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Cognitive Processes and Their Relation to Word Reading, Comprehension, and Math Competence in A Sample of School Children Who Live in Poverty

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ABSTRACT

The present paper reports an investigation into the structure of the relationship between cognitive processes on the one hand, and Reading and Math competence on the other within a neurocognitive frame-work (Planning, Attention, Simultaneous and Successive processing, PASS). The participants were children in Grades 4 and 5 from a school located in a low-SES region of Odisha, India. All of them were English Language Learners whose mother tongue was Odia. Structural Equation modelling showed that Word decoding was best predicted by a latent factor comprising Planning, and Successive and Simultaneous processes, whereas Comprehension was better explained by Successive and Simultaneous processing. Math competence was best predicted by Simultaneous processing and to a lesser extent by Planning. These results were weakened by the deleterious effects of chronic poverty that included lack of exposure to English language and reading materials. In spite of this limitation, broad relationship between PASS processes on the one hand, and Reading and Math achievement on the other, replicated previous findings as noted in a meta-analysis. That lead us to suggest a reason based on the basic universality of structure and functions of the brain.

Keywords

Poverty, PASS Processes, Reading and Math Achievement.

Introduction

The paper provides an overview of cognitive processes which predict reading, comprehension and mathematical ability in children, followed by a report of an investigation. The study examines the structure of relationship between cognitive processes on the one hand and Reading and Math competence on the other, within a neurocognitive frame-work: The Planning, Attention, Simultaneous and Successive processing (PASS).

Although the majority of research on PASS Planning-Attention-Simultaneous frame-work as it relates to reading and math has been conducted in North America, outside this cultural domain, like Indian culture, PASS Tests have a fair chance of both exposing cultural nuances and explaining them.

PASS processes and Relation with Reading, Comprehension and Math

In their 1979 study, Das, Kirby, and Jarman [1] proposed specific connections between the PASS processes and word reading. They suggested that successive processing aids word reading through phonological processing (sounding out), while simultaneous processing aids it through orthographic processing (refer to Figure 1). When children learn to read, they recognize words by phonological recoding, which involves identifying individual letters, recalling their sounds, storing these sounds in short-term memory, and blending them in a sequential manner. These steps exemplify successive processing. Conversely, familiar words can be recognized by sight, utilizing orthographic knowledge.

To elaborate, orthographic processing, which involves simultaneous processing, is crucial for distinguishing between phonologically similar words. Children with reading difficulties often exhibit significant deficits in both simultaneous and successive processing

[1]. For instance, Das and colleagues [2] studied English-speaking children in Grades 3 and 4 and found that children with a standard score below 80 in successive processing had a high probability (.75) of being poor readers. For simultaneous processing, the probability was lower but still notable at .50. This highlights the importance of both types of processing in reading proficiency.

Word Reading and Simultaneous and Successive Processing

One of the distinctive features of PASS theory of intelligence is its close link to academic achievement. Das et al. [1] proposed specific links between the PASS processes and word reading. More specifically, they proposed that successive processing contributes to word reading through the effects of phonological recoding (sounding out) and simultaneous processing contributes to word reading through the effects of orthographic processing (the ability to form, store, and access orthographic representations). The idea is rooted in the way reading develops [3].

What does the figure below represent? Successive process involves the identification of individual letters, the retrieval and storage of corresponding sounds in short-term memory, and the blending of sounds into serial order for the assembling pronunciation. Effects of simultaneous processing on word reading are mediated by orthographic processing of familiar words. Via a direct visual route, words are coded as holistic units because we know how to use visual and orthographic knowledge. This is obvious in sight reading. Both simultaneous and successive processing are combined and integrated during word reading.

