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**Premature thoughts on writing disorders**

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## Abstract

Three papers appeared in the 19<sup>th</sup> century describing the dissociation between speech and writing: Marcé (1856), Ogle (1867) and Pitres (1884). An account of the convincing evidence of dissociations put forward in these papers is presented. Three explanations are proposed as to the reason why the observations reported by these authors were overlooked or rejected by their contemporaries, namely: a) in the first half of the century it seems that very little knowledge of the processes underlying writing (as opposed to speech) was available, b) the debates focussed on the independence of speech versus motor control and language versus the intellect, c) parallelisms between phylogeny, ontogeny and aphasia impeded the application of the principle of double dissociations, including the dissociations between speech and writing. It is argued that this phenomenon in the history of aphasia is best captured by the concept of prematurity in scientific discovery proposed by Stent (1972, 2003).

## Introduction

Three papers appeared in the 19<sup>th</sup> century describing the dissociation between speech and writing: Marcé (1856), Ogle (1867) and Pitres (1884). An account of the evidence put forward in these papers will be presented. The impact they had on the contemporaneous views in France and England on the organization of spoken and written language in the brain will be critically examined.

From an evolutionary cultural perspective writing and speech can be distinguished in that the former is a relatively recent activity and it is not universal. Even in literate cultures, the range of writing activities performed by individuals varies hugely across the population along a few dimensions including the frequency of use (Parr, 1992) and the range of activities practiced (Parr, 1992, David, et al. 2000, Rapp & Gotsch, 2001). The impact of these activities on our system of knowledge has led Harnad (1991) to label the rise and spread of literacy in the 18<sup>th</sup> and 19<sup>th</sup> centuries as the “second cognitive revolution” (the “first cognitive revolution” being the emergence of speech). This increase in the use of literacy by a larger proportion of the population in the Western world was generated by, and occurred in parallel to, a process of industrialization and institutionalisation (Artières, 1998). Indeed by the end of the 19th century, the study of writing was of concern to the medical, the educational and the legal spheres.

Artières (1998) convincingly argues that one of the hallmarks of the 19<sup>th</sup> century is that writing primarily belonged to the medical sphere. A range of sources of evidence support this view: the numerous medical publications on the physiological aspects of the teaching of writing, the identification of a disease contracted by children whose sight and general health were thought to be affected by too much writing labelled “graphomania” (Artière, 1998). More importantly for the topic under investigation, writing was perceived by clinicians as the privileged means to gain access to the mental states of atypical individuals, including geniuses (see for instance the study on the handwriting of Leonardo de Vinci by Ballet, 1900), criminals (Lombroso, 1884), and those affected by a medical condition. This led to numerous studies on the writing of patients affected by various pathologies including dementia, epilepsy and Parkinson. Phenomena of the writer’s cramp and mirror writing were also investigated.

This brief overview indicates that interest in writing and its disorders was common in 19<sup>th</sup> century Europe. In this sense the study of writing disorders by aphasiologists was not original or unexpected: this domain of expertise was not the exclusivity of this group of

clinicians. However, the study of agraphia was distinct from other medical endeavours devoted to writing in that it attempted to capture the nature of writing *per se*. Alienists (i.e., psychiatrists) assumed that writing samples constituted a direct reflection of an individual's mental state while those who investigated epilepsy and Parkinson used it as a diagnostic tool. Considerations of the physiological substrate and its relation to other language functions are the main focus of this paper.

### **Premature thoughts on the dissociation between speech and writing disorders I: the contribution of Marcé (1856)**

In the history of medicine, the name of Louis Victor Marcé (1828-1864) is usually associated with the first description of post-natal depression (Marcé, 1858). The names of the UK and Australian associations for the welfare of families at the time of childbirth bear witness to this contribution. In addition to the distinction between this female disorder and other psychiatric pathologies, the French clinician made at least two other significant contributions to the field: a substantial treatise on mental pathologies including their legal aspects, and a now largely forgotten article entitled "*Mémoire sur quelques observations de physiologie pathologique tendant à démontrer l'existence d'un principe coordinateur de l'écriture et ses rapports avec le principe coordinateur de la parole*" ("*Memoir on some observations of pathological physiology that seem to demonstrate the existence of a faculty governing speech and its relation with the faculty governing writing*") which was presented to the *Société de Biologie, Paris* and published in the society bulletin. This section assesses the originality of the latter contribution of Marcé (1856) in light of the views entertained by his contemporaries.

As the title indicates, the aim of Marcé's publication was to shed light on the relation between speech and writing. His interpretation is based on a detailed re-examination of cases published in the English, French and Irish literature and original cases of his and his clinical colleagues. In his introduction, Marcé (1856) refers to the distinction proposed by Bouillaud between the representation of concepts and the principle which underlies the muscular activity involved in speech, associated with physiological localization in the anterior lobes.

"Nature- says he [Bouillaud] – has placed next to each other the principle responsible for the signs (symbols) which represent our ideas and the principle devoted to bring into play the muscular apparatus which converts these interior signs into exterior signs or spoken utterances" (Marcé, 1856, 94)<sup>1</sup>

Marcé (1856) voices his surprise that writing has not received the attention it deserves from those who have devoted their talent and energy to the study of speech disorders. He explicitly states that the aim of his publication is to demonstrate that, as in cases of speech disorders, the integrity of the motor aspects of writing are necessary but not sufficient to the integrity of writing: this activity also requires the memory trace of signs (symbols) and of what they stand for (94-95). Marcé (1856) notes that most cases of speech disorders co-occur with writing disorders. However in cases when the patient improves, speech and writing are typically not recovered at the same time. Marcé (1856) argues that this constitutes evidence that these skills are independent from each other (95). Marcé (1856) details a precise method for the examination procedure each patient should undergo, so that the source of the speech and writing disorders can be determined.

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<sup>1</sup> Except when indicated otherwise, all the English translations are by Isabelle Barrière & Marjorie Lorch.

## Paralysis of the muscles of the speech apparatus

### Damaged

- The tongue can hardly be pulled out of the mouth and if it can it tends to hang towards one side of the mouth;
- The movements that the tongue carries out are incomplete, irregular and lack precision;
- When the patient is still able to speak, the sounds he produces are not well articulated and hoarse;
- If the paralysis has spread, the lips hang down, the patient continuously drools, and may even experience problems with chewing and deglutition.

### Intact

- The patient remembers the meaning and forms of words;
- The oral comprehension is perfect;
- The recovery period is characterized by the improvement of the mobility of the tongue and the fact that the words produced always correspond to the objects named;
- For a long time, syllables may remain confused and poorly articulated, even unintelligible when the patient tries to speak fast;
- The patient never uses a word instead of another.

This description of the diagnostic criteria of the paralysis of the speech apparatus by Marcé (1856) is relatively precise in that it considers the motricity of the main muscle involved, i.e. the tongue, as well as the speech characteristics that this syndrome triggers.

## Loss of the faculty which governs the production of words

### Damaged

- The patient has forgotten the meaning of words and the movements that need to be transmitted to his tongue in order to utter words;
- Some of these patients remember one word and systematically produce this word, regardless whether this is the word they were looking for;
- When presented with an object, they either provide an inappropriate name or invent a strange meaningless word;
- Thus in this loss of the faculty of speech, the meaning of words and the relation between objects and their names are completely forgotten;
- Some patients, when asked to repeat after they have heard a word several times produce *chapeau/hat* when asked to repeat *fauteuil/armchair*;
- Some of them manage to produce a three-syllable word when they have been provided with the first two, or after numerous attempts repeat several syllables, but a few seconds later they have forgotten the syllables and their meaning;
- Some of them, more advanced, can pronounce sentences: in those cases the utterances are always well articulated but the series of words that are produced are incoherent and do not bear any relation with the ideas or the object they have on their mind;
- Although some words may be appropriate, they co-occur with unintelligible sentences in which substantives, verbs and adjectives undergo substitutions;
- When the patient is polyglot, that is familiar with more than one language, words that belong to various languages occur next to each other, without motivation which gives rise to jargon;

- Another slightly different disorder, which pertains to memory problems triggers a dissociated pattern: these patients on the whole still remember the meanings of words but they have forgotten many words, typically substantives and adjectives.

#### Intact

- The precision of the tongue and mouth movements is intact;
- The patient articulates well one or more syllables;
- The intellectual faculty is intact: when the word or the sentence that the patient is looking for is pronounced in front of him, he indicates that it is what he was looking for.

