
<b>Factor and IQ Indexes</b>				
Working Memory	19.5 (4.8)	14.7 (4.6)	13.0 (5.2)	7.5 (4.5)
Abbreviated IQ	19.1 (4.6)	16.5 (3.9)	14.1 (5.5)	6.9 (4.0)
Nonverbal IQ	48.4 (10.6)	36.2 (9.4)	34.1 (12.8)	18.8 (9.8)
Verbal IQ	47.9 (10.8)	38.7 (7.4)	31.6 (15.1)	17.9 (15.1)
Full Scale IQ	96.3 (20.2)	74.8 (15.8)	65.6 (26.8)	36.7 (19.3)
Group Size	211	22	54	104

**Assumptions of the MANOVA**

Given that the SB-5 and other intellectual ability tests use normalized scores (e.g., subtests with mean 10, standard deviation 3, fitted to the normal curve), the score data conforms

to the assumption of analyses of variance—normally-distributed variables, MANOVA also assumes equality of variance (e.g., equal standard deviations) across cells in the design. In actuality, the method is fairly robust to departures from variance homogeneity (Guildford & Fruchter, 1978). The Levene test is a common test of equality of variance used in the Statistical Package for the Social Sciences (SPSS), given the robustness of MANOVA and the relatively large sample of control subjects, the significance level for the Levene test was set liberally at  $p < .01$ .

Table 3 shows that on 10 of 19 scores on the Stanford Binet-5 the variances among the four experimental groups are significantly different. Therefore, 8 of the group comparisons fit the assumptions of MANOVA while the other instances should be interpreted with some caution. None of the 5 nonverbal subtests nor the Nonverbal IQ showed significant differences in variance. An examination of the descriptive data in Table 2 reveals that participants with disability exhibited more variable scores than normative-control participants on over half of the SB-5 scales.

Table 4 shows the results of the MANOVA F-tests for mean differences between groups. All of the variables showed significant differences with 41 to 56% of the variance accounted by group membership (as measured by the squared multiple correlation). An inspection of Table 2 again shows that the low scores of the intellectual disability group, in particular, account for the major differences, with the developmental delay group being the next lowest in mean scores. Additional analyses were conducted to assure that a difference between groups was due to group membership alone, as contrasted with other demographic differences. For the educational level of the parents, 9 of 19 were significant, as shown in Table 5. Therefore, some group differences

should be attributed to the educational background (and, thus the level of educational enrichment) within the child's home environment.

Ideally education should be controlled, but due to absence of essential data on all participants this was not possible for this sample.

Table 3

*Levene's Test of Equality of Variances for 10 of the 19 Stanford Binet-5 Subtests and Index Scores that were Significant*

Subtest	F	Sig.
Nonverbal Domain (No subtests significant)		
Verbal Domain		
Fluid Reasoning	8.43	≤ .004
Knowledge	25.01	≤ .001
Quantitative Reasoning	7.74	≤ .006
Visual-Spatial Ability	8.94	≤ .003
Factor and IQ Indexes		
Knowledge	13.15	≤ .001
Quantitative Reasoning	8.90	≤ .003
Visual-Spatial Ability	8.53	≤ .004
Abbreviated IQ	12.49	≤ .001
Verbal IQ	16.72	≤ .001
Full Scale IQ	11.22	≤ .001

*Note.* All F-ratios have degrees of freedom 1 and 372, and only subtests, factors and IQ Indexes with significance are shown.

Table 4

*F-tests and Variance Accounted (R-squared) for the Mean Group Difference on all Stanford Binet-5 Subtests and Indexes*

Subtest	F	R <sup>2</sup>
<b>Nonverbal Domain</b>		
Fluid Reasoning	94.09	.44
Knowledge	96.92	.46
Quantitative Reasoning	98.00	.46
Visual-Spatial Ability	108.04	.49
Working Memory	83.36	.42
<b>Verbal Domain</b>		
Fluid Reasoning	80.21	.41
Knowledge	129.92	.55
Quantitative Reasoning	85.04	.42
Visual-Spatial Ability	96.80	.47
Working Memory	119.98	.51
<b>Factor and IQ Indexes</b>		
Fluid Reasoning	119.83	.50
Knowledge	142.64	.56
Quantitative Reasoning	110.82	.49
Visual-Spatial Ability	137.72	.55
Working Memory	137.51	.54
Abbreviated IQ	156.40	.58
Nonverbal IQ	163.72	.59
Verbal IQ	161.85	.59
Full Scale IQ	180.26	.61

*Note.* All *F*-ratios have degrees of freedom 3 and 372, and all are significant at  $p < .001$ .



