CORTEX 40th ANNIVERSARY

THE HISTORY OF NEUROPSYCHOLOGY ACCORDING TO NORMAN GESCHWIND: CONTINUITY AND DISCONTINUITY IN THE DEVELOPMENT OF SCIENCE

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Traditionally, the birth of neuropsychology, i.e. the investigation of disorders of cognitive processes following acquired cerebral lesions, is associated with the clinical descriptions by Paul Broca in the period 1861-1865 and the discovery of the left hemisphere dominance for language (Broca, 1865). The importance of Broca's studies is mainly methodological. He showed that a specific cognitive disorder can be systematically associated with focal brain damage, thus leading to the claim, following Bouillaud (1825), that the site of the lesion corresponds to the centre of the function. Theoretically more relevant was the contribution of Carl Wernicke (1874) who proposed the first neuropsychological model in so far it depicted the different levels of processing underlying the simple task of oral repetition (psychological description), the cerebral areas and the subcortical and transcortical connecting pathways that are associated to each processing stage (neurological description), and the specific symptoms that follow circumscribed brain lesions (clinical description). After Wernicke, any neuropsychological model should comprise these three planes of description. Therefore the actual birth of neuropsychology should be dated to 1874, i.e. when the monograph of Wernicke was published. It is worth noting that in the same year Wilhem Wundt (1874) published the book that set the foundation of the scientific psychology, conceived as the discipline investigating the mind in physiological condition.

A widely-accepted version of the history of neuropsychology (see for instance Luria, 1967; Lecours and Lhermitte, 1979; Finger, 1994; Basso, 2003) assumed that different eras can be identified according to the emphasis that has been given to the cerebral basis of mind and behaviour, or, alternatively, to an explicit, psychological theory of human cognition. Depending on the prevalence of the neurological or psychological side of the coin, the development of neuropsychology can be subdivided by five different periods.

1. *Associationism*. Following Wernicke (1874), in the last quarter of the XIX century several authors, later called "diagram makers", proposed different schematic models depicting how language is represented in the brain (see Jacyna, 2004a; 2004b). They suggested the existence of networks associating simple components, either sensory-motor or conceptual (Charcot, 1883; Lichtheim, 1885; Dejerine, 1892; Bastian, 1898). Language disturbances were studied mainly from an anatomical point of view and different taxonomies of aphasia based on the localisation of the cerebral lesions were proposed.

2. *Holistic approach*. Influenced by Jackson (1866) and Freud (1891), a different approach prevailed in the first half of twentieth century, stating that language disorders have to be studied from a psychological perspective. Aphasia was conceived as a unitary disorder that varies only in severity, and reflects an impairment of the symbolic processes underlying communicative behaviour and interaction (Marie, 1906; von Monakow, 1910; Head, 1926; Goldstein 1948). Patients were assumed to be equally affected in receptive and expressive language, the core defect being the reduction to concrete levels of verbal behaviour (that was described as linguistically regressed and dependent on environment and emotions). The idea that a specific component of the language function could be localised to discrete cerebral areas was rejected. The influential group of German speaking authors made reference to the Gestalt theory that was dominant in European psychology. The contribution from different disciplines (e.g. philosophy, linguistics, anthropology) was taken into account.

3. *Experimental studies*. After the Second World War, the unitary interpretation of aphasia was abandoned whereas the different clinical manifestations of aphasia were reconsidered. Using the methodology of experimental psychology (statistical analyses, group studies, standardised testing batteries), most studies addressed clinical-anatomical issues as well as physiopathological hypotheses, returning to investigating the brain-behaviour relationships. In the sixties, different teams of researchers provided important empirical data about the differential functional roles of the cerebral hemispheres and the clinical features of the major neuropsychological syndromes (Benton, 1961; Hecaen and Angelergues, 1961; De Renzi and Vignolo, 1962; Warrington and James, 1966). Interdisciplinary journals specifically devoted to neuropsychology (i.e. Cortex and Neuropsychologia) were founded to disseminate the growing amount of experimental reports.

4. *Cognitive approach*. Following the seminal papers by Marshall and Newcombe (1966; 1973), in

the late 1970s and 1980s a new approach prevailed. Performances of brain-damaged individuals were used as source of evidence to derive hypotheses about the functional architecture of cognitive processes in normal conditions (Shallice, 1979; Caramazza, 1984). Neuropsychology was assumed to be a branch of cognitive psychology, its aim being to provide empirical facts to be compared with data coming from experimental studies with neurologically intact individuals. Similarly to the era of "diagram makers", the single case study approach was employed and "box-and-arrows" models were proposed to represent the flow of information underlying task performances. However, at variance with the associationistic approach, in most cases, the anatomical issues were not addressed and the cerebral basis of cognitive processes were ignored.

