The Theory of Information as a Testing Technique to Determine Spanish Reading Proficiency

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THE THEORY OF INFORMATION
AS A TESTING TECHNIQUE TO DETERMINE
SPANISH READING PROFICIENCY

THESIS

Submitted to the graduate committee of the
Department of Education and Human Development
State University College at Brockport
in partial fulfillment of the
requirements for the degree of
Master of Science in Bilingual Education

by

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ABSTRACT

The purpose of this study was to expand on previously-limited investigations into the use of information theory as a Spanish language assessment technique, within an English-speaking setting, by providing a larger data base and employing a wider variety of reading passages. A further purpose was to attempt the development of a Spanish reading proficiency test that could be used in the classroom to provide a broad picture of a student’s ability to comprehend reading material at or near his/her level of language learning. At no time was this study an attempt to analyze specific strengths or weaknesses in a student’s reading ability or to debate the usefulness of any existing Spanish language reading proficiency tests.

At the time of this study, Sandra Kukuvka was a first grade teacher at Dr. Martin Luther King Jr. School # 9 in Rochester, New York, working in a Spanish dominant bilingual setting. Jean Hurst was teaching English-speaking students in a second grade Primary Approach to Language (Spanish exposure) program at Abelard Reynolds School # 42 in the same district. Both of these educators felt that a limited number of Spanish language assessment tools existed and were, together, informally
investigating alternative techniques. As a result of this preliminary search, they discovered previous theses written by Eliza Bennette-Kinkead and Ivette Robles that suggested the diagnostic theory of information (a mathematical based theory of language transmission) as a potential important language assessment tool. Further investigation into the research done by Bennette-Kinkead and Robles revealed that minimal work had been published on this application of the theory. This latter discovery prompted the authors of the current study to further expand upon the previous investigations in the hopes of transforming the theory into a more developed, practical testing tool.

With regard to a student’s comprehension ability, both authors felt that consistency in genre and readability within the passages chosen for the tool would eliminate variables that might otherwise interfere with such comprehension, i.e., literary and poetry style, rhyme and rhythm, technical jargon, etc. With the intent to control variables for the sake of reliability, these researchers chose 6 short (1 and 2 paragraphs), non-fiction passages from published first-grade reading and science textbooks around which to develop their assessment tool. With the variables of genre limited, interference could be somewhat controlled and emphasis could, therefore,
be placed on the percentage of bits deleted in attempting to target a passage
to a specific reading level. The authors also agreed that creating 2 passages
targeted for the beginning Spanish reader, 2 for the intermediate, and 2 for
the advanced would serve to verify the level at which an individual is
reading consistently. The final battery of tests, then, consisted of 2
passages with approximately 10% of the information missing from both, 2
passages with approximately 18% of the information missing, and 2
passages with approximately 29% of the information missing. The
objective of the test was for the subjects to record missing letters in a given
passage within a period of 45 minutes.

Once the battery of tests had been completed, the authors asked students
from 4 Spanish classes at the State University of New York, College at
Brockport, to complete the passages. The first class was identified by
course number as an Intermediate I class and was composed of 9 students.
The second class was identified as an Advanced Conversation and
Composition class and was composed of 10 students. The third group, a
beginning Spanish class, contained 14 students. The final class was
identified as an Advanced Grammar course and contained 15 students. The
authors felt that targeting students known to be working at the beginning,
intermediate, or advanced levels, would provide evidence as to the validity of their tool. With this in mind, the authors hoped to obtain test results from beginning students that showed a steep downward trend as they progressed from one set of tests to another. They hoped that results from the intermediate students would show minimal change when progressing from the first set of tests to the second and an obvious downward trend from the second set to the third. Finally, they hoped that students working at an advanced level in Spanish reading would show minimal change when progressing through the three sets.
CHAPTER I

Statement of the Problem

Purpose

The purpose of this study was to expand on previously limited investigations into the use of information theory as a Spanish language assessment technique, within an English-speaking setting, by providing a larger data base and employing a wider variety of reading passages. A further purpose was to attempt the development of a Spanish reading proficiency test that could be used in the classroom to provide a broad picture of a student's ability to comprehend reading material at or near his/her level of language learning. At no time was this study an attempt to analyze specific strengths and weaknesses in a student’s reading ability or to debate the usefulness of any existing Spanish language reading proficiency tests.

Need for Study

Historically, theories surrounding the process of language acquisition have determined the nature of language assessment tools. Educational institutions reflect this regularly. Organizations which espouse the Gestaltist, top down, view of language learning, tend to adopt ongoing
techniques such as portfolios or hands-on projects, while those who view language learning as a “bottom up” process traditionally choose skill based examinations to assess their students’ progress. Such disparity among the theories and their resultant assessment tools has engendered much discussion and research around how the nature of language itself determines the process of its acquisition. Jeremy Campbell (1982) in Grammatical Man suggested that a mathematical theory developed by Claude Shannon, surrounding the transmittal of messages from one place to another (specifically through the telephone and telegraph systems), could be applied to written language. Assuming that the adaptation of this math-based theory to language is sound, an assessment tool developed from it would offer a relatively objective measure of language proficiency. A need exists, then, for the development of such a language assessment tool, which can be used as an alternative to those currently in circulation. This study offers a preliminary tool and investigates its use in validating 3 levels (beginning, intermediate, and advanced) of Spanish reading proficiency.
Questions

This study will attempt to answer the following questions:

Is the theory of information a valid measure of Spanish reading proficiency?

Is the theory of information a valid measure of Spanish reading comprehension?
CHAPTER II

Rationale

Definition of Terms/Review of Literature

In order to appreciate the development of the theory of information as a language testing tool, the authors of this study felt that relevant terms and concepts needed to be clearly defined at the outset. The following are concepts that appear frequently in the content of this study. All are examined as to their direct relationship to the theory and its application in this study.

The Theory of Information

With respect to language, The Theory of Information is a formal theory of syntax in which "a single relation of word-sequence gives to the set of these sequences the structure of a mathematical object, and produces a base set of sentences which carry all the information that is carried in the language." (Harris: 1990) In other words, a message (in the case of this study, a written message) contains more data than is necessary to adequately
convey the meaning intended by the sender and as such, is highly predictable.