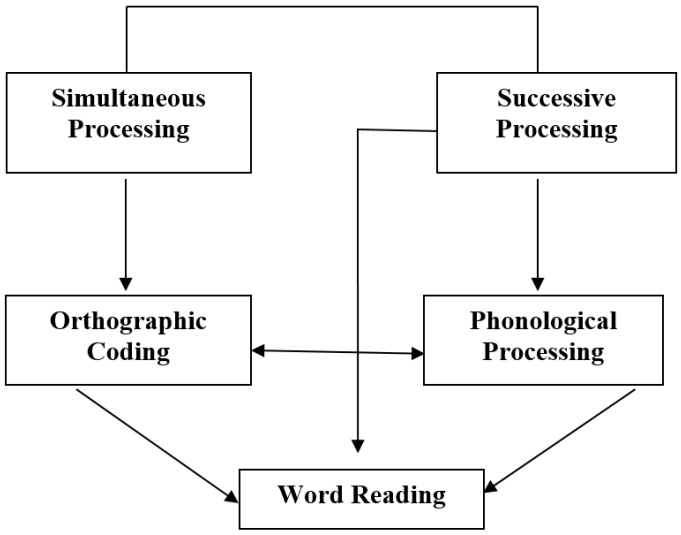

Figure 1: PASS processes underlying word recognition.

PASS processes are also associated with reading comprehension [4,5]. To grasp a story's meaning, children need to understand the relationships among its facts, which requires good simultaneous processing to integrate the main ideas within sentences. Planning and attention are equally vital for reading comprehension. Readers need to develop and actively revise a plan to approach a passage effectively. Earlier research by Das et al. [6] demonstrated that both planning and simultaneous processing were significant predictors of reading comprehension among fourth and sixth grade English-speaking children. More recently, Georgiou et al. [7] in a metanalysis and Georgiou and Das [5] extended these findings by showing that simultaneous processing influences reading comprehension in young adults, beyond the contributions of word- and text-reading fluency. This underscores the importance of simultaneous processing in understanding texts, indicating that its role extends from childhood into adulthood. Thus, a reader's ability to plan and integrate information simultaneously is crucial for effective comprehension. However, it is expected that these results of the present investigation will be moderated by two factors participants were English Language Learners(ELL), and lived in poverty.

PASS processes are also linked to mathematics [8,9], and the meta-analysis. Naglieri and Rojahn [10] reported that the average correlations between PASS processes and Broad Math scores range from .45 to .58, with the highest correlation found between simultaneous processing and Broad Math. Studies involving typically-developing children [9,10] and children with mathematics difficulties [11,12] have generally supported these findings, confirming the significant role of PASS processes in mathematical ability.

Success in math learning relies on the ability to solve problems involving words and numbers. Comprehension of the given problem and selecting procedures for working out the solution step by step are required. These are associated with successive processing and planning. Problem solving clearly involves simultaneous processing. PASS processes, therefore have a central role in math performance. A standard test of Math achievement, Wechsler individual achievement test (WIAT), has measures for problem solving and Math operations. In the present study, we have included WIAT to examine its association with PASS.

Poverty and Academic Achievement

Reading is a multifaceted activity encompassing numerous subprocesses, as noted by Gough and Tunmer in 1986. This complexity is amplified for children living in poverty. Chronic exposure to stressors induces the production of cortisol, a stress hormone, which negatively impacts the executive functions in children [13]. Consequently, this hampers the acquisition and development of reading skills [14]. Multiple studies have established a robust and consistent correlation between poverty and academic performance [15]. Research consistently demonstrates the detrimental effects of poverty on children's reading achievements. For instance, complex cognitive tasks such as word decoding and passage comprehension are adversely affected when cognitive processes are compromised. Similarly, mathematical abilities are at risk. Fundamental mathematical skills, including digit knowledge, randomization, size estimation, develop alongside letter and phonemic awareness as children start school and learn various concepts. Therefore, poverty is presumed to negatively impact the cognitive predictors essential for reading, comprehension, and mathematical abilities.

Poverty significantly impacts children's overall development and reading progress. Throughout the developmental process in early years of children, home literacy environment is considered a crucial factor for enhancing reading development and academic success [16]. In this study, all participants were from poor families.

The study was conceptualised to examine different cognitive factors predicting different aspects of reading development. One of the examining aspects was to compare the predictability of the cognitive factors for reading development and mathematic ability in typically developing children and children living in poverty. Apart from the environmental factor, we asked if in both groups of children, the same cognitive factors predict reading and mathematics ability.