Table 5

*Significant Parent Educational-Level Group Differences on Stanford Binet-5 Subtests and Indexes*

Subtest	<i>F</i>
Nonverbal Domain	
Knowledge	13.61
Quantitative Reasoning	6.83
Verbal Domain	
Knowledge	6.19
Quantitative Reasoning	11.21
Working Memory	3.38
Factor and IQ Indexes	
Knowledge	15.56
Quantitative Reasoning	9.55
Verbal IQ	7.79
Full Scale IQ	5.81

*Note.* All *F*-ratios have degrees of freedom 3 and 375, only subtests, factors, and IQ Indexes with significance are shown, and all are significant at  $p < .001$ .

**SB-5 Scores and Group Classification Accuracy**

Overall, the scores of the SB-5 significantly separated the four groups. The means of the participants with intellectual disabilities were nearly two standard deviations below the control sample, as expected (see Table 2). Summary statistics such as *F*-tests from multivariate analysis of variance (MANOVA) and discriminant function analyses (DFA) showed many significant differences below the .001 level. The most effective separations among groups in the MANOVA were found for the Knowledge, Visual-Spatial, and Working Memory areas. The DFA (see Table 6) showed moderate classification accuracy for the control and intellectual disability cases—62.6% and 79.8% respectively. Lowest classification accuracies were for the Orthopedic and

Developmental Delay cases—55.6 and 46.3%, respectively. Excluding normal participants, classification accuracy was 67%.

Table 6

*Classification Frequency and Percentage for the 4 Groups Based on Discriminant Function Analysis Using the 10 subtest Scores from the SB-5*

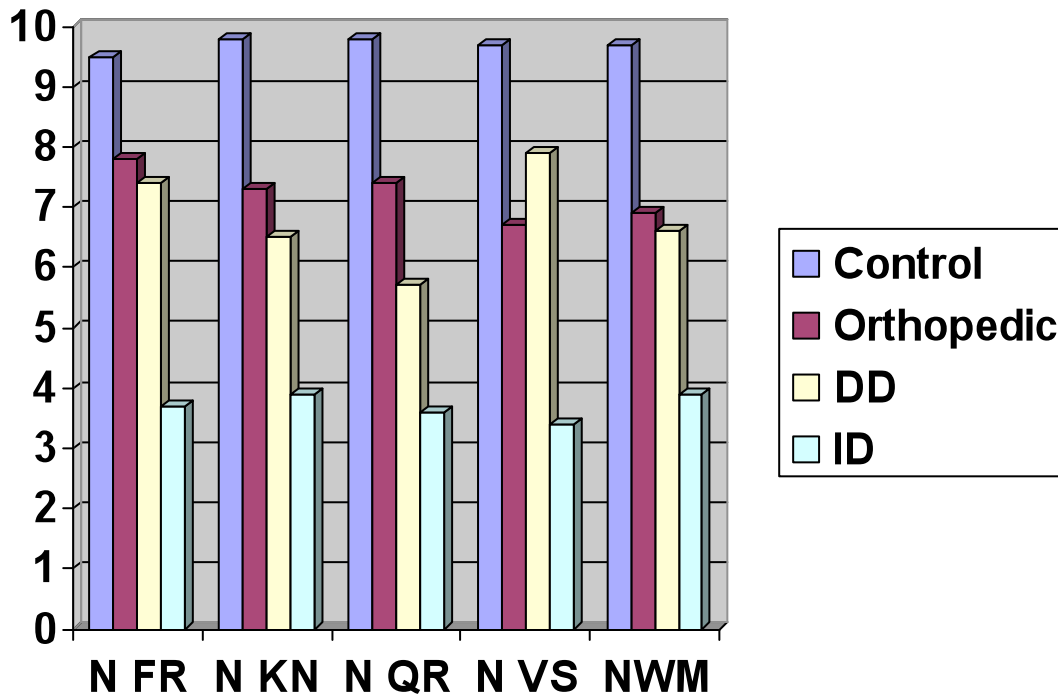
Groups	Predicted Group Membership				Total
	Control	Orthopedic	Developmental	Intellectual	
<i>Original Count</i>					
Control	132	44	29	6	211
Orthopedic	5	10	2	1	18
Developmental Delay	12	8	25	9	54
Intellectual Disability	0	9	12	83	104
<i>Percentage</i>					
Control	62.6	20.9	13.7	2.8	100.0
Orthopedic	27.8	55.6	11.1	5.6	100.0
Developmental Delay	22.2	14.8	46.3	16.7	100.0
Intellectual Disability	0	8.7	11.5	79.8	100.0

