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READING/LANGUAGE ARTS

The Relationship between Mathematics and Reading/Language Arts TCAP Scores
Among Third Grade Males

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Abstract

The purpose of this study was to determine the relationship between mathematics and reading/language arts Comprehensive Assessment Program (TCAP) scores at a selected elementary school. The sample consisted of 12 randomly selected males in a third grade classroom. Data were collected for this study using the overall reading/language arts subtest scores, overall mathematics scores, mathematic scores in the criterion referenced categories of number sense theory and computation, and, reading/language art scores in the criterion referenced categories of content and meaning. Data were analyzed using A Pearson's Product Moment Correlation and Multiple Regression procedures. The results indicated significant relationship between TCAP overall scores of mathematics and reading/language arts scores ($r=.904$, $p = .001$). Also, significant relationship was found between reading/language arts meaning and mathematical number sense theory ($r=.734$, $p=.016$). Similarly, significant relationship was found between reading/language arts content and mathematics computation ($r=.811$, $p=.004$). Finally, significant influence was found in reading/language art scores in the criterion-referenced category of meaning and content on the overall TCAP mathematics score in males. Reading/language arts meaning had the most influence, followed by reading/language arts content.

Introduction

Each year, Tennessee students from third grade up to eighth grade take the state commercial achievement test, known as the TCAP. The TCAP is a standardized assessment that is mandated for all students in 3-8th grade. The results of the TCAP tests provided information regarding all students' progress in Tennessee. The TCAP uses multiple-choice questions in the subject areas of reading, language arts, mathematics, science, and social studies. State educators use the TCAP to compare students' performances across the state, target areas for improvement, and provide developmental information about student achievement over time (State of Tennessee, 2008).

The TCAP subtests include reading/language arts, mathematics, science and social studies. Each subtest is broken down into seven criterion-referenced items that are directly aligned with Tennessee's Content Standards and State Performance Indicators. Reporting categories in the 2007 TCAP subtest for third grade in reading/language arts were content, meaning, vocabulary, writing/organization, writing/process, grammar/conventions, and techniques and skills. Reporting categories of the TCAP subtest for third grade students in 2007 in mathematics included number sense theory, computation, algebraic thinking, real world problem solving, data analysis and probability, measurement, and geometry (State of Tennessee, 2007).

Review of Related Literature

Few studies exist on the exact relationship of males' standardized test scores between the subjects of reading/language arts and mathematics. Past completed studies that were reviewed in this chapter included; measuring the relationship between gender and standardized tests scores, studying reading comprehension skills among males, analyzing a possible relationship between mathematical skills and gender, and the influence of economic and social conditions on reading skills.

When attempting to examine the difference in male reading test scores and mathematics scores, one must first determine that there is a difference in achievement between males in mathematics and reading versus females. In 1998, Herbert Marsh and Alexander Yeung conducted a longitudinal study that examined sex and gender differences in the development of Math and English. The aspects of Math and English that were studied consisted of school grades; standardized tests, academic self-concept, affect, and coursework selection based on three different waves (8th, 10th and 12th Grades) of data consisting of a sample of 24,599 students all over the United States. Marsh and Yeung wanted to look not only at standardized test scores and grades, but the different self-concepts that males and females had regarding each subject. They found that while Girls had higher math school grades, they had lower math self-concepts and standardized test scores. After analyzing the data Marsh and Yeung concluded that:

Girls consistently scored much better than boys on English grades but only slightly better on English test scores, whereas they scored slightly better than boys

on Math grades but did slightly worse than boys on math test scores. These gender differences were consistent across the three waves of data (p. 732). Marsh and Yeung study is significant in the fact that they were able to find some relationship between lower achievements among Males in the subject of English, which upholds prior similar studies conducted. Although Marsh and Yeung examined the effect of gender on achievement in English and Mathematics, they failed to explain why such differences might occur, and possible intervening variables in the study.

A study conducted by Randhawa looked specifically for the reasons in the differences in males and females in standardized test scores. Randhawa sought to examine different reasons as to why males might have a lower reading score and higher mathematical scores than females. Randhawa believed that one possibility could be the locale that pupils were exposed to. Randhawa's study examined the effects of rural and urban education differences and gender on standardized tests scores. The study was completed in 1988 and consisted of a sample of 10% of classrooms (1587 students) from Midwestern Canada. The students were given a standardized achievement test battery consisting of "four tests of mathematics, reading, written expression and using sources of information" (Randhawa, 1988, p. 141). Randhawa examined gender and rural-urban differences in achievement in not only macro-skills in mathematics but micro-skills as well.

