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Brain Plasticity and Cognitive and Behavioral Changes in Early Development: *19th* Century Perspectives

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Introduction

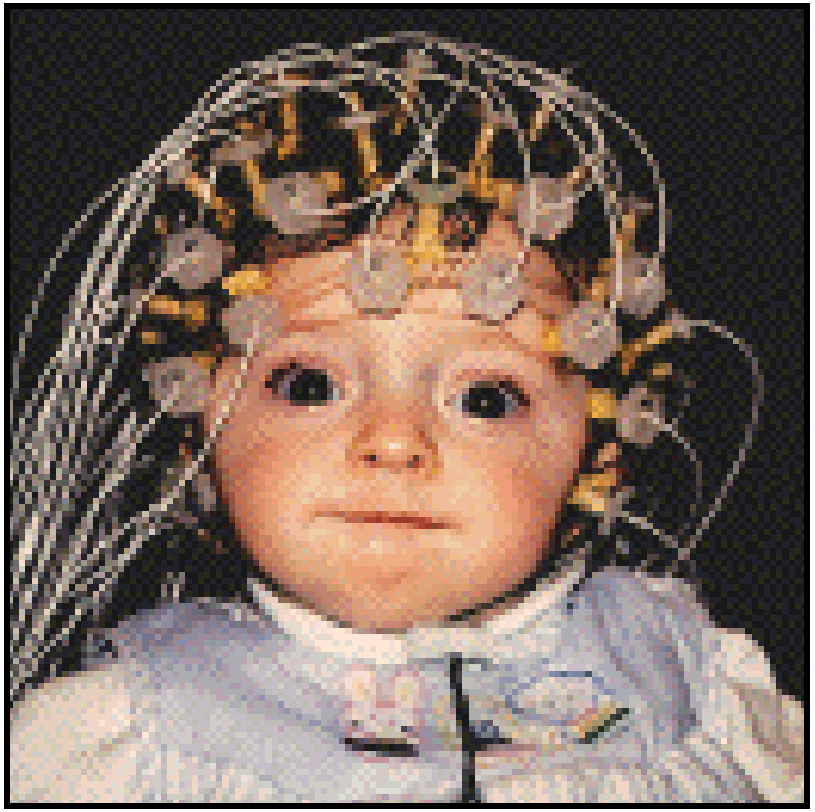
At the beginning of the 19th century no distinction between the learning capacities of children and adults was assumed. This study explores the evolution which has led to the current developmental concepts of **Critical Period**, **Modularity and Modularization** and the distinction between **Universal and Culture-specific** cognitive skills regarding the application of these notions.

The findings which emerge from the examination of 19th century monographs and unpublished archives reveal a) that the role of 19th century aphasiologists has been crucial in altering the views entertained on brain maturation and the developmental concepts mentioned above and b) that notions such as the **Critical Period** and **Modularization** slowly evolved in the course of that period. The impact of this work on developmental psychology is assessed.

20th & 21st Century: The Child as an Object of Study in Cognitive Science

- **Critical Period (Lenneberg, 1967)**
- **Modularity (Fodor, 1983) & Modularization (Karmiloff Smith, 1992)**
- **Focus on Universal cognitive skills**

→ **Considerations of fast changes in early brain maturation**



History of childhood

Steedman (1992) emphasizes the contribution of Cognitive Scientists to the current conceptualization of childhood.

History of childhood

Ariès (1960):

Distinction between
childhood and
adulthood
→ recent concept

Jean Marie Gaspard Itard
1801, 1806

- 1st experiment in developmental psychology
- Assumptions based on Locke, Condillac: education of skills and knowledge→ possible at all ages.

Commentary on Itard by Dacier, *1806*

"This class of the Academy acknowledges that it was impossible for the institutor to put in his lessons, exercises, and experiments more intelligence, sagacity, patience, courage: and that if he has not obtained a greater success, it must be attributed, not to a lack of zeal or talent, *but to the imperfections of the organs* of the subject upon which he worked"

Early *19th century* perspectives

Only 2 possible explanations for lack of progress of Wild Boy of Aveyron:

1. Pedagogical intervention
2. Physiological imperfection

No consideration of **Critical Period**

Between the beginning and the end of the 19th century

WHO

contributed to changing the conceptualization of the link between children's cognitive and behavioral development and the maturation of their brains?

