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Dyslexia and brain scans

Abstract. This is a critical examination of the theoretical foundation of brain scan experiments conducted by Dr. Posner on phonological dyslexics as stated in his book *Images of Mind*. The design did not control crucial variables such as emotional blocking or phonic choice. The experiments point to orthographic rather than phonological dyslexia.

Brain scan technology has made an impact on educational theory. This can be seen in brain scans designed by specialists such as Dr. Posner on patients who are apparently impaired:

> *Patients with phonological dyslexia,…appear to have lost the ability to sound out words based on the rules of the language. These patients may be able to read even highly irregular words like "pint" correctly, but have real difficulty pronouncing nonsense strings like "caik" even when they could correctly pronounce the corresponding word "cake." Patients with phonological dyslexia have relatively intact connections between the visual and semantic systems, but not between the visual and pronunciation systems.* (Posner, 1999)

This experiment deserves careful study because society has uncritically taken this technology at face value. The hypothesis is that phonological dyslexia is caused by dysfunctional neurological components. A structural analysis of the experimental design reveals the following elements: the digraph *ai*, when applied to the model (C)+VV+C, results in failure to recognize and articulate [ā] due to neurological problems. On the other hand, the *in* digraph when applied to the same model is recognized even though it is considered "irregular" by the designers. The global

formula for long vowel articulation, C+V+C+e, when *a* is inserted is recognized as [ā]. The components are as follows:

Model	Successful	Unsuccessful
C+VV+C	C+in+C	C+ai+C
C+V+C+e	C+a+C+e	

Shifting

Dr. Posner finds that the unsuccessful C+ai+C articulation is indicative of a neurological defect. However, the digraph *ai* is also found in examples such as *bait*, *air, certain, aisle*, and *said* where the productions *shifts* from [ā] to [â] to [ŭ] to [ī] to [ĕ] not to mention regional variants. While the C+V+C+e model has minor shifts, C+ai+C shifts in the position of the tongue are major:

(i) mid front spread (*bait*)

(ii) low front (*air*)

(iii) lower central spread (*certain*)

(iv) low rear (*aisle*)

The shifts in decoding or encoding are accomplished by indexing associated *ai* neurological instructions. The only other explanation would be *a priori* neurological components, and the necessity of education becomes one of a Platonic reminder. Because the C+VV+C is not recognized as a global formula such as C+V+C+e for the successful production of long vowels by the patients, how can these structures be said to "correspond?" Why is [ā] the "correct" selection for the *ai* digraph, and does environmental conditioning determine neurological connectivity as in this case of the *ai* nexus?

Environmental Variables

Perhaps, the patient's brain scan shows that he is just stuck in a phonic choice, a phonic loop. Perhaps, an associated negative self-image is blocking the operation; inhibitions seen in analogs such as phobias have powerful, uncontrollable, inhibiting effects. Perhaps, the "patient" agrees with the designers that this is *nonsense* and just stopped cooperating. Perhaps, she just missed the particular lesson of *abstracting meaningless sounds and applying them to nonsensical graphemes*. The experimental design assumes the existence of an established, strong connection between the [ā] and *ai* in the "patient's" schemata including established class comparisons, and that this schema has been relevant and coherent. According to Vygotsky:

> *A sign is always originally a means used for social purposes, a means of influencing others, and only later becomes a means of influencing oneself…the function is its social function; and if we want to trace how it functions in the behavior of an individual, we must consider how it is used to function in social behavior.* (Wertsch, 1985)

Building upon Vygotsky's viewpoint, orthography is a tool of written communication where a finite number of signs are continually recombined into symbols by following artificial rules of formulation. It is a set of abstract tools for written communication. The *caik* sign is not a useful tool of communication, but a capricious application of an orthographic rule. These signs can be reduced to sets of associated neural instructions for decoding or encoding the encryptions. Core orthography is a way to quickly communicate by transformational generative rules, rules that process visual, tactile and phonic signals directly into neural signals that trigger physiological and cognitive responses.

