Learning Style and Academic Achievement in Homeschooled Children

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Abstract

The purpose of this research was to see if homeschooled children whose parents more accurately perceived their learning style preferences had higher academic achievement scores. Homeschooled children (57 boys and 57 girls) from grades 5 through 12 completed the *Stanford Achievement Test* and the *Learning Style Inventory* (LSI). The LSI measures learning preferences that encompass the physical and social environment, motivation, physiological needs, and learning tasks themselves. Parents rated their child's learning preferences in the same areas measured by the LSI. Parents accurately perceived most of their children's learning style preferences, and parents' accuracy in perceiving their children's preference for noise level and their child's sense of responsibility was significantly related to Stanford Complete Battery scores. For noise level, sense of responsibility, persistence, need to eat and drink, and need to move around while learning, parental accuracy was also significantly related to specific Stanford subtest scores.

Learning Style and Academic Achievement in Homeschooled Children

The idea that not everyone learns the same way has found expression in many different forms. Since the 1970's, when this idea gained traction in educational research and theory, more than a dozen different models of learning style have been proposed. Most have "a narrow focus," postulating "only one or two variables, usually on a bipolar continuum" (Parris, 2008, p. 17). Often they are simple typologies that describe different kinds of learners, each with their own distinct set of strengths and weaknesses. A few, however, are comprehensive multidimensional systems that encompass a variety of learning abilities and preferences. (For reviews of many of these models, see Coffield, Moseley, Hall, & Eccelstone, 2004; Curry, 1987; DeBello, 1990; Desmedt & Valcke, 2004; Hall & Moseley, 2005; Lemire, 2002; Parris, 2008; Swanson, 1995).

There is little similarity among these different models. They not only represent the characteristics of learners differently, but also recommend different strategies for teachers. For example, some argue that teaching techniques should be matched to each student's individual learning style (e.g., Dunn & Dunn, 1992, 1993). Others recommend teaching everyone the same way, but using methods designed to help all kinds of learners (e.g., McCarthy, 1990). And still others propose actively working to change some students' learning style to one that is associated with higher academic achievement (e.g., Letteri, 1980).

Furthermore, learning style is often confused with similar concepts such as cognitive style and multiple intelligences (Desmedt & Valcke, 2004; Dunn, Denig, & Lovelace, 2001; Gardner, 2004). As a result, the learning style literature is so heterogeneous that one review describes it as a "jungle" that can leave researchers "daunted by the multitude of definitions, theoretical models, and learning style instruments" (Desmedt & Valcke, 2004, p. 445).

Although it is difficult (and perhaps misleading) to compare these very different approaches to learning style directly, the model developed by Dunn and Dunn (Dunn, 1994, 1997-1998, 1999-2000, 2003; Dunn & Dunn, 1992, 1993, 1999) is one of very few multidimensional models of children's learning. It has generated hundreds of publications of all types. There are, for example, over a thousand references listed in the bibliography available at Dunn and Dunn's website (*www.learningstyles.net*). A citation analysis in 2004 (Desmedt & Valcke) found that Dunn and Dunn had more impact on the learning style literature than anyone except Kolb (1976), whose model was developed to describe adult learning.

The Dunn and Dunn Learning Style Model

Dunn and Dunn (Dunn, 1994, 1997-1998, 1999-2000, 2003; Dunn & Dunn, 1992, 1993, 1999) have proposed that learning style can be described in terms of 22 specific preferences organized into 5 categories: features of the environment in which the child learns; who, if anyone, the child wants to work with while learning; emotional factors affecting the child's motivation and ability to complete tasks; the child's physical needs and perceptual preferences; the child's optimal ways of processing information (see Figure 1). Dunn and Dunn maintain that no child's performance is affected by all the elements included in their model. For most children, they say, only 6 to 14 preferences really matter (Dunn & Dunn, 1998). But if children are taught in a way that complements those preferences, Dunn and Dunn believe their academic achievement and their attitude toward learning will both improve (e.g., Dunn, 1997-1998).