*Note.* 64.6% of original grouped cases correctly classified.

### SB-5 Subtest Profile Patterns

Figures 2 and 3 show the graphic, comparative magnitude of the 10 SB-5 subtest scaled scores for each sample, nonverbal subtests and verbal subtests, respectively. Compared to national average scaled scores of 10 (standard deviation of 3.0), the control sample averaged

about 9.6 (approximate average *SD* in the 2 to 3 range), the orthopedic sample 7.5, the developmental delay sample 6.6, and Intellectual Disability sample 3.7. Thus, effect sizes for group differences (derived from Table 1) were one to three *SD* units—extremely large effects due to the disability conditions (and, apparently some educational-background effects).



*Figure 2.* Mean SB-5 Nonverbal Subtest Scaled Scores for the Four Contrasting Groups (Matched control group, orthopedic impairment, developmental disability, and intellectual disability).

*Note.* N = Nonverbal, FR = Fluid Reasoning, KN = Knowledge, QR = Quantitative Reasoning, VS = Visual-Spatial Ability, and WM = Working Memory.

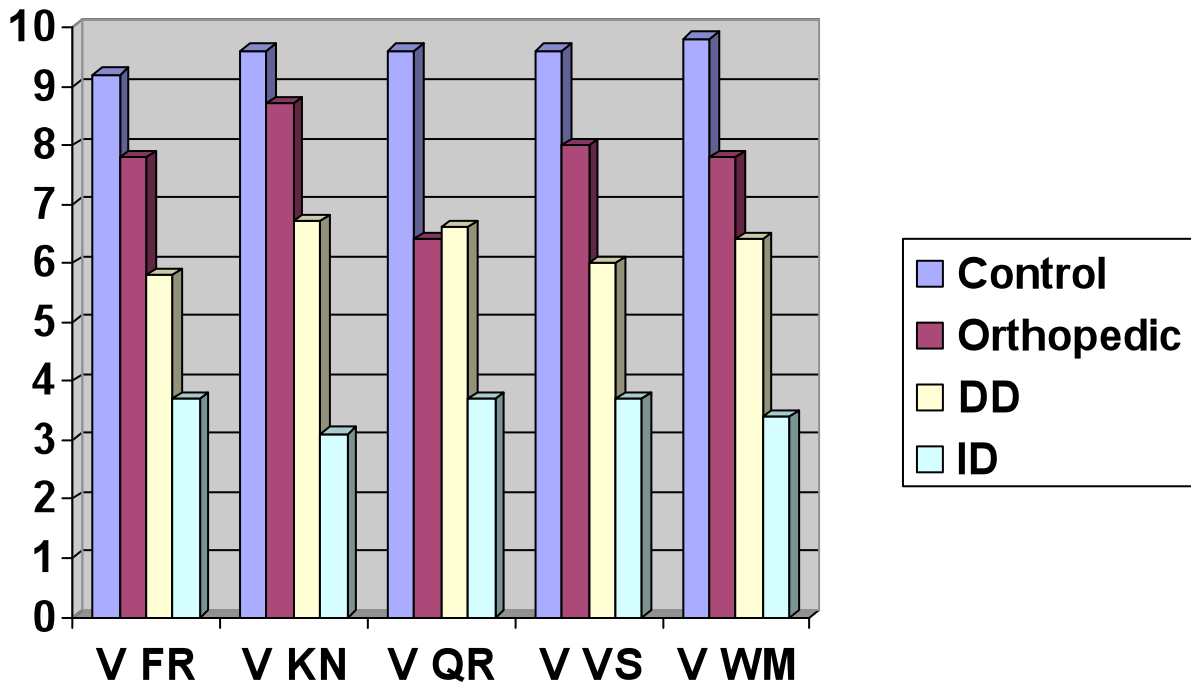


Figure 3. Mean SB-5 Verbal Subtest Scaled Scores for the Four Contrasting Groups (Matched control group, orthopedic impairment, developmental disability, and intellectual disability).