The present study has the following objectives:

- To identify the cognitive processes which predict reading, comprehension, and mathematical ability in children given that they are English language Learners, and live in poverty.
- To examine if PASS theory of cognitive processes provides a useful framework for differential prediction of the three academic subjects.
- Can the cognitive predictors of the three, reading, comprehension and math achievements, be distinguished by specific patterns of prediction by cognitive tests of PASS? We use Structural Equation Modelling as the main statistical tool.

Methods

Participants

The study was conducted in Bhubaneswar Orissa, an eastern state of India. All children were recruited from a school in an extremely low economic area of the city. They were chronically poor. However, all of them were given free uniforms to wear to school. The school was clean and provided good sanitary facilities in contrast to the surrounding 'slum'. Discipline was not a problem and comparable to schools in better socioeconomic areas. Teachers had requisite college education, and most lived in the same area where the school was located. They were exceptionally dedicated in spite of their low salaries compared to other schools. Teachers were mentors. School- climate provided a protective and secure environment. These factors might have mitigated and reduced the effect of chronic poverty on children's academic learning.

The study included 80 pupils from grades four and five. Among them, 35 were girls and 45 were boys. The pupils were selected from a public school in Orissa, where the medium of instruction was Odia. The school was selected on the basis of its language of instruction. The mean age for the sample was 9.8 years. The initial literacy instruction for the sample was Odia. However, they were introduced to English at an early age in school, when they usually begin to read. The approximate age would be five years when they start learning to read in English. However, the initial literacy instruction for English is Odia and gradually they learn English. The medium of instruction for other subjects taught in the classroom was Odia. The school was in a primarily low middle-class area. The school followed simple methods for both languages, which were predominantly look and say, as is the practice in typical Odia-medium schools.

Measures

The study was designed to assess children's word reading, reading comprehension, cognitive, and mathematical abilities. Reading fluency was measured using TOWRE. Word reading and Reading comprehension in English were assessed by Woodcock Johnson Test Battery. The word reading and comprehension test in Odia was developed parallel to the English one and the reliability check had been done earlier for another research study in Odia language [17]. The same Odia test was used in this study. The phonological awareness was assessed using Comprehensive tests of phonological processing (CTOPP). Rapid automatic naming test, a cognitive predictor of reading, was administered to the children to measure reading fluency. In addition, cognitive abilities of the children were assessed using Das-Naglieri Cognitive Assessment System [9]. Mathematical problem solving and mathematical fluency were tested using WAIT- III.

Test of Word Reading Efficiency (TOWRE)

TOWRE [18], a part of CTOPP, was designed to test the reading fluency in English. This test assesses single-word reading ability by speed and accuracy. In this study, the sight-word reading test was used. In this test the child is allowed to read as many words as possible in 45 seconds only. The words were simple and high in frequency in the beginning and gradually changed to complex and low frequency words.

Woodcock Reading Mastery Test

This tests battery has test for word reading and reading comprehension in English [19]. In word reading there are 106 items and the level of complexity increases with number of items. Basically, the words vary from high frequency to low frequency. The child is allowed to look to the word and say it out loud. The test stops at four consecutive errors. The reading comprehension test has 56 items and like word reading, the level of complexity increases with the number of items. The discontinuation rule is same as word reading. The parallel test for word reading and reading comprehension in Odia follows the same norm and difficulty levels in items. The test administration and instructions were same for both the English and Odia tests.

Comprehensive Test for Phonological Processing (CTOPP)

This test measures phoneme awareness in English. The 'Elision' test from CTOPP [18] battery was used. In this test the child is asked to repeat a word, and then asked to say the remaining word after a small part is taken away. For example, "say 'bat', now say 'bat' without saying without '/b/'. Correct answer "at".

Rapid Automatic Naming (RAN)

RAN test is designed to measure the reading fluency. In this study, rapid colour, letter and digit naming tests were used. In the test, a set of items are shown in two different sets (set A & set B). The child needs to serially name pictures of colours, letters or digits, presented as rows on a card, as fast as s/he can. The time (seconds)

to name all items for each set is recorded. The RAN subtests from the CTOPP were used.