To examine this hypothesis, Lovelace (2005) completed a meta-analysis of 76 studies testing the effect of instruction that was "responsive" to students' learning style. She concluded that the "results overwhelmingly supported the position that matching students' learning-style preferences with complementary instruction improved

academic achievement and student attitudes toward learning" (Abstract). "Traditional education," she said, "never produced higher achievement or attitudes than did learning-style instruction in any of the studies investigated" (Results, ¶ 4). Based on the effect sizes her analysis yielded, Lovelace reported that "learning-style instruction might be expected to increase student achievement by 25 to 30 percentile points" (Results, ¶ 5).

Others, however, argue that the research is more equivocal than these conclusions suggest and that it leaves many questions unanswered (Coffield et al., 2004; Ford & Chen, 2001; Kavale, Hirshoren, & Forness, 1998; Kavale & Lefever, 2007). For example, the reasons why matching teaching methods to students' learning styles might work have not been clearly identified (cf. Given, 1997-1998). Perhaps the most defensible position extant research allows is that teaching children the way they prefer to learn may be particularly effective for a variety of reasons.

The Present Research

Homeschooling affords parents an extraordinary level of control over their children's education. They have the opportunity, at least, to create an ideal learning environment and to tailor their teaching methods to the way their children learn best. But do homeschooling parents know what their children's learning style preferences are? And if so, do their children have higher achievement scores? Is there a relationship between particular learning style preferences and academic achievement, whether or not parents are aware of their children's preferences? The present research addressed these three questions.

It was hypothesized that parents would be aware of their children's learning style preferences and that this awareness would be related to children's academic achievement. It was also expected that children's achievement would be above average

and that their persistence, sense of responsibility, motivation to learn, and motivation to please their parents would be associated with higher scores.

Method

Participants and Procedure

Annual achievement testing is one of the ways that families in Florida can satisfy the requirements of the state law governing homeschooling. Local homeschool support groups, therefore, often provide testing as a service to families in their area. In this study, every child in grades 5 through 12 who was tested by a homeschool support group in Central Florida was also given a measure of learning style preferences. In all, 114 homeschooled children participated. Table 1 shows the number of boys and girls at each grade level.

Questionnaires were distributed to the parents, and for 67 (59%) of the children, questionnaires were returned either to the administrator at the testing site or to the experimenter by mail. Participating parents reported their children's age, the number of years their children had been homeschooled, and the number of years, if any, their children had attended a conventional school. This information is also presented in Table 1. Parents were asked to indicate their children's ethnic background. All the children of parents who completed the questionnaire were Caucasian except for one Hispanic girl and one Asian boy.

The sample was not necessarily representative of the population of homeschooling families in the area. There may have been differences between families who opted to satisfy the state law through achievement testing and families who chose another method. Parents who returned the questionnaire may also have differed from those who did not.

Materials

Academic Achievement. The *Stanford Achievement Test*, Eighth Edition, (Psychological Corporation, 1992) measured academic achievement. The Stanford, a norm-referenced, multilevel test battery, assesses achievement in reading, mathematics, language, spelling, study skills, science, social studies, and listening. In addition to these subtest scores it yields a Complete Battery score.

Reliability has been tested using Kuder-Richardson, alternate forms, and test-retest methods. The reliability coefficients generated by these methods "cluster around .90" (Keyser & Sweetland, 1987, p. 540). Test validity is largely based on item development—items were derived from an extensive review of many of the most popular textbook series at each grade level and were thoroughly field-tested (Keyser & Sweetland, 1987).

The Stanford yields many different kinds of scores, but scaled scores were used here. Scaled scores represent "approximately equal units on a continuous scale; that is, a difference of five points between two students' scores represents the same amount of difference in performance wherever it occurs on the scale" (Psychological Corporation, 1992, p. 20). Also, these scores are independent of grade level, which makes them "suitable for comparing scores when different levels of the test have been administered," as in this study (Psychological Corporation, 1992, p. 20.) Scaled scores were used in all analyses involving Stanford data.