A previous study completed in 1973 by Randhawa and Fu suggested that students educated in rural environments might be disadvantaged versus the larger society. But, much has changed in society since the study was completed in the 60's and 70's. Randhawa sought to "determine whether there have been concomitant shifts in the

traditional patterns of achievement of males and females and of students from rural and urban centers” (Randhawa, 1988, p. 143). The classrooms were given tests in the same order and at the same time. The data were analyzed using a two-factor (sex x locale) multivariate analysis of variance. The study found that females, as Randhawa expected, were “superior to males in all except the mathematics test, in which males were better than females” (p. 145). When Randhawa examined the specific times of the mathematical tests the results showed that when grouped into three mental-process or macro-skills categories “males were better than females on only the problem-solving component” (p. 145). Similarly, on an analysis of eight math components, comprising content-specific mental process produced sex differences on three components and locale differences on two. When analyzing the results of specific mathematical skills in relationship to student locale Randhawa found that in rural classroom males and females were similar on computation, but in the urban classrooms males were better than females. However, students from a rural classroom achieved better on concepts than those from urban classrooms. In summation, Randhawa’s study found that sex differences between mathematical and language achievement did exist as was expected, but the expectation of research differences in locale did not exist. Previous studies suggested that rural pupils were disadvantaged educationally, but Randhawa’s study showed no such significant difference. Randhawa does speculate that perhaps:

In rural communities, boys and girls are expected to perform various tasks and to be competent in them regardless of their sex. Such may not be the case in urban communities where sex role differentiation may be more rigid or there are more opportunities to be stereotyped (p. 147).

Randhawa's study concludes that locale did not have an effect on test achievement, but does not rule out the possibility that sex role differences in location and expectations may have an effect on standardized tests achievement.

A similar study conducted by Alexander and Olsen attempted to understand the origin of gender differences favoring girls in reading skills. Alexander and Olsen focused on the factors of the sex of a student, their socioeconomic status, ethnicity and treatment of parents. Alexander and Olsen examined mainly the performance of students who were in the same grade, with samples pooled across socioeconomic status. The conductors of the study used a longitudinal sample in Baltimore. In the study all students were randomly selected between a panel of students who were the same age and were followed from the beginning of the first grade. Alexander and Olsen found that the early reading skills of boys who were receiving meal subsidies—those who were disadvantaged—were lower than those of girls. Among children who were not on meal subsidies, boys did about the same as girls (Alexander & Olsen, 2007). This gender gap that emerges over the elementary school years was explained in terms of the higher retention rate of disadvantaged boys, which traced back to teachers' low ratings of classroom behavior and reading skills for boys on meal subsidies and to their parents' lower expectations for boys' school performance.

On the other hand, Ryan and Ryan believed that “negative stereotypes can create a situational pressure that depresses the students performance” (Ryan & 2005, 53). The authors examined various studies completed as far back as 1970 and found that while females scored better than males in elementary standardized tests scores; the males begin in eighth grade to outscore the females in mathematics. Ryan and Ryan (2005) also

found that high negative stereotype was linked to a decreased verbal performance for high – achieving Black college students and was not confined to college students only but also in lower levels. They stated that:

Negative stereotypes threats that impact math performance are in place by early adolescents (11-12 years old). By early adolescents, students are aware of negative stereotypes about female and minority students, have developed a sense of gender and/or ethnic identity, have sophisticated conceptions of academic ability, and have the advanced cognitive skills to comprehend the implications of negative stereotypes. (p. 56)