Cognitive Assessment System (CAS)

The CAS is an assessment battery designed to evaluate cognitive processing. It was developed to integrate theoretical and applied areas of psychological knowledge using cognitive processing theory and tests designed to measure Planning, Attention, Simultaneous, and Successive Processing (PASS) in individuals ages 5–17. CAS is based on Luria's PASS model. The Planning, Attention, Simultaneous and Successive (PASS) cognitive processing model is a modern theory as it is based on Luria's analyses of brain structures and functional organization (1966, 1973). The model looks at information processing as dynamic instead of static. The children were administered 2 tests from each aspect, thus, giving a total of 8 tests for all the 4 aspects of cognition. The subtests for planning are matching numbers and planned codes. Expressive attention and number detection are the subtests for attention. The subtests for simultaneous processing are non-verbal matrices and verbal spatial relation. Finally, the subtests for successive processing skills are, word series and sentence repetition. For details of the subtests of CAS and elaboration, please see the appendices.

WAIT-III

(Wechsler Individual Achievement Test, 3rd Edition) WAIT is a comprehensive test battery to assess a wide range of mathematical abilities through different kind of tests. Mathematical fluency and Mathematical problem solving are two among them. In the fluency test, the child needs to do a set of (contains 16 items) mathematical addition, subtraction, division and multiplication. The number of correct responses is the scores. On the other hand, problem solving has 70 items, they are mixed of kinds (e.g., matrices, spatial relation tasks and small comprehensive sums). The complexity of items increases with the number of items. The child has to understand the question and answer seeing the pictures or reading the question given in the task. The rule to stop the test is four consecutive errors.

Ethical Consideration

Before collecting the data, an ethical approval was obtained from the principal of the school, since the study required the involvement of school children. Initially a request was made to the principal of the school for the study. After getting the permission from the principal, the selection of participants was made after seeking their parental consent. All the pupils were briefed about the method and purpose of the study. They were also told that they were free to withdraw from the study at any point.

General Procedure

The study was conducted in Orissa, an eastern state of India, during the months of November and December 2015. After selecting the school and children for the study, the children were briefed about the tests they were going to take. Each child was taking the whole set of tests in two different days, with a day break in between, to reduce the effect of fatigue and boredom. Each child was tested for 110 minutes approximately in total. The principal of the school was kind enough to provide the researcher with a quiet room for the tests. Before starting the tests, the researcher introduced herself to the child and explained the child's importance in the study. Test administration began after establishing rapport with the child. It was prudently taken care that the child did not feel uncomfortable during the tests and continuous encouragement and positive feedback was given to each child during the tests. Before each test, the child was given precise instructions and examples for the tests. The set of instructions for each test was provided in Odia with a mixture of English to promote easy understanding.

Results Analysis

Table 1: Correlation among PASS Processes, Word Reading, Reading Comprehension and Math Competency (N= 80).

	Comprehension	Math Competency	PASS	Reading
Comprehension	1			
Math Competency	0.346	1		
PASS	0.402	0.524	1	
Reading	0.471	0.633	0.55	1

Results in table 1 show, among others, the strong correlation is found between reading and mathematics. Reading comprehension also illustrates a correlation with mathematics. Nonetheless, results show overall PASS processes contribute to mathematics ability in children in fair way.

Table 2: Correlation among Individual PASS Processes, Word Reading, Reading Comprehension and Math Competency (N= 80).

	Pla	Att	Sim	Succ	Reading	Comp	Math
Pla	1						
Att	0.501	1					
Sim	0.513	0.328	1				
Succ	0.381	0.334	0.493	1			
Reading	0.363	0.256	0.43	0.304	1		
Comp	0.269	0.104	0.369	0.349	0.447	1	
Math	0.411	0.308	0.527	0.351	0.66	0.343	1

Results in table 2 show relationships between individual cognitive processes and reading, comprehension, and mathematics ability. Furthermore, the table shows mathematics has a strong correlation between simultaneous processing skills. However, mathematics also has shown association with other cognitive processes.

Poverty Has Not Interfered with the Cognitive Processes

In this brief report, we present the major results. The first objective of data analysis was to examine the relationship between the 4 cognitive processes in PASS and achievement in Reading, Comprehension and Math.

Secondly, in a fine grain analysis that followed, we asked, how does each of the 4 major cognitive processes distinctively predict outcome measures of Reading tests, comprehension tests and tests of math achievement?

