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Separated at birth Rediscovering the lost emotions in Lurias working brain

Oliver H Turnbull; Christian E Salas; Alfredo Ardila; Rashad Bagus; Monica Rosselli

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Special Issue: Luria's legacy in the era of cognitive neuroscience

Separated at birth: Rediscovering the lost emotions in Luria's Working Brain



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ABSTRACT

Aleksandr Luria repeatedly emphasised the importance of emotions and the right hemisphere in his neuropsychological writings. It is surprising, therefore, that Luria's most influential book, *The Working Brain*, appears to lack an explicit section on these topics. This is especially notable because of a comment in the book's English-language Introduction, by Karl Pribram, referencing Luria's thoughts about precisely this material. Remarkably, it seems that Luria *did* write such an explicit chapter, in the original Russian edition. However, in the English-language version, the relevant sections were separated, embedded elsewhere without chapter headings, and altered, presumably following an explicit translation decision. The present paper tracks the nature of these changes and, 50 years later, presents the material for the first time translated and reunited in English, as Luria intended. After the translation, we offer a brief commentary, on the ways in which Luria's ideas were in some respects prescient, and in other respects less well-informed about the brain basis of emotions and the right hemisphere. This reunification offers an interesting time capsule on the opinions of one of neuropsychology's greatest minds, on a topic which Luria admits had, at the time, only a modest empirical foundation.

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> *"Neuropsychology is still a very young science, taking its very first step, and a period of thirty years is not a very long time for the development of any science. That is why some very important chapters, such as motivation, complex forms of emotions and the structure of personality are not included in this book. Perhaps they will be added in future editions."*
>
> Aleksandr Luria (1973b) *The Working Brain. An Introduction to Neuropsychology* (pp. 341–342).

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1. Luria and emotion

Human neuropsychology has changed substantially in the last few decades. One important element of this has been a slow, but growing, consideration of emotion (McDonald, 2017). This phenomenon has led some authors to even suggest the birth of a new field called the neuropsychology of emotion (Borod, 2000; Bechara, Damasio, & Damasio, 2000; Gainotti, 1972; Heilman, Scholes, & Watson, 1975; LeDoux, 1992; 1996; Stuss, 2011), or affective neuropsychology (McDonald, 2017), in parallel with the emergence of affective neuroscience (Panksepp, 1998). The field has, inevitably, long antecedents, but the large-scale shift is usually dated to the final decades of the last century (McDonald, 2017).

One might argue that this represents a substantial change of direction for the field, because neuropsychology has historically been interested primarily in cognition – hence the frequent denomination of the *entire* field as a *cognitive* neuropsychology (Caramazza & Coltheart, 2006; McCarthy & Warrington, 1990; Rapp, 2015). In a recent review, we discussed the place that emotion had in modern neuroscience and neuropsychology (Salas et al., 2016, 2017, 2019). We surveyed the *Encyclopedia of the Human Brain* (Ramachandran, 2002), and found a mere 2% of the text dedicated to emotion, as opposed to 38% for cognition. Similarly, Kolb and Wishaw (2003) had just 4% of the text dedicated to emotion. These findings support the opinion that emotion has been regarded as something of a blind spot for neuropsychology, or at least an area of very modest focus (McDonald, 2017; Turnbull, 2001 for more on this theme).

While historically, neuropsychology has tended to emphasize the study of cognition over emotion, a few authors have, over the decades, stressed that this imbalance should be corrected (Goldstein, 1939; Jackson, 1888; MacLean, 1952; Schilder, 1936). This was the case for Aleksandr Luria (1902–1977), who explicitly acknowledged that mental phenomena such as "motives, complex forms of emotions and the structure of personality" should be systematically investigated (Luria, 1973b, p. 341). Luria was, of course, profoundly influential in the development of neuropsychology as a field, as well as in the training of many generations of clinical neuropsychologists (Stringer, Cooley, & Christensen, 2002). His influence also touches the development of theoretical models of brain functioning, such as the functional systems concept (Mecacci, 2005), the process-based approach to neuropsychological assessment (Ardila, 1992; Libon, Swenson, & Ashendorf, 2013; Luria & Majovski, 1977), and neuropsychological rehabilitation (Luria, 1963; Mikadze, Ardila, & Akhutina, 2019; Turnbull, 1996). In addition, Luria's books have educated and inspired generations of clinical and experimental neuropsychologists, influencing their view of mind and brain.

