

Title: Explanation of Learning Disorder from Cognitive Perspective

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Abstract: Recognition of problem areas increases due to social awareness. Among them learning disorder is growing concern. Learning Disorder generally considers children or adolescent with under achievement in academic field. Poor intellectual capacity or health related issues are not the sole cause of this academic under achievement. Different researchers from the biological or social perspectives trying to explain causes of learning disorder in their own way but those explanations are not enough. Over all difficulty arise due to nature of the disorder itself. Actually learning disorder is a group of disorders with several dimensional differences like verbal, visual, abstract, symbolic etc. In this analysis we are trying to make an explanation of learning disorder from cognitive perspective. We consider traditional cognitive model of reading with other several models in this regard and make significant contribution to explain learning disorder. Another approach which is viewed as learning disorder is not typically related with children and adolescents rather acquired at any stage of life due to psychosocial or physiological causes. This will also be discussed in brief in the presentation.

Index Term: cognition, learning disorder, dyslexia

Introduction

Reading disorder is commonly known as reading disability, learning disability, alexia, and developmental word blindness. Among them Alexia was accepted and defined as a developmental deficit in the recognition of printed symbols.

The term was simplified by adopting the term dyslexia in 1960s. Dyslexia was used extensively for many years to describe a reading disability syndrome.

Reading disorder, commonly known as Dyslexia, related with a variety of difficulties related in reading and comprehension. People who suffer with dyslexia have face difficulties in reading, pronunciation, follow instruction. Proper expression of their inner thought of mind is suffered due to poor presentation in various modes such as written, verbal etc. Cognitive aspect of semantic understanding of the meaning of the word, recognition of regular with irregular word, word and non-word and new word are seriously face difficulty in those patients who suffered with dyslexia. It is quite difficult to find out causes of dyslexia because in all the cases how information becomes distorted during information is processing yet not been cleared. In this paper we try to explain causes of dyslexia by using information processing approach and try to provide a uniform model for dyslexia irrespective of sense modalities.

Understanding of cognitive process of human behaviour by using computer analogy is essentially utilized by the cognitive scientists. The information processing in the computer is simply divided in to three well known processes like *input or data entry*, *storage* of information in memory device and *output* of information when it required by the user. Using this simple input, storage and output device can be utilized in the information processing of human behaviour. For human being the information comes from environment in terms of physical stimulus. The physical properties are like intensity, brightness, frequency etc. But the physical properties of information cannot be recognized until it transfers as nerve impulse for neural activation. This transduction of physical properties of information into nerve impulse is called as sensation. This transformation of physical stimuli (like light, sound etc.) into nerve impulses is processed in receptor cell organ. In human among five sense organ vision is most important (eye for vision, ear for audition, nose for olfactory, tongue for taste and skin for tactual). The nerve impulse from the receptor cell then goes to the brain for further processing. Storage of new information is done in the brain and that information may utilize or modified according to the demands of the environment.

Research in learning disorder basically focused on visual mode of information processing. The most popular disorder known as dyslexia was predominating with review of visual processing of words or letters. But from the review it was found dyslexia is common in visually challenged people. (Veispaka A., Boetsb B., Männamaac M., & GhesquièreaP.P, 2012)¹. Unlike any vision related problems, dyslexia is a disorder in cognitive level, rather a disorder of vision. Here we consider information processing in dyslexia is not limited in visual transformation of information. The significant role of phonological components needs to be identified. Another attempt has to be made in nature of information processing. In which level the information is traveled to further processing need to be clarified. For hypothetical understanding we assume that peripheral dyslexia suffered in encoding level where as central dyslexia suffered in storage and decoding level. We limited our explanation on dyslexia. But some time attempt to explain any relevant phenomenon in writing expression on the basis of our findings.