Metacode

Brains are pattern detectors because they are pattern generators. We generate our codes around direct isomorphic neurological correspondences or indirect social conventions that are somehow reduced to associated neurological instructions. Phatic codes are not directly reducible to transformational generative phonological rules due to historical accident or design in their orthographic architecture. English orthographic metacodes are assemblages having subsets of associated instructions as to the target audience, cultural status, contexts, education and other social registrars. Institutions requiring these forms construct their rules of communication around these metacodes and their associated semantic codes. These symbols are rarely constructed around direct neural signals, but reference etymological metacodes for a semantic value. The following metacodes have a one-to-many correspondence:

opisthognathous

(1) target=medical culture

(2) source code=Greek

(3) metacode=English orthographeme

(a) associated syntactic instructions:

(b) associated semantic instructions:

(c) associated neurological instructions:

rhyme

(1) target=poetry

(2) source code=Greek

(3) source code=Latin

(4) source code=French

(5) metacode=English orthographeme

(a) associated syntactic instructions

(b) associated semantic instruction:

Nevertheless, metacodes built upon social patterns must contain some neurological directions in order to decode them spontaneously. The amount of neural directions cannot be so reduced as to become undecipherable. The metacode *colonel* cannot be initially decoded without context, negative conditioning, or positive conditioning in the form of hyper mnemonics. Metacodes require large investments in didactics and the development of metacognitve and metamneumonic strategies when under the aegis of positive reinforcement. The neurological instructions in (c)

are not first order because they must be decoded from subsets of instructions acquired elsewhere. The instructions to decode the symbol in the initial experience are derived from paradigmatic sets of associated instructions and can be "wrong." This is especially true in children; children are always in the process of developing their communicative toolkits, and depending on the quality of their education, health, and so on, some can be relatively impressive or sadly lacking. Examples of direct generative orthography can be seen in children's uninhibited on-line conversations. Again, if a phonic choice underlies the application to arrive at the "right" pattern, why is this pattern the "correct" choice as perceived by the designers? I find no compelling need to communicate in such a manner, nor can I recall such a lesson in early learning settings:

Example A

Meye ryd in a cayk with eighd of eighry eighggs that ye broak on the chear.

(eye) (hay) (neighbor) (bear)

My ride in a cake with aid of airy eggs that I broke on the chair.

Dr. Posner's experiment illustrates orthographic rather than phonological dyslexia. Illustration (A) extends the application to show its lack of relevance. It is clearly outside the need for authentic communication. This issue becomes compelling when institutions refer to brain scan technology such as Dr. Posner's to make their ethical case that one brain is structurally different from another "normal" brain without controlling all variables. Are the dyslexic brain images the cause or the effect of academic treatment of the child? Are they pictures of associated low self-esteem locking up their performance? These variables must be eliminated to validate their case. Questions about these variables have been around since the 1930's:

> *If maldevelopment* (brain lesion dyslexia) *is the causal factor, then the disability for understanding certain kinds of printed or written symbols should be no greater than for other kinds. Specific disabilities of this kind are encountered, and*

> *since most of these congenital cases can be taught to read, we must view with a certain amount of skepticism the maldevelopment theory. How many of these cases are due to emotional blocking, improper motivation, inadequate techniques in instruction, and suggestion is difficult to estimate...Fernald attributes many of the cases of word blindness to the techniques used in the educational system in teaching reading...These methods, although they have been used successfully with the majority of children, make it impossible for certain children to learn because they interfere with the functioning of certain abilities which these children possess. ...If the case is one in which emotional maladjustment towards the reading problem has arisen because of some other failure in adjustment, improvement in reading ability will take place with better social adjustment.*
> (Dorcus, 1939)

Neural Signals

Encoding and decoding activities are functions of communication. Orthographic choices inhibit and delay transformational generative phonology by obstructing successful decoding and encoding operations. A graphic sign is a set of associated neurological instructions detailing a process of sensory identification, replication and relationship with other factors; for example, the phoneme [b] or grapheme *b* has the following instructions: *glottal labial stop, +voiced*, or each phonic or graphic sign corresponds to a series of cerebrally directed pathways resulting in a graphic or phonic production representing the associated neurological process and rules for its successful repetition, e.g., the phoneme [b] is a set of associated neurological instructions triggering its identification, context, integration, and organic reproduction by directed coordinated fingers, toes, etc. Each person may or may not have the necessary set of associated

instructions to communicate successfully with others because of variables such as quality instruction or emotional blocking and isomorphic inconsistency in which the signs composing the metacode:

(1) point to conflicting, valid, multiple, offsetting choices of neurological instructions (*sew, brew*); (*heart, heard*); (*toes, shoe, poem*) as illustrated in the ai experiment;

(2) or *must* not be represented while their processes *must* be added to be successful (*colonel, soldier*), and in this case, the instructions *must* be supplied by associated memories to be successful;

(3) where the sign *must* be present, but part of the articulation process suppressed (*solder, lamb*) which is the reverse of (3) with the extra step that select signs are added but their instructions suppressed in order to be successful.