The theory demonstrates, mathematically, that most of the information contained in any given sentence is so interrelated that the presence of one bit of information will necessitate the presence of another. For example, the presence of the word "it" in English necessitates the presence of a noun nearby. A corresponding example in Spanish would be that the presence of the word "las" necessitates the presence of a feminine plural noun nearby. Such redundancy and predictability implies that part of the information in a sentence could be deleted without significantly hindering the reading process. In effect, the reader would be able to reconstruct the message by using his/her language skills to recognize cues in the sentence. This application of the theory of information was adopted in these researchers' final language assessment tool.

Information

The term information has commonly been defined as news, facts, or ideas that can be acquired and passed on as knowledge. During the age of electronic communications, however, the term has come to represent the
agent that "informs the material world, much as the messages of the genes instruct the machinery of the cell to build an organism, or the signals from a radio transmitter guide the intricate path of a vehicle on its journey through space." (Campbell: 1982) For the purpose of this study, these researchers define information as the agent that instructs the written word to build meaning.

**Entropy**

While information is defined as the agent which generates new structures, entropy is seen as its opposite; the agent of chaos, which tends to destroy meaning. Its importance in this study derives from a view of the universe, adopted by many scientists, which contends that random and nonrandom forces coexist in a complementary relationship. (Campbell: 1982) In terms of language, this would further explain the predictability inherent in such a flexible message system.

**Language/Language Acquisition and Learning**

Although generally considered as any means of communicating, these researchers define language, within the context of this study, as the written symbols for human speech or vocal sounds; letters, numerals, rules, etc.
used for the transmission of information.

Knowledge of language is acquired unconsciously. (Harris, 1990) The theory of information makes it clear that symbols cannot be strung together at random; there must be an agent that instructs words to build meaning. If there is no such agent, the messages generated will not be intelligible, nor will they be protected against error. (Campbell: 1982) With this in mind, the acquisition of a language can be seen as a process of identification and interrelation of the elements of language. In other words, the language learner begins to recognize nonrandom patterns. Actual language learning, then, would be the conscious knowledge and application of those patterns.

Communication

In the same way that genes are a system for sending chemical messages to the protein factories of the cell, instructing them to make a living organism, so is communications a system which sends messages of speech to a receiver, instructing it to create meaning. (Campbell: 1982) Such messages of speech can be sent in a variety of ways; including body language, orally, or via the written word. The focus in this study, is on the transmission of a message via the written word.
Claude Shannon's theory of information relies on this definition of communication; without a system, the nonrandom elements of redundancy and predictability would be scarce in language, if not completely nonexistent. The use of the system image implies some type of order and structure. It is this connection between the system of communications and the mathematical view of language (the theory of information) that has led these researchers to believe that the latter can be of use in determining an individual's proficiency in the former.

Message

A meaning that is transmitted through a system of rules that reduces uncertainty. (Campbell: 1982) For example, a written message would be a meaning that has conformed to rules of spelling, structure, and sense that are shared between the writer and the reader, making it understandable to both. Because these rules make the message partly predictable, proficiency in a written language necessitates an ability to identify and use those rules.

Predictability

Generically, predictability can be defined as the ability to foretell what will follow. Educators often use this concept as a strategy to teach
comprehension; a primary teacher, while reading a story, may encourage students to use their life experiences and common sense to guess (or predict) what will happen next.

According to the theory of information, the ability to foretell what will follow (or predictability) is possible because in all forms of communication, more messages are sent than are strictly necessary to convey the information intended by the sender. (Campbell: 1982) These additional messages act to decrease the surprise effect of the information being sent, thereby making it more predictable (or more easily foretold).

**Redundancy**

Closely related to predictability is the concept of redundancy. With respect to language, redundancy is a consistent use of more bits of information than are actually needed to send a message. In effect, it is the quality of redundancy (the rules of spelling, structure, and sense mentioned above) that makes written language predictable in the first place.

After conducting numerous experiments with English text in which he eliminated varying amounts of information, Claude Shannon concluded that English is about 50% redundant when we consider samples of eight letters at a time. He claimed that if the length of the sample is increased, the
redundancy is much greater and that in the case of whole pages or chapters, where the reader is able to get an idea of the theme and literary style of a text, up to 75% could feasibly be redundant. Again, it is partially the intent of this study to determine if the concept of redundancy (as defined by the theory of information) can be used to determine language proficiency (specifically Spanish).

Readability

Readability is a term used in education to describe the sum total of the elements contained in a piece of printed material with respect to how successful a group of readers might be in decoding and comprehending it. (Bennette-Kinkead: 1990) Claude Shannon, in applying his theory of information, felt that in the same way in which that theory could be used to determine redundancy in a text, so could it be used to determine readability. It is not the intent of these researchers to determine whether or not this may be the case, however; their interest in this concept lies in its application to the validity of the tool they developed. With this in mind, they used publishers' descriptions of readability to select passages operating at comparable levels of difficulty in their original form. This was done so as to eliminate readability as a variable affecting the outcome of subjects' scores.
as they progressed through the sets of passages.

Proficiency

Whether demonstrated through comparison (as in trends or bell curves) or against a standard, proficiency is the degree of correctness and ease identified through training or performance. (Bennette-Kinkead: 1990) For the purpose of this study, proficiency is the degree of competence in correctly identifying missing bits of information from written passages.

Proficiency Test

While proficiency is the degree of correctness, a proficiency test is the method or the tool used to measure that degree. Within this study, when employing the term proficiency test, these researchers are referring to assessment tools designed to measure an individual’s competence in a second language, independent of any particular curriculum or course of study. One of the purposes of this study is, in fact, to design a test where the percentage of missing bits identified, correctly serves as a measure of an individual’s proficiency in Spanish reading.
Bit

A bit, or binary digit, is a measure of amount of information. In the historical sense, the term arises from the electrical (and more recently, computer) representation of information: the choice between an electrical impulse, or “1”, and no electrical impulse, or “0”. In other words, it is a choice between two equally probable messages; it either is or is not something. (Campbell: 1980) In language, and for the purpose of this study, a bit is the smallest piece of information conveyed by a letter, space, or punctuation. In other words, a missing bit in the tool developed by these researchers is a missing piece of information that requires identification. All of the bits deleted by these researchers were chosen based on their relationship to the redundancy of the text.