Learning Style. The *Learning Style Inventory* (LSI) (Dunn, Dunn, & Price, 1989) was used to measure children's learning style. The LSI is a 104-item, self-report test that assesses preferences in specific areas related to learning. Some of these areas have to do with the environment: noise level, room temperature, lighting, and seating (that is, at a desk or not). Others concern the social context, such as the presence of other children or a parent and a desire to learn in a variety of social settings. Emotional factors include

children's persistence, sense of responsibility, motivation to learn, level of structure needed, and desire to please parents and teachers. Physiological preferences include the need to move around frequently, the need to eat or drink while learning, the time of day the child has the most energy, and the preferred sensory modality—auditory, visual, tactile, or kinesthetic—for learning new information. Auditory learners prefer to learn by listening and discussing, visual learners by seeing and reading, tactile learners by manipulating objects with their hands and writing, and kinesthetic learners by doing and moving while they are concentrating (Dunn, Denig, & Lovelace, 2001).

Internal consistency reliability coefficients for LSI preference scales are reported to range from a low of .55 to a high of .88, with most in the .70's (Dunn, Dunn, & Price, 1989). Claims to validity are based on research suggesting that children do have learning preferences, that learning preferences are relatively stable over time, that different groups of students have different patterns of preferences, and that preferences influence how children respond to particular teaching strategies (Dunn, Dunn, & Price, 1989). Raw scores were used in all analyses involving LSI data.

Parent Questionnaire. Participating parents not only reported demographic information but also rated their child's learning preferences in the same areas measured by the LSI (except for the desire to please teachers and the time of day the child has the most energy), using a five-point scale. They indicated their child's preferred sensory modality for learning by simply choosing which of the four—auditory, visual, tactile, or kinesthetic—they believed was their child's favorite. A copy of the parent questionnaire is provided in the Appendix.

Results

Academic Achievement

Mean Stanford subtest and Complete Battery scores are presented in Table 2. As the meaning of scaled scores is not self-evident, values were converted to percentile ranks for presentation. All of the Complete Battery scores and all but three subtest scores were above the 50th percentile, the average for public-school students.

An analyses of variance (ANOVA) was computed with grade and gender as the factors and Stanford Complete Battery scores as the dependent variable. An alpha level of .05 was used for this and all subsequent statistical tests. The effect of grade was statistically significant, $F(7, 98)=5.19$, $p<001$. The effects of gender and of the interaction between grade and gender were not statistically significant.

Correlations between Stanford scores and the number of years children had been homeschooled and the number of years they had attended conventional schools are presented in Table 3. Although only Science was significantly correlated with the number of years children were homeschooled, Reading, Math, Language, and Complete Battery scores approached statistical significance. Achievement scores were more highly related to the number of years of homeschool than to the number of years of conventional school for all Stanford scores except Spelling and Listening.

The Relationship between Academic Achievement and Learning Style

A multivariate analysis of variance with grade and gender as the factors and all LSI preference scores as the dependent variables yielded no statistically significant effects. Therefore LSI data were collapsed across these two variables for all subsequent analyses. Correlations between Stanford Complete Battery scores and LSI preferences were calculated, but only one was statistically significant. There was a positive correlation between Complete Battery scores and "prefers to eat or drink while learning," $r=.20$, $p=.031$. There were, however, several statistically significant correlations between Stanford subtest scores and LSI preferences. These correlations

are presented in Table 4. None of the relationships were very strong—the strongest involved the Listening subtest, which is administered to children in the lower grades only.

Parents' Perceptions of Children's Learning Style

For those parents who participated in the study, questionnaire responses were correlated with their children's LSI scores to see if parents accurately perceived their children's learning style preferences. There were statistically significant positive correlations between parent and child ratings for noise level, room temperature, lighting, seating, persistence, sense of responsibility, motivation to learn, and the need to move around frequently. These correlations are found in Table 5. The correlation for the need to eat or drink while learning approached significance, r=.23, p=.058.