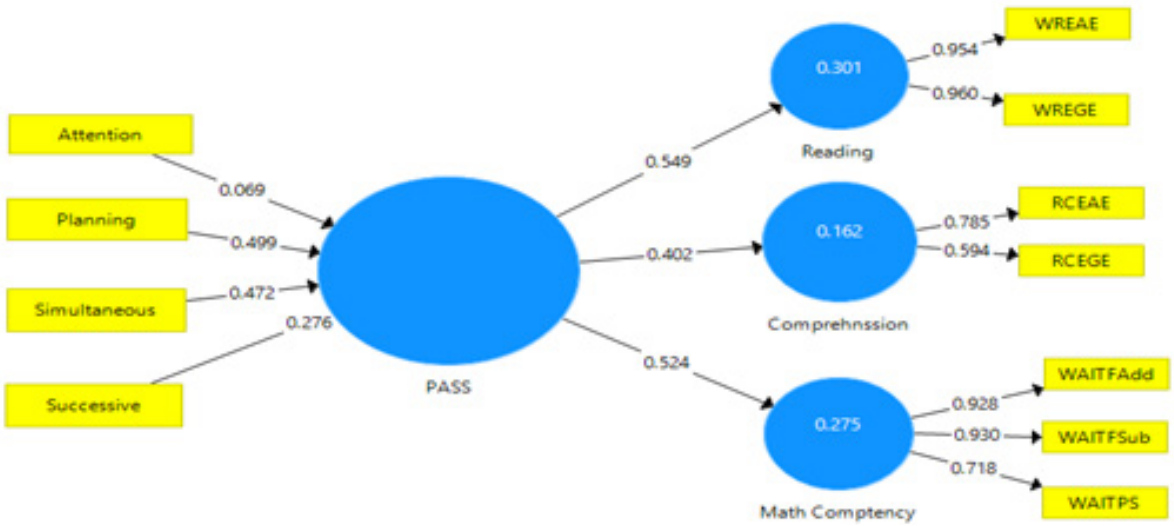

Figure 2: Showing the relationship between PASS processes, reading, comprehension and mathematics competence.

We have used Structural equation modelling to answer each of these questions. In Table 1, correlations among 4 latent variables are presented. PASS represents the subtests of four scales that constitute Planning, Attention, simultaneous and Successive processing. Likewise, reading comprises Test of word reading efficiency (TOWRE) and age equivalent word reading scores as measured by Woodcock Reading Mastery test. Comprehension comprised Woodcock age equivalent and Grade equivalent mastery scores. Math Competence constituted two measures in WIAT (Wechsler Individual Achievement Test), i.e., math fluency (addition and subtraction) and math problem solving.

The results show a strong association among PASS, Reading and Math. The relationship between PASS and Comprehension is relatively less strong. Among the reading and math competence measures, positive association was found to be clearly significant. Comprehension measure was comparatively weaker. We offer some possible explanation for this in Discussion.

Discussion

We had two questions to answer in the present study:

Does PASS theory of cognitive processes provide a useful framework for differential prediction of the three academic subjects? Figure 2 has clearly shown the relationship among the PASS processes along with the Reading *(.54*), Comprehension (*.40*) and Math competency (*.52*). Furthermore, can the cognitive predictors of the three (i.e., reading, comprehension and math achievements) be distinguished by specific patterns of prediction by cognitive tests of PASS? The results provide reasonably good answers for both. In figure 3, it can be noticed that reading and math competency are comparatively stronger variable than reading comprehension, predicted by PASS processes. However, we discuss some research findings in details.

Reading comprehension (.40) was found to be the weakest variable amongst all. The Reading Comprehension measure used from Woodcock Reading Mastery showed extremely low ability. Competence in Reading words fared relatively better. In the sample of children in the school, knowledge of English was severely limited (ELL). By Grade 4 and 5, the participants were still at a lower level of basic reading, and even lower in comprehension. Thus, the relative weakness in comprehension was the result of poor reading level as well as unfamiliarity with the English language. Reading needs to reach a sufficiently high level before we could consider the cognitive processes that may predict competence in comprehension. In spite of this limitation, PASS latent variable, a composite score of all 4 processes, did predict Reading. Mathematics competence level was better than reading and comprehension. Hence the latent variable, PASS had a stronger association with Math. However, Math latent variable included three subtests; only two of these, problem solving and Math fluency, appear to be contributing much more than the other towards the latent variable that represented Math competence. The present paper reports work in progress. It awaits a comprehensive analysis.