Comprehension

Webster’s New World Dictionary, 1988, defines comprehension as “the capacity for understanding facts, ideas, etc.”

While comprehension itself is not visibly tangible and measurable in a concrete sense, “a reader’s comprehension can be measured by his or her behavior exhibited after he or she has read a passage.”
(Bennette-Kinkead: 1980). In an educational setting, comprehension of a particular passage is most frequently measured by a question-and-answer format. In this particular investigation as well, each passage was followed by 2 multiple-choice questions pertaining to the content of each passage. Said questions were an attempt by these researchers to measure a degree of comprehension on the part of the reader.

Validity

The validity of a test is the extent to which a test actually measures what it claims to measure. (Robles: 1992)

The tests prepared by these researchers attempted to validate the reading proficiency levels of Spanish language learners who had been previously identified as working consistently at either a beginner, intermediate or advanced level.

Reliability

The term reliable is “applied to a person or thing that can be counted upon to do what is expected or required.” (Webster New World Dictionary, 1988)
While the tools of this study actually attempted to validate predetermined learning levels, reliability was attempted by administering a second test of approximately the same degree of difficulty at each designated level.

**Summary**

In 1948, Claude Shannon of the Bell Telephone Laboratories, published two papers consisting of a set of theorems dealing with the problem of sending messages from one place to another quickly, economically, and efficiently. (Campbell: 1982) In effect, Shannon succeeded in defining information mathematically, enabling him to generalize it and establish laws that hold good for all types of information. When applied to language, information becomes the agent that instructs the written word to build meaning. Shannon’s theory became known as the theory of information. In the application of his theory to language, Shannon discovered that language is redundant; it conforms to rules of spelling, structure, and sense, and in so doing reduces uncertainty. (Campbell: 1982) It stands to reason, then, that redundancy increases predictability.

In this study, the researchers have attempted to translate this theory into
an actual tool to measure proficiency. They believe that an individual’s ability to use his/her knowledge of redundancy in the Spanish written language can be measured and can be considered an indication of his/her level of proficiency.
CHAPTER III

Design of the Study

Purpose

The purpose of this study was to investigate the use of information theory as a testing technique to diagnose Spanish reading proficiency of students learning the Spanish language. Based on the above investigation, a further purpose of this study was to develop a Spanish reading assessment tool, which could be used in the classroom, to provide a broader picture of a student's ability to comprehend reading material at or near his/her level of language learning.

Methodology

This study was based on two prior masters' theses written by Eliza Bennette-Kinkead and Ivette Robles, respectively, (published by the State University of New York, College at Brockport) on the use of the theory of information as a testing technique.

In determining the types of passages to be used, the authors of this study felt the need to eliminate as many possible variables of comprehension
interference as could be eliminated. Consequently, they chose 1 genre of
non-fiction, and chose 6 passages within that genre from published reading
and science textbooks which were designated for the first grade level.

Using these primary passages, the degree of difficulty was determined as
follows:

All bits of information were counted -- every letter, punctuation mark,
space, etc. -- and a percentage of those bits were deleted and increased
accordingly as levels of difficulty increased. Two passages at each level
were created, with the intent being that the second test would verify the
level at which a student was reading consistently.

Level 1 consisted of 2 passages with approximately 10% of the
information missing from each passage. Level 2 was comprised of 2
passages with approximately 18% of the information deleted, and 2
passages at Level 3 had approximately 29% of the information omitted.

With regard to determining the rationale for the deletion of bits of
information, both authors of this investigation decided to place the heaviest
emphasis on the factor of redundancy, with secondary emphasis being given
to predictability.
The subjects of this study were Spanish language students of various proficiency levels from the State University of New York, College at Brockport; there were 4 groups of students. Each student gave written consent to participate in this study, and all tests were administered anonymously.

Although each group was designated by the college to be at a specific ability level, these researchers felt that there would very likely be some students who would not actually be performing at their designated placement level. Therefore, with this in mind, these researchers also asked the students to self-determine their own level of Spanish reading proficiency.

The first group to be tested was college-designated as an Intermediate I group, and consisted of 9 students. Within this group, 1 student described herself as a beginner. A major cause for the limited data at this level was the weather; many students did not appear in class that morning due to impassable road conditions.

The second group of 10 students was designated as an Advanced Conversation and Composition class, and among those subjects, 5 were self-described as intermediate learners.
The third group of subjects were college-designated as Spanish language Beginners, and of that group of 14 students, 1 person classified herself as intermediate.

Finally, the fourth group was enrolled in an Advanced Grammar course, and of those 15 advanced students, 3 described themselves as intermediate learners, and 1 subject failed to indicate any self-description at all.

The subjects of this study underwent a battery of 6 tests: 2 tests at Level I (designated 1-A and 1-B), 2 tests at Level II (designated 2-A and 2-B), and 2 tests at Level III (designated 3-A and 3-B).

Test 1-A contained a total of 280 bits of information, with 28 deletions made, for a total percentage of 10% deletions. Level 1-B contained 303 total bits of information, had 32 deletions, for 11% of total bits deleted.

Test 2-A had 321 total bits of information, 53 deletions, or 17% of the bits deleted. Test 2-B had 399 total bits of information, less 70 deletions, for a total of 18% deletions.

Finally, test 3-A had a total of 496 bits, 142 deletions, for 29% of total bits omitted. Test 3-B contained a total of 434 bits, had 131 omissions, for a total of 30% deletions.
Procedure

The first order of business was, essentially, to create the test materials themselves. These researchers believed that maintaining a genre style and readability level would lessen variables which might otherwise interfere with reading proficiency. Accordingly, 6 non-fiction passages were chosen from published reading and science textbooks designated as first-grade material. By increasing the percentage of bits of information deleted, thus was the degree of difficulty increased.

In addition to the testing materials, these researchers felt it necessary to obtain certain personal information from their prospective subjects solely for the purpose of population identification. Therefore, a Personal Data Questionnaire was prepared, which asked for each subject's gender and self-perceived level of Spanish reading proficiency.

With these materials completed, these researchers then proceeded to administer the tests to 4 different groups of college students studying Spanish. In administering the tests, the students were given an oral explanation/description of this pending research, and were asked to
participate. Clarification was made on the chalkboard as to exactly how to proceed in filling in the missing bits of information on the tests themselves.