Singh (2008) believed that despite the adverse impact that negative stereotypes may produce, the use of cognitive methods in teaching could influence academic performance. Singh attempted to determine the significant facts that might influence reading literacy differences between males and females. Singh used the Canadian results from the PISA reading literacy assessment to determine differences in reading performance based on item type and item task for 15 year olds. The assessment that Singh used to compare and analyze results was a standardized test in Canada called the PISA (the Programme for International Student Assessment). Singh recognized that many different factors contribute to reading literacy scores and includes the cognitive, socio-cultural environment, and reading behaviors as factors in the study. Singh conceded that a possible difference in reading achievement may be because of varying interest, and that students reading materials according to their reading identity and the socio-cultural support for that identity” (p. 338). Females tend to prefer reading non-fiction for leisure whereas males tend to prefer to read non-fiction or factual materials

such as baseball cards and information text. The study found that females tend to read more often for enjoyment and with a wider range of materials than males. Singh also found a moderate correlation between enjoyment of reading and each of the achievement scores. He concluded that the amount of reading and the types of reading materials could have an impact of achievement reading tests scores. This was one way to explain females' superiority in reading scores on standardized tests, and males significantly lower scores.

On the other hand, Yazdanpanah did not believe that negative sex stereotype was the only reason for the differentiation in males reading scores. In his study, Yazdanpanah attempted to look at one specific possible cause of sex and its relationship between reading test scores. Yazdanpanah's study examined the effects of background knowledge and reading comprehension on male and female performance using standardized test scores. This study investigated the interaction of a reading comprehension test with gender in a formal testing context. It also attempted to investigate the performance of males and females on reading test items with regard to demands on strategy use. There were 187 participants including 59 females and 128 males, and were international students ranging from 17 to 20 years of age. These students were studying English at the intermediate level, at The School of Foreign Languages in North Cyprus. The test that was given consisted of three reading comprehension passages with 25 questions. The tests were given to the participants as the final exam of the course. Two of the texts had male topics and one had a neutral topic. The questions on these passages tapped different information and each question required the students to interact with the reading passages in a different way. Yazdanpanah's study broke the test down into six different categories:

identifying main idea, reading for specific information, guessing meaning from context, identifying referential information, matching titles with paragraph, and text coherence. Yazdanpanah's findings suggest that males and females perform differently on different items. Females scored higher on identifying main idea, guessing meaning from context, and text coherence questions. Conversely, males outperformed females in reading for specific information, identifying referential information, and matching titles with paragraph. However, gender affected item performance in only two cases: guessing meaning from context, and text coherence in favor of the females. Although the study suggests that the texts used in this study favored males more than females, the overall performance of females on the whole reading test was higher than the males. The study also shows that although the overall reading grade of females was higher than males, this difference was not significant. The findings can imply that sex differences in verbal ability are fading. This implies that text topic did not influence male and female performance on the reading comprehension test (Yazdanpanah, 2007).

A similar study conducted by Oakhill and Petrides attempted to also examine the effect of interest on a topic and differences in reading comprehension between males and females. Oakhill and Petrides predicted that both sexes would score better in reading comprehension if they read a text they were interested in. This study compared the reading comprehension of groups of boys and girls (aged 10-11) on two tests, one of which was about the evacuation of children during the Second World War and the other of which was about spiders. These were the actual year 6 SATS' reading tests administered in the UK in 1998 and 1999. The majority of the boys said that they would prefer to read the text about spiders, and the majority of the girls said they would prefer

to read the text about leaving home in wartime. The study found that patterns of preference were reflected in the children's performance on the actual tests. However, whereas the boys' comprehension was significantly affected by the content of the tests (they showed better performance on the test about spiders) the girls' performance was relatively little influenced by the content of the test. Girls did not tend to perform better on text that they were seemingly more interested in. Oakhill and Petrides found that males' success on reading comprehension test scores was affected by their level of interest in the test. Perhaps interest in text plays a part in males reading comprehension test scores.

Another element that has been thought to play a role in reading comprehension success is the use of strategies in males and females on standardized tests. In 2003, Aek Phakiti conducted a study using 384 Thai students who took a multiple-choice reading comprehension test. The students completed the test and then completed a questionnaire based on their strategy used during the test. Phakiti examined not only the strategies used on the test, but the sex of the students to determine the effect on reading comprehension test scores. Phakiti found that males did not differ from females in their reading comprehension performance and their use of comprehension strategies. Males did report significantly higher use of metacognitive strategies than females. This study looked at the differences between males and females use of strategies and reading comprehension test scores. Although the strategies used in the studied could be situational, it is important to note that males did report a slightly higher-level usage of metacognitive strategies.