It is surprising, therefore, that Luria's most influential book, *The Working Brain*, appears to lack an explicit section on emotion. Remarkably, this is *not* because – at least in the English-language edition – the author did not *write* one. Instead, it appears to have resulted from a translation decision. Considering the remarkable impact of Luria on the field, we can only wonder about the consequences of this translation choice, and its effects.

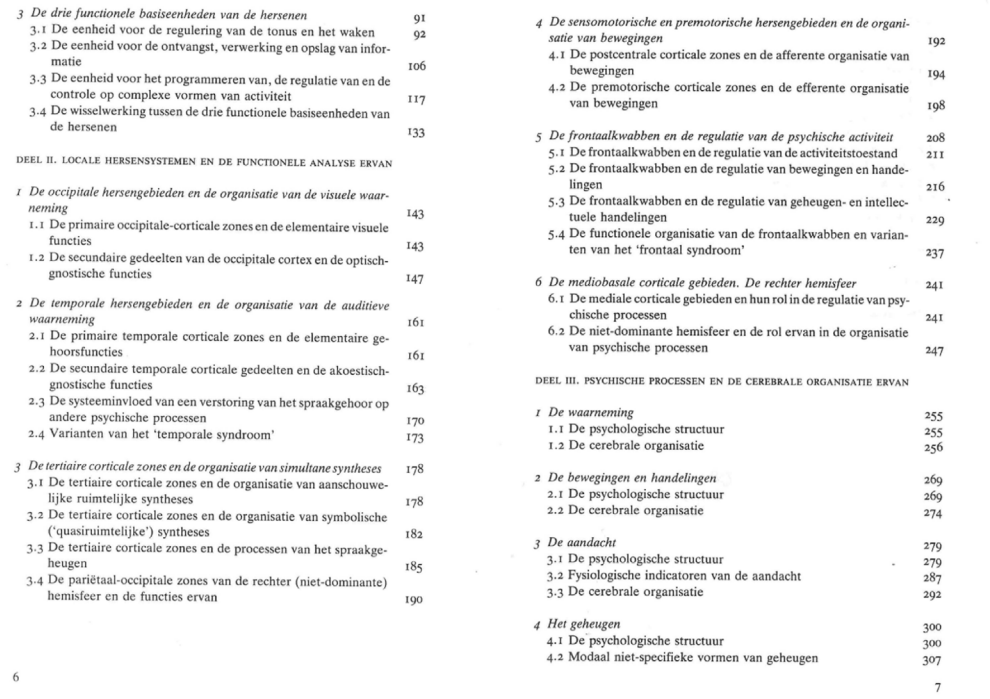
2. A lost chapter?

The Working Brain (Luria, 1973b) contains the sorts of chapter that one might expect in a neuropsychology textbook: covering the themes of object recognition and language, memory and executive function, and so on. Or, at least, that is the impression which we have when one reads the English version (Fig. 3). A different conclusion is reached if one reads the *Dutch* version of *The Working Brain*, translated as: '*Grondslagen van de neuropsychologie*' ('Foundations of neuropsychology', Lurija, 1982, note the Dutch spelling). One difference (noticed in 1991 by two of us, OT and RB, who can both speak Afrikaans, and thus read basic Dutch, see below) is that the chapter order (Fig. 1) appears to have been modified across the two languages. Importantly, there is one section, Chapter 6, which it seems did not appear *at all* in the English version? The chapter (in Dutch) contains a short introduction, and two sections. One is headed (if translated to English) '*The Mediobasal Regions of the Cortex and its Role in the Regulation of Psychological States*' and the second is the '*Non-Dominant Hemisphere and its Role in the Organization of the Psychological Processes*'. When comparing the English version with the original Russian version (Fig. 2) a similar error of omission can be observed.

This surprising difference suggested variation in the translation from the Russian original. OT and RB then wrote (in 1991) to René van der Veer, the Vygotsky and Luria scholar who assisted with the Dutch *Working Brain* translation. He confirmed the existence of the mistake (see Fig. 4). In van der Veer's words (paragraph 3 of his 1991 letter) "two translators made a crude first translation of the book from the English edition". When van der Veer was asked to check the translation's reliability, he "noticed that several chapters from the Russian book were missing in the English edition". On this basis, van der Veer reports that he decided to translate them himself, from the Russian, for the Dutch edition. This appears to explain the discrepancy, though of course not its cause.