In an effort to keep the tests and subjects completely anonymous, a separate consent form was given to each student, signed by him or her, and returned to the researcher. At that point, pre-numbered test packages were then handed out to the students. The first page of the packet was the Personal Data Questionnaire wherein the gender and self-perception was asked of each student. Again, it was the intent of these researchers to use this particular data solely for population referents. The remainder of the packet contained the battery of 6 tests in ascending order in degree of difficulty. After each passage were 2 written, multiple-choice, comprehension questions. The students were given 45 minutes to complete the 6 tests, which appeared to be ample time. Once completed, the test packets were returned to the researcher.
Summary

The theory of information claims, among other things, that due to the factors of redundancy and predictability, much information of a given text can be omitted and still allow a reader to read the text proficiently and maintain comprehension. Based on this theory, these researchers expanded upon prior theses written by Eliza Bennette-Kinkead and Ivette Robles and developed a battery of 6 different assessment tools for Spanish language learners.

Whereas Bennette-Kinkead and Robles repeated the same passages in descending order of difficulty, these researchers developed 6 different passages, 2 passages each at approximately the same level of difficulty, and administered them in ascending order. It was the belief of these investigators that the second test at each level would serve to better validate these assessment tools. Additionally, by administering the tests in ascending order, it was intended that the beginner students be able to find some degree of success and not reach an immediate frustration level of proficiency.

All 50 subjects of this investigation were students of the State University of New York, College at Brockport, during the Spring semester 1994. All 4 classes chosen were pre-designated at levels ranging from
beginner to advanced Spanish language learners. These researchers asked each participant in this investigation, via the Personal Data Questionnaire, to evaluate his or her own proficiency level in order to shed any light on potential inconsistencies in the data outcome. All students were given a time frame of 45 minutes within which to complete the testing packet.
CHAPTER IV

Analysis of Data

Purpose

The purpose of this study was to investigate the use of information theory as a testing technique to diagnose Spanish reading proficiency of students learning the Spanish language. Based on the above investigation, a further purpose of this study was to develop a Spanish reading assessment tool, which could be used in the classroom, to provide a broad picture of a student’s ability to comprehend reading material at or near his/her level of language learning.

Establishment of Proficiency Criteria

The criterion reference for this tool was chosen after careful empirical review of the data. Students were to correctly supply 80% of the missing bits of information for both tests at each level to be deemed “proficient.” While 80% is somewhat arbitrary, it is not a “wild guess”; the researchers discovered that most college-classified advanced students were the only students to score 80% or better on measures 3a and 3b, while only the college classified beginners were not able to score at least 80% at the
intermediate level. Additionally, the researchers accepted Campbell's argument that in order to successfully determine the identity of a missing bit, an individual must employ his/her knowledge of redundancy in language, and therefore employ comprehension abilities. (Campbell: 1982) These researchers allotted a 20% leeway at each testing level to adequately provide for factors such as poor spelling ability on the part of the test taker, or poor choice on the part of the test developers of some of the bits deleted (extremely low redundancy, for example).
The above group of students was classified by the college as beginning Spanish language learners. With a criterion level of 80% proficiency in both passages at this level, this assessment tool would seem to confirm the beginning level placement for the majority of these students. The mean scores at each level also show a distinct downward trend in proficiency as the percentage of deleted information increased.
An interesting discrepancy to note is Subject No. 21. While this subject was placed in a beginner group, she described herself on the Personal Data Questionnaire as being an intermediate student. According to this tool, she did, in fact, test out at the intermediate level.

With respect to Subject No. 25 and her performance at the intermediate level (according to this tool), these researchers attribute this borderline proficiency to actual growth in learning as these tests were administered late in the Spring semester. (The tests were administered in early April; the college semester ended in May.)
At the time of this study, subjects 1 through 9 were the only participants undergoing Spanish instruction at the intermediate level. The above table is arranged by subject number, and displays the score obtained by each on all 6 passages, in terms of the percentage of missing bits correctly identified. The mean score for each test is given at the bottom of the table. Taken together, these mean scores show a downward trend as the intermediate group moves...
from one set of tests to another (in effect, moving from one level of difficulty to the next).

As a group, these students correctly identified an average of 90% of the missing bits on passage 1a and 86% on passage 1b. As both these scores exceed the benchmark of 80% correct identification, it can be concluded that, as a group, these students are proficient in Spanish reading at at least the beginner level.

An examination of the average scores of these students on passages 2a and 2b (passages which the researchers intended to reflect an intermediate level of difficulty) indicate that, as a group, they are working below level. The average score on passages 2a and 2b were 78% and 77% correct identification respectively. Both of these scores fall below the benchmark of 80%, indicating that the type of deletions made at this level may need to be modified in order to increase the reliability of the tool, or that some of the students may, indeed, be placed incorrectly.

It is apparent to these researchers that the discrepancies evident in the results obtained by subjects 1, 4, 5, 8 and 9 are responsible, in part, for the overall “poor” (below benchmark) mean performance on passages 2a and 2b. Subject 1 shows a curious discrepancy in that her score on passage 2a is
lower than those obtained in the more difficult 3a and 3b passages. Based on this data and the criteria for evaluation set above, the researchers have classified this subject as a beginner.

Although not lower than their 3a and 3b scores, subjects 8 and 9 also scored "low" (below the benchmark) on passage 2a (68 % and 77 % respectively). Noteworthy also, is the fact that both subjects scored above the benchmark on passage 2b; identifying their score on 2a as the only factor that has kept the researchers from classifying them as intermediate students as opposed to beginners. This evidence suggests that passage 2a may be the weaker of the two in determining intermediate ability for these students.

Subjects 4 and 5 both scored lower on passage 1a (a passage aimed at a beginning Spanish level in terms of percent and type of bits deleted) than they did on one of the two more "difficult" passages in the second set. These researchers feel that results from a larger population of preidentified intermediate students is needed before attempting to adequately explain this type of discrepancy. They tentatively suggest that these scores might be coincidental; possibly caused by personal circumstances on the part of the subject such as distraction, anxiety, etc., or indicators of a need to modify
that particular passage. Based on this information, they conclude that these two students are working at a beginning Spanish level.