Note. V = Verbal, FR = Fluid Reasoning, KN = Knowledge, QR = Quantitative Reasoning, VS = Visual-Spatial Ability, and WM = Working Memory.

### The Orthopedic Impairment Group

As was discussed in Chapter 1 knowing which subtests pose the greatest disadvantage for individuals with physical disabilities also would help to determine modifications that would provide more accurate testing. The more subtle differences between the orthopedic impairment (OI) group and the developmental disability (DD) group was a major research question of this study because these two categories are often overlapping when children are examined for early-emerging disabilities. Federal guidelines on developmental disabilities often include physical or motor deficits as part of “delay,” because some children “grow out” of these deficits. To further

explore the differences between these groups, two additional analyses were conducted—a second MANOVA, and profile analysis. In a second MANOVA, the 10 SB-5 subtest scores were again used, but only the OI and DD groups were included. Although the overall multivariate test of group differences (Wilk’s Lambda) was significant at the .02 level, only 3 of the SB-5 subtests were significantly different across groups beyond the .05 level (degrees of freedom were 1 and 70). These 3 subtests and their individual F statistics were Verbal Fluid Reasoning, Verbal Knowledge, and Verbal Visual-Spatial, where the OI group was consistently higher than the Development Disability group (see Figure 3). Because the DD group often includes individuals with speech and language delays (and less so with the OI group), the verbal-score differences were in the expected direction (Roid 2003).

As shown in Figure 2, however, the only reversal of the trend in higher scores for OI was the Nonverbal Visual-Spatial subtest with means of 6.70 and 7.9, for the OI and DD groups respectively. This difference is significant at the “clinically meaningful” level of .15 (Wechsler, 1991), with an effect size (mean difference between the groups divided by the control group SD) in the moderate range, .52 (Cohen, 1988). To explore the profile of the OI group in more detail, we conducted an investigation of the largest subset of cases—the 14 individuals with cerebral palsy.

### **Study of Cerebral Palsy (CP) Subgroup**

Cerebral Palsy is any neurological disorder that is diagnosed in infancy or early childhood that permanently affects body movement and muscle coordination that is not progressive. Impairments of muscle movement and coordination are caused by abnormalities in the motor cortex. There are six common types of Cerebral Palsy: (a) Spastic Hemiplegia which

affects one side of the body, (b) Spastic Diplegia which affects predominately the legs, (c) Spastic Quadriplegia the most severe type that is usually associated with mental retardation and all four limbs being affected, (d) Dyskinetic Cerebral Palsy and is characterized by withering movements of limbs and face, (e) Ataxic Cerebral Palsy which is rare and affects balance and depth perception, and fine motor control, and (f) Mixed Type which is most common and can have any number of symptoms from any of the other types. Cerebral Palsy of all types affects both fine motor movements and gross motor movements (National Institute, 2006).

The SB-5 subtest scores of a subgroup of participants with diagnosed CP were calculated in search of profile patterns within this specific group. This group of 14 individuals (ages 3 to 21; average age 11) with CP included 6 females and 8 males with demographics similar to the U.S. population (75% white, 14% Hispanic, 7% African-American) except in having a higher degree of college educated parents, lower than average Full Scale IQ (mean 83.7) and home residence in the Southern region of the U.S. All participants had English as their primary language and all but one was receiving special services for motor impairment (of 10 hours or more per week) in their schools.