Marcé (1856) assigns a range of functions to the faculty that governs word production: it holds the memory of the motor coordination, it controls the retrieval and repetition of target words, the arrangement of words into sentences and in the case of polyglots the separation between the two languages.

#### Loss of handwriting

##### Damaged:

- The loss of handwriting occurs due to a variety of conditions that impede muscular actions including cerebral or spinal paralysis, muscle atrophy, contracture and partial paralysis;
- The loss of handwriting is systematically accompanied by the loss of the skills for which these muscular synergies are brought into play.

It is important to note that compared to the description of the motor aspects involved in speech, the diagnostic criteria for the identification of the loss of handwriting are neither clear nor detailed: the first point refers to the actual sources of the loss and does not therefore present diagnostic criteria per se and the second point states the obvious, that it results in the loss of handwriting skills. No information is provided as to the way writing skills should be assessed and their loss diagnosed at this point.

#### Loss of the faculty governing writing

The faculty governing writing is responsible for a) the graphic representation of ideas, b) letter shapes, c) their combinations into syllables and the accurate spelling of words. This faculty is rarely impaired on its own but on the basis of careful examination, this type of cases can be identified. Two degrees characterize the loss of this faculty, namely:

1. The patient can only produce circles, sticks and illegible signs;
2. More frequently the patient is able to write words, syllables and can copy a sentence, regardless of whether he understands its meaning but he finds it impossible to combine syllables in order to express what he means. To dictation he produces substitutions and create strange words. Sometimes patients are unable to produce digits, sometimes they can produce single digit numbers. Dissociations between the ability to produce digits and to count have been identified.

Like the speech faculty, the writing faculty is assigned a range of functions namely: the production of letter shapes and digits- which are separate- as opposed to other types of graphic outputs and the retrieval of appropriate words.

According to Marcé (1856) reading aloud is best described as “writing translated into speech” (98) and is therefore expected to bring into play both the speech and the writing faculties. However he notes that, against his expectation, when the speech faculty is impaired, patients are not able to read accurately even when they are still able to write. He notes that this type of observation is significant for considerations of how the three complex language functions- speaking, reading, writing- are related to one another.

Marcé (1856) notes that although the symptoms and their sources can be distinguished, patients rarely exhibit pure disorders. In addition, in instances when the motor aspects of one of the language functions- speaking or writing- are impaired it is impossible to assess the state of the faculty governing the relevant language function. Marcé (1856) illustrates his point with the following example: when a patient suffers from a paralysis of the hand it is impossible to find out whether the faculty governing writing is damaged.

These considerations form the basis of the classification into three categories that Marcé (1856) applies to twelve cases, including four that are original observations and eight that have been previously reported in the literature. Two criteria were employed by Marcé (1856) for the selection of these cases, namely: a) the integrity of the intellectual faculty, and b) detailed information on the patients’ education, including the level of their pre-morbid reading and writing skills. The effort to obtain evidence of both pre-morbid and post-morbid writing skills in aphasic patients was exceedingly rare in the literature of the time. With regard to the notion of Intellect, Marcé (1856) adopts the view proposed by Gall and that is best described as the interior force that precedes and gives rise to signs.

The cases presented by Marcé (1856) are briefly summarised in table 1:

<INSERT TABLE 1>

On the basis of these observations, Marcé (1856) identifies three clinical profiles, namely:

- Loss of speech and reading, writing intact (Observations I and II);
- Motor coordination of speech or writing intact associated with the loss of the speech and writing faculties ((observations III, IV, V, VI, VII, VIII);
- Loss of the faculty governing writing associated with the loss of the movements involved in speech production and integrity of the intellectual faculty (Observations IX, X, XI, XII).

Marcé (1856) states that two conditions are necessary to the functioning of speech and writing, namely a) the integrity of the relevant muscles and b) the existence of an a faculty that governs the movements involved in each of these languages skills and word retrieval. In contrast comprehension requires the integrity of intelligence that is the representation or access to signs (symbols).



The role of the faculty governing writing is parallel to that which controls speech in various ways. Its activity precedes writing, in the way that the faculty governing speech precedes speech. It is responsible for the drawings of letters and their combinations into syllables. The production of isolated letters is easier than their combinations into words: in observations VI and VIII, the signs produced by the patients were illegible while in observations IX, X and XI, although the patients could produce letters in isolation, they were unable to produce words or sentences. Marcé (1856) also notes that similar dissociations between isolated letters versus words can be observed in reading aloud. According to Marcé (1856), observations V and X constitute examples of this dissociation in reading: although the details of observations 5, including the example he provides demonstrates that the patients letter-by-letter reading aloud was accurate while his whole word reading was not, none of the details provided on observation X focuses on this issue. Instances of dissociations between letter and digit writing were identified in observations VII and X in which the patients were also able to count. Marcé (1856) notes that this supports Gall 's view on the "independent existence of digits" (111).

In the next section Marcé (1856) discusses the independence of the faculty governing writing in relation to a) the faculty of speech and b) the motor skills involved in writing. He admits that in the observations he has described, there is no case in which writing was either selectively damaged or selectively spared. However, in observations I and VII, the patients were able to write while they were unable to speak, despite the facts that their writing was not perfect. The evidence Marcé (1856) includes examples of the patients' production in speech and writing. The patient studied in Observation I produced the following sentences when asked whether whether he had a headache:

- Spoken reply: "*Les douleurs ordonnent un avantage*" ("*the pains control an advantage*" ) (100);
- Written reply: "*Je ne souffre pas de la tête*"/ (Literally, "*I don't suffer in the head*", appropriate construction in French for *I don't have a headache*) (100).

When he was asked to repeat the word *tambour/drum*, he produced *fromage/cheese*. In contrast, he was able to write it correctly.

Examples of his words substitutions in speech are also presented: *un drap/a sheet* instead of *une plume/a quill*, *un crâchoir/a spittoon* instead of *une plume/a quill*, *une main/a hand* instead of *une tasse/a cup* and *une bague/ a ring* instead of *un crâchoir/ a spittoon*.

With respect to the independence of the faculty governing writing in relation to the motor aspects of writing, Marcé (1856) notes that in nine of the cases reported, the patients could not write although control of their limbs was intact, thus their impairment did not lie in the motor skills which subserve handwriting. Marcé (1856) also notes that although in cases I and VII both the agent governing writing and the motor skills involved in speech were affected, this co-occurrence is not systematic: although none of the cases presented by Marcé (1856) provides evidence in support of this dissociation, he mentions the facts that some of his colleagues have come across patients with left hemiplegia and with paralysed tongue, who could write. Unfortunately no further details are provided.

It is interesting to note that although Marcé seems to have gone out of his way in his bibliographic research to present cases that illustrate the distinction between speech and writing, he does not mention the memoir published by Jacques Lordat thirteen years before. Lordat (1843) includes three observations in which the patients' writing is commented on. The last case described in Lordat (1843) comes from a memoir written in Bordeaux and illustrates one of the points emphasized by Marcé (1856), and before him Gall, regarding the

distinction between the abilities to write letters and digits. Two other cases presented by Lordat (1843) would have provided additional evidence to Marcé (1843) in favour of the distinction between the speech and writing faculties. The first one is that of a patient that Lordat examined himself who was found unable to speak after an emotional shock (Lordat, 1843, 52). Initially Lordat (1843) thought he had also lost his ability to understand, and thereby his intellect and his memory (52). However this diagnosis was challenged by the fact that the patient spontaneously wrote to communicate with him (Lordat, 1843, 52). The second case that presents the same type of dissociation is that of a young woman examined by Lordat himself and a colleague (60). When aged 24, she lost consciousness and when she came round she had lost the ability to speak and she had also contracted a slight paralysis. Lordat (1843) describes her state a year later. Her speech impairment had persisted while she was able to understand what was said to her and she had recovered her ability to write (Lordat, 1843, 60-61). Lordat (1843) notes that although she was able to use writing to communicate, she did not like to do so. The author suggests that this may have been caused by her embarrassment with respect to her spelling errors. As Lordat mentions these could either be part of her syndrome or due to a lack of education: given that he was unable to have access to pre-morbid samples he was unable to determine the causes behind the patient's reluctance to write.