Another factor to consider when reviewing males' reading comprehension standardized test scores is the prior experiences that young children have with reading and exploring different genres of books. If students' are not familiar with a type of genre on a test, there is a possibility that it may influence test scores. The majority of test items in the Tennessee Comprehensive Assessment Program (TCAP) reading comprehension section is composed of stories that are fiction, but could happen in real-life, or are non-fiction pieces. Pinar Girmen conducted semi-structured interviews of 27 fifth grade students in Turkey. The study had a sample of 14 girls and 13 boys and asked the sample students' questions about what type of books that they read, and how often they read their book. Girmen's study found that the majority of students' read adventure books the most. This could explain the possibility of lower test scores among males simply because of their lack of experience with the text on the TCAP, or lack of interest. Girmen's study is important to help understand a possible explanation for males' reading comprehension scores (Girmen, 2008).

Koller, Baumert and Schnabel also believed that there might be a possible relationship between interest in a subject, particularly mathematics, and test scores. Koller, Baumert, and Schnabel used a sample of 602 German students tested three times, at the end of Grade 7, Grade 10, and the middle of Grade 12, to investigate the relationship between academic interest and achievement in mathematics. Koller, Baumert, and Schabel also looked at sex differences, interest and course selection. Koller, Baumert and Schabel predicted that interest in the lower grades had no effect on achievement and course selection (Grade 5 to 10), but that it appears after Grade 11.

Koller, Baumert and Schnabel, 2001, cite two particular important findings in their review of literature:

1. Most studies show that young girls perform better than boys in arithmetic and computation in the younger age groups.
2. All but one of the studies (covering Scotland) provides evidence that boys perform better than girls in almost all areas of mathematics in older age groups (p. 452).

Koller, Baumert, and Schnabel's study found sex differences in favor of boys mathematic achievement, interest, and opting for an advanced mathematics course. However, interest was shown to have no effect on learning from Grades 7 to 10. Highly interested students were found more likely to choose advanced courses. This study completed by Koller, Baumert, and Schnabel helps to demonstrate the possibility of interest on subjects and academic achievement and the effect that subjects of low interest might have on test scores.

Conclusion

Many prior studies have been completed to attempt to determine a relationship between lower standardized test scores in reading and higher mathematical test scores among males. Although interest may play a small part in the outcome of standardized test scores, other variables that may influence test scores among males include, locale, sex role stereotyping, background information, and a student's motivation. These variables are critical to understanding the significance of students' standardized test performance.

Methodology and Procedures

The focus of this study was to examine a possible relationship between males' Tennessee Comprehensive Assessment Program (herein referred to as TCAP) scores in the subtest of Mathematics and Reading/language arts. The data were collected using the data collection instruments discussed in the section below.

The population for this study consisted of 452 students at an elementary school in Kingsport Tennessee. The school comprised of grades K-5 with 228 females (50.4%) and 224 males (49.6%). The students represented primarily middle class Caucasian families residing in Kingsport Tennessee. The racial breakdown was 80.3 Caucasian, 13.9% African American, 4.9% Hispanic and 0.9% Asian/Pacific Islander. Sixty nine percent qualified for free or reduced lunch.

The sample came from 35 male students from three fourth grade classes. The first class had 10 males, second class had 12 males, and third class had 13 males. Twelve students were randomly selected from the total population of males across the three fourth grade classes. The boys ranged from 9- 10 years.

Data were collected using the 2008 Tennessee Comprehensive Assessment Program (TCAP) of the sample group. The TCAP is a standardized assessment that is mandated for all students in 3-8th grade. The TCAP is a criterion-referenced test that examines students' achievement according to various Tennessee State Performance Indicators in the subjects of Language Arts/Reading, Mathematics, Social Studies, and Science. The TCAP results are measured according to a norm-referenced group to help ensure validity and reliability. To ensure test validity, the norm-referenced module for the TCAP test was established in 1989 and was specifically created so that it had proper

characteristics of reliability, adequate floors and ceilings, and articulation across test levels. In addition, fresh non-redundant tests are used each year. Only a small percent of test items can be carried over from one item to the next. The relevance of the test to Tennessee's academic program can be inferred from the tendency of scores across the state to approximate or slightly exceed the national norms in all subject areas and all grades (Shinkfield & Stufflebeam, 1996).