Parent–child comparisons for children's preferred sensory modality were handled differently. Children had an LSI score for each modality—visual, auditory, tactile, and kinesthetic—but parents were simply asked to choose their child's most preferred modality. This analysis, therefore, determined whether parents' choices matched the modality for which their children had the highest score. Table 6 shows the results of this comparison. Overall, 38% of the parents agreed with their children, but a chi-square analysis found that the relationship between parents' and children's choices was not significant, $X^2(16, N=71) = 14.20$, p=.584.

Parents' Accuracy and Children's Achievement

It was hypothesized that children whose parents accurately perceived their learning style preferences would have higher achievement scores. Therefore a simple parent–child difference score was contrived for each learning preference. First, parents' questionnaire ratings and children's LSI scores were converted to z-scores so that both types of scores could be compared on the same scale. Then the absolute value of the

difference between the parent's *z*-score and that of his or her child was computed for each learning preference, and these difference scores were correlated with the child's Stanford scores. It was found that parents' accuracy in perceiving their children's preference for noise level and their child's sense of responsibility was significantly related to Stanford Complete Battery scores. These correlations and statistically significant correlations between difference scores and Stanford subtest scores are shown in Table 7. All of the correlations are negative, because smaller differences—that is, better agreement—between parents' and children's preference scores were associated with higher achievement scores.

Once again, modality preferences were handled differently. To see if parents' accuracy in perceiving their children's preferred sensory modality affected Stanford scores, the sample was divided into two groups. Parents and children who agreed on the child's preferred modality formed one group, parents and children who disagreed formed the other. These two groups were compared using an ANOVA with group as the factor and Stanford Complete Battery scores as the dependent variable. The effect of group was not statistically significant.

Discussion

The homeschooled children in this study scored well above average in academic achievement, and their overall performance was more highly related to the number of years they had been homeschooled than to the number of years they had attended conventional schools. There was a statistically significant effect of grade level on achievement scores, but not simply because older children were more academically advanced than younger children. (Children in different grades took different levels of the test, and the standard scores used in this study were independent of grade level.) This effect indicated instead that from one grade to another, homeschooled children's

performance varied when compared to the Stanford norm group, which was made up of public-school students. For example, children in grades 5, 11, and 12 scored higher overall than 75% of their public-school peers, while children in grades 8 and 10 performed better than only slightly more than 50%.

Children's motivation to learn and persistence were related to achievement for specific subjects, but the association between motivational factors and achievement was neither strong nor general. Children who preferred to eat or drink while learning had higher achievement overall—a rather puzzling result that should delight many children, if not their parents. This and some of the other preferences associated with achievement—preferences involving variety, lighting, and the perceptual modality of leaning—would appear to be easily accommodated in a homeschool setting.

Parents accurately perceived most of their children's learning style preferences, and for some preferences, parental accuracy was related to children's academic achievement, typically in specific subjects. Although these results generally supported the hypotheses, they were more limited than expected. It is likely that parents' knowledge of their children's learning style preferences is only one of many influences on homeschooled children's academic performance.

There were also methodological issues that may have affected the outcome of this study. For example, many of the parents chose not to participate, and on average, the children had attended conventional schools longer than they had been homeschooled. Also, while parents indicated what they believed to be their child's favorite modality for learning, children's modality preferences as measured by the LSI were not well differentiated. That is, many children had moderately high scores for two or three types of learning, rather than a clearly dominant preference for one. Therefore,

choosing the modality preference with the highest score, so that parents' and children's choices could be compared directly, oversimplified the data.

Another limitation of this research was that parents' teaching practices were not measured. Even though parents may be aware of their children's learning style preferences, they may not put this knowledge to practical use. The way parents conduct their homeschool is likely to be influenced by many considerations other than their children's preferences. For example, although parents may know their child likes to study in bed, take frequent breaks, eat and drink while learning, and to learn kinesthetically rather than by reading, they may believe that indulging these inclinations would not help their child prepare for college or an adult occupation. Whether there is a correspondence between parents' knowledge of their children's learning style preferences and their actual teaching practices—and if not, why—would seem to be relevant questions for subsequent research to address.