Conclusion

In conclusion, the report of the study showed that even in a sample of children of a region that is severely economically restricted, we could observe the same relationship between cognitive process measures on the one hand, and competence in basic academic skills in Reading and Math on the other. Furthermore, PASS processes can differentially predict reading and math in disadvantaged children as in non-disadvantaged children. By extension, similar intervention programs for building the foundations of these core academic subjects can be useful for groups of children who live in a severely disadvantaged socioeconomic environment.

The results showed a strong association among PASS processes and reading ability as well as with math ability. The probability of finding this should be small because we were predicting reading and comprehension in English. Proficiency in both subjects was

low. The children were living in poverty; that could disrupt the expected impact of cognitive factors on reading and math. We wouldn't perhaps make the claim that the PASS processes are one of those cognitive universals that prevail in spite of the socioeconomic conditions of students. Nonetheless, the results are remarkable. Cognitive factors, PASS processes are distal predictors, unlike the proximal determinants such as phonological processes and vocabulary. The study adds to the evidence that distal cognitive factors may still influence reading and math achievement. This is one more reason why we should use programs that strengthen the cognitive foundations of reading and math at an early age to reduce the effect of poverty. It is also apparent from the results that reading and mathematics are significantly related. Then the question arises what could be the reason for the strong association. It is well known, correlation between the two is high in elementary school. The results confirm this even in the case of underprivileged students.

Successive processing skill has been found to be the weakest underlying variable. This finding needs an explanation. Successive processing skill, was a weak predictor because of several reasons. An obvious reason is the lack of exposure to reading materials. Besides, administering successive test was somewhat problematic for the present study. Remember in presenting serial word recall, and sentences orally, there was no uniformity in pronunciation of words among the several examiners. Additionally, one may wonder if all students could understand oral presentation of English words as their familiarity with spoken English was severely limited. The students were also uncertain about their proficiency in expressive speech when oral response was demanded in serial word recall test.

Furthermore, association between PASS and comprehension is found to be relatively weak. We can argue that it requires a basic competency level in reading and comprehension for the impact of cognitive processes to emerge. We can bring the Simple view of reading (SVR) into the picture. Listening comprehension **X** decoding skills = Reading Comprehension. In addition to a good decoding skill and a reasonable level of basic PASS processes, the critical component for development of comprehension for children living in poverty is poor literacy environment. That could be a primary reason why they lag behind in reading comprehension as well as in understanding math problems. Early educational intervention is a compelling need for combating the deleterious effect of poverty.

In the Appendix, we have presented 3 cognitive training programmes derived from PASS that mitigate the adverse effect of poverty by promoting literacy (COGENT), and at a later stage, build the cognitive foundations of Reading (PREP), and Math (Math Modules). At the end, we wish to revisit a broader question related to cross cultural studies that support PASS as a predictor of school achievement. The majority of studies on PASS theory of intelligence have been conducted in North America (see Das, 2018, for a recent review). However, CAS has been adapted and used to predict in many other European and non-European languages. How is that possible? Because, we suggest CAS has two conditions that are conducive to a comparison of mental functions across languages and cultures: (a) it does not have test items that overlap with school-learned content to the same extent as traditional tests of IQ, and (b) it is based on a theoretical model comprising basic cognitive processes.

Supportive evidence has been provided by a meta-analysis of the relation of PASS theory to academic achievement [5]. Data from 62 studies with 93 independent samples revealed a moderate-to-strong relation between PASS processes to reading, r = .409 and mathematics, r = .461. Language in majority of the studies were conducted in English but also in other European languages, and in several non-European languages. Interestingly, their relationship was moderated by the language in which the study was conducted. PASS processes are likely to be universal as they have a basis in the functional organization of the brain. However, at the same time, all intellectual functions have their origin in the cultural environment in which an individual lives [20,21]. Cultural differences would therefore be anticipated in PASS processes.