The data that were compared in the study consisted of subtest results in mathematics and reading/language arts. The data that were looked at in the subtest of mathematics consisted of items in the reporting categories of: number sense theory, computation, algebraic thinking, real world problem solving, data analysis and probability, measurement, and geometry. The number of items in each reporting category were as follows; number sense theory– 13 items, computation –7 items, algebraic thinking – 12 items, real world problem solving – 9 items, data analysis and probability – 8 items, measurement – 11 items, and geometry – 7 items, for a total of 67 items on the mathematics subtest.

The data examined in the reading/language arts subtest of the TCAPS were the reporting categories of: content, meaning, vocabulary, writing/organization, writing/process, grammar/conventions, and techniques and skills. The number of test items in each reporting category were: content – 10 items, meaning – 9 items, vocabulary – 15, writing/organization – 9, writing/process – 9 items, grammar/conventions – 8 items, and techniques and skills – 7 items, for a total of 67 items on the Reading/language arts subtest.

Procedures

To begin the study, permission was requested and granted from the principal of the school to conduct research in the selected elementary school. Permission was then requested and received from each of the three fourth grade teachers. The male students then received a permission slip to send home to their parents/guardians informing the parents/guardians of the research, and the ability to withdraw from the project at anytime with no penalties. The researcher received the consent forms and a sample was selected. The sample consisted of 12 males who were randomly selected from a total of 35 male students in three fourth grade classes. The data for the sample were collected by obtaining by obtaining a copy of the TCAP 2008 student profile performance results from each of the student's teachers. The data were then randomly assigned a number replacing the name of the student, to assure the anonymity of the student. Next, the data were divided into the subject of Mathematics and Reading/language arts. After the data were separated into subject, the data were then separated into performance indicators. After the data were separated into separate performance indicators, they were analyzed using Pearson's Correlation Coefficient test. After using Pearson's Correlation Coefficient, two indicators in Reading/language arts were paired with the composite Mathematics score and analyzed using Multiple Regression.

Results

Research Questions

Four research questions were used to guide the analysis of data.

Research Question 1: Is there a relationship between males' composite TCAP tests scores in the categories of mathematics and reading/language arts?

Research Question 2: Is there a relationship between males' tests scores on mathematical number sense theory and reading/language arts meaning?

Research Question 3: Is there a relationship between males' TCAP scores in mathematical computation and reading/language arts content?

Research Question 4: What is the impact of males' TCAP scores in reading/language arts in the subtest of meaning and content on males' composite TCAP mathematics scores?

Each research question was followed by a research hypothesis and a null hypothesis. Research questions 1, 2, and 3 were analyzed using Pearson Product Moment Correlation procedures. The results for research questions 1, 2, and 3 yielded significant results at .05 level respectively. ($r=.904$, $p=.001$; $r=.796$, $p=.016$; $r = .811$, $p = .004$). The results are displayed in Tables 1, 2 and 3 respectively.

Table 1

Correlation Matrix for Males' Overall TCAP Scores in Reading/language arts and Mathematics

	Reading TCAP Score
Mathematics TCAP Score	
Pearson Correlation	0.904
Significance (two-tail)	0.001*
N	12

Note * $p < 0.05$

Table 2

Correlation Matrix for Male Students' TCAP Scores in Mathematical Number Sense Theory and Reading/Language Arts Meaning

	Mathematical Number Sense Theory Scores
Reading/Language Arts Meaning Scores	
Pearson Correlation	0.796
Significance (two-tail)	0.016*
N	12

Note: * $p < 0.05$

Table 3

Correlation Matrix for Male TCAP Scores in Mathematic Computation and
Reading/Language Arts Content

	Mathematic Computation Score
<hr/>	
Reading/Language Arts Content Score	
Pearson Correlation	0.811
Significance (two-tailed)	0.004*
N	12

Note: * $p < 0.05$

Research question 4 was analyzed using Multiple Regression procedure. The results indicated a Multiple Regression Coefficient β of .762 and a coefficient of determination (R squared) of .581. This indicates that 58% of the variance in males composite TCAP mathematics score could be explained by the Reading/Language Arts scores in meaning and content. The two predictor variables were significant with reading /language arts meaning being the most influential followed by reading/language arts content. The results are displayed in Table 4.