3. A separated and hidden chapter?

In 2013 two of us (OT and CS) resumed this enterprise, and obtained an English translation of the 'lost' section (Chapter 6) from the Dutch version. However, it was not until a serendipitous encounter with Alfredo Ardila, the prominent Latin-American neuropsychologist, and former student of Luria, that the plot changed radically. In 2018 one of us (CS) met Ardila, and mentioned the 'lost chapter' anecdote to him. He was extremely surprised about the existence of such a mistake, and eager to compare our English version with the Russian original. A few months later he and Mónica Rosselli confirmed that Chapter 6 was missing from the English translation. After some editorial review, and changes made by AA and MR, we felt confident we were on the right track to present this archaeological finding to the neuropsychological community.



3 De drie functionele basiseenheden van de hersenen 91
3.1 De eenheid voor de regulering van de tonus en het waken 92
3.2 De eenheid voor de ontvangst, verwerking en opslag van informatie 106
3.3 De eenheid voor het programmeren van, de regulatie van en de controle op complexe vormen van activiteit 117
3.4 De wisselwerking tussen de drie functionele basiseenheden van de hersenen 133

DEEL II. LOCALE HERSENSYSTEMEN EN DE FUNCTIONELE ANALYSE ERVAN

1 De occipitale hersengebieden en de organisatie van de visuele waarneming 143
1.1 De primaire occipitale-corticale zones en de elementaire visuele functies 143
1.2 De secundaire gedeelten van de occipitale cortex en de optisch-gnostische functies 147

2 De temporale hersengebieden en de organisatie van de auditieve waarneming 161
2.1 De primaire temporale corticale zones en de elementaire gehoorsfuncties 161
2.2 De secundaire temporale corticale gedeelten en de akoestisch-gnostische functies 163
2.3 De systeeminvloed van een verstoring van het spraakgehoor op andere psychische processen 170
2.4 Varianten van het 'temporale syndroom' 173

3 De tertiaire corticale zones en de organisatie van simultane syntheses 178
3.1 De tertiaire corticale zones en de organisatie van aanschouwelijke ruimtelijke syntheses 178
3.2 De tertiaire corticale zones en de organisatie van symbolische ('quasiruimtelijke') syntheses 182
3.3 De tertiaire corticale zones en de processen van het spraakgeheugen 185
3.4 De pariëtaal-occipitale zones van de rechter (niet-dominante) hemisfeer en de functies ervan 190

6

4 De sensomotorische en premotorische hersengebieden en de organisatie van bewegingen 192
4.1 De postcentrale corticale zones en de afferente organisatie van bewegingen 194
4.2 De premotorische corticale zones en de efferente organisatie van bewegingen 198

5 De frontaalkwabben en de regulatie van de psychische activiteit 208
5.1 De frontaalkwabben en de regulatie van de activiteitstoestand 211
5.2 De frontaalkwabben en de regulatie van bewegingen en handelingen 216
5.3 De frontaalkwabben en de regulatie van geheugen- en intellectuele handelingen 229
5.4 De functionele organisatie van de frontaalkwabben en varianten van het 'frontaal syndroom' 237

6 De mediobasale corticale gebieden. De rechter hemisfeer 241
6.1 De mediale corticale gebieden en hun rol in de regulatie van psychische processen 241
6.2 De niet-dominante hemisfeer en de rol ervan in de organisatie van psychische processen 247