Lordat (1843) uses the dissociations mentioned above to argue for the fact that *alalie* does not trigger the loss of words or the alteration of the intellect (61). It is interesting to note that like Marcé (1856), Lordat (1843) attempts to identify the different levels involved in language production (6-7). His account of speech production is much more sophisticated than that of Marcé (1843)<sup>2</sup>: it distinguishes 10 distinct components that today would be referred to as levels of processing (Roch Lecours, 1984). These include the generation of a concept, the proposition it gives rise to, the retrieval of words, their combination into sentences and various levels involved in the retrieval of motor-articulatory processes involved in speech production. However, unlike Marcé (1856), he focuses on speech production and only mentions writing parenthetically to illustrate his point. Lordat (1843) mentions several authors who have contributed to the understanding of the motor aspects of speech while he does not do so with respect to writing.

Lordat (1843) and Marcé (1856) have in common the following. First both of them contain convincing observations of cases of dissociations between speech and writing. Secondly, both of them shed light on the more developed knowledge of the motor processes involved in speech that seem to have led to systematic and detailed clinical examinations teasing apart the state of the motor capacities in relation to the ability to retrieve the spoken forms of the words. Thirdly, it is notable that neither of these authors attempted to localize language functions. Lordat (1843) held vitalist views and thus assumed that there was a spiritual matter involved in cognitive functions that prevented him from attempting to localize. In contrast, although Marcé (1856) does not include any mention of vitalist concepts in his paper he also omits any suggestions of possible localization.

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<sup>2</sup> According to Alajouanine (1968) Lordat (1843) insists on the parallelism between spoken and written language disorders: this statement is ambiguous in that it may imply that both faculties are equally impaired, which as the cases of Lordat (1843) reported here indicate is not the case. Furthermore Alajouanine's statement that Lordat (1843) insists on this parallelism is an overstatement: Lordat (1843) describes the writing abilities in only three cases and uses this as additional evidence for the distinction between language and the intellect rather than as evidence for the dissociation between speech and writing per se.

## **Evolution, language disorders and the concept of double dissociations: from Marcé (1856) to Ribot (1881)**

Marcé (1856) presents a discussion on the parallelism between speech and writing and on the evolutionary factors that affect the loss and recovery of different language functions. A brief outline of Marcé (1856)'s views is followed by a contextualization of his statements. According to Marcé (1856), writing is a simpler function and is subordinate to speech. Speech production requires a complex muscular action, which involves precise, delicate and quick movements. In contrast writing requires less flexibility in that only one group of muscles is involved in the grasping of the writing tools and the hand movement. With respect to phylogeny, Marcé (1856) makes the statement that in the order of origin "writing derives from speech" (112). In the cases in which both speech and writing are lost, writing is expected to come back first, as in observation VII. This is based on the observation that writing is simpler and more elementary than speech. The recovery of function was thought to occur in the reverse order of the loss of functions. However Marcé (1856) disagrees with the reason proposed by Osborne (1833) for this order of recovery. According to the Irish clinician, the explanation lies in the smaller number of muscles involved in speech versus writing. Marcé (1856) criticized this view for failing to distinguish between the motor aspects involved in writing and the faculty governing writing which is a higher intellectual faculty. Osborne's position is not in fact accurately represented by Marcé (Lorch, 2003).

The originality and significance of Marcé's views on the parallelism become apparent when considering that the most notable evolutionist before Darwin (1859) was Lamarck (1744-1829) according to whom the most recent is also the most complex. The views expressed by Marcé (1856) reflect the opposite view contradicting Lamarckian teaching. The second issue that Marcé's interpretation and argumentation raise is that they present an obstacle to the principle of double dissociation. According to Luzatti & Whitaker (2001), Bouillaud (1825), whose work is referred to in Marcé (1856), was the first to apply the notion of double dissociation. Marcé (1856) employs this methodological tool in order to argue for the independence of a principle underlying writing in relation to the mechanisms that underlie spoken language ability. In outlining his assumptions about the parallelism between phylogeny and loss and recovery of language functions, Marcé (1856) asserts two ideas which appear to be contradictory: on clinical grounds the two faculties of speech and writing are best considered to be distinct while on evolutionary grounds writing is subordinate to speech. It seems that Marcé (1856) nevertheless paves the way for numerous subsequent authors throughout the end of the 19<sup>th</sup> century who also assumed a parallelism between phylogeny and aphasia in France and in Britain (see below sections on Ogle and Pitres). It is indeed difficult to overstate the importance of these ideas in the literature of the time (Ey, 1978, Lorch & Barrière, 2002a). Darwin himself discussed losses of speech and writing in his notebook (1838, 1839) and in *the Descent of Man* (1871). In 1877, Bateman published a monograph entitled *Darwinism tested by Language* in which he presents arguments against Darwinian evolution that focus on aphasia and lesion localizations as the test case upon which the theory will stand or fall: he assumes that only what is genetically determined can be localized (see Farah & Wallace, 1991, for a modern statement of this view) and therefore that the localization of species-specific functions such as speech should be localizable if Darwin's views are right. A few years later, the French clinician Ballet (1886) defined aphasia in relation to evolution. He suggested a distinction between two forms of communication: a) a basic form of communication that man shares with animal and b) artificial forms of language that encompass both speech and writing and are both damaged in aphasia. According to Ballet (1886):

“This radical distinction between these two modes of expression, one is described as *emotional* while the other is *rational*, has been adopted by several philologists (Max Müller, Renan). It has also been used by some authors as a criterion to define aphasia. Thus according to Proust and Mr. Grasset, aphasia would consist of the loss of artificial language and the integrity of natural language” (2-3)

Twenty five years after Marcé (1856) Ribot (1881) proposed another principle that was to predict the loss of memory that relied on a related parallelism, namely that between the order of acquisition and loss and recovery of functions, which was to have an enormous impact, including on authors studying disorders of writing, such as Pitres and Dejerine, discussed below.

### **Mid-19<sup>th</sup> century views on the organization of language in France and Britain**

The honour of being the first author to explicitly state the localization of spoken language production in the brain is typically attributed to the French surgeon Paul Broca in 1861. The aim of this section is neither to question the originality of his discovery (Roch Lecours, 1984) nor address the validity of Broca’s scientific contribution (Selnes & Hillis, 2000) but to briefly outline Broca’s views on the organization of language.

The description of the organization of language proposed by Broca (1861) comprises three levels: a) an amodal language faculty (that applies to a number of systems of communication), b) modality specific-connections, and c) the motor skills involved and the nerves that control them. The distinction between these last two levels seem unclear: the third one seems to encompass the function fulfilled by the second one. Furthermore there does not seem to be a level responsible for word retrieval: given that the first amodal level deals with different types of symbolic communication, it does not apply to a specific language. In his description of the famous patient Tan, Broca (1861) mentioned that given that his hand was paralysed he was unable to write. No attempt seems to have been made at assessing his writing with his left hand and/or his ability to spell.

Three years later, Trousseau (1864) asserted that in cases where aphasia occurred without a right hemiplegia patients would demonstrate a parallel difficulty in writing. In the same year, in England, research into the relation between language disorders and brain function was explored by John Hughlings Jackson and Jabez Spence Ramskill in 1864 (Lorch, 2002). These two papers appear to be the first British contributions to the topic of aphasia after Broca’s revolutionary speeches to the Paris Societies of Anthropology and Biology (1861). In these papers, and those that followed over the next few years both in France and the United Kingdom, little interest was shown in by clinicians in the issues initially raised by Marcé (1856), of what is now referred to as distinctions in output modalities (Cf Bastian, 1869).

Jackson (1866b) considered impairments of writing to reflect the same linguistic deficiency as speech and reading. Jackson asserted that a disturbance of writing will always be seen in conjunction with disturbance of speech (327).

There were two other important aphasia papers published in the UK which took an early stand on the issue of whether speech and writing could be shown to be dissociable the first by W R Saunders of Edinburgh (1866) and the second by W T Gairdner of Glasgow (1866a and b) presented to their respective learned societies and appearing in print in the months between February and May. Saunders (1866) used a classification of aphasia which divided it into Ataxic and Amnesic types. Saunders states: “...it is very remarkable that, in some cases,

when the power of vocal speech is lost, the patient retains the ability to write distinctly what he wishes to communicate. In other cases, however, the power of written language is impaired or lost as well as vocal speech; and in the worst case, even gestures and other imitative signs are wanting.” (813)

With Marcé (1856), as in Ogle (1867) discussed below, the attempt is to document dissociations. With Gairdner (1866a) the opposite appears to be the case. Gairdner acknowledges that there are documented cases of aphasia with intact written language production but does not give any citation. It is notable that Marcé (1856) is not referred to in his lengthy paper although it is filled with references to the French literature. However, Gairdner (1866a) is more interested in the interpretation of the more typical instances in which both speech and writing are impaired to the same extent. The motivation behind this argumentation seems to be a desire to clarify the distinction between speech (*vis a vis* motor control) and language (*vis a vis* intellect). It is this distinction, (tied to the new distinction in physiological role of the corpus striatum and the left anterior cortex), which was of crucial relevance in the mid-nineteenth century.