These researchers caution that while this tool indicates that only 4 of the nine students identified as intermediate students (by virtue of the course in which they were enrolled) appear to be working at that level, a much larger population is required to obtain an accurate picture. Results from the population of 9 appear to indicate that passages 2a and 2b may need some modification in terms of type of information deleted (i.e. vowels, nouns, etc.), or that the students may have been placed in an inappropriate setting.
Advanced

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<th>1b Percent Score</th>
<th>2a Percent Score</th>
<th>2b Percent Score</th>
<th>3a Percent Score</th>
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<td>100</td>
<td>94</td>
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<td>100</td>
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<td>99</td>
<td>95</td>
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<td>A</td>
<td>A</td>
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<td>90</td>
<td>88</td>
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<tr>
<td>Standard Deviation</td>
<td>1.64</td>
<td>1.8</td>
<td>3.8</td>
<td>5.9</td>
<td>10</td>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Two groups of subjects who participated in this study were studying Spanish at an advanced level. Subjects 10 through 19 were enrolled in a Spanish conversation and composition class, while subjects 36 through 49
and subject 51 were taking an advanced grammar course. The above table is arranged by subject number, and displays the score (in terms of the percentage of missing bits correctly identified) obtained by each on all 6 passages. The mean score for each test is given at the bottom of the table. Taken together, these mean scores show a gradual downward trend as the advanced group moves from one set of passages to another (in effect, moving from one level of difficulty to the next).

As a group, these students correctly identified an average of 99 % of the missing bits on passages 1a and 1b. As both these scores exceed the benchmark of 80 % correct identification, it can be concluded that, as a group, these students are proficient in Spanish reading at at least the "beginner" level.

An examination of the mean scores of these students on passages 2a and 2b (96 % and 93 % respectively) indicates that, as a group, these students are also proficient at the intermediate level.

The mean scores on passages 3a and 3b (90 % and 88 % respectively) also surpass the benchmark, leading the researchers to conclude that, as a group, these subjects preidentified by class designation as advanced students, are, in fact, proficient at that level.
With the exception of numbers 42, 43, and 45, an examination of the scores by individual subject reveals a "gentle" (an average of 3 points per set of passages) decrease when moving from one set to the next. The decrease is explained by the fact that each set of passages contains a higher percentage and more difficult type of deletions. The bits targeted were of lesser redundancy than those in previous passages. These subjects performed as predicted; their scores were still "high" (above the benchmark) on passages 3a and 3b. Based on this information, the researchers classified those 22 individuals as advanced students.

Subjects 43 and 45 scored at least ten points above the benchmark on the first two sets of passages, indicating that they are working at at least an intermediate level. Both of these subjects fell below the benchmark by almost 20 points in passages 3a and 3b, demonstrating that they are not proficient at an advanced level. The researchers suggest that, although enrolled in an advanced grammar course, these students may be intermediate level students who are consciously working above level for personal reasons (degree requirements, or a desire for the information supplied in that particular course, for example). It is worth noting that both of these subjects indicated on the Personal Data Questionnaire that they felt
they were at an intermediate level of Spanish proficiency.

The other discrepancy between designation by course enrollment and designation by this tool occurs in the scores obtained by subject 42. This student scored 100% on both passage 2a and 2b, indicating quite strongly that she is proficient at at least the intermediate level. On passages 3a and 3b, she scored 80% and 79% respectively, which falls just short of these researchers' criteria of 80% or better in both passages at a given level for that subject to be classified proficient. Subject 42, then, has been classified as an intermediate student, as per their criteria. They felt that the closeness of the scores to the benchmark did warrant mention and that this student might, in fact, be working at an advanced level and may have "rushed" through the last 2 passages. In other words, they caution that such a close score may indicate variables other than simply the level of reading ability.

The results from this population of 25 "advanced" subjects appears to confirm the usefulness of this tool; 22 of the 25 subjects scored above the benchmark on both passage 3a and 3b. In terms of identification of an advanced student, then, these researchers conclude that this tool can be successfully employed. They also suggest that further
research into the percentage and type of bits deleted in passages 3a and 3b (specifically with respect to the law of diminishing returns) be made. They feel that testing Claude Shannon's claim that an individual can understand a passage even if 75 % of the information is missing, (Campbell: 1982) will further validate their findings.

Reliability

**RELIABILITY OF LEVEL THREE MEASURES**

**CORRELATION BETWEEN 3A AND 3B**

<table>
<thead>
<tr>
<th>PARAMETER</th>
<th>COEFFICIENT</th>
<th>STD ERROR</th>
<th>T-VALUE</th>
<th>PROB</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONSTANT (A)</td>
<td>11.47517</td>
<td>4.873456</td>
<td>2.354627</td>
<td>.0229</td>
</tr>
<tr>
<td>3B (B)</td>
<td>.653051</td>
<td>.066186</td>
<td>12.88876</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

**UNADJUSTED R^2** = .783142  
**ADJUSTED R^2** = .778427  
**CORRELATION COEF** = .884953

**REGRESSION ANOVA**

<table>
<thead>
<tr>
<th>2-TAILED PROB</th>
<th>DEGREES OF FREEDOM</th>
<th>F</th>
<th>DURBIN-WATSON STAT</th>
<th>DEPENDENT VAR. MEAN</th>
<th>COEFF. OF VARIATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>.0229</td>
<td>1 AND 46</td>
<td>166.1207</td>
<td>1.782376</td>
<td>70.83334</td>
<td>.155904</td>
</tr>
</tbody>
</table>

**WITH X = 3B AND Y = 3A**

\[ Y = 11.4752 + .8531 \times X \]
In the development of most measurement tools, it is a common practice to determine the tool’s reliability via a test-retest procedure. This, however, was not done in the current research. Instead, the approach used herein was 2 forms of the measuring instrument pitted against each other. The crucial measuring tool in the current study was the set of 2 parallel measures called “3a” and “3b”, which were designed to differentiate the advanced students from the intermediate, as well as confirm the lowest level of performance on the part of the beginners. Table A shows the statistical workup for this third level (advanced) measure. Here, the correlation coefficient between the 2 forms was .88. Since .80 is a commonly accepted benchmark for establishing interform reliability, and since this was exceeded, it can be concluded that the tests are highly reliable. This statistical relationship demonstrated in Table A is further supported by Graph A, which indicates, subject by subject, the same strong interrelationship between the two test forms 3a and 3b.