Results showed interesting patterns in the mean profiles of the cases. Compared to an overall mean profile of 7.8 (on a scale with mean 10, SD 3), there were significantly lower scores on Nonverbal Visual-Spatial (NVS, mean 5.8; the Form-Pattern puzzle task), Nonverbal Working Memory (NWM, mean 6.8; block tapping), and the Verbal Quantitative Reasoning subtest (VQR, mean 5.6). Except for VQR, these low scores match the expected pattern of low scores on tests that require rapid, and precise motor responses tasks for motor involved participants, and demonstrate the construct validity of the SB-5. This slow-response difficulty is

confirmed by the high mean duration of testing (67 minutes; with one participant taking 148 minutes) for the age level of the participants (compared to 45 minutes in the normative sample for younger participants). The two notable speeded subtests were Nonverbal Visual-Spatial, including the placement of pieces in a formboard or form completion using tangram-style pieces, and Nonverbal Working Memory, involving the rapid tapping of blocks from memory, these findings will be discussed in the next section.

Table 7

*Significant difference ( $p < .001$ ) on Tests that Require Rapid, and Precise Motor Responses for Control versus Orthopedic (Scores with  $M = 10$ ,  $SD = 3$ )*

	Puzzles	Tapping
Control	$M = 9.7$	$M = 9.7$
Orthopedic	$M = 6.7$	$M = 6.9$

Findings summarized in Table 7 suggest that SB-5 subtests effectively separate control cases from the more severe conditions of developmental and intellectual disabilities. Also, the subtests and tasks that most clearly differentiate the orthopedic cases, particularly those with cerebral palsy, from DD or MR and Control cases were those emphasizing verbal ability and two subtests involving speed of performance.

## Chapter 4

### Discussion

The present data analyses were conducted to determine whether or not there is a significant difference between the SB-5 subtest scores of orthopedic participants and control participants on tests that require rapid, and precise motor responses on the SB-5. The logical assumption is that orthopedic delayed participants would score lower than control participants on the subtests that require rapid, and precise motor responses involving motor performance. This suggests that accommodations are needed for participants with orthopedic disabilities in order to provide accurate full-scale IQ scores. According to this assumption, timed subtests would most clearly differentiate between orthopedic cases and the DD or ID and control cases.

The results of the analyses showed that, as anticipated, the ID participants scored the lowest of all the participants assessed. However, it also found an interesting pattern in the mean profiles of orthopedic participants (specifically cases of cerebral palsy) compared to overall means. Participants with cerebral palsy scored significantly lower on both the NVS (form pattern puzzle) subtest and the NWM (block tapping) subtest. These subtests were expected to be lower among orthopedic participants. The analyses also showed an unexpected significantly lower score on the VQR subtest. These findings demonstrate the validity of the SB-5 in effectively separating control participants from more severe conditions of developmental disabilities (Roid & Tippin, 2009). It also demonstrates the importance of providing accommodations to



participants with orthopedic disabilities. Briggs (1960) found that dominant versus non-dominant hands made a 3 point difference in the overall IQ score of control participants. This finding shows that motor ability can affect the accuracy of the Full Scale IQ.

The SB-5 is effective in separating the groups included in this study, in part due to the much lower level of performance by individuals with intellectual disabilities. But it also provides valuable information used to assess individual participants as a whole (Roid & Pomplun, 2004). The analyses showed orthopedic participants have significantly lower means, accurate accommodation for both time and accommodations to build bonus points will provide the next step in providing non biased IQ tests to all participants being tested. Accurate information can affect many areas from schooling, social security and needed accommodations for the participants being tested (Phillips, 1994). It also can provide more accurate information in diagnosing participants, allowing a faster and earlier start in providing accommodations. This allows a longer exposure to needed help, to get the greatest benefit, of the services the information helps to provide.

The present study provides strong evidence that performance on some subscales of the SB-5 is adversely affected by the motor impairments common among individuals with orthopedic handicaps. More research is needed to determine the exact amount of adjustment possible in overall IQ as a result of accommodations such as allowing longer testing times. Several different types of accommodations may have to be contrasted to determine the most valid type (such as graphic computer-administration versus physically placing puzzle-like pieces by hand). Future research should focus on examining other IQ measures to determine which subtests are most affected by motor functioning, thus allowing for more accurate assessment

from all IQ instruments. It should control for more variables; education level of examinee, type of orthopedic impairment, level of orthopedic impairment, and overall IQ of examinees providing a more precise look at the differences between the four groups. Future research should also be used to help determine either accommodations that can provide more accurate assessment scores, or help design adjusted scoring criteria that will provide more accurate IQ scores by adjusting for motor deficits. Clearly, accommodations are not only important, but required by the Americans with Disabilities Act of 2004.