Finally, this study did not explore how children's own behavior might shape their learning environment. Do children influence their parents to teach in accordance with their learning preferences, whether or not their parents are aware of those preferences? Do children themselves try to arrange the conditions of their learning environment to complement the way they learn best? Children are active agents in their own development and in reciprocal interactions with their parents. It may be, then, that over time there is increasing harmony between children's learning preferences and features of their homeschool that support those preferences. If so, the extent to which children are able to influence conditions of the learning process may be critical to the academic success of homeschooling (cf. Edmond, 2007; Farkas, 2007). This, too, would seem to be a relevant issue for future research.

In conclusion, homeschooled children's academic achievement was high overall, and their motivation to learn and persistence were related to their performance in specific subjects. Parents accurately perceived most of their children's learning style preferences, and for some preferences, parental accuracy was related to children's achievement. Although many learning preferences would seem to be easily accommodated in a homeschool setting, this research did not determine how often parents actually teach in a way that complements their children's learning style, or how much children themselves are able to influence their learning environment.

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Appendix

Parent Questionnaire

Please complete one of these questionnaires for EACH child being tested in grades 5 – 12.

Child's Name:_____ Date of Birth:_____

My child is: ☐ White ☐ Black ☐ Hispanic ☐ Other

My child has spent _____ years in home-school and _____ years in conventional schools.

What type of learner is your child?

- ☐ auditory – learns best from listening and discussing
- ☐ visual – learns best form reading and observing
- ☐ tactile – learns best form touching and writing
- ☐ kinesthetic – learns best from moving and doing

Please use the rating scale below to describe how your child prefers to do his/her school work. Mark one box on each line. For example, if your child almost always prefers quiet when working, mark the box to the far left. If your child sometimes prefers quiet, mark the second box from the left. If your child has no preference regarding quiet or noise, mark the middle box. If your child sometimes prefers noise when working, mark the second box from the right. And if your child almost always prefers noise, mark the box on the far right.

prefers quiet	☐ ☐ ☐ ☐ ☐	prefers some noise
prefers low light level	☐ ☐ ☐ ☐ ☐	prefers bright lights
prefers cool temperature	☐ ☐ ☐ ☐ ☐	prefers warm temperature
prefers to work seated at desk or table	☐ ☐ ☐ ☐ ☐	prefers to work lying on floor or bed, or seated in easy chair
prefers to study alone	☐ ☐ ☐ ☐ ☐	prefers to study with other children
prefers to work without parent present	☐ ☐ ☐ ☐ ☐	prefers to work with parent present
prefers to have specific directions to follow	☐ ☐ ☐ ☐ ☐	prefers to do assignments his/her own way
prefers to have variety	☐ ☐ ☐ ☐ ☐	prefers to have routine
prefers to work until finished	☐ ☐ ☐ ☐ ☐	prefers to take frequent breaks
prefers to eat or drink while studying	☐ ☐ ☐ ☐ ☐	prefers not to eat or drink while studying
is able to sit still for long periods of time when working	☐ ☐ ☐ ☐ ☐	is not able to sit still for long, needs to move around frequently
has an internal desire to achieve academically	☐ ☐ ☐ ☐ ☐	needs to be motivated by external rewards
has a desire to do what he/she thinks ought to do or has been asked to do	☐ ☐ ☐ ☐ ☐	does not like to do things just because someone has asked him/her
wants to please parents by doing well in school work	☐ ☐ ☐ ☐ ☐	is not concerned about pleasing parents

Table 1

The Number of Boys and Girls in Each Grade with Means and Standard Deviations of Their Age, Number of Years of Homeschool, and Number of Years of Conventional School

Grade	Number of Boys	Number of Girls	Age in Years	Years of Home School	Years of Other School
5	5	8	11.18 (.23)	3.38 (1.19)	2.63 (1.51)
6	9	8	12.21 (.52)	3.32 (2.22)	3.50 (2.11)
7	12	10	13.22 (.80)	2.93 (1.87)	5.11 (2.13)
8	4	7	14.27 (.46)	3.00 (2.39)	5.50 (2.72)
9	9	8	15.02 (.33)	3.75 (3.42)	6.14 (3.48)
10	11	10	15.94 (.37)	4.91 (3.75)	5.55 (3.59)
11	4	5	17.17 (.20)	1.20 (0.57)	10.00 (1.06)
12	3	1	18.66 (.00)	3.00 (0.00)	6.50 (3.54)
Total	**57**	**57**	**13.89 (1.94)**	**3.36 (2.55)**	**5.21 (3.07)**