DEEL III. PSYCHISCHE PROCESSEN EN DE CEREBRALE ORGANISATIE ERVAN

1 De waarneming 255
1.1 De psychologische structuur 255
1.2 De cerebrale organisatie 256

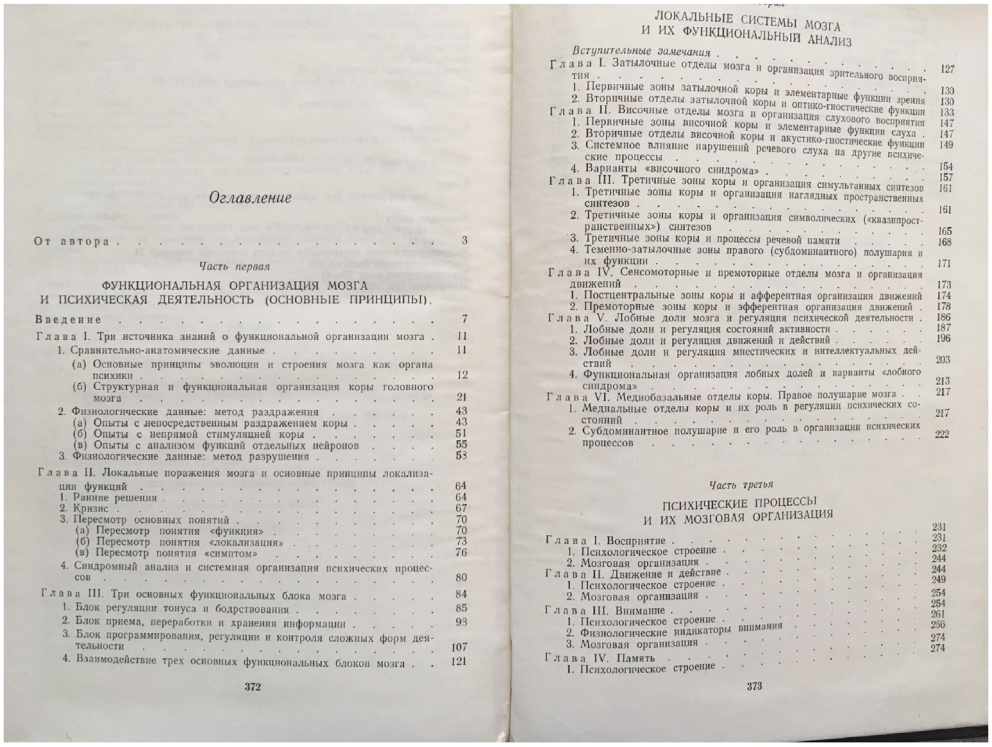
2 De bewegingen en handelingen 269
2.1 De psychologische structuur 269
2.2 De cerebrale organisatie 274

3 De aandacht 279
3.1 De psychologische structuur 279
3.2 Fysiologische indicatoren van de aandacht 287
3.3 De cerebrale organisatie 292

4 Het geheugen 300
4.1 De psychologische structuur 300
4.2 Modaal niet-specifieke vormen van geheugen 307

7

Fig. 1 – The Dutch edition of *The Working Brain*. The 'Mediobasal Cortical Zones' and 'The Right Hemisphere' sections are in Chapter 6.



Оглавление

От автора 3

Часть первая

ФУНКЦИОНАЛЬНАЯ ОРГАНИЗАЦИЯ МОЗГА
И ПСИХИЧЕСКАЯ ДЕЯТЕЛЬНОСТЬ (ОСНОВНЫЕ ПРИНЦИПЫ)

Введение 7

Глава I. Три источника знаний о функциональной организации мозга . 11
1. Сравнительно-анатомические данные 11
(а) Основные принципы эволюции и строения мозга как органа психики 12
(б) Структурная и функциональная организация коры головного мозга 21
2. Физиологические данные: метод раздражения 43
(а) Опыты с непосредственным раздражением коры 43
(б) Опыты с непрямой стимуляцией коры 51
(в) Опыты с анализом функций отдельных нейронов 55
3. Физиологические данные: метод разрушения 55

Глава II. Локальные поражения мозга и основные принципы локализации функций 64
1. Ранние решения 64
2. Кризис 67
3. Пересмотр основных понятий 70
(а) Пересмотр понятия «функция» 70
(б) Пересмотр понятия «локализация» 73
(в) Пересмотр понятия «симптом» 76
4. Синдромный анализ и системная организация психических процессов 80

Глава III. Три основных функциональных блока мозга 84
1. Блок регуляции тонуса и бодрствования 85
2. Блок приема, переработки и хранения информации 93
3. Блок программирования, регуляции и контроля сложных форм деятельности 107
4. Взаимодействие трех основных функциональных блоков мозга . . 121

372

ЛОКАЛЬНЫЕ СИСТЕМЫ МОЗГА
И ИХ ФУНКЦИОНАЛЬНЫЙ АНАЛИЗ

Вступительные замечания 127

Глава I. Затылочные отделы мозга и организация зрительного восприятия 130
1. Первичные зоны затылочной коры и элементарные функции зрения 130
2. Вторичные отделы затылочной коры и оптико-гностические функции 133

Глава II. Височные отделы мозга и организация слухового восприятия 147
1. Первичные зоны височной коры и элементарные функции слуха . 147
2. Вторичные отделы височной коры и акустико-гностические функции 149
3. Системное влияние нарушений речевого слуха на другие психические процессы 154
4. Варианты «височного синдрома» 157