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APPENDIX

Georgiou, George K; Guo, Kan; Naveenkumar, Nithya; Vieira, Ana; Paula. Alves; Das, J.P. (2020). *PASS theory of intelligence and academic achievement: A meta-analytic review.* Intelligence. 79; 2-19.

Abstract

Although Planning, Attention, Simultaneous and Successive (PASS) processing theory of intelligence has been argued to offer an alternative look at intelligence and PASS processes – operationalized with the Cognitive Assessment System – have been used in several studies, it remains unclear how well the PASS processes relate to academic achievement. Thus, this study aimed to determine their association by conducting a meta-analysis. A random-effects model analysis of data from 62 studies with 93 independent samples revealed a moderate-to-strong relation between PASS processes and reading, r = 0.409, 95% CI = [0.363, 0.454]), and mathematics, r = 0.461, CI = [0.405, 0.517]. Moderator analyses further showed that (1) PASS processes were more strongly related with reading and math in English than in other languages, (2) Simultaneous processing was more strongly related to math accuracy and problem solving than math fluency, (3) Simultaneous processing was more strongly related to problem solving than Attention, and (4) Planning was more strongly related to math fluency than Simultaneous processing. Age, grade level, and sample characteristics did not influence the size of the correlations. Taken together, these findings suggest that PASS cognitive processes are significant correlates of academic achievement, but their relation may be affected by the language in which the study is conducted and the type of mathematics outcome. They further support the use of intervention programs that stem from PASS theory for the enhancement of reading and mathematics skills.

PASS Intervention Programs: Reading and Math

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J.P.Das Learning Clinic, Bhubaneswar, India. Contact Swagatika Samantaray (swagpsy@gmail.com)

PASS theory has enabled the construction of intervention programs that ameliorate cognitive difficulties related to learning. The following are the details of the programs.

1 - PREP (Pass Reading Enhancement Program) –

What is PREP?

PREP is a remedial program for primary school-aged children who are experiencing difficulty with reading, spelling and comprehension. It is based on widely accepted theories of child development and cognitive development.

PREP is a remedial reading program. It is therefore imperative that children begin the program at their own reading level irrespective of their current age or grade. PREP is a reading enhancement program that aims at improving the information processing strategies that underlie reading, while at the same time avoiding the direct teaching of word reading skills.

Why is it called PREP?

PREP stands for PASS Reading Enhancement Program. It is based on the PASS theory of Intelligence (Planning, Attention, Simultaneous and Successive Processing), and should be understood within the framework provided by PASS theory. What does PREP do? The PREP program improves the information-processing strategies that underlie reading, while avoiding the direct teaching of word-reading skills. This method is founded on the premise that it is easier for children to learn these strategies by inductive rather than deductive means (Carlson & Das, 1996). Accordingly, the program is structured so that tacitly acquired strategies are likely to be used by the children in appropriate ways. Attention and planning are important aspects of tasks given in the program. Specifically, attention is required to perform each task, and planning skills are developed by encouraging the children to discuss their strategies and solutions both during and following each task.

PREP has two different parts having several modules. The first part contains different tasks facilitating Successive Processing Skill and the second part contains tasks facilitating Simultaneous Processing Skill. Every module has dimensions; global and bridging. Global part enables concepts and principles and bridging part emphasizes generalisation and application. Thus, children learn concepts and principles and then learn how to apply those principles in other contexts.

In summary, for building the cognitive foundations of reading and comprehension, specifically focused on simultaneous and successive processing: PREP (PASS Reading Enhancement Program). The program consists of successive and simultaneous processing modules, which develop reading strategies such as rehearsal, categorization, monitoring of performance, prediction, revision of prediction, sounding, and sound blending.

2 - COGENT (Cognitive Enhancement Program)

Cognition simply translated refers to knowledge, to knowing. Cognition develops as children develop, starting from infancy and continuing throughout their developmental period, usually until 16 to 18 years. Development is an active period for learning. One of the unique kinds of learning in human beings is the acquisition of language so that language can be used as a tool. Language in the forms of speaking, reading and writing are the major tools children need throughout their developmental period. Of these three, reading and writing have to be taught, whereas speech occurs naturally. But does all of it? The content or meaning of children's speech can be a different matter altogether from their ability to speak properly. The development of meaning and eloquence depend on children's family and the community in which they find themselves. The active involvement of both is necessary - it takes a whole village to bring up a child.