Gairdner presents a detailed case of loss of speech associated with preserved ability to write (1866a) and wrote a second paper (1866b) after the patient’s death on the negative post mortem results. He included a rare specimen of the patient’s handwriting and gave a detailed analysis of the difference between orthographic and graphic features of the written production to verbal request for the patient to write his name, and subsequently to perform a copy (See FIGURE 1. In the handwriting specimens, Gairdner draws attention to the fact that although the written production of the patient’s name to verbal request

“may be safely said to defy interpretation... [consisting of] ... sprawling errors...in unintelligible characters...[the production of a written copy had] ... tolerable accuracy... [being] quite easily legible.”

<INSERT FIGURE 1>

The most significant note is that when copying his sister’s written production of his own name “it is quite evident to a critical eye that he has grafted, as it were, the original characteristics of his own handwriting upon the copy made (especially in the J, M, y, r and H.)” (Gairdner 1866b, 12).

### **Premature thoughts on the dissociation between speech and writing disorders II: Ogle (1867)**

In 1867, William Ogle published a paper in the second volume of the St. George’s Hospital Reports. It consisted of 5 of his own cases and 20 reviewed from other sources in the published literature and other doctors’ caseloads. Like Marcé (1856) (of whom he and other English clinicians appear unaware), Ogle explored the relation between spoken and written production. He is typically identified as the first clinician to use the English term *agraphia*. In German, the term ‘*agraphie*’ was used two years earlier, but this work by Benedikt (1865) does not seem to be known to either the British and French clinicians at this time.

Ogle considers the written language impairment: “Of this defect, for which, for convenience, I would coin the name *agraphia*, there are moreover, as of aphasia, two forms—an amnemonic and an atactic.” (Ogle, 1867, 99). In making this division, Ogle was drawing a distinction (which he also makes for spoken language disorders) between two types of

disordered written language production: 1) the amnemonic type who can form letters and words “with sufficient distinctions”, with evidence of substitutions of words in writing and in more severe cases the production of only confused series of letters and 2) the atactic type who have lost the power to write individual letters and who produce “ a mere succession of up and down strokes.” Without comment, Ogle replaces the terms amnesic and ataxic used by Saunders (1866 discussed above) and others at the time with slight variants. Ogle presents evidence from his own clinical observations which have bearing on two significant issues: 1) the relation between the production of written and spoken language, and 2) the relation between writing and spelling.

Ogle acknowledges the clinical generalization that aphasia and agraphia are usually seen to co-occur. However, he makes the novel assertion that they may differ in the type of disorder and/or in the severity of the disorder. He presents 5 cases from his own patients which show these kinds of dissociations. The crucial piece of evidence regarding the agraphic patient for Ogle is that they can not arrange words from letters written on cards while being able to produce written copies. This was an innovative piece of clinical assessment technique.

In the 20 additional cases that Ogle includes in his paper, drawn from the clinical literature, he is prevented from extending his inquiry into the relation between spoken and writing language. This is due to the fact that no information about the written modality is included in these other case reports. Due to this limitation, Ogle’s argumentation turns to aspects of Broca’s localization of the language faculty. This second portion of Ogle’s paper consists of an investigation of aphasia cases with lateralized sensory motor signs and autopsy data. The ensuing discussion is pursued without any reference to written language. The final section of the paper makes reference to Moxon’s (1866, see Finger et al. 2003 for a modern discussion of this paper) theory of lateral dominance but Ogle refrains from making any comment on the implications of possible connexions between handedness, language and writing. Indeed, a review of this paper in the *British and Foreign Medico-Chirurgical Review* (1867) emphasises that the contribution made by this paper is primarily on the second and third points. It acknowledges the new terminology and description of agraphic disorders as a minor point of note.

Below is a tabulation of the 5 cases Ogle presents of aphasia and agraphia, all had right hemiplegia.

<INSERT TABLE 2>

It is of note that there is no case presented here showing what might be considered pure agraphia. Though Ogle interprets Case III as one who could produce spoken but not written language, by current standards the evidence given seems to suggest that this patient was indeed aphasic though fluent. It was almost 20 years before a case of isolated disorder of writing was described in detail. In 1884, the French clinician Pitres published the first detailed clinical case study of pure agraphia (see below) (see Lorch & Barrière, 2003 for a consideration of pure agraphia).

Case V is the only one of Ogle's 5 cases who died and a post mortem was carried out. The autopsy reported finding an embolism in the left middle cerebral artery with a lesion which included the third frontal convolution (Broca's area). In his final summary, Ogle points to Case III and V as important evidence demonstrating the dissociation between writing and speech impairments. Ogle classifies Case III as slight amnemonic aphasia and severe agraphia of both the atactic and amnemonic types. He argues that Case V shows a rare example of aphasia with intact writing. This case was taken by Ogle as evidence "that the faculty of speech and the faculty of writing are not subserved by one and the same portion of cerebral substance"(1867, 106). He does not put forward any suggestions as to the cortical localization for this written language faculty. However, this is not too surprising in light of contemporaneous views in London on localization of functions in the brain. Jackson (1866a) was a strong proponent of the notion that motor control in general and speech functions in particular were located in the corpus striatum.

Ogle's 1867 paper puts forth evidence and argument to overturn Jackson's 1866 assertion of the consistency in the degree and type spoken and written language disturbances. The significance of Ogle's argument is that the degree and type of impairment is not always identical in the two modalities. It is likely that Jackson was aware of Ogle's work, for even though he was not listed as a subscriber to the St George's Hospital Reports, the paper was reviewed in the widely-circulated Medical-Chirurgical Review (1867). However, Jackson was not ready to change his mind on this point. Even in 1870 (i.e. three years after Ogle's paper), Jackson stated emphatically "It is *a priori* incredible [i.e. not credible] that a person who cannot speak should be able to write....The fact that an aphasic person cannot write must not be brought forward as *additional* evidence on his mental condition. It is the *same* defect as the loss of speech in another manifestation." (p. 20)

### **Premature thoughts on the dissociation between speech and writing disorders III: Pitres (1884) case of pure agraphia**

Five years before the publication of Ogle's (1867) paper, Jean Martin Charcot (1825-1893) started a life-long association with the Salpêtrière hospital: it is difficult to overestimate his influence on the European medical sphere of the time. His most famous students include Josef Babinski, Sigmund Freud and Gilles de la Tourette. The work of Albert Pitres (1848-1924) is not as well known as may have been expected from his long-lasting association with his master (Lorch & Barrière, 2003): Pitres was a co-author on the most notable publications of Charcot. This includes a series of articles on the determination of the neurophysiology of motor control in which they investigate the anatomico-pathological correlations between the etiology of hemiplegic symptoms and the cortical lesions that underpin them, based on 108 patients, that appeared in 1877. Pitres's interest in the localization of motor control led to the publication of four volumes with Charcot (Charcot & Pitres, 1877, 1878, 1883, 1895) and to experimental work on the anatomy and physiology of the brain with Francois- Franck (Francois Franck & Pitres, 1883, 1885) (Lorch & Barrière, 2003). Pitres's publications on aphasia were also well regarded by his contemporaries: the English neurologist David Ferrier

(1878) considers the case presented in Pitres (1877) as the most reliable source of evidence of the role of Broca's area in speech production (Lorch & Barrière, 2003).

Maybe unsurprisingly given his interest in both aphasia and motor processes, Pitres (1884) also made a very important contribution to the study of writing through his first clinical report of pure agraphia. In his article Pitres acknowledged both the contributions of Marcé (1856) and Ogle (1867) as the first to emphasize the dissociations between speech and writing. Pitres (1884) was also strongly influenced by a modular approach to memory proposed by the Founder of experimental psychology in France, Ribot (1839-1916) (Nicolas & Murray, 1999). The three components of his reading and writing models reflect this influence:

- a) a visual component that stores the memory for letters and how they combine to form syllables and word;
- b) an auditory component that stores the memory for the sound of these letters;
- c) a motor component that stores the motor-graphic memory of the letters.