Table 4Multiple Regression Coefficient

	Standardized Beta	Significance
Reading/Language Arts Meaning	0.760	.004*
Reading/Language Arts Content	0.724	.008*

Dependent Variable: TCAP Mathematics composite score

Note: $p < 0.05^*$

Discussion

Four research questions were addressed in this study.

Research question one focused on the relationship between males' composite TCAP tests scores in the categories of mathematics and reading/language arts. A Pearson's Product Moment Correlation was conducted. The mean score for reading/language arts was 48.75, and the mean score for Mathematics was 52.50. The results indicated a significant relationship between males' overall TCAP Reading/language arts scores and Mathematics scores ($r=0.904$, $p=0.001$); therefore, the

null hypothesis was rejected. This evidence supports the new brain research that shows that boys process information differently than girls.

The results were consistent with the literature discussed, a significant relationship was found between composite TCAP scores. For example, Marsh and Yeung in 1998 concluded that girls consistently scored better than boys on English, but did slightly worse than boys on math test scores. They found that the gender differences were consistent across the three waves of data (p. 732).

Research question 2 examined the relationship between males' test scores on mathematical number sense theory and reading/language arts meaning TCAP test scores.

The results indicated a significant relationship between the males' TCAP scores in mathematical number sense theory and reading/language arts meaning scores ($r=0.796$, $p=0.016$); therefore, the null hypothesis was rejected. The results suggest that boys appear to be superior in number sense theory over meaning.

These findings also support the prior research completed, that indicated that males often outscore their female counterparts in mathematics, but have lower scores in reading/language arts than females. One possible explanation for this correlation is the effect that negative gender stereotypes have on students' academics and standardized test scores. A study conducted by Ryan and Ryan in 2005 reported several different studies that found that negative stereotype threat affects the performance of adolescents (i.e., girls perform worse than boys when gender is made salient) (p. 56). If these stereotypes are well known because of the factor of locale and/or race, then academic performance on a standardized test could be affected.

When research question 3, is there a relationship between males' tests scores on mathematical computation and reading/language arts content TCAP test scores was examined, a Pearson's Product Moment Correlation was conducted between the male students' mathematical number sense theory and reading/language arts meaning. The results indicated a significant relationship between mathematical number sense theory and reading/language arts meaning ($r=0.811$, $p=.004$); therefore the null hypothesis was rejected. The results suggest that boys tend to do well in composition as opposed to reading content.

These findings were consistent with a study conducted by Koller, Baumert, and Schnabel (2001) that indicated that males were more likely to have a higher interest level in math, and interest level plays a factor in their decision to take more advanced courses, and learn more advanced mathematical skills. Also, Singh conducted a study in 2008 that studied the amount of student reading and the relation to the amount of achievement on a standardized test. Singh also found that "there was a moderate correlation between enjoyment of reading and each of the achievement scores" (p. 341). Singh's study helped to conclude that the amount of reading and the types of reading materials could have an impact of achievement reading tests scores.

Research question 4 focused on the impact of reading/language arts content, and reading/language arts meaning on composite TCAP mathematics scores. A Multiple Regression test was conducted to predict the impact of males' reading/language arts in the subtest of content and meaning on the composite mathematics TCAP score. The mean composite Mathematics score was 84.08, the mean reading/language arts content score was 74.75, and the mean reading/language arts meaning score was 82.75. The

Multiple Regression coefficient (R) was .762. The coefficient of determination of the regression ($R^2 = .581$). The results indicated that TCAP reading/language arts scores in meaning and content could explain 58% of the variance in males' composite TCAP mathematics score. The most influential variable that can be attributed to the variance in males' math composite scores was reading/language arts meaning, followed by the variable of reading/language arts content. If the student is unable to understand the content of a question in mathematics then he/she is more likely to get the question incorrect. Being able to read and understand a question is an essential part of standardized tests.

Conclusion

The purpose of this study was to determine the relationship between mathematics and reading/language arts TCAP scores of third grade male students. The results indicated a significant relationship between males' overall TCAP scores in reading/language arts and mathematics. Similarly significant results were realized between reading/language arts meaning and mathematics number sense theory, and reading/language arts content and mathematics computation. Reading/language arts subtests of content and meaning were also found to have a significant influence on mathematics scores

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