Validity

The case for the validity of the instrument rests upon its ability to predict the level of global language performance. The classification made
by the college is based upon the student’s progress through it’s established program, while the classification made by these researchers is based solely on the results of their tool. Despite this difference, the new reading proficiency measure did agree with the college instructors’ classifications in 77% of the cases. With respect to those subjects classified by these researchers as operating at a lower level than that designated by the college, the argument can be made that 1) these are students who are at risk of failure in that particular class, 2) were affected by emotional factors, or 3) have been incorrectly placed by the college. In cases where the researchers’ placement was higher than that given by college course, it could be said that since this data was collected at the end of the semester, some of the changes might be attributed to the learning that took place during the semester. Noteworthy, however, is the fact that no college classified “advanced” student was classified by the new tool as a “beginner”, or vice versa. Because the test was given anonymously, the researchers do not have access to the college instructors’ performance data concerning any individual subject. Such information might explain some of the classification discrepancies and is, therefore, offered as an element to be considered in the event that further data is collected based on this tool.
### 3a and 3b Score Distributions

<table>
<thead>
<tr>
<th>ESCAT GROUP</th>
<th>N</th>
<th>MIN.</th>
<th>LOW QUART.</th>
<th>MEDIAN</th>
<th>UP QUART.</th>
<th>MAX.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>17</td>
<td>26</td>
<td>36.5</td>
<td>51</td>
<td>58.5</td>
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<td>2</td>
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<td>65.5</td>
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<td>TOTAL</td>
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</table>

<table>
<thead>
<tr>
<th>ESCAT GROUP</th>
<th>N</th>
<th>MIN.</th>
<th>LOW QUART.</th>
<th>MEDIAN</th>
<th>UP QUART.</th>
<th>MAX.</th>
</tr>
</thead>
<tbody>
<tr>
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<td>16</td>
<td>31</td>
<td>41</td>
<td>60</td>
<td>71</td>
</tr>
<tr>
<td>2</td>
<td>10</td>
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<td>62</td>
<td>68</td>
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<td>3</td>
<td>21</td>
<td>80</td>
<td>85.5</td>
<td>93</td>
<td>97</td>
<td>100</td>
</tr>
<tr>
<td>TOTAL</td>
<td>48</td>
<td></td>
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</tr>
</tbody>
</table>

The above histogram shows the breakdown in the score distributions by proficiency level (beginner, intermediate, and advanced) in the measures known as “3a” and “3b”. Again, both measures clearly distinguish between the three performance levels, thus (further) supporting the reliability and validity of the instrument. It should be noted, however, that the discriminatory ability of 3b is superior to that of 3a.
CHAPTER V

Conclusions/Recommendations

Conclusions

The purpose of this study was to further investigate the use of information theory as a Spanish language assessment technique, within an English-speaking setting, by broadening the data base and employing a wider variety of reading passages. A further purpose was to attempt the development of a Spanish reading proficiency test that could be used in the classroom to provide a broad picture of a student's ability to comprehend reading material at or near his/her level of language learning.

The subjects of this investigation were college level Spanish language learners, pre-classified as either beginner, intermediate or advanced students.

With respect to the population, these researchers feel that a significant limitation of this investigation was the actual size of the data base. Due to the relatively small sample population, these researchers would highly recommend a larger data base should this investigation be replicated at a future date.
The criterion reference for this tool was chosen after careful empirical review of the data. Students were to correctly supply 80% of the missing bits of information for both tests at each level to be deemed "proficient." While 80% is somewhat arbitrary, it is not a "wild guess"; the researchers discovered that most college-classified advanced students were the only students to score 80% or better on measures 3a and 3b, while only the college classified beginners were not able to score at least 80% at the intermediate level. Additionally, the researchers accepted Campbell's argument that in order to successfully determine the identity of a missing bit, an individual must employ his/her knowledge of redundancy in language, and therefore employ comprehension abilities. (Campbell: 1982)

These researchers allotted a 20% leeway at each testing level to adequately provide for factors such as poor spelling ability on the part of the test taker, or poor choice on the part of the test developers of some of the bits deleted (extremely low redundancy, for example).

The bias of these researchers was that definite trends in Spanish language reading proficiency would correspond directly with the percentage of deletions made in each passage. It was also the hope that the second passages at each level would support these findings. The mean scores of
each test level did indicate a consistently downward trend in proficiency, and the overall correlation among the testing tools themselves (at each level) confirmed that. The researchers did find then, that there was a strong relationship between the deletions and the level of reading proficiency.

The investigators express some concern over the multiple-choice comprehension questions that appear at the bottom of each passage. A few subjects indicated that they were able to supplement their knowledge of the missing bits of information with the content of the actual questions and answer choices themselves. These researchers would recommend either: a) placing the questions on a separate page following each test, b) placing the questions on a separate sheet after the entire battery of tests, or c) total omission of the questions altogether.

In actuality, the comprehension data of this tool was not given a great deal of credence by these investigators. Initially, the questions were meant to determine a degree of comprehension, but as the overall responses to the questions were correct, despite low percentage scores on the tests themselves, these researchers ultimately determined this portion of the tool as a limitation of this study. The discrepancy between the scores and the comprehension questions could be attributed to the ease of and familiarity
with the subject matter -- being that all passages were taken from published first-grade readers. Thus, these investigators would reiterate the above recommendations, as well as suggest that careful consideration be given to the actual wording of the questions, and possibly to reconsider the format of questions asked.

In addition to the discrepancy between the test scores and comprehension portion, there were several discrepancies among the data at the intermediate level. The fact that these disparities were bi-directional is of particular interest as the intermediate level of proficiency is very often the most difficult level for educators to determine. These researchers feel that this bi-directionality of scores may be the result of the subject’s degree of familiarity with the passage content. We would recommend, therefore, that for an English-speaking class learning Spanish, more culturally hispanic passages would be appropriate to lessen the interference of the subject’s prior knowledge.

As it stands, these researchers feel that this tool is useful in determining the level of Spanish reading proficiency of a student. The minimal discrepancies in data at the beginner and advanced levels would seem to support this belief (no beginners are classified as advanced by this
tool or vice versa). With this observation in mind, then, these researchers feel that with a larger data base, such would also be the case at the intermediate level.