Each of these memories can be selectively impaired: for instance the loss of visual memory will trigger a loss of reading ability. In addition each of these memories is hypothesized to be further divided. For instance printed letters, cursive letters, digits, musical notation are supposed to be stored independently in both the visual and motor memories. Pitres (1884) mentions the case of a patient by Charcot whose reading and writing were both impaired but whose ability to transcribe music and decipher musical notation were intact. One of the arguments that Pitres (1884) invokes for the distinct mechanisms that underpin each of these symbolic systems is based on the assumption that each of them is acquired successively and that this difference in timing of acquisition has an effect on the order of losses. This argument has its root in Ribot (1881)'s *Law of the Dissolution of Memory* to which Pitres (1884) refers and that Charcot contributed to develop and transmit through his lectures: it hypothesizes that what is acquired first is most robust, and is therefore lost last and recovered first. According to Gasser (1995) this Law proposed by Ribot (1881) was strongly influenced by the approach developed by Hughlings Jackson. Ribot (1839-1916) was an admirer and advocate of the works of his English and German contemporaries which he translated and synthesized for dissemination in France (Ribot, 1870, 1879). It is important to note that the parallelism between phylogeny and ontogeny made by Ribot (1881) leads to a different conclusion compared to the parallelism drawn by Marcé (1856) between evolution and loss and recovery of functions. For Ribot (1881) the most recent is the most complex and lost first whereas for Marcé (1856) what is the most recent is the most simple and therefore lost last and recovered first.

Pitres (1885) reviews case 3 presented in Ogle (1867) and a case of polygot agraphia observed by Charcot (Rummo, 1884). Before his illness the "*Major Russe*" spoke Russian, his mother tongue, French and German. After his illness his speech in his mother tongue was intact but he could no longer produce French and German although he still understood these two languages. He finally recovered his ability to speak French while the one he had learnt last, German, remained the most impaired. This case provided evidence in favour of the *Law of the Dissolution of Memory* proposed by Ribot (1881).

The most important case is that of a patient observed by Pitres himself. The most notable aspects of the examination lie in the number of tasks attempting to tease apart the patient's abilities to perform the fine motor actions required in writing and in other tasks (picking up a pin from the floor) and as in Ogle (1867), the patient's abilities to spell. This distinguishes



Pitres (1884) approach from that of Marcé (1856). For the latter, the inability to spell and to govern the motor aspects involved in writing correspond to the same syndrome. For Marcé (1856), the motor movements that are involved in handwriting are not specific to this language modality: thus the preservation of the movements of the upper limb was seen as guaranteeing the preservation of the movements involved in handwriting. In contrast, according to the more modular approach of Pitres (1884), a specific store of memories is devoted to the motor processes involved in writing. This approach is a reflection of his interest in gaining insights into the physiology of motor processes in general which his own work with Charcot and Francois-Franck and that of his contemporaries such as Ferrier (1878) contributed to develop. This motivation is quite different from those reflected in the earlier works of Lordat (1843) and Marcé (1856). The case study presented by Pitres (1884) as a demonstration of pure unilateral agraphia has many significant features which are discussed in detail in Lorch & Barrière (2002, 2003). The salient points can be summarised as follows:

### **Mr. L's Pure unilateral agraphia**

- Mr. L. , a 31 year old wine merchant had suffered from syphilis for 10 years;
- He had completely lost the ability to write with the right hand;
- He could read and spell;
- He could only produce written copies with his right hand;
- He could not transcode from print to script with the right hand;
- He could transcode with the left hand and then once this task was completed he would copy the results with his right hand.

On the basis of the cases discussed in his article, Pitres (1884) proposes a classification of agraphia:

- a) agraphia by word blindness in which the patient can no longer copy a model although he can write spontaneously and to dictation;
- b) agraphia by word deafness in which the patient can copy a model and write spontaneously but can no longer write to dictation;
- c) motor agraphia or “graphoplegia” in which the patients can no longer write at all although his ability to spell is preserved.

In addition to the detailed model Pitres (1884) outlines, the originality of his contribution also lies in the fact that unlike Marcé (1856) and Ogle (1867) Pitres (1884) localized language functions including writing in relation to each type of memory stores outlined below:

<INSERT TABLE 3>

The confidence that Pitres had in the localization of writing and the importance he assigned to this discovery are such that a year after the death of Charcot, at a meeting that saw the rise of the holists, Pitres (1894) delivered an address to the Congrès Français de Médecine Interne (Lyon) and used his case of pure motor agraphia as the most reliable source of evidence of the localization of functions (Lorch & Barrière, 2003).

In his conclusion, Pitres (1884) stresses that as in the cases of aphasia, in cases of agraphia the intellect is not systematically impaired.

In his 1895 paper on polyglot aphasia (that presents a re-examination of the *Major Russe*), Pitres slightly modified Ribot's *Law of the Dissolution of Memories*: instead of fully relying

on the order of acquisition to predict the order of loss and recovery of functions, he considered the notion of strength of associations (Lorch & Barrière, 2001).

Although the parallelism with phylogeny and ontogeny manifest themselves differently in Marcé (1856) on the one hand, and in Ribot (1881) and Pitres (1884) on the other, in each case they constitute obstacles to the principle of double dissociations.

### **The rejection of the independence of writing**

Lorch & Barrière (2003) emphasize the singular fate of pure agraphia in the history of aphasiology: robust clinical case reports have met the scepticism of clinicians throughout the 19th and 20th centuries. In this section we focus on the views of Dejerine (1849-1917) with regard to his localizationist views and his position with respect to that of his master Charcot.

In 1891, Dejerine wrote “the question of agraphia is the most controversial in the study of aphasia” (11). Other authors of the period including Wernicke (1874) also rejected the possibility of pure agraphia, although Wernicke (1903) did later change his position (De Bleser, 1996). In his 1914 monograph entitled *Sémiologie du système nerveux*, Dejerine devotes a substantial section to agraphia. Although in his (1914) publication he acknowledges Marcé (1856) as the first author to describe writing disorders he does not discuss in any detail the cases reported in that publication. However, he includes a review of all the cases published in the literature since Ogle (1867) and discusses Pitres (1884). Dejerine adopts the view that “the alterations of writing, agraphia, constitute a common symptom found in some forms of motor and sensory aphasia”(p124). In his introduction, although he is familiar with the case reported by Pitres (1884) he rejects the possibility of unilateral agraphia as he assumes that writing disorders are to be manifested in the same way whatever hand is used-- although the hemiplegia often associated with cases of motor aphasia often impede the motricity of the dominant hand. Dejerine asserts that apart from this motor problem, there is no difference between the written production carried out by the two hands (or in fact for any other limbs). In making this statement, Dejerine seems to depart from the approach advocated by Charcot for whom cognitive faculties were tied to the specific motor processes through which they were expressed (Barrière & Lorch, 2002). Dejerine’s approach also departs from Marcé (1856), Ogle (1867) and Pitres (1884) in that he attempts to classify writing disorders as part of the etiologies of different types of aphasia, as summarized in table 4:

< INSERT TABLE 4 >

Dejerine’s ideas on the order of recovery of functions are the opposite of those expressed by Marcé (1856): according to him the recovery of writing depends on the recovery of aphasia (p137). When the speech impairment persists, so does the agraphia. The only exceptions to this rule concern the cases in which Broca’s aphasia turns into pure motor aphasia which in Dejerine’s own words “reflects the recovery of *inner speech*” (p138). The recovery of spontaneous writing and writing to dictation co-occur but the latter progresses more slowly. Dejerine’s explanation is that in the case of spontaneous writing the patients choose the words they can produce. Dejerine draws the distinction in which in Broca’s aphasics, recovery of writing is slow and exhausting for the patient however these patients always fully recover writing. In contrast, in sensory aphasia, the writing disorders typically persist. This

reflects Dejerine's belief that sensory aphasics do not recover their functions whereas Broca's aphasics do. Dejerine (1914) concludes his section on recovery:

"On the basis of what I have just said, it seems that writing disorders are often observed in cases of motor or sensory aphasia; that they systematically co-occur with them in the most common forms of the alteration of inner speech; that they are absent in cases in which inner speech is intact, that is in pure motor aphasia or aphemia; in pure varieties of word blindness or deafness (except of course, copying in the case of pure word blindness and writing to dictation in the case of pure word deafness). In other words, writing disorders are systematically found when inner speech is altered." (p138)