Глава III. Третичные зоны коры и организация симультанных синтезов 161
1. Третичные зоны коры и организация наглядных пространственных синтезов 161
2. Третичные зоны коры и организация символических («квазипространственных») синтезов 165
3. Третичные зоны коры и процессы речевой памяти 168
4. Теменно-затылочные зоны правого (субдоминантного) полушария и их функции 171

Глава IV. Сенсомоторные и премоторные отделы мозга и организация движений 173
1. Постцентральные зоны коры и афферентная организация движений 174
2. Премоторные зоны коры и эфферентная организация движений . 178

Глава V. Лобные доли мозга и регуляция психической деятельности . 186
1. Лобные доли и регуляция состояний активности 187
2. Лобные доли и регуляция движений и действий 196
3. Лобные доли и регуляция мнестических и интеллектуальных действий 203
4. Функциональная организация лобных долей и варианты «лобного синдрома» 213

Глава VI. Медиобазальные отделы коры. Правое полушарие мозга . . 217
1. Медиальные отделы коры и их роль в регуляции психических состояний 217
2. Субдоминантное полушарие и его роль в организации психических процессов 222

Часть третья

ПСИХИЧЕСКИЕ ПРОЦЕССЫ
И ИХ МОЗГОВАЯ ОРГАНИЗАЦИЯ

Глава I. Восприятие 231
1. Психологическое строение 231
2. Мозговая организация 232

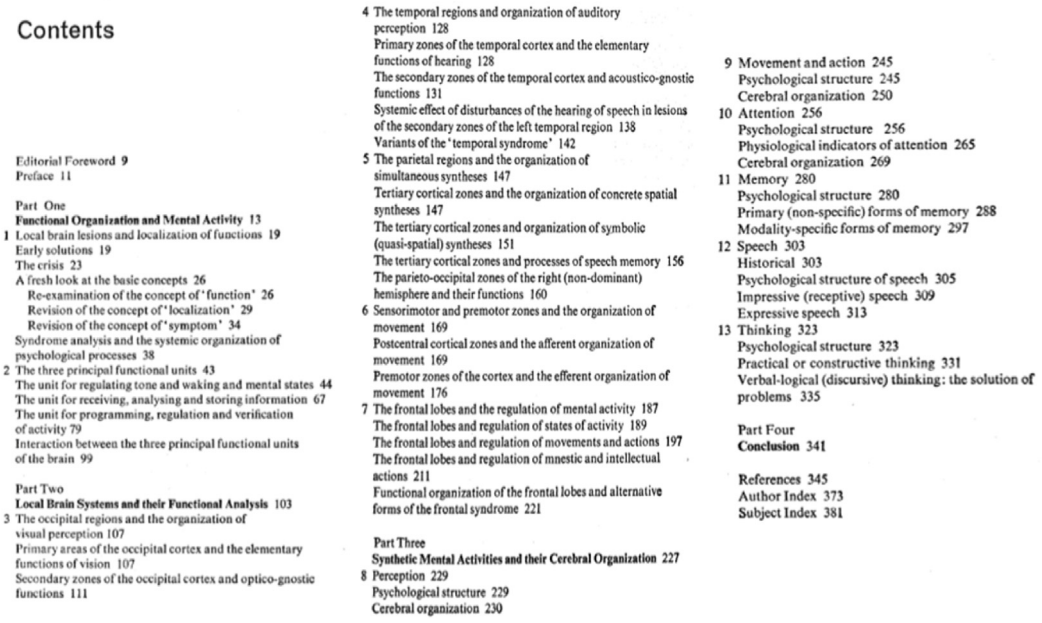
Глава II. Движение и действие 244
1. Психологическое строение 244
2. Мозговая организация 249

Глава III. Внимание 254
1. Психологическое строение 254
2. Физиологические индикаторы внимания 261
3. Мозговая организация 296

Глава IV. Память 274
1. Психологическое строение 274

373

Fig. 2 – The Russian edition of The Working Brain. Again, the 'Mediobasal Cortical Zones' and 'The Right Hemisphere' sections are in Chapter 6.