¹AnneliVeispaka,BartBoetsb, MairiMännamaac, &Pol GhesquièreaProbing (2012). Perceptual and cognitive underpinnings of braille reading retrieve from <http://www.ifla.org/files/assets/libraries-for-print-disabilities/conferences-seminars/2012-08-tallinn/2012-08-09-veispak.pdf>

Learning disorder is not a problem of due to intellectual deficiency². Intelligent Quotient is indicator of intellectual deficiency. In maximum standardized intelligence test, intelligence is asses by two substests, one is verbal and another is nonverbal. It is due to difficulties in verbal comprehension and reading, patients with leading disorder remarkable shows poor score in IQ assessment. Intellectual capacity may be indicator of cognitive ability, but it is not sole factor which govern our cognitive ability, like reasoning, memory, attention, language and many other types of cognitive ability is important to get a total profile of learning disorder. Mental imaging studies also supported that learning disorder may be independent of intelligence.³

Thus, from the above discussion two things are clear; one, dyslexia is not disorder due to visual problem, second, Dyslexia is not caused by Intellectual deficiency, rather measurement of dyslexia is influenced by poor verbal comprehension, behaviour scientists needs to focused on measuring intellectual capacity in an alternative way like assuring 'prefer mode of response' of the performer.

Our discussion will focused on how information processing may helpful to understand the causes of dyslexia irrespective of any biological approach. Here we discuss it in details;

Information processing is started with input or encoding system. The encoding system is governed by nature of stimuli which is to be response and process. For different modalities there are different types of receptor organs. Dyslexia in maximum cases related with problem of vision, thus maximum cases it is describe with individual with normal vision.

Dyslexia has two types, developmental or acquired. Developmental dyslexia is described as a specific impairment in reading abilities, unexplainable by any kind of deficits in general intelligence, learning opportunity, general motivation or sensory acuity.⁴ Whereas acquired dyslexia is describe as is a disorder in reading that occurs in adults who once knew how to read well, usually due to damage to the nervous system, they suffered with dyslexia.⁵ Among them acquired dyslexia is more important, it may be started at any stage of life, irrespective the knowledge gather by the person the difficulties in reading or other learning related issues may be arise. Here now we describe few analogy of reading disorder with computer information processing system and biological structure of information processing. In encoding section information is process in receptor cell; this is possible due to activities of peripheral nervous system. The next most important storage process comes from brain or central nervous system itself. Decoding of information is possible through activation of Central Nervous System and Motor neuron itself. Here according to level of information processing acquired dyslexia classified into two distinct categories, peripheral and central dyslexia.

Peripheral dyslexia; suggesting information distorted from periphery level of processing. Take following example under consideration; in case of negative dyslexia, failure in attend to the first part of the letter in a string. Its either in omission form like cage become "age" by subtracting letter 'C' ,or in substitution of letters like yellow become "pillow" by substituting 'ye' as 'pi'. Here we describe this faults are not due to any biological causes. Attentional shift from one letter to another letter due to rapid eye movement may be possible cause of it. Association of words which are not mentioned but stored in memory may cause substitution of letters. Hence, scientific experiment on this argument is not yet mentioned.

Another peripheral problem which is found in case of Letter by Letter dyslexia is that the learner learns the word in a slow rate. The actual time to read the word took longer and unnecessary with pause. Like the word CASTEL become C A S T E L. We describe it may due to low level of Memory Span or Working Memory capacity. The person suffer with this letter to letter dyslexia might have lower working memory capacity and recognize only limited letter in one moment than other. ⁶ In a study conducted by Brooks A.D. (2011) found that dyslexic children have difficulty in reversing previous word, it is possible that when a simple word is read by the student, he has to read the first letter, then second and again back to the first and second and make an association between them and follow the nest. In that case reversing the backward to forming a letter string is might be difficult to them, as a result total time for associating a word increased. This interpretation also applicable in case of the length of the lesson cases also.

Attentional deficit is long been described as the cause of dyslexia, like ⁷ Raynerad K. et al. (1988) found that attentional deficits (difficulty reading words presented in text. Like reading POT BIG HUT as "but, big hut") as a probable cause of dyslexia. In their study limited

²By Shari Roan, Los Angeles Time

<http://articles.latimes.com/2011/nov/03> 04.07.2013

³ Emily Finn, MIT News Office

<http://web.mit.edu/newsoffice/2011/dyslexia-iq-0923.html> 04.07.2013

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Habib, M. (2000). The neurological basis of developmental dyslexia An overview and working hypothesis. *Brain*, 123(12), 2373-2399

⁵Rosenhan, D. L., & Seligman, M.E.P. (1989). *Abnormal Psychology*. New York: W. W. Norton and Company.