M. J. Parrot, *1879*
Sur le développement du cerveau chez les enfants du premier âge

"Chez l'enfant qui vient de naître, l'encéphale est de tous les viscères le plus imparfait: et il n'acquiert qu'avec lenteur, la structure nécessaire à l'accomplissement de ses hautes fonctions.-- Combien dure cette période de la vie où l'organe cesse d'augmenter de poids, et qui, d'après […] Broca coïnciderait à peu près avec la quarantième année?"

"In the newly born child, of all the bodily organs, the encephalon is the most imperfect: and it is only very slowly that it acquires the structure necessary to carry out higher functions-- How long does this period last until the organ stops increasing in weight, which, according to […] Broca roughly coincides with the age of forty?" (translated by IB & ML)

Parrot
(*1829-1883*)

- Distinction between the young and mature brain: difference in weight
- Emphasis on imperfection of the young brain
- Emphasis on slowness and length of maturation
- Reference to Broca who 18 years before had launched the ‘modern era of localization of functions’

Who wrote about child development and brain maturation?

- Jean-Martin Charcot
- Théodule Ribot
- Benjamin Ball

→Acquired disorders

→Nascent field of aphasiology

Charcot (*1825-1893*) on early development and brain maturation

Observations Charcot, (n.d.) Bibliothèque Charcot Paris VI, MA 8 12, Chemises 4-2.

"Dans Ribot la mémoire fait biologique
quand l'enfant apprend à écrire …, il lui est impossible de remuer la main toute seule. Il fait se mouvoir aussi sa langue, les muscles de la face et même son pied. Il en vient avec le temps à supprimer les mouvements inutiles…
Enfin par [l'exercice], les mouvements appropriés dit Ribot se fixent à l'exclusion des autres. *Il se forme dans les éléments anatomiques des associations [permanentes], et des associations dynamiques [tendances secondaires] + stables.*" (transcribed by IB)

"In Ribot's Memory as a biological fact when a child learns to write…, he finds it impossible to move solely his hand. He also moves his tongue, his facial muscles and even his foot. As time passes, the unnecessary movements are suppressed … Finally through [exercise], the appropriate movements, says Ribot, are fixed to the exclusion of others. *[permanentassociations And dynamic associations [secondary tendencies] + stable form in the anatomy."* (translated by IB & ML)

Charcot
on the specialization of functions

Observations Charcot, (n.d.) Bibliothèque Charcot Paris VI, MA 8 12, Chemises 4-2.

"Education des centres. Quand on apprend à lire ou écrire ou parler dit Ribot on organise ou on s'efforce d'organiser un système particulier disponible de cellules qui sera l'appareil coordinateur de l'écriture– C'est quand l'appareil de la mémoire graphique motrice d'articulation ou d'écriture [est] organisée que nous [savons] lire ou écrire. Il y a donc a cet âge et un peu toute la vie des cellules disponibles".

"Education of the centres. When one learns to read or write or speak, says Ribot, … one organizes or attempts to organize a particular system of cells which will make up the apparatus controlling writing—It Is when the apparatus of the graphomotor memory of articulation or of writing [is] organized that we [know] how to read or write. Thus there is at this age and, to a certain extent throughout the entire lifetime, cells that are available.

"C'est ici le cas de dire avec Bastian 'le cerveau pour une part est un organe toujours en voie développement *c'est une [masse] à virtualités structurales* plutôt que de [tissus nerveux] développés
Et avec Spencer: 'le cerveau est un registre organisé d'expérience nombreuses'

C'est la fonction qui fait l'organe".
(transcribed by IB)

"It is appropriate to agree with what Bastian says: 'in a way, the brain is a constantly Developing organ *it is a [mass] endowed with structural propensities* rather Than developed [brain tissues];
And with Spencer: 'the brain is a store which consists of Numerous experiences'.
It is the function which determines the organ."
(translated by IB & ML)

Charcot's perspective

- The process of Modularization applies to both Universal (*speaking*) and Culture-specific (*reading*, *writing*) language skills
- Precursor to Critical Period

Ball (*1834-1893*), *1884* in his preface to the French edition of Kussmaul, *1876*

“Nos enfants n’ont plus à faire acte de créateur. Nés au milieu d’une société régulièrement organisée, entourés d’une famille donc chaque individu concourt à leur instruction, déjà pourvus d’aptitudes héréditaires qu’une longue série de générations leur a léguées, ils arrivent promptement à substituer au langage naturel la langue nationale; et après avoir parlé, peut être avec le bulbe, ils arrivent à se servir des régions les plus nobles de l’encéphale.