## References

- Binder, L. M., (1987). Appropriate reporting of Wechsler IQ and subtest scores in assessments for disability. *Journal of Clinical Psychology, 43*, 144-145.
- Braden, J., & Elliott, S. (2003). Accommodations for the SB-5. *Assessment Service Bulletin*, No. 2. Itasca, IL: Riverside.
- Briggs, P. F. (1960). The validity of WAIS performance subtests completed with one hand. *Journal of Clinical Psychology, 16*, 317-320.
- Cohen, J. (1988). *Statistical power analysis for the social sciences*. Mahwah, NJ: Erlbaum.
- Elliott, C. D. (1990). *Differential ability scales: Introductory and technical handbook*. San Antonio, TX: The Psychological Corporation.
- Elliot, J., Ysseldyke, J., Thurlow, M., & Erickson, R. (1998). What about assessment and accountability? Practical implications for educators. *Teaching Exceptional Children, 31*, 20-27.
- Guilford, J. P., & Fruchter, B. (1978). *Fundamental statistics for psychology and education*. New York, NY: McGraw-Hill.
- McGrew, K. S., & Woodcock, R. W. (2001). *Woodcock-Johnson III: Technical Manual*. Itasca, IL: Riverside.
- Naglieri, J. A. (1997). *Cognitive assessment system: Interpretive handbook*. Itasca, IL: Riverside.
- National Institute of Neurological Disorders and Stroke National Institutes of Health. (2006). Hope through research cerebral palsy [Pamphlet]. Latham, R: Author.

- Phillips, S. E. (1994). High-stakes testing accommodations: validity versus disabled rights. *Applied Measurement in Education*, 7, 93-129.
- Roid, G. H. (2003). *Stanford-Binet Intelligence Scale, Fifth Edition Technical Manual*. Itasca, IL: Riverside.
- Roid, G. H., & Miller, L.J. (1997). *Leiter International Performance Scale—Revised (Leiter-R)*. Wood Dale, IL: Stoelting.
- Roid, G. H., & Pomplun, M. (2004). Interpretive strategies for the Stanford-Binet 5th Edition. In D. Flanagan & P. Harrison, *Contemporary intellectual assessment* (2nd ed.), New York, NY: Guilford. (pp. 325-343).
- Roid, G. H., & Tippin, S. (2009). Assessment of cognitive strengths and weaknesses with the SB5, pp. 127-152. In J. Naglieri & S. Goldstein, *A Practitioner's Guide to Assessment of Intelligence & Achievement*, New York, NY: Wiley.
- Wechsler, D. (1991). *Wechsler Intelligence Scale for Children—Third Edition Manual*. San Antonio, TX: Harcourt Assessment.

Appendix  
Curriculum Vitae

*Curriculum Vitae***Megan Lorraine Rabon, M.A.**

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 Pueblo, CO 81008  
 Phone (360) 609-6561  
[mrabon05@georgefox.edu](mailto:mrabon05@georgefox.edu)

**Education**

- 2005 – Present      **Student in Psy.D, Clinical Psychology Program**  
 Graduate School of Clinical Psychology (*APA Accredited*)  
 George Fox University, Newberg, OR  
*Cumulative GPA 3.464*  
*June 2011*
- 2005 – 2007      **Master of Arts, Clinical Psychology**  
 Graduate Department of Clinical Psychology (*APA Accredited*)  
 George Fox University, Newberg, OR  
 April 2007
- 2001 – 2004      **Bachelor of Arts in Psychology**  
**Minor in Human Development**  
 Washington State University, Vancouver, WA
- 1997 – 1999      **Associate of Arts in Behavioral Science**  
 Clark College, Vancouver, WA

**Supervised Clinical Experience**

- 7/10-present      **Internship**  
**Cesar Chavez Academy/Delores Huerta Predatory High**  
**Facility:** Elementary, Middle School, and High School  
**Population:** Child and Adolescent  
**Supervisor:** Sharla Marek, PhD
- Individual therapy sessions elementary, middle school with high school age students. Many of the students had Individualized Education Plans, for academic and behavioral issues. Led multiple social and study skills groups with both elementary students. I conducted multiple assessment batteries with elementary and junior/senior high school students. Assisted in helping students to set goals and maintain grades. I worked in crisis situations and provided trauma counseling. I worked closely with teachers, administrators, parents and the special education coordinators to provide assessment, therapy and assistance to students with special needs throughout the year.
- 9/08-5/09      **Preinternship**  
**St. Paul School District**  
**Facility:** Elementary and High School  
**Population:** Child and Adolescent  
**Supervisor:** Elizabeth Hamilton, PhD