Grammar and pronunciation, fluency and the ability to segment a stream of speech, improve rapidly during preschool years and the cultural environment holds the key for learning to read when children enter school. Is it possible to accelerate these components of speech and consequently children's ability to think and understand? Is this possible for those who might have missed the 4 cultural advantage that promote speech and language? The answer is yes, and the entire program that follows, namely COGENT, provides a series of select procedures to accomplish this goal.

Who wants cognitive and language enhancement?

Kindergarten teachers and anxious parents express a need for program that has a solid foundation in research and common-sense experience. Particularly for those who suspect that their children may be at risk of falling behind in language development. Other children may be at risk because they are slow learners due to a variety of predisposing conditions including medical, sensory and physical handicaps, psychological conditions including attentional deficit, emotional trauma, and dyslexia, and as mentioned above, cultural disadvantage.

The COGENT Program is designed for the enhancement of cognition, especially linked to literacy and school learning. The objective of the program is to supplement children's literacy skills that could be acquired spontaneously at home, school, and the community.

COGENT is designed Kindergarten aged children. However, it would also benefit older children with special needs. These include children with limited exposure to literacy, mild developmental delay, and those at risk for developing dyslexia and reading difficulties. Teachers, Teacher's Aides under the supervision of teachers, and parents or guardians who have some background in psychology or education.

COGENT is not a set of drills/exercises. It provides a supplementary route toward the development of reading and associated academic skills through the development of cognitive processes inasmuch as these skills are assumed to be a part of general cognitive development.

Special Features of the program are, some parts of the program are specific to English phonology and orthography; these however can be easily adapted to other languages. The program allows room for improvisation by teachers and many activities to which students can contribute. An important caution, however, is that the theories and logic provided in the background for each task should be followed.

In summary, for facilitating literacy acquisition, a prerequisite for school readiness: COGENT (Cognition Enhancement Training). The program consists of modules that train attention and orienting to instruction, metalinguistic concepts, phonemic discrimination, syntax, semantics, inhibition, and automaticity in recognizing shapes, colours, and letters.

3 - MATH MODULES

Focusing on math education in primary school is essential for building a strong educational foundation, developing critical life skills, and preparing students for future academic and career success. Providing a strong math education in primary school can help close achievement gaps and provide all students, regardless of background, with equal opportunities to succeed academically and professionally. By mid-elementary school, some children have completely lost interest in learning math. Although there are multiple causes for disinterest and frustration, the most obvious is that students experience great difficulties in learning the mathematical concepts. Two conditions affect their inability to learn: failure of instruction in school and children's specific cognitive deficiencies. The good news is that scientific research has introduced various rules and tools to help. This manual applies some of those rules and tools as it seeks to strengthen children's foundations of mathematical concepts. Furthermore, it proposes remedial methods guided by research.

Modules for Math targets basic math skills and includes training programs that are expected to improve them. The conceptual framework of this manual is not the only one that may be valid; consider it as a reasonable approach that gives a rational base for remedial programs. Mathematics and science have come to have an undeniable importance in today's society. It will be a great pity if a significant number of children fail to develop an interest and ability due to early experiences of failure. Often, these types of experiences lead to anxiety,

fear of punishment and poor self confidence in mathematics. Current reputable books on math learning include The Mathematical Brain (Butterworth), Number Sense (Dehane), and insightful studies on how children do mathematics (Nunes & Bryant). There is a paradigm shift in regarding 'intelligence' and 'ability' as malleable rather than stable traits throughout an individual's life. A child's first attempt on an intelligence or standardized test is not a 'true' measure of his or her potential. As advocated by Vygotsky, the modules in this program allow ample opportunity for discovery, creativity and learning in collaboration with others.

In summary, for learning mathematics, Modules for Math focuses on foundational mathematical concepts, comprising size and value, number lines, numerosity, accurate and approximate number systems, and working memory. PASS processes of planning/executive functions, simultaneous processing and pattern recognition are explicitly used in specific modules (Das, 2009; Das & Misra, 2015). Recent reviews of the efficacy of the programs are published in Das and Misra (2015). Math Module & efficacy of training reported in a recent study (Das, 2024).