Dejerine rejects the concept of motor graphic images adopted by Pitres (1884) on the basis of the fact that the retrieval of the written word cannot be intact when, as in the cases of Broca's aphasia, the retrieval of the spoken word is lost. Thus Dejerine's view of word retrieval is best captured as hierarchical in that the retrieval of the written modality is subordinated to that of the spoken modality (p139). Dejerine (1914) further asserts that the motor-auditory images have a higher status in that they are developed first (possibly revealing the influence of Ribot, 1881, see section on Pitres) whereas "No graphomotor images exists in inner speech." (140). Dejerine reinterprets Pitres (1884) case as a type of sensory agraphia: that the patient could not write with his right hand is explained by the fact that he suffered a right hemianopsia. On the basis of Dejerine's own description of writing disorders (see table above) it is unclear how he diagnoses Pitres's (1884) patient as exhibiting sensory agraphia: Pitres's (1884) examination included the drawing of geometric figures and a human profile by the patient using his right hand, that he successfully completed. Not surprisingly Dejerine (1914) rejects the idea of a graphic centre. Although he acknowledges that cases published in the literature seem to provide evidence in favour of such a centre, he has not himself observed cases of dissociations between speech and writing. Dejerine (1914, 145) further argues that while the vocal box is specialised for the use of speech [sic], writing is not the only function of the hand: thus the former is localizable while the latter is not. Dejerine (1914) refers to Pierre Marie (1897, cited in Dejerine, 1914) who rejects the idea of a centre for writing on the basis of the different status of speech and writing in the evolution of the species. Dejerine (1914) refuses to accept this view as children need to be taught speech or at least hear it in order to speak. If this were not the case, deaf children would develop speech which is not the case (Dejerine, 1914). Thus Dejerine seems to conform to Ballet's (1886) view according to whom speech and writing share the same evolutionary status.

## Conclusion

The review of the works of Lordat (1843) and Gairdner (1866a, b), and more specifically, Marcé (1856), Ogle (1867) and Pitres (1884) demonstrates that these authors provided robust evidence for a number of dissociations, based on detailed single case studies, namely:

- Intact writing associated with speech disorders (Lordat, 1843, Marcé, 1856, Ogle, 1867, Pitres, 1884);
- Intact copy associated with inability to write spontaneously (Marcé, 1856, Gairdner, 1866a, Pitres, 1884);
- Intact speech associated with writing impairments (Pitres, 1884 case of pure agraphia);
- Intact drawing associated with writing impairment (Marcé, 1856 and Pitres, 1884);

- Intact spelling abilities associated with impaired handwriting (Ogle, 1867 and Pitres, 1884);
- Production of digits less impaired than word writing (Marcé, 1856, Ogle, 1867);
- Intact production of letters associated with inability to write words (Marcé, 1856);
- Distinct timing and patterns of recovery for speech and writing (Marcé, 1856).

Marcé (1856), Ogle (1867) and Pitres (1884) also attempted to propose theoretical accounts for the observation of these dissociations. The limited impact of both their empirical evidence and of their explanations on the discussion on the organization of the language faculty and on the localization of functions is discussed below.

Stent (2003) defines the concept of *prematurity in scientific discovery* in the following terms: “A discovery is premature if its implications cannot be connected by a series of logical steps to contemporary canonical [or generally accepted] knowledge”(24). Stent (2003) emphasizes that this concept is distinguishable from an unexpected discovery in that the latter can be related to the generally accepted knowledge although it may lead to the rejection of a few ideas that make up this knowledge. This concept may shed light on the discussion surrounding the contributions of Marcé (1856), Ogle (1867) and Pitres (1884) with respect to the dissociation between speech and writing

In the first half of the 19<sup>th</sup> century, it seems that the lack of knowledge regarding the movements involved in handwriting prevented the systematic and detailed examinations of relevant subskills involved in this activity. Thus some of the evidence presented in Lordat (1843) and Marcé (1856) could not be appreciated in the context of such poor understanding of the processes involved: note that the contributions of Bouillaud (1825) and Broca (1861) did not suffer the same fate as at the time the authors proposed the localization of speech disorders, much was known about the articulatory processes underpinning this modality as our review of Lordat (1843) and Marcé (1856) emphasizes. The clear distinction between spelling versus the fine motor skills involved had to await the contributions of Ogle (1867) in England and Pitres (1884) in France.

In most of the publications discussed in this critical review, it is unclear whether an amodal level of word retrieval was assumed: a) in Marcé (1856) the discussion of the relation between the speech and written modalities is ambiguous, b) in Broca (1861), the amodal level seems to apply to a range of communication systems and does not pertain to the word per se, c) neither Ogle (1867) nor Pitres (1884) are explicit about the possibility of such amodal level and d) Dejerine (1914) assumes that the spoken word is tied to inner speech while the written word isn't, which makes it dependent on the spoken modality. This lack of clarity and consensus with respect to this issue may have been due to the fact that much of the discussion of the time was primarily focussed on two other issues, namely the distinction a) between speech and motor control and b) language in relation to the intellect. Those two issues were the focus of the debates between the Holists and Localizationists launched in 1894 in Lyon, a year after Charcot's death (Pitres 1894) and continued in Paris (Klippel, 1908a, 1908b)

Finally, the parallelisms assumed between phylogeny, ontogeny and order of loss and recovery of functions impeded the real application of the principle of double dissociations. The assumptions of these parallelisms gave rise to predictions on the possible combinations of symptoms. Authors assuming one or the other parallelism seemed to have overlooked relevant evidence pointing to other factors. For example, Marcé (1856) does not consider the potential existence of pure agraphia as writing is supposed to be most simple and therefore least vulnerable. He would not have predicted the selective loss of writing would be possible

(see Lorch & Barrière, 2001, for a detailed discussion of this issue with respect to Pitres 1884).

Had some of the observations outlined in this review been “logically connected” (Stent, 2003) to the developing theoretical constructs of the times, it would have for instance provided additional support for the independence of language from the intellect, and it would have informed distinctions between concepts, words and their expression. In turn neither Jackson nor Trousseau nor Dejerine integrated the findings they themselves cited into the constructs they were developing on the organization and localization of the language faculty. The contributions of Marcé (1856), Ogle (1867) and Pitres (1884) in advance of their times are best captured as premature thoughts on obscure writing disorders, to use the concept defined by Stent (2003).

According to Stent (1972, 2003) the lack of impact of premature scientific discoveries on the intellectual context in which they are expressed can also be partly explained by the lives of their authors. Marcé died at the age of 38, 3 years after Broca (1861). The publication reviewed here seems to be the only one he wrote on aphasia (Dechambre, 1921) and Ogle (1867) is also his only work on this topic. He resigned from St George's Hospital in 1872 "on considerations of health" (Anonymous, 1912) shortly after and then took up an appointment as the Registrar-General of the national Census from 1881-1891 during which time he wrote a large number of papers on public health and epidemiology and demographic statistics. He was elected Fellow of the Royal Statistical Society in 1885 and died in 1912 (Anonymous, 1912). Pitres's mentor, Charcot died shortly after the publication reviewed here (Pitres, 1884). Pitres continued to publish on issues surrounding aphasia and the localization of functions. Because he was based in the medical centre of Bordeaux his presence is not felt in the debates that were a feature of the Paris neurological community at the end of the 19<sup>th</sup> century. The critical review of these authors' publications on writing disorders presented here is an attempt to reinstate their insights into the development of the understanding of language production.