Recommendations for Further Study

These researchers suggest that this tool be used in conjunction with Spanish proficiency tests given by colleges in New York State that determine the eligibility of a candidate to teach Spanish in the public school system. They feel that such use of the tool will serve to establish concurrent validity. If, in a population of at least 100, it can be demonstrated that all persons who obtained 80% proficiency on levels 3a and 3b of this tool did pass the college-given proficiency exam, then a strong case will have been made for the administration of this tool as a prerequisite to the college exam.

The researchers feel that reliability has been adequately established, and therefore, suggest that only one passage be given at each level when the tool is next administered. They recommend all three "b" passages due to their stronger showing in the breakdown of tests (see Appendix).
Summary

This study attempted to answer two questions: Is the theory of information a valid measure of Spanish reading proficiency? and, Is the theory of information a valid measure of Spanish reading comprehension? It was concluded that the theory of information can be used to develop an effective Spanish reading proficiency assessment tool. The test data indicated that the subjects were successful (in terms of the benchmark set by the researchers) up to and including the passages at their level. Because the deletions made in each passage were based on degrees of redundancy in the text, it is logical to conclude that the subjects were required to use their knowledge of syntactic and semantic cues to determine the missing information. As the subject moved from one set of passages to another and was required to rely more and more on his/her knowledge of language, he/she showed a decrease in the percentage of missing bits correctly identified. Advanced students showed less of a decline in scores as they moved through the sets, while beginners showed the most severe downward trend.
With respect to its use as a measure of reading comprehension, these researchers conclude that this tool does appear to be an indicator. They agree with Campbell's argument that in order to identify the deletions, a student is forced to use his/her understanding of the passage content. They do caution that the multiple choice questions may have affected some scores. With only a change in comprehension question format or presentation, they offer their tool as an effective measure of Spanish reading proficiency.
REFERENCES


LIST OF APPENDICES

• Test Passages in Original Form Without Deletions
• Instructions to Subjects
• Consent form
• Final Battery of Tests
• Data from Study
• Reliability of Level One Measures: Correlation between 1a and 1b
• Reliability of Level Two Measures: Correlation between 2a and 2b
• Breakdown of 1a and 1b
• Breakdown of 2a and 2b
Original Form of Passage 1a:

Alexander Graham Bell

El inventor del teléfono nació en Escocia en 1847. Vino a los Estados Unidos cuando tenía 24 años de edad. Fue maestro de niños sordomudos. También fue profesor en la Universidad de Boston. Creó una gran compañía telefónica. El hizo posible la comunicación a larga distancia.

[From pg. 163 of Tradición y Fantasía.]

Original Form of Passage 1b:

Noche Y Día

En la mañana el Sol parece salir del este. Parece que se mueve a través del cielo durante el día. Al mediodía está alto en el cielo. Al anochecer parece que se pone en el oeste.

Nos llega más luz del Sol durante el día. Por eso recibimos más calor durante el día. En la noche no recibimos luz del Sol.

[From pg. 146 of Ciencias.]
Margarita Robleda Moguel

Margarita Robleda Moguel nació en México y vivió en San Antonio, Texas, cuando era muy pequeña. A ella le gusta escribir y cantar canciones para niños. También es la autora de muchos cuentos. Margarita Robleda Moguel dice que toma las ideas para sus cuentos de sus recuerdos de Texas y de sus viajes por todo México.
Las Supersticiones

Las supersticiones o creencias populares también forman parte de las tradiciones. En Puerto Rico, como en otros países, existen muchas supersticiones.

Algunas de ellas son:

* Ver una mosca grande en la casa anuncia una visita.

* Pasar por debajo de una escalera da mala suerte.

* Romper un espejo anuncia una desgracia.

* Ver volar un pajarito dentro de la casa anuncia que se recibirá una visita.

[From pg. 86, Por El Mundo Del Cuento y La Aventura]
Una Tradición

Lo que tu familia y tu comunidad hacen es tradición. Una tradición es una costumbre que pasa de padre a hijos a través del tiempo. La gente de un país o comunidad siente que sus tradiciones son algo muy suyo. Piensan que son algo que no debe cambiar.

La gente tiene también otras cosas como cuentos, leyendas, chistes, dichos, canciones y creencias, que forman parte de su tradición.

A todo este tipo de costumbres y tradiciones que forman parte de la cultura de un pueblo se le llama folklore.

[From pg. 79, Por El Mundo Del Cuento y La Aventura]
Japón

En el Japón, el Año Nuevo se celebra el día primero de enero y continua durante quince días. La gente pone sus casas bien bonitas para recibir a la familia. Preparan como postre un gran bizcocho de arroz y les dan regalos a los niños y a las niñas.

Frente a la casa ponen dos ramos. Uno es de pino y el otro es de bambú. Según la creencia de los japoneses, estos ramos darán felicidad y larga vida a la familia que vive en la casa.

[From pg. 74, *Por El Mundo Del Cuento y La Aventura.*]
DESCRIPTION OF THE ORAL PRESENTATION TO BE GIVEN BEFORE THE STATEMENT OF CONSENT:

This study involves research into the validity of a new type of modified cloze procedure that we think can be used to determine a student's level of Spanish reading comprehension. We need people who are currently at the beginning, intermediate, or advanced levels to help us test whether or not our procedure accurately predicts the level a student is at. If you agree to participate in this project you will be asked to read as many as 6 short passages, to fill in the missing letters in those passages, and to answer two brief questions about each passage. The process will last approximately 1/2 hour and a pizza dinner and refreshments will be provided. Your name will never appear on any of the passages and the results will only be used to determine whether or not our tool works, not where your strengths or weaknesses may be. Those who are interested in the results of our research or who have any other questions related to the research may contact Dr. Robert Ribble in the Department of Education and Human Development or Dr. Victor Rojas in the Department of Foreign Languages here at Brockport. We can answer any questions you have now.
STATEMENT OF CONSENT

You are being asked to make a decision whether or not to participate in the project. If you wish to participate and you agree with the statement below, please sign in the space provided. Remember, you may change your mind at any point and withdraw from the study. All information collected in this study will be kept strictly confidential. If any publication results from this research, you will not be identified by name.

I __________________________, having understood the information provided regarding this project, agree to participate as a subject in this project.