Contents

Editorial Foreword 9
Preface 11

Part One
Functional Organization and Mental Activity 13
1 Local brain lesions and localization of functions 19
Early solutions 19
The crisis 23
A fresh look at the basic concepts 26
Re-examination of the concept of 'function' 26
Revision of the concept of 'localization' 29
Revision of the concept of 'symptom' 34
Syndrome analysis and the systemic organization of psychological processes 38
2 The three principal functional units 43
The unit for regulating tone and waking and mental states 44
The unit for receiving, analysing and storing information 67
The unit for programming, regulation and verification of activity 79
Interaction between the three principal functional units of the brain 99

Part Two
Local Brain Systems and their Functional Analysis 103
3 The occipital regions and the organization of visual perception 107
Primary areas of the occipital cortex and the elementary functions of vision 107
Secondary zones of the occipital cortex and optico-gnostic functions 111
4 The temporal regions and organization of auditory perception 128
Primary zones of the temporal cortex and the elementary functions of hearing 128
The secondary zones of the temporal cortex and acoustico-gnostic functions 131
Systemic effect of disturbances of the hearing of speech in lesions of the secondary zones of the left temporal region 138
Variants of the 'temporal syndrome' 142
5 The parietal regions and the organization of simultaneous syntheses 147
Tertiary cortical zones and the organization of concrete spatial syntheses 147
The tertiary cortical zones and organization of symbolic (quasi-spatial) syntheses 151
The tertiary cortical zones and processes of speech memory 156
The parieto-occipital zones of the right (non-dominant) hemisphere and their functions 160
6 Sensorimotor and premotor zones and the organization of movement 169
Postcentral cortical zones and the afferent organization of movement 169
Premotor zones of the cortex and the efferent organization of movement 176
7 The frontal lobes and the regulation of mental activity 187
The frontal lobes and regulation of states of activity 189
The frontal lobes and regulation of movements and actions 197
The frontal lobes and regulation of mnestic and intellectual actions 211
Functional organization of the frontal lobes and alternative forms of the frontal syndrome 221

Part Three
Synthetic Mental Activities and their Cerebral Organization 227
8 Perception 229
Psychological structure 229
Cerebral organization 230
9 Movement and action 245
Psychological structure 245
Cerebral organization 250
10 Attention 256
Psychological structure 256
Physiological indicators of attention 265
Cerebral organization 269
11 Memory 280
Psychological structure 280
Primary (non-specific) forms of memory 288
Modality-specific forms of memory 297
12 Speech 303
Historical 303
Psychological structure of speech 305
Impressive (receptive) speech 309
Expressive speech 313
13 Thinking 323
Psychological structure 323
Practical or constructive thinking 331
Verbal-logical (discursive) thinking: the solution of problems 335

Part Four
Conclusion 341

References 345
Author Index 373
Subject Index 381

Fig. 3 – The English edition of *The Working Brain*. Here, the chapters are differently organised, there appears to be no section dedicated the Mediobasal Cortical Zones or the Right Hemisphere.