5. *Brain Imaging studies*. In the last decade of the last century, new technological opportunities produced a return to studies focussed on brain-behaviour relationships (Corbetta et al., 1993; Frackowiak, 1994; Markowitsch et al., 2003; Postle et al., 2003). Neuroimaging allowed investigators to observe the cerebral activity of normal individuals while they performed cognitive tasks, the identification of the neural networks that underlie cognitive processes was again the main purpose of neuropsychology. The cerebral basis of processing components were not thought of as a set of independent centres, but as a network acting as a functional system (see for instance the studies on the phonological loop component of working memory, Paulesu et al., 1993) similar to that hypothesised by Luria (1966a). This approach has provided a very large set of evidence confirming available data from previous clinical studies.

The brief history of neuropsychology can be described as the succession of these different stages. Its development could be described either as a sequence of completely new approaches that substituted the preceding ones, or as a pendulum-like movement, in which the neurological and the psychological descriptions of the cognitive processes alternated as the main goal of clinical investigation. Even if the different approaches co-existed in the same period, only one appeared dominant in terms of theoretical influence and available resources. For any epoch, the most influential authors are assumed to belong to a specific school and portrayed either as advancing contrasting and novel ideas that replaced the dominant views or as re-proposing forgotten theories and methods as a contrast to contemporary and widely accepted approaches.

Norman Geschwind (1926-1984) played a relevant role in developing neuropsychology in the second half of the last century. In a series of influential papers published in Brain, he introduced the concept of "disconnection syndrome" (Geschwind, 1965) and proposed a revised version of the Wernicke model that is now referred to as the Wernicke-Geschwind model (e.g. Kandel and Schwartz, 1985; Gazzaniga et al., 1998). Without returning to the original notion of "centres", Geschwind suggested a close relationship between the linguistic components selectively impaired in the different forms of aphasia and the localisation of the documented brain lesions.

Seemingly, Geschwind's contribution in challenging the then predominant holistic orientation and reasserting the importance of the investigation of the anatomo-clinical correlations for a better understanding of aphasia represents a break in the history of neuropsychology. This has been acknowledged by most textbooks (e.g. Basso, 2003). However, in a paper preceding those in Brain and published in the first volume of *Cortex*, Geschwind (1964) illustrated his own position suggesting a continuity across the different neuropsychological approaches.

Geschwind wrote that "Somewhat about 1960 I awoke, perhaps belatedly, to my own profound confusion. I had regarded myself as a member of the philosophically sophisticated Jackson-Goldstein-Head group" (p. 215). At that time, he acknowledged that he was part of the so-called "reform movement" that overcame the "long dark ages" dominated by the diagram makers: he quoted the influential work put forward in France by Pierre Marie, in Switzerland by von Monakow, in England by Henry Head and in Germany by Kurt Goldstein.

However "I was persistently troubled by the fact that people who had left their mark so indelibly in many areas of neurology, such as Wernicke, Bastian, Dejerine, Charcot, and many others, could apparently have shown what was asserted to be the sheerest naivete and incompetence in the area of the higher functions. It seemed difficult to accept the view that men who had established long-honored clinical pictures should have apparently been so incapable of examining an aphasic, or that scholars who had made fundamental anatomical investigations of permanent worth should have been so perfunctory and sloppy in their descriptions of the brains of aphasics" (p. 215).

Therefore, he decided to recover the original literature that at that time was not available in English. "The picture that emerged (…) was (…) that of healthy active disagreements of a lively science. The broadside accusations of carelessness, of inadequate examination, of unconcern with psychology were all unfounded, at least when the best of the classicists were involved." (p. 215). "My colleagues and I (…) had expected to find that most of the criticisms of the great reformers were justified and we were quite unprepared to find the case to be so clearly otherwise." (p. 216).

At that point Geschwind went back to the writings of the "great reformers" and "re-read them

as carefully as their predecessors". He found that the diagram of the lesions producing the different aphasic syndromes proposed by Marie and Foix (1917) was not very different from the preceding diagrams; that von Monakow came to the same conclusion reached by Liepmann (his "list of sites of predilection of apraxia (…) do coincide with Liepmann's older list"); that Head proposed a set of localisations for his four types of aphasia in most instances coinciding with those of earlier authors and that his definition of "schema" is quite similar to Bastian's notion of "centre".