_____________________________  __________________________
Signature of Subject.           Date
Personal Data Questionnaire

It would be helpful to us to get a general "big picture", so to speak, of the population that has agreed to help us in the development of our assessment tool. We ask that you complete this questionnaire but do not put your name on it. All of this data will be kept confidential. Circle or fill in the blank for each question.

1. Gender
   a. female
   b. male

2. How would you characterize your level of Spanish reading ability?
   a. beginner
   b. intermediate
   c. advanced or native speaker
Alexander Graham Bell

1. Alexander Graham Bell fue un inventor y
(a) un atleta
(b) un educador
(c) un músico

2. Según el autor, Alexander Graham Bell hizo posible
(a) la comunicación entre los sordomudos
(b) la creación de la Universidad de Boston
(c) la comunicación a larga distancia
Noche Y Día

En la mañana el Sol parece salir de este. Parece que se mueve a través de cielo durante el día. Al anochecer parece que se pone en el oeste.

Nos llega más luz del Sol durante el día. Por eso recibimos más calor durante el día. En la noche no recibimos luz del Sol.

1. ¿De qué habla estos párrafos?
   
   (a) el movimiento de los planetas durante la noche y el día
   (b) la ruta que parece tener el Sol en el cielo
   (c) la diferencia entre el Sol y la Luna

2. Según este párrafo, recibimos más calor
   
   (a) al anochecer
   (b) durante la noche
   (c) durante el día
Margarita Robleda Moguel

Margarita Robleda Moguel nació en México y vivió en San Antonio, Texas, cuando era una niña. A ella le gustaba correr y cantar para niños. Murió es la autora de muchos cuentos. Margarita Robleda Moguel dice que toma ideas para sus cuentos de sus recuerdos de Texas y de sus viajes por todo México.

1. Margarita Robleda Moguel es
   (a) una niña
   (b) una autora
   (c) un personaje en un cuento

2. Las ideas de Margarita Robleda Moguel vienen de
   (a) sus experiencias
   (b) sus canciones
   (c) su familia
Las Supersticiones

Las supersticiones o creencias populares tienen forma parte de las tradiciones. En Puerto Rico, como en otros países, existen muchas supersticiones, algunas de las cuales son:

* Ver una mosca grande en casa anuncia una visita.
* Pasar por debajo de una escalera da mala suerte.
* Romper un espejo anuncia una desgracia.
* Ver volar un pájaro dentro de la casa anuncia que se recibirán buenas noticias.

1. Según este artículo, ver volar una mosca grande en la casa:
   (a) significa que se recibirán una visita
   (b) anuncia una desgracia
   (c) anuncia que llegarán buenas noticias

2. ¿Cuál de estas supersticiones es mencionada en el artículo?
   (a) caminar debajo de una escalera da mucha suerte
   (b) romper un espejo da buena salud
   (c) caminar debajo de una escalera da mala suerte
Una Tradición

Lo que tú familiar y _ comun_da hac__ es tradici___, Una _di__ón es _stu__bre que _sa de pa__e a _jos a t__vé de tem__o, _ ge__te de u__aís o co__n_da si__nte q__ su_ tra__ci__es _ ago m__u__yo. Pi__ns__ que _on a__o que no _be c__bi__r.

La _te t__m__ ot__es co__ cu__nt__, le__das, ch___s, d__h__e__nes y cr__nes, que f__m__ ar_e _ su _ci__n.

A to__ te _po _ cos__bres y tra__cione q_e _or__nte de _ cul__ra de _ pu__blo se le _ma fo_k__re.

1. ¿A qué (o quién) pertenecen las tradiciones?

   (a) a los cuentos
   (b) a la gente
   (c) a las canciones

2. Según el artículo, las tradiciones...

   (a) son muy importantes en una comunidad
   (b) deben cambiar por necesidad
   (c) duran poco tiempo
1. ¿Qué tipo de comida preparan los japoneses para celebrar el año nuevo?
   (a) un pastel de arroz
   (b) arroz con pollo
   (c) arroz con habichuelas

2. Para los japoneses, ¿qué significan los ramos de pino y de bambú?
   (a) buena salud
   (b) decoraciones de bienvenido
   (c) felicidad y larga vida
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<th>1a Percent Score</th>
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RELIABILITY OF LEVEL ONE MEASURES
CORRELATION BETWEEN 1A AND 1B

LINEAR \( Y = A + B \cdot X \)

\[
Y = 33.9371 + .6428 \cdot X
\]

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<tr>
<th>PARAMETER</th>
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<th>T-VALUE</th>
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UNADJUSTED \( R^2 \) = .604023
ADJUSTED \( R^2 \) = .595415
CORRELATION COEF = .777189

REGRESSION ANOVA \( F = 70.16653 \)
2-TAILED PROB \( P = <.0001 \)
DEGREES OF FREEDOM = 1 AND 46

STD ERR OF ESTIMATE = 5.178256
VARIANCE OF ESTIMATE = 26.81433
MEAN ABSOLUTE ERROR = 3.87145
COEFF. OF VARIATION = .055668

WITH \( X = 1B \) AND \( Y = 1A \)
RELIABILITY OF LEVEL TWO MEASURES

CORRELATION BETWEEN 2A AND 2B

LINEAR

\[ Y = A + B \times X \]

\[ Y = -14.0427 + 1.1571 \times X \]

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UNADJUSTED \( R^2 \) = .703993
ADJUSTED \( R^2 \) = .697558
CORRELATION COEF = .839043

STD ERR OF ESTIMATE = 9.949936
VARIANCE OF ESTIMATE = 99.00123
MEAN ABSOLUTE ERROR = 7.166254

REGRESSION ANOVA \( F = 109.4017 \)
2-TAILED PROB \( P < .0001 \)
DEGREES OF FREEDOM = 1 AND 46

DURBIN-WATSON STAT = 1.660226
DEPENEDNET VAR. MEAN = 82.64584
COEFF. OF VARIATION = .120392

WITH \( X = 2B \)
AND \( Y = 2A \)

\[ Y = -14.0427 + 1.1571 \times X \]
COMPARISON OF PROFICIENCY GROUPS
AS CLASSIFIED BY THE PRESENT RESEARCH CRITERIA OF 80%

### BREAKDOWN OF '1A'

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