Table 2

Mean Stanford Achievement Test Scores, Converted to Percentile Ranks, for Each Grade

	Grade							
Stanford Subtest	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Reading	89	76	82	77	76	60	75	74
Math	70	67	65	45	72	48	60	75
Language	75	66	71	57	76	55	68	68
Spelling	76	71	70	66	75	60	88	60
Study Skills	65	68	54	40	58	52	75	67
Science	87	77	73	60	68	52	80	86
Social Studies	71	67	56	53	68	66	69	67
Listening	80	88	71	79				
Complete Battery	**77**	**68**	**68**	**55**	**73**	**54**	**80**	**76**

Note. Listening is not tested in grades 9–12.

Table 3

Correlations between Stanford Achievement Test Scores and the Number of Years Children Had Been Homeschooled and the Number of Years Children Had Attended Conventional Schools

Stanford Subtest	**Years of Homeschool**		**Years of Other School**	
	r	***p***	***r***	***p***
Reading	.23	.057	-.05	.676
Math	.24	.054	.05	.693
Language	.21	.092	.02	.878
Spelling	-.09	.464	.24	.050
Study Skills	.19	.120	.03	.836
Science	.25	.038	-.02	.845
Social Studies	.16	.186	.05	.667
Listening	-.06	.723	-.03	.845
Complete Battery	**.21**	**.084**	**.11**	**.361**

Table 4

Significant Correlations between Children's Stanford Achievement Test Scores and Learning Style Inventory Scores

Stanford Subtest	**Learning Style Preference**	***r***	***p***
Reading	Motivation to learn Prefers variety	.20 .19	.031 .040
Math	Prefers to eat or drink while learning	.20	.032
Language	Prefers brighter lighting in room Prefers to eat or drink while learning Prefers variety	.19 .20 .23	.043 .029 .013
Science	Persistence	.21	.027
Social Studies	Motivation to learn Prefers to eat or drink while learning	.20 .20	.032 .034
Listening	Motivation to learn Prefers tactile learning	.29 .26	.021 .039

Table 5

Significant Correlations between Children's Learning Style Inventory Scores and Parents' Ratings of Their Children's Learning Style Preferences

Learning Style Preference	***r***	***p***
Prefers louder ambient noise level	.44	<.001
Prefers warmer room temperature	.24	.049
Prefers brighter lighting in room	.30	.013
Prefers to sit at a desk	.53	<.001
Persistence	.24	.049
Sense of responsibility	.26	.035
Motivation to learn	.34	.005
Prefers to move around while learning	.41	<.001

Table 6

Agreement between Parents and Children's Choices of the Child's Preferred Learning Modality

Parents' Choice	**Children's Choice**			
	Auditory	Visual	Tactile	Kinesthetic
Auditory	**7**	6	3	5
Visual	4	**13**	5	3
Tactile	2	1	**1**	1
Kinesthetic	4	4	4	**5**