⁶Brooks AD, Berninger VW, Abbott RD.(2011) . Letter naming and letter writing reversals in children with dyslexia: momentary inefficiency in the phonological and orthographic loops of working memory. *Dev Neuropsychol*;36(7):847-68. doi: 10.1080/87565641.2011.606401.

⁷Keith Raynerad, Lora A. Murphy, John M. Henderson & Alexander Pollatsek (1989) Selective attentional dyslexia *Cognitive Neuropsychology*

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information does not interfere in reading, but leading is affected by vast amount of information. Deficits in visual attentional also describe as probable cause of limited word span.⁸

Thus from the analysis of the peripheral dyslexia it may be said that, deficit in attentional system either selective or visual, effect on word processing and cause distortion on information follow to the brain. Low span of working memory also provide sufficient information in peripheral dyslexia. Further well approved design will help full of understanding of dyslexia in peripheral level.

Central dyslexia (difficulty in reading irregular word) is more critical and mysterious type of learning disorder, suggested difficulties in both spoken and written words. Finding are associated with difficulties in Phonemic orthography.⁹ Phonemic orthography is system of English writing in which written symbol is corresponding to the spoken sound of language. Essentially the written symbol is in visual form. Let's discuss with the help of traditional model of reading.

Traditional model of reading composed with three alternative processes. Those three processes start with written words and goes down accordingly nature of processing. The printed word goes to the visual lexicon (These are where whole known word forms are stored), and then move to the visual input lexicon, from visual input goes down speech output lexicon. The semantic analysis of information is done in this step and information further processes in to the next step. According to this model, this follow of information is only possible if the information comes visually. The semantic system is shown surrounded by lexicons, one for each of the processing routes.¹⁰ This model is not empirically supported but has great influence on interpreting behavioral difficulties specially related with language

Recently it was found that not in phonological level rather patients with surface dyslexia suffer problem of visuo-spatial attention.¹¹ Another study significantly relates eye moment as the probable cause of acquired central dyslexia.¹² Both of these two incidents are significantly highlighted that visual processing of information is affected in central dyslexia. This distortion is primarily associated during input or encoding of information. But our question is that, if problem arises in reading during encoding level, how changes occur in the word structure of the encoded information during output/decoding? (For example, reading gauge as "gorge" /write come as kome). A part form visual encoding and decoding, in central dyslexia difficulties are found both in visual form and in written expression. Thus, there is possible interplay of phonological alternative pathways of information flow apart from visual encoding. This question is arising from comparing the dyslexic printed reader performance with braille readers. Both of the readers have shown same level of performance in phonological awareness task. They are also shown equal capacity in verbal short term memory. Although the study was conducted to show any developmental pattern in dyslexic patients, but here we found that, if other things are being equal, no mark difference is found in blind and sighted dyslexic in phoneme level.¹³ Thus phonological path way may be alternative in dyslexia and problem arises due to poor collaboration between phonological output and visual input. It is then important to justify in which level the difficulties are arise in dyslexic patients. There is evidence that sighted people have used both visual and phonological alternatives. The style of reading in braille techniques is sequential. It is called sequential because information is processed in one by one mode. Then this unit wise information organized with the help of phonological pathway. Information from the phonological goes for semantic analysis. Whereas, sighted individual uses both semantic and phonological pathways in alternative way. Comparing with blind people, sighted individual took less time in recognition of new words and various word structures cover much more length of the lesson.¹⁴

⁸ Developmental dyslexia: The visual attention span deficit hypothesis Marie-Line Bosse, Marie Josèphe Tainturier, Sylviane Valdois Cognition 104 (2007) 198–230

⁹ Anne Castles (1996) Cognitive Correlates of Developmental Surface Dyslexia: A Single Case Study, Cognitive Neuropsychology, 13:1, 25-50, DOI: 10.1080/026432996382051

¹⁰ <http://www.smithsrisca.co.uk/how-to-draw-cog-diagrams.html>

¹¹ Trichur R. Vidyasagar & Kristen Pammer, (2010). Dyslexia: a deficit in visuo-spatial attention, not in phonological processing. Trends in Cognitive Sciences Volume 14, Issue 2, Pages 57–63. retrieve from, <http://dx.doi.org/10.1016/j.tics.2009.12.003>, How to Cite or Link Using DOI