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TABLE 1: cases of dissociations between speech and writing disorders reported by Marcé (1856)

Obs.	SPEECH	WRITING	READING	ORAL COMPREHENSION & OTHER FACULTIES (INCLUDING INTELLECTUAL FACUTLY)
I (from Martinet)	Spontaneous production of sentences impaired One word repetition impaired: substitutions Naming: some substitutions No motor problem (as he produces words, although not the appropriate ones)	Spontaneous writing of single words and sentences intact Writing to dictation intact Copying intact	Impaired: inability to read what he has written	
II (Osborn, 1833) polyglot	Spontaneous speech fluent but unintelligible, and accent changed (sounded like a foreigner) Ability to repeat some, but not all, single syllables intact	Fluent spontaneous writing, appropriate spelling, occasional word substitution	Reading comprehension Intact Reading aloud: use of syllables that belong to different languages, improved through training	Recovered after 2 weeks, independently from speech, as evidenced by his reading abilities Arithmetic intact Ability to remember familiar tunes
III (Pinel)	His own name	Lost	Lost	Remembered objects related to his

(solicitor)	and names of his relatives forgotten Tongue movement intact			job: <ul style="list-style-type: none"> <li>- indicated with his fingers files that contained documents that colleagues could not find</li> <li>- gestured to communicate that his ideas were still organized in a coherent way.</li> </ul> Oral comprehension: intact
IV (Gall) (soldier)	Impaired: cannot express his feelings, ideas. Unable to articulate on the spot when asked to repeat but shortly afterwards, he produces this word involuntarily Phonatory apparatus intact (tongue movement etc) Very good repetition of isolated words	Lost	Lost	Intact: his facial expression does not exhibit signs of disorder; Embarassed: points to the lower part of his forehead; Oral comprehension intact: he carries out commands and requests When asked what an armchair is for he replies by sitting in it. No memory impairment.” “communicated veividly that he was upset he could not express many things he wanted to tell {the doctor} about”.
V solicitor Emphasis on the fact that experiments	No problems with phonatory apparatus Produces apparently well-	Spontaneous writing (including of his name) impaired Can copy	Impaired: when asked to read the word <i>mouchoir</i> that he has written,	Intact: when shown a tissue he shows what it is used for Memory: in the morning better than in the afternoon.

<p>carried out with many words and objects and the outcome is always the same</p>	<p>constructed sentences Stammers Inappropriate use of words: meaning forgotten Poor naming, including of objects which he is shown Can repeat a word he has just word, but a few minutes later, he has forgotten it.</p> <p>When not shown an object, he can repeat its name, but he does not know what object is being referred to.</p> <p>Lesion of the faculty controlling speech.</p>	<p>Immediately after the repetition of a word, he can write it effortlessly, but a few minutes later he has forgotten the word and how to write it.</p>	<p>he spells out each letter and manages to pronounce <i>boischair</i> (non word) When not shown an object, when asked to repeat its name, he can write it correctly but he does not know what object is being referred to.</p>	
<p>VI (Hérard, 1848)</p>	<p>Phonatory apparatus intact Distinct and fluent articulation of words</p>	<p>Lost: when asked to write his name, he produces unintelligible characters</p>		<p>Oral comprehension intact: reacted when heard his name and the name of his profession.</p>

	<p>Word substitution Sometimes able to finish a word when presented with phonological cue</p> <p>Spontaneous sentences: short and composed of incoherent and unintelligible words</p>			
VII (no author, 1845)	<p><u>1<sup>st</sup> attack:</u> difficulty in articulation and expression of ideas</p> <p><u>1<sup>st</sup> recovery:</u> disappearance of the symptoms</p> <p><u>2<sup>nd</sup> attack:</u> impossibility to produce syllables, no paralysis</p> <p>Produced no request</p> <p><u>2<sup>nd</sup> recovery:</u> pronunciation still impaired, only inarticulate sounds and very rarely complete</p>	<p><u>2<sup>nd</sup> attack:</u> unable to write</p> <p><u>2<sup>nd</sup> recovery:</u> inability to write, including his</p>		<p><u>2<sup>nd</sup> recovery:</u> intellectual faculty recovered, still unable to count and to produce digits to represent a figure,</p>

	<p>words produced.</p> <p><u>3<sup>rd</sup> sequential recovery- 8 stages:</u></p> <p>2. Recovery of movements of the phonatory apparatus: fluent humming.</p> <p>3. Ability to deny and assert, unable, despite attempts to produce words.</p> <p>7. Ability to</p>	<p>name and digits (see intellectual faculty).</p> <p><u>3<sup>rd</sup> sequential recovery- 8 stages:</u></p> <p>3. Depite attempts, unable to write words.</p> <p>4. Effortful copy of drawing of objects.</p> <p>5. Ability to copy</p>	<p><u>3<sup>rd</sup> sequential recovery- 8 stages:</u></p>	<p>ability to whistle familiar tunes.</p> <p><u>3<sup>rd</sup> sequential recovery- 8 stages:</u></p> <p>1.Recovery of his intellectual faculty: general behaviour and performance at chess.</p> <p>3. Resorted to gestures to communicate.</p>
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	<p>repeat memorized verses recovered.</p> <p>8. Ability to speak recovered.</p>	<p>his name when given a model recovered, still unable to write to dictation.</p> <p>6. Ability to produce and place digits accurately.</p> <p>7. Ability to write recovered.</p>		<p>6. ability to carry out complicated calculations recovered</p>
VIII (no author, 1841) reverend	<p>Phonatory apparatus intact.</p> <p>Inability to produce single words.</p> <p>Blood let → recovery</p>	<p>Impaired: asked for paper and pen and produced an unintelligible sentence.</p> <p>Blood let → recovery</p>		<p>All senses intact.</p> <p>Oral comprehension intact: understood questions</p> <p>Communicated using gestures.</p> <p>Surprised, almost amused by his condition.</p> <p>Blood let → recovery</p>
IX (Marcé)	<p>Inability to pull his tongue out of his mouth.</p> <p>Inability to articulate a single.</p> <p><u>1<sup>st</sup> slight improvement:</u> Still unable to speak.</p>	<p>Impaired: when asked to write, he produces sticks and unintelligible signs.</p> <p><u>1<sup>st</sup> slight improvement:</u> Can write the word <i>oxygène/oxygen</i>, his name and birth place but</p>		<p>Hearing intact.</p> <p>Seems to understand what is said to him: replies with headshakes.</p>

	<p><u>2<sup>nd</sup> improvement:</u> Improvement of articulation: asked clearly and without word substitution to be brought specific book, weak voice at the end of each word and between each syllable, marked pause.</p> <p><u>3<sup>rd</sup> improvement:</u> Complete recovery of the voice.</p> <p><u>4<sup>th</sup> improvement:</u> back to normal.</p>	<p>after numerous hesitations and the letters are not well-formed.</p> <p><u>3<sup>rd</sup> improvement:</u> effortless writing.</p> <p><u>4<sup>th</sup> improvement:</u> back to normal.</p>	<p><u>4<sup>th</sup> improvement:</u> back to normal.</p>	<p><u>4<sup>th</sup> improvement:</u> back to normal.</p>
X (probably)		Pre-morbid	Pre-morbid	Pre-morbid faculty: very intelligent,



<p>Marcé, 1853) (sommelier in famous restaurant) Emphasis on the fact that tasks carried out many times and always the same outcomes.</p>	<p>Unable to produce single utterance. Tongue flexible, although hanging slightly on the right → paralysis of the phonatory muscles diagnosed.</p>	<p>writing: very good.  When asked to write, he communicates that he remembers but he produces meaningless (non) word, e.g. <i>bauru</i> and gets frustrated. To dictation: 1<sup>st</sup> syllable is correctly spelled while the 2<sup>nd</sup> one is composed of letters combined by chance. When presented with a sentence, his copy is exact. If the word he has just read is hidden, he stops writing or he produces a series of incoherent letters. When asked to write a figure</p>	<p>reading: very good.  Vision intact.</p>	<p>very good education.  Hearing intact. Comprehension intact: when asked a question, he indicates he has understood using gestures.  Taste intact. when asked a question, he indicates he has understood using gestures</p>
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	<p><u>1<sup>st</sup> phase of improvement:</u> Able to produce 2-syllable words and to appropriately name objects.</p> <p><u>2<sup>nd</sup> phase of improvement:</u> Gradual improvement.</p> <p><u>3<sup>rd</sup> phase of improvement:</u> Speech clearer, as long as slow, produces whole sentences.</p> <p><u>4<sup>th</sup> phase of improvement:</u> Only slight</p>	<p>made up of a single digit, he is able to but gets confused when the figure is more complex.</p> <p><u>1<sup>st</sup> phase of improvement:</u> in written naming: systematic substitutions.</p> <p><u>2<sup>nd</sup> phase of improvement:</u> Still substitutions: <i>funnel/entonnoir</i> instead of <i>Bourgogne/county &amp; wine</i></p> <p><u>3<sup>rd</sup> phase of improvement:</u> can sign his name and write to dictation, but hesitates.</p> <p><u>4<sup>th</sup> phase of improvement:</u> Writes, with no</p>		
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	articulation defect	hesitations.		
XI (observation by Chairou, colleague of Marcé) Businessman	Unable to reply, except using 2 syllables <i>oui/yes</i> and <i>non/no</i> which he often substitutes, using one instead of the other.	Cannot write to dictation but can copy letters. Production of digits: can write dates but cannot write his age or date of birth. Spontaneous writing impossible.	Vision intact. Los of reading comprehension, although he distinguishes letters from each other but combining them to form syllable and read aloud impossible.	Smell and taste intact. Communicates through facial expression and gestures. Hearing intact. Understands sentences said to him. Can understand when people read aloud.
XII (Abercrombie, undated) Death a few months later.	<u>Improvement:</u>  After a while, began to talk about domestic matters.	Right hemiplegia.  <u>Improvement:</u> Able to write, often wrote lines composed of German and Latin words → meaningless words but well-formed letters.	<u>Improvement:</u> Reading impaired. Started to read Latin again rather than German (mother tongue) words. Could only read a few words at a time.	Loss of intellectual faculty followed by improvement  <u>Improvement:</u> Started to recognize his friends, remember words and recite the Sunday mass.  After a while, he became more attentive to his environment.  Often complained of the loss of his intellectual faculty and expressed the hope that it would return.