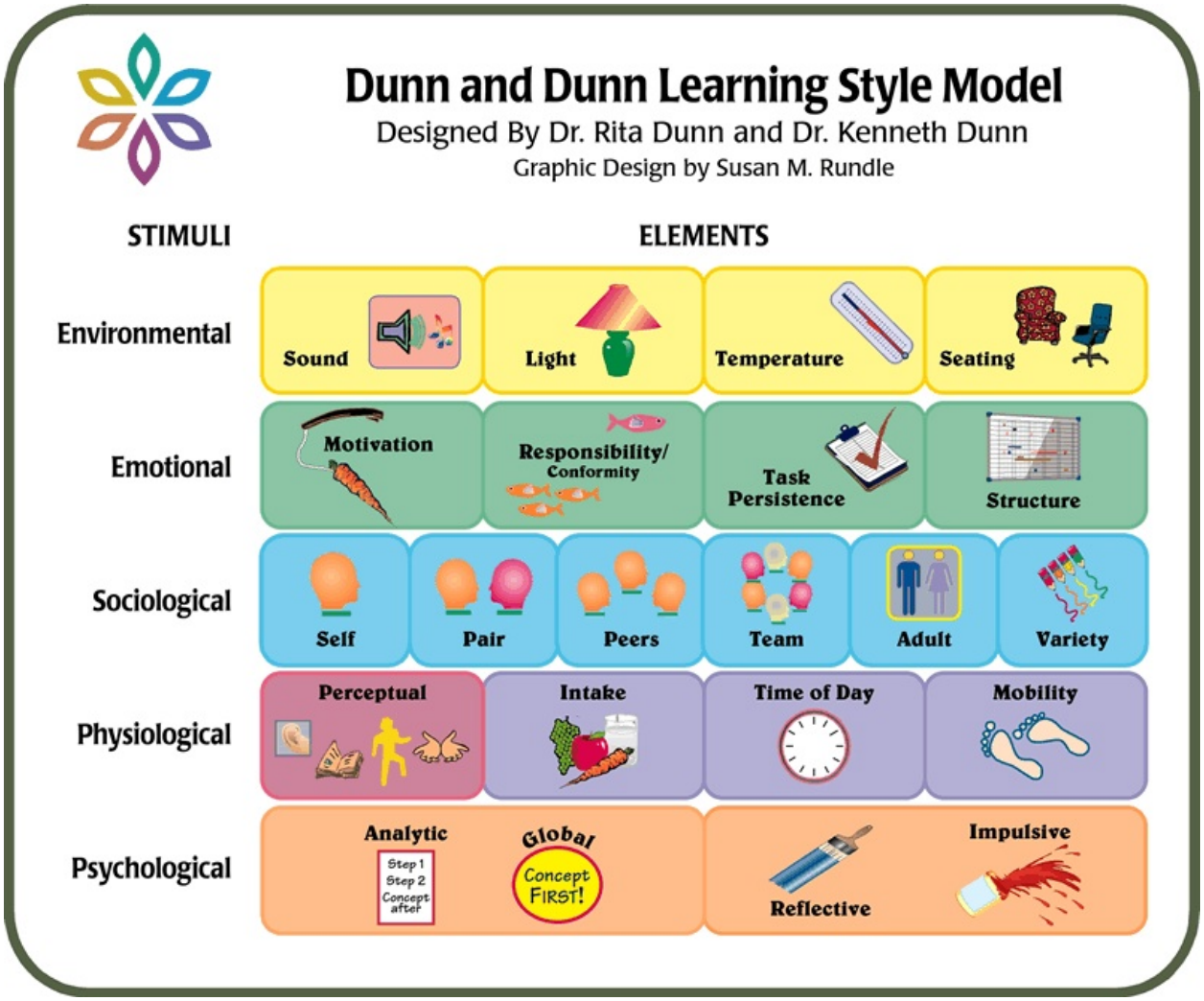
Table 7

Significant Correlations between Parent–Child Difference Scores for Learning Style Preferences and Stanford Achievement Test Scores

Learning Style Preference	**Stanford Subtest**	***r***	***p***
Prefers louder ambient noise level	Complete Battery	–.32	.009
	Reading	–.26	.037
	Language	–.34	.006
	Social Studies	–.28	.026
Persistence	Study Skills	–.32	.011
Sense of responsibility	Complete Battery	–.29	.021
	Reading	–.35	.005
	Language	–.28	.024
	Spelling	–.25	.046
	Study Skills	–.35	.005
	Science	–.25	.046
Prefers to eat and drink while learning	Study Skills	–.25	.044
Prefers to move around while learning	Listening	–.49	.001

Figure Caption

Figure 1. The Dunn and Dunn learning style model. (From *www.learningstyles.net*.



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