¹² Schattka KI, Radach R, Huber W. 2010. Eye movement correlates of acquired central dyslexia. *Neuropsychologia*. 48(10):2959-73. ; doi: 10.1016/j.neuropsychologia.2010.06.005. Epub 2010 Jun 12

¹³ Anneli Veispaka, Bart Boets, Mairi Männamaa, & Pol Ghesquière (2012). The perceptual and cognitive underpinnings of braille reading. An Estonian population study. *Research in developmental disabilities*. Volume 33(5) p 1366–1379

¹⁴ Anneli Veispaka, Bart Boets, Mairi Männamaa, & Pol Ghesquière (2012). Perceptual and cognitive underpinnings of braille reading retrieve from

<http://www.ifla.org/files/assets/libraries-for-print-disabilities/conferences-seminars/2012-08-tallinn/2012-08-09-veispak.pdf>

Another study conform that phonological pathway itself sufficiently consider for dyslexic problem. For example in study patients with damage perisylvian cortical regions have difficulties in information processing at phonological level. The patients also have behavioral problems like dyslexia and dysgraphia.¹⁵ Thus, printed media is not the sole factor for information processing in traditional model of reading.

A thus not only visual pathway, central dyslexia is a result poor coordination in both in visual and phonological pathways. From the discussion of the causes of dyslexia from cognitive perspective, now three things are more common, i) cognitive flow of information required both visual and phonological pathways, as it related with either reading of words or writing of information. ii) Well coordination of different pathways is essential and iii) information must be transformed for further semantic analysis.

Unlike any other subtypes of dyslexia, deep dyslexia is directly related with the semantic understanding and processing of meaning of the information. The patients suffering with deep dyslexia also have done mistake by altering meaning of the word. (For example, cost becomes replied as “money”). The main attempt of behavioral scientist is to justify how meaning of a word delivered by the patients in wrong way. The problem with semantic error in deep dyslexia is not clearly explained although few attempts have been taken. The first attempt tried to explain by using reading models, according to Patterson (1980) patients with deep dyslexia does not differentiate abstract words and between their close synonyms. Such as solder replace with army man which may be closing synonymous but not the true replacement of it.

Another attempt has been made from biological perspective. It describe that patients with deep dyslexia read with right hemisphere but three consequence steps for reading like orthographic processing, then semantic processing, then phonological processing was conducted in left hemisphere. The right hemisphere mechanism is required if read aloud. But experimental finding in this regard is not sufficient and criticize in most cases.¹⁶

Our attempt in this respect was derived from tradition model based works followed by Patterson and others. The biological assumption in deep dyslexia was not giving the total explanation in this regard.

Different Linguistics and Psychologists attempts to explain the phenomenon of language by describing pathways, how information been transmitted, and a visual information become converted in to phoneme or written language. In the traditional model of reading the simple path ways are stated with orthographic transmission to transmission of phoneme. This transmission describe as the core area for phonological deep dyslexia.¹⁷ In a study conducted by Jenni Crisp, David Howard, and Matthew A. Lambon Ralph. (2011), patients engaged with spoken to written nonwords matching, a novel word matching and pseudo homophone reading. Study indicates that two factors are responsible in dyslexia continuum, how much the phonological impairment was occurred and level of interaction between the phonological presentations with semantic understanding. In maximum cases dyslexia was explain with this kind of poor performances due to phonological processing problem with semantic understanding and finally subjects response by replacing words with merely similar words which by meaning differ from original.

Here we assume that the change in the meaning of the words is not due to problem in the follow of information from orthographical level to photographical level, rather due to poor conceptualization of objects. We also assume that this poor conceptualization is caused by the poor level of categorization of the objects; actually they categorize maximum objects on the basis of their own understanding by refusing marked conceptual differences among them.

The traditional (some time refers as classical) model of reading processing composite of three routes from written to sound processing;

- a. From whole word orthography to semantics and then to whole word output to phonology.
- b. From whole word orthography directly to whole word output phonology.
- c. From sub lexical orthography units to sub lexical phonology.

Researchers argued that, there must be some medium of recognition of printed words by assembling a pronunciation of a letter string via spelling and sound.