Individual therapy sessions with high school age adolescents in a rural area. Many of the students had Individualized Education Plans, for academic and behavioral issues. Co-led multiple social and study skills groups with both elementary and high school students. I conducted multiple assessment batteries with elementary and junior/senior high school students. Assisted in helping students to set goals and maintain grades. I worked closely with teachers, administrators, parents and the special education coordinators to provide assessment, therapy and assistance to students with special needs throughout the year.

8/07-6/08

**Practicum II****Columbia River Mental Health****Facility:** Outpatient Treatment Community Mental Health**Population:** Adult and Young Adult**Supervisor:** Colin Joseph, PhD and Neil Freedman, LMSW

I conducted individual therapy sessions with low income and Medicare adult clients using client-centered, CBT, and DBT approaches. Clients averaged 10-14 sessions total, 1 hour a week. I completed mental status exams, therapeutic interventions, and goal setting with each client. I also did risk assessment with suicidal clients and co-led DBT skills groups, and individual DBT therapy sessions. Our main goal was to help clients to gain insights and coping strategies, to deal with everyday issues as well as severe life interrupting symptoms.

7/06 –7/07

**Practicum I****Multnomah County Corrections****Facility:** Inpatient Treatment**Population:** Adolescent and Adult**Supervisor:** Stephen Huggins, Psy.D

I conducted individual therapy sessions with incarcerated adults and adolescents using client-centered and CBT techniques. Each client had one session of therapy a week for amount of time each individual client was incarcerated. I also completed clinical interviews, mental status exams, detailed progress notes, and administer cognitive, personality, and limited neuropsychological assessments. Our main objective was to help clients obtain personal goals and insight.

9/05 – 5/06

**Prepracticum****George Fox University Health and Counseling Center****Facility:** Outpatient Day Treatment**Population:** Young Adult**Supervisor:** Clark Campbell, PhD

I conducted individual therapy sessions with two university students using client-centered techniques. Each client had one 50 minute session of therapy per week, for a 10 week period. I obtained informed consent at the beginning of the 10 week treatment period, and formulated a termination summary at the end of the 10 week period. Duties included clinical interviews mental status exams, treatment plans based on each client's personal goals, and detailed progress notes.

**Relevant Work Experience**

6/03 – 8/04

**Intern**

Undergraduate Prepracticum at Vancouver Children's Therapy Center, Vancouver, WA.

**Facility:** Outpatient Care

**Population:** Family and Child

**Supervisor:** Erin Auclair

I interned one semester at VCTC, a center which provides therapy, resources and supervised visitation to low income families. I conducted supervised visits with parents working to regain custody of their children. I also provided resources and information to families in need of financial, medical, and food assistance. I went on several home visits to low income families in crisis to assess the current living situation. I took crisis line calls for parents with disabled children in need of respite care providers.

**Research Experience**

August 2007

McClellan, M. L., & Roid, G. H. (2007, August). Comparative cognitive performance of orthopedic delay, and retardation cases: Accommodations? Poster session presented at the annual convention of the American Psychological Association, San Francisco, CA.

*Affiliations:* George Fox University and Southern Methodist University

*Site:* San Francisco

*Statement of the Problem:*

Not enough studies of individuals with orthopedic disabilities and their performance on widely used cognitive assessments. Need to know how scores of this group differ from normative sample and what patterns of scores are common; allowing for appropriate accommodations to be made for these special populations.

November 2005–Present

**Dissertation and Research Vertical Team**

George Fox University, Newberg, Oregon

*Supervisor:* Roger Bufford PhD

Bi-weekly meetings with a research vertical team for consultation regarding dissertation progress and research design.

Doctoral dissertation is in progress, which investigates the importance of testing accommodations for clients with motor disabilities, when being tested with cognitive assessments whose scores are dependent upon speed of clients' completion.

November 2007

**Preliminary Oral**

Received a full pass for dissertation research at preliminary oral.