According to Geschwind, all these authors, Pierre Marie, von Monakow and Head, "did contribute to the advance of knowledge of aphasia", but "they were not so revolutionary as they thought they were and that for all their protests they were nearer to the classical tradition (which was in any case not at all monolithic as is often suggested) than they asserted they were." (p. 217).

Geschwind discussed mainly the work of Kurt Goldstein. He acknowledged that Goldstein is a great figure in the history of aphasia, but considered that his contribution was "not totally to destroy his predecessors, to abolish the diagrams". (p. 222). On the one hand Goldstein distinguished between different types of aphasia, on the other hand his views on the localisation of aphasic syndromes or his discussion on the role of the corpus callosum in determining the unilateral agraphia of the non dominant hand appeared very similar to those proposed by Liepmann and Bastian. Geschwind concluded that "Goldstein, like Head, von Monakow, and Marie, (…) rather than being the initiator of a totally new approach, he was a brilliant developer and reviser of a magnificent understructure developed in the years before his arrival on the scene" (p. 222); "his contribution as a localizer in the classical sense is in fact highly significant although rarely taught" (p. 223). This interpretation has been recently confirmed by Noppeney and Wallesch (2000) who stated that also "the (Goldstein's) theoretical concepts seek to bridge the gap between localizationism and holism" (p. 372).

The work of Goldstein is even more important than what was described by Geschwind in the 1964 paper. Luria (1976) defined Goldstein "one of the greatest neurologists who lived in the first half of this century" (p. 241) and considered the systematic and thorough neuropsychological analysis of the clinical data "as his undisputable contribution to contemporary neurology" (Luria, 1966b, p. 312). For example, his examination of repetition tasks led him to reconsider the clinical picture of conduction aphasia, that he re-named "central aphasia", allowing to Luria (1966a; 1976) to hypothesise the existence of two different forms of conduction aphasia, then confirmed by Shallice and Warrington (1977). Goldstein proposed enlightening and original analyses on the relation between thought and language and on the several factors causing the complex patterns of symptoms. By and large, his theoretical work addressed important issues that are still debated (see Noppeney and Wallesch, 2000; Noppeney, 2001). Geschwind recognised the influential role of Goldstein in the development of neuropsychology; however, he aimed to highlight that Goldstein "did not reject his predecessors as much as many other people thought he had" (p. 223).

In his Cortex paper, Geschwind maintained that "our standard view of the history of aphasia is at least a seriously distorted one" (p. 222). In my opinion, this is a crucial point. The description of history as a sequence of successive approaches, is based on simplified representations of the dominant theoretical views. To distinguish the different positions within a community of scientists, historians have to emphasize differences and contrasts, and to ignore what is shared and definitively acquired. They tend to underscore disagreements between different eras and to condense and homogenize opinions within the same phase. The endeavour of historians is to produce an abstract description of a general movement: they depict tendencies, notice the introduction of innovative elements, and identify the way the dominant approaches prevailed.

The historical point view takes account of the collective dimension. In contrast, the scientific debate has to point to the individual position. The schematic or reduced descriptions of the different authors' contribution are misleading. By definition the work of each individual scientist is not homogeneous and may remain relevant well beyond the years in which they acted. Their work cannot be simply labelled as closely associated to a given school, and definitively abandoned when different approaches prevail. The development of science is plenty of discontinuities. However, beside breaks and changes, some basic ideas are maintained across different eras. There are *fils rouges* across phases to be recognised. The Wernicke-Geschwind model, for instance, is as linked to the "diagram makers" era as it is related to the recent brain imaging studies.

If one thinks that the current era is completely different (or even more advanced) than the preceding ones, he has to conclude that this era is the only one to be considered, thus limiting the discussion to the contemporary authors and to the currently disputed issues. When dealing with a topic, previous relevant studies, even if very old, have to be known, whereas standard quotations without a direct reading should be avoided. If the contributions of the preceding authors (more articulated than usually presumed) are ignored, the main risk will be either to repeat their discoveries or to delay important acquisitions. And this does occur very often. Geschwind concluded his paper

in *Cortex* stating "the widespread neglect of the important elucidation of the functions of the corpus callosum by such people as Dejerine, Liepmann, and Goldstein himself at the turn of the century is an excellent example of the damage done by this failure to appreciate the past; significant experimental and clinical study was almost certainly delayed for many years by this neglect of the classical localizers" (p. 222).

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