The assembling of pronunciation depends on the predictable relation between the spelling and (orthography) and phonology (sound). But this application does not follow all the printed words in dictionary. This is because the pronunciation does not follow its phonology. For example, in English the concept of regular words (Like Man, cat etc) and irregular words (like flood, yacht etc.) was describe is the pronunciation follow according to the spelling or not. Thus reading and writing must involve both phonological mediated sub words translation process (to deal with new words) and a whole word recognition and production process (to deal with regular spelling).

Let's discuss few problems with the patients of deep dyslexia,

Usually patients with deep dyslexia read a word by producing a semantically related response to the target (for example, table is read as chair). Thus, their first problem is related with semantic response of a target word. This problem found maximum when they asked to response on abstract concept rather than concrete one.

¹⁵ Steven Z. Rapcsak, Pélégie M. Beesonb, Maya L. Henry, Anne Leyden, Esther Kim, Kindle Rising, Sarah Andersenb, and HyeSuk Cho(2008). Phonological dyslexia and dysgraphia: Cognitive mechanisms and neural substrates. *Cortex*. Volume 45, Issue 5, Pages 575–591.

¹⁶ David Caplan(1994). *LANGUAGE structure, Processing and Disorders*, TheMit Press ,Cambridge, Massachusetter, London,England pp176-187

¹⁷ Jenni Crisp, David Howard, and Matthew A. Lambon Ralph. (2011). More evidence for a continuum between phonological and deep dyslexia: Novel data from three measures of direct orthography-to-phonology translation. *APHASIOLOGY*, 25 (5), 615–641

Another problem is related with numerous error in reading grammatical functional words, (if, and, when, for) which are either omitted or substituted by another word from the same types of vocabulary.

Addition or omission of substitution of affix (prefix/infix/ suffix) which is valid according to the word but no correct because it is not presented in the target word (like walking read as walked or helpless read as helplessly).

Marked error in reading to some extents looks like visual error is also common, like, 'tantrum' for tandem or monument for moment.

The possible attempt for cognitive perspective explain deep dyslexia in their own way, among them one explanation consider the semantic pathway is the only mean of responding to the patients of deep dyslexia cause the sub word pathways and non-semantic pathways are not effective for them. (Morton and Patterson, 1980)¹⁸

The target word may not be accordingly pronounced by the performer as a result the the near meaning of the word as alternative. (Marshall and Newcombe,1973)¹⁹. For example the word *gift* becomes transfer as *presentation*.

Apart from the few of cognitive perspective by using simple classical or traditional models of reading, our assumption regarding the cause of deep dyslexia is different. We explain deep dyslexics are unable to form a proper concept either in objective form or in grammatical form. The lack of this concept formation caused because deep dyslexic might have problem in categorization of concepts. We assume deep dyslexics incorporated huge number of *non-necessary* features of objects under same dimension. In the following paragraph we will explain it.

Typical representation of the category is viewed by the normal readers. The chair might not be good exemplar of table. The target word is viewed as similar (as both are furniture) with the concept by viewer but it is actually not. The reader actually used single sets of positive instances to fit the premise, and makes error. The chair and table are functionally differ but viewed as similar many instances due to the are in common category as furniture, but precisely different in concept.

But in making precision, additional information may be incorporated by the viewer. Like, the feature made of wood does not indicates all the table and chairs because this attribute may not be referred table or chair made by steel. Like common attribute flies may not represents all the birds, even fly is the feature of Jet plain or airplane. So, those non-necessary features may helpful in precision of categorization.

Here, we assume in deep dyslexia the patients may gather non-necessary items to making concepts of common objects and judge accordingly. This non-necessary items or feature actually additional information for making precision of objects among them. As because they cannot differentiate the precise information in their target word and judge accordingly with larger number of precise properties which the perceived as common one. For example the dyslexic *cost* (*specific*) become *money* (general) or favor become taste.

Thus, from the paper it is viewed reading disorder basically describe by the cognitive psychologists by using classical model of reading, which may not be explain exceptional case like braille reading. Other necessary cognitive function may associate with reading disorder. In review it is found that peripheral dyslexia is much more dependent on attentional and short term memory process where as central dyslexia related with memory and concept formation. Deep dyslexia is viewed as problem of categorization to make detailing of the objects.

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