*Title:* **Comparative Cognitive Performance of Orthopedic Delay, and Retardation Cases: Accommodations?**



**Professional Affiliations**

- 2005-present      **American Psychological Association Student Affiliate**
- 2004-2010        Kappa Omicron Nu National Honor Society member
- 2001-present     Psi Chi National Honor Society member

**Professional Seminars**

- January 2011      **SLD Identification: Body of Evidence in Areas of Literacy and Math**  
Speakers: Melody Ilk, Alameda Literacy Project Coordinator Jeffco Public Schools, Candy Myers and Jason Harlacher, Principal Consultants  
Exceptional Student Leadership Unit, CDE  
Pueblo Community College
- January 2011      **CDE CLEAPro Training**  
Speaker: Donna Crawford  
Freed Middle School
- January 2011      **Do No Harm: A Critical Empirical Analysis of Child Psychotropic Medication**  
Speaker: Brian De-Santis PsyD, ABPP  
University of the Rockies
- December 2010    **Trends in the Prescription of Antipsychotic Medications to Young Children**  
Speaker: Mark Olsson, MD. MPH  
Webinar
- December 2010 **Transference-Counter Transference**  
Speaker: Judith Schaeffer, PhD  
University of the Rockies
- November 2010 **FERPA and Public Health**  
Speaker: Ellen Campbell  
Webinar
- November 2010 **Treatment of Sex-Offenders: Adult and Adolescent**  
Speaker: Lorraine White, PhD  
University of the Rockies
- October 2010      **Integrating Substance Abuse with Clinical Sensibilities**  
Speaker: PsyD  
University of the Rockies
- September 2010   **Neurofeedback: The Hidden X Factor**  
Speaker: Steven Gray, PhD  
University of the Rockies
- August 2010      **Psychology in the Schools**  
Speaker: Sharla Marek, PhD  
University of the Rockies

- February 2009      **Counseling Refugees with Psychological Traumatization**  
 Speaker: J. David Kinzie, M.D.  
 George Fox University, Newberg, OR
- October 2008      **Towards a Global Christian Psychology: Re-considering Culture and Context**  
 Speaker: Derek McNeil, PhD  
 George Fox University, Newberg, OR
- February 2008      **The Psychology of Forgiveness in Clinical Practice: The Benefits and Pitfalls of Helping Clients Forgive**  
 Speaker: Nathaniel G. Wade, PhD  
 George Fox University, Newberg, OR
- January 2008      **Case Presentation on Integrative Approach**  
 Speaker: Dr. William Buhrows, PsyD  
 George Fox University, Newberg, OR
- November 2007      **Competency Evaluations**  
 Speaker: Dr. Daniel Smith, PsyD  
 George Fox University, Newberg, OR
- November 2007      **Risk Assessment**  
 Speaker: Dr. Elena Balduzzi, PsyD and Dr. Alex Millkey, PsyD  
 George Fox University, Newberg, OR
- September 2007      **PSM Psychodynamic Diagnostic Manual**  
 Speaker: Nancy McWilliams, PhD  
 OHSU, Portland, OR
- August 2007      **The Lucifer Effect**  
 Speaker: Philip G. Zimbardo, PhD  
 APA Convention 2007, San Francisco, CA
- October 2006      **Motivational Interviewing**  
 Speaker: William Miller, PhD  
 George Fox University, Newberg, OR
- March 2006      **Recognizing and Treating Sexual Addiction in Everyday Practice**  
 Speakers: Earl Wilson, PhD, and Ryan Mosley, M.A.  
 George Fox University, Newberg, OR
- November 2005      **Multimethod Church-Based Assessment Process (MCAP)**  
 Speaker: Mark McMinn, PhD  
 George Fox University, Newberg, OR
- November 2005      **Cognitive Interpersonal Therapy**  
 Speaker: Mark McMinn, PhD  
 George Fox University, Newberg, OR
- October 2005      **Post Traumatic Stress Disorder**  
 Speaker: Patrick Stone, PhD  
 George Fox University, Newberg, OR

**Awards**

August 2007

Datablitz Superstar Award from APA for graduate research, given for poster presentation presented at APA 2007.

**Comparative Cognitive Performance of Orthopedic Delay, and Retardation Cases: Accommodations?**