“Our children do not need to act as creators. Born in a well-organized society, surrounded by relatives all of whom contribute to their instruction, already endowed with hereditary aptitudes that a long series of generations have passed on to them, they rapidly succeed in substituting the natural language with the language of their country; and, after they are able to speak, perhaps with the bulb [brainstem], they come to use the highest areas of the encephalon.

Le temps et l' éducation aidant,la faculté de la parole se développe de plus en plus; elle traduit avec une souplesse merveilleuse les aptitudes naturelles de l'individu, les impressions transmises par l'éducation et l'influence toute puissante du milieu.
L'évolution s'arrête à l'âge de la puberté et nous voyons vers cette époque la langue maternelle s'identifier avec la pensée de l'individu au point de rendre difficile l'acquisition des langues étrangères."(p.viii)

With the help of time and education, the faculty of speech further develops; it translates with a wonderful flexibility the natural aptitudes of the individual, the impressions transmitted through education and through the all powerful influence of the environment. The evolution stops at the age of puberty and it is at this stage that we observe that the mother tongue is associated to such an extent with the thought of an individual that it impedes the acquisition of foreign languages." (translated by IB & ML)

Ball's views

- Young brain different from mature brain
- Distinction involves a process of displacement of functions
- Precursor to Critical Period

Edouard Séguin
(1812-1880)

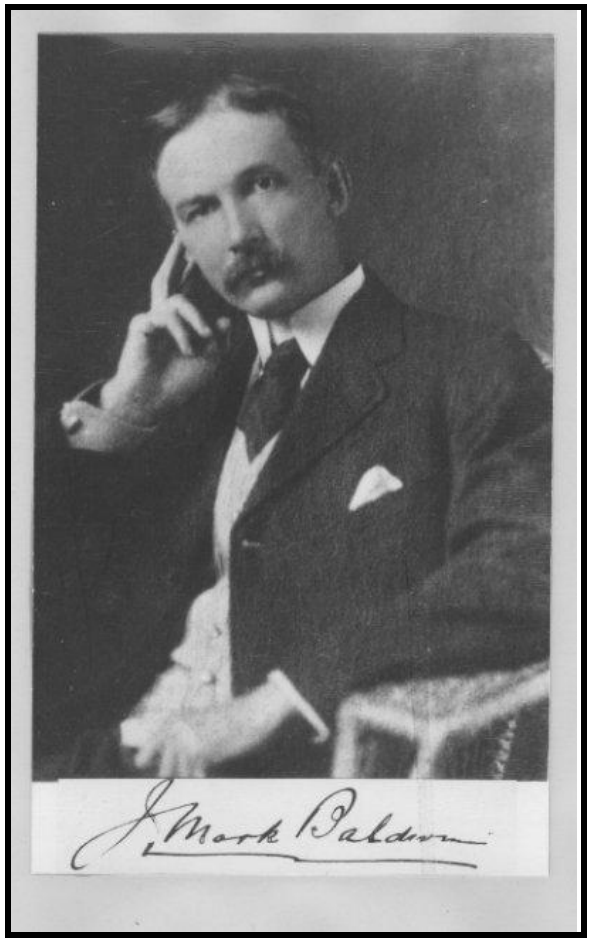
- Idiocy→the brain does not present structural abnormalities but its growth is interrupted

- The earlier the intervention, the better

→ Critical Period

J. Mark Baldwin
(1861-1934)

"For example: a psychology which holds that we have a 'speech faculty', an original mental endowment which is incapable of further reduction, may appeal to the latest physiological research and find organic confirmation, at least as far as determination of its cerebral apparatus is concerned; but such support for the position is wanting when we return to the brain of the infant. Not only do we fail to find the series of centers into which the organic basis of speech has been divided, but even those of them which we do find have not taken up the function, either alone or together, which they perform when speech is actually realized." (1906, p7)



Baldwin's views

- Direct reference to work of aphasiologists
- Relevance and limitation of their findings

→New agenda for the study of brain maturation and behavioral and cognitive development.

Conclusions

- **19th CENTURY Aphasiologists contributed to changes in the conceptualization of childhood entertained by Cognitive Scientists today.**
- **DEVELOPING conceptualization of causal link between brain maturation and early development.**
- **NO DISTINCTION between Universal versus Culture-specific abilities.**
- **PRECURSORS to current notions such as Modularization (Charcot, Ribot) and Critical Period (Charcot, Ball, Séguin).**

Main references

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