False, absent, and misrepresented neurological instructions and arbitrary assemblages are unhealthy for developing brains because they impede successful communications and are targets of corrective behavior often leading to disengagement or public humiliation when persisting reinforcing the impediment. These negatively reinforced conventions become another subset of associated neurological directions:

(i) do not proceed unless certain,

(ii) to proceed with uncertainty could change the environment,

(iii) the environment will probably become negative unless certain

(iv) wait until certainty,

(v) etc.

Uninhibited certainty is the experience of neurological connectivity consistently resulting in a positively altered environment confirming the behavior and reinforcing associated neural connections.

Halfway Dyslexics

The control or removal of confusing signals must be present to validate Dr. Posner's assumptions. Dr. Posner's confirmation that the structures C+a+V+e and C+in+C were successfully processed is significant and cannot be ignored. The patients cannot be halfway dyslexics unless there are functioning C+V+C+e and C+VV+C, but not C+ai+C pathways. The dichotomy must be explained or the hypothesis revised.

Reversals

Outside of Dr. Posner's study, the presence of reversing can be viewed as a subset of rules for graphic organization and production. Grapheme reversals are harmless epiphenomenona until they come into conflict with social conventions and prejudices. They are not indications of dyslexia, but are due to rule confusion. Direction generates rules of graphic construction as found in the principles of calligraphy. Reversals are rule-driven encodings; hence other readers can decode them without the aid of mirrors. Since a sign is a set of associated neurological instructions concerning identification, articulation, duplication, combination, etc., and whose left or right direction of encoding and decoding is established by force of convention and habit, then there are two sets of instructions with left or right starting points. Obviously, these sets of instructions can be overridden or disengaged, showing we are not automatons. For example, the grapheme *b* is a set of associated neurological instructions:

(1) glottal labial stop,

(2) +voiced

(3) on an x/y coordinate moving in a general direction in order to execute the next set of instructions.

The mandated direction in forming the coordinate is an associated subset of instructions involving eye-hand movements. If the direction is innate, then it is a primary direction; but if it is leaned, then it is secondary and in conflict with the innate tendency. Inconsistent reversals seen in early writing are examples of this confusion that does not interfere with decoding or encoding operations except in the mind of the beholder who is the receiver of the communication. Even though the message is often successfully decoded, it is often deemed *incorrect* or *dysfunctional.* Moreover, conventional direction is a subset of associated instructions and should not be seen as a cause or effect of phonological dyslexia. When false phonological instructions are present, as in the above examples, they involve overriding metacognitve instructions as when the red light is broken and a policeman must step in and direct congested traffic. On the other hand, directional tendencies often generate instructions that conflict with conventions as in the case of *p/q* or *b/d* signs that must be corrected producing a programmatic stumbling effect:

Example B

[pail]

I. Decoding phoneme **[P] +**signal

(a) emotional association +/-/º

(b) associated neurological instructions:

(1) directional tendency← Left direction (ontogenetic)

(2) *glottal labial stop*

(3) +*voiced*

(4) redirected, corrected Right direction→ schema (phylogenetic)

(5) redirect, invalidate (1)

(6) repeat (2), (3)

(7) phonic choice

(8) misidentification, repeat (7) until successful or quit,

(9) + blend / segment

'pail'

II. Encoding operation:

(a) emotional associations

(b) associated neurological instructions:

(1) directional tendency← Left direction (ontogenetic) "q"

(2) physiological instructions for mechanical replication

(3) redirected, corrected Right direction→ schema (phylogenetic) "p"

(4) repeat (2), (3)

(5) + blend / segment

Both operations in B involve distorted strategies and broken assemblages. It is not necessarily a case of phonological dyslexia if the symbol [pail] was "improperly" articulated; rather, it is a possibly a state of confusion generated by several possible variables:

(1) indecision of the *ai* matrix,

(2) negative conditioning and reinforcement,

(3) and conflict of directional decoding and encoding tendencies with social conventions.

Children with weak, confused or nonexistent associations can make a mess of the instructions and appear impaired.

Associations

The principle of association is fundamental to education. Associations are formed in the sender and the receiver of the message; both cannot have received the same quality education; both cannot have constructed the same associated sets of neurological instructions in the decoding and encoding of signs and their operations; both cannot have identical emotional content. The label "dyslexic" has multiple conventional associations that may or may not have foundations in fact and can influence or even distort the viewpoints of both the *dyslexic* and *normal* population.

Conclusion

The existence of phonological dyslexia as stipulated by Dr. Posner has not been proven given his experimental design. Indeed, the removal or control of variables such as emotional blocking and phonic proairesis is critical before any such claims can be made. On the other hand, orthographic dyslexia is present and a sufficient explanation for Dr. Posner's findings.

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