TABLE 2: cases of aphasia and agraphia reported by Ogle (1867)

OGLE, 1867	Speech	Writing	Letter Arrangement	Reading	Comprehension
Case I	Only “no”	Only “74”	Can not do	Can point to spoken written words	Intact Nods answers
Case II	“yes” “no” and “a few words”	Letters produced “in meaningless succession”			
Case III	Word substitutions, Repetition OK	Can not form letters, can not copy	For his name James Simmonds produced JICMNOS	Intact	Intact
Case IV	“can say a few words but most an unintelligible gabble”	None	For his name James Pascoe produced JASPENOS	Intact	Intact
Case V	“yes” “no” and “a few monosyllables”	Could write with left hand words he could not say, some tendency to reduplicate letters: testament > TESTATAMENT attributed to low education level			Intact

TABLE 3: Pitres’ classification of lesion sites and disorders.

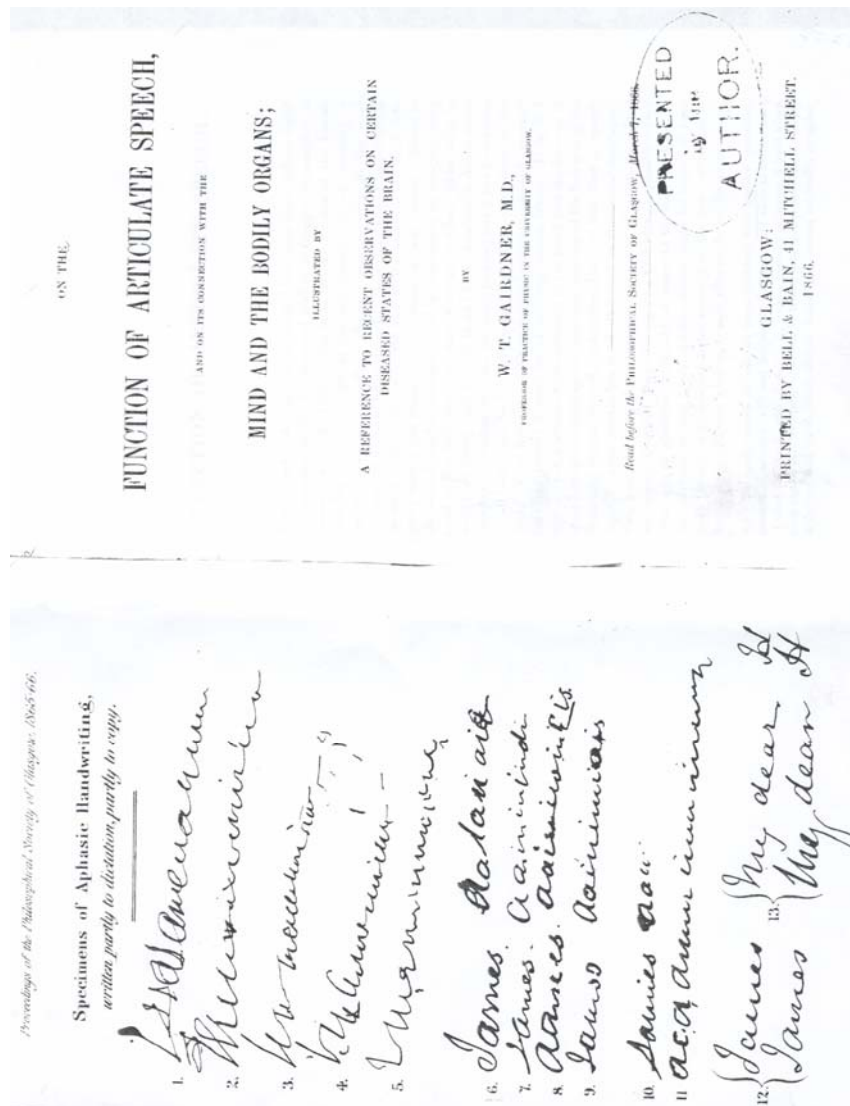
Lesion	Memory store damaged	Disorder
Limited lesion of angular gyrus or of 1 <sup>st</sup> temporo-sphenoid convolution	Visual memory of letters, syllables, words	Word blindness or pure word deafness
Greater lesion of angular gyrus or of 1 <sup>st</sup> temporo-sphenoid convolution	Visual memory of letters, syllables, words and motor zones	Word blindness or pure word deafness & hemiplegia
Foot of second frontal convolution	Graphic memory	motor agraphia
Foot of third frontal convolution	Phonetic memory	aphasia

TABLE 4: Dejerine's classification of agraphias

Aphasia	Spontaneous writing	Writing to dictation	Copying	Spelling (with letter blocks)
Broca's aphasia	Impossible (except for very familiar words, including own names, address etc): writing reflects speech	As damaged as spontaneous writing	Preserved but cursive transcoded in cursive and print transcoded into cursive, graphic output looks normal	Impaired
Pure motor aphasia/aphemia	Intact	Intact	Preserved but as above print transcoded into cursive	Intact
Wernicke's/sensory aphasia & global aphasia	Typically impossible: the patient can only produce strokes that don't look like letters. The ability to write name, signatures is preserved but as he is unable to separate letters the performance of this task cannot be interrupted in the flow; More rarely → paragraphia, resulting in written jargonaphasia; Very rare: production of meaningful existing words but their combination does not make sense → written paraphasia; Associated with blindness	Impossible as the patient does not understand what is dictated to him, since he suffers from word deafness; even when he thinks he has understood, he produces illegible signs, his name or meaningless words; Complete parallelism with spontaneous writing	No difference between copying print and cursive: patient copies stroke by stroke as if he was copying hieroglyphs or Chinese; when given large writing to copy, sometimes he produces the general outline of the letter and subsequently adds additional strokes; If he model is remove the patient is unable to finish what he started; very slow performance: the patient needs a few hours to produce a few	

	prevent patient from correcting their errors and result in larger size of writing; Generally the writing of digits, better preserved than the production of letters or words.		words	
Pure word blindness	Preserved but writing larger than usual and not as horizontal, due to hemianopsia; Handwriting different in spontaneous writing and writing to dictation	Preserved but writing larger than usual and not as horizontal, due to hemianopsia	Preserved and faster than in sensory aphasia; patient does not transcode cursive into cursive	

FIGURE 1: The handwriting of Gairdner's (1866b) patient



EXPLANATION OF THE LITHOGRAPHIC DRAWING OF APHASIC HAND-WRITING.

Figs. 1, 2, 4, 5. Fac simile of the first attempts of J. A. M. to write his own name without a copy.

Fig. 3. An attempt to write his sister's name—A. M.

Figs. 6-11, Attempts in which the first or Christian name was set as a copy, the surname being mostly written to dictation, letter by letter.

Figs. 12, 13. The upper line was written by his sister, the lower copied by J. A. M., the characters of his own hand-writing being distinctly preserved in some of the minute differences of the lower from the upper line, as mentioned in the text.

*N.B.*—After copying his *whole* name with considerable success (the fac-simile of this is omitted for obvious reasons), by far the worst specimen of the series, 6-11, was produced, showing that the fact of copying once or twice successfully failed to make a permanent impression on the power of writing spontaneously.