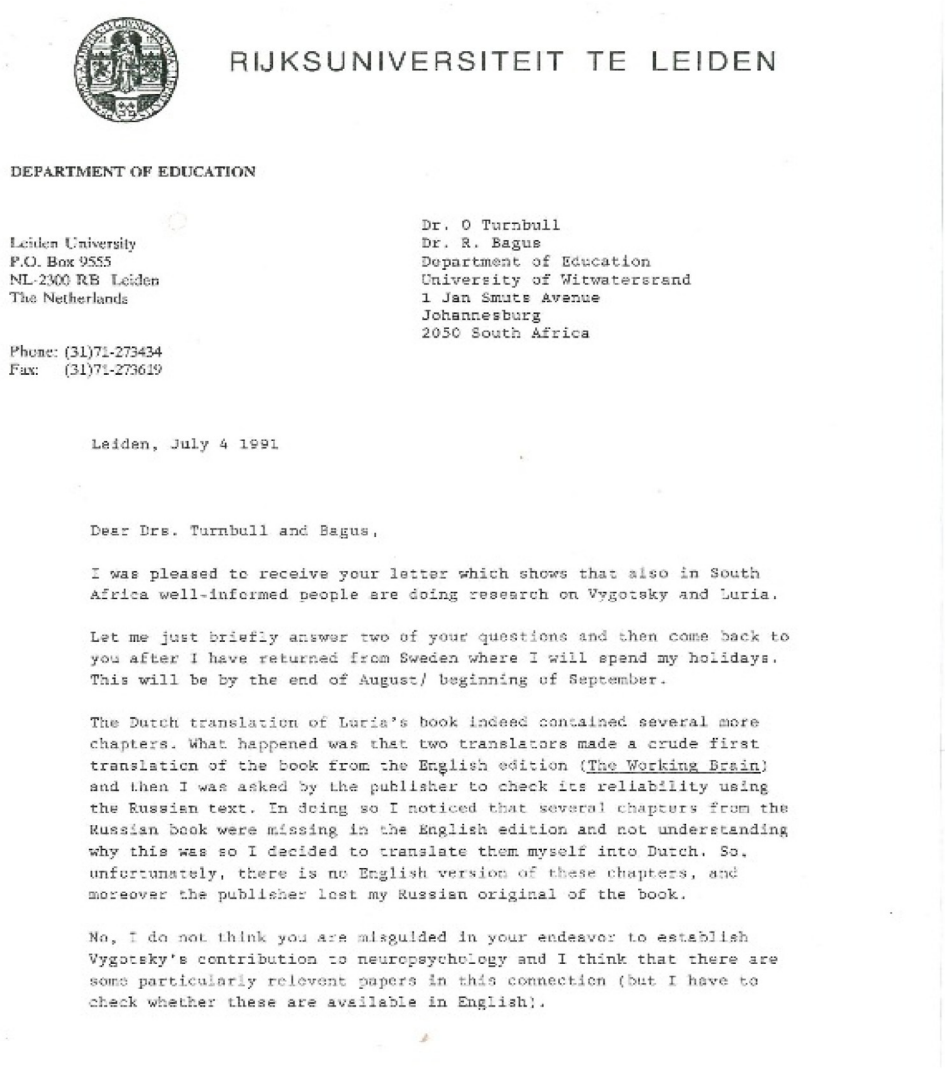
Bizarrely, the story was not as simple as we initially imagined. An item of particular note was a figure included in Chapter 6 (Fig 96. The Papez Circuit). This is in the Russian original, but interestingly does not appear in the appropriate part of the Dutch translation. Ardila told us that he had reviewed the whole book again, since "something about Fig. 96 felt familiar". To our shock, he found that Fig. 96 *was* present in the English version, but it was now Fig. 11, and had been moved to page 63, as part of Chapter 2 (The Three Principal Functional Units). The figure had been inserted in the sub-section: The Unit for Regulating Tone and Waking and Mental States. Furthermore, much of the text of the first section of Chapter 6 (*6.1 The medial cortical zones*) was actually *merged* with Chapter 2 (pp. 60–67). A similar modification had occurred to the second section of Chapter 6 (*6.2 The non-dominant hemisphere*), which was now included in Chapter 5 (The Parietal Regions and the Organization of Simultaneous Synthesis, pp. 162–168), and merged with the section: *The tertiary cortical zones and processes of speech memory*.

Thus, to our surprise, and after almost 30 years of inquiry, we realized that Chapter 6 had *not* been lost in translation, as we and van der Veer had thought, but instead separated, and allocated – without their original chapter titles – to completely different sections of the book. In the Russian and the Dutch versions, we have two sections that appear roughly 250 pages into the book, the location that Luria intended. In the English edition, these parts had somehow been transposed to roughly page 60 and page 160, and merged – one might say 'hidden' – in the text without their chapter headings. We also found that complete paragraphs, such as the introductory paragraph of Chapter 6, had been deleted, and in one case a new paragraph had been added (p. 164 second paragraph).

English speakers have read *The Working Brain* for half a century, assuming its translation was a 'best intentions' reflection of Luria's ideas. However, our story suggests that this may not be the case, and that the English edition underwent extensive modifications, beyond chapter 6.[1]. In many disciplines, there have been debates regarding how truthful a translation can be to its original. The most notable are cases where the mistranslation of a key concept has generated decades of confusion and theoretical discussion. A famous example would be the English translation of Freud's '*trieb*' as either instinct or drive (Solms, 1999). However, here we have a completely different category of mistranslation, where an entire chapter is separated, silently allocated to different destinations, removed of its headings to denote prominence, and acquired further modifications.

We are not aware of the reasons why the translator of Luria's book made such a decision, though a range of reasons are possible, and the 1970s were, of course, a different time in

[1] Comparison of the English edition with the Dutch and Russian edition reveals several other changes. Notably, Part I, on the 'Functional organization of the brain and mental activity' differs substantially from the other editions, particularly in the introduction. Notably, there is a section on the 'Three sources of knowledge about the functional organization of the brain,' including a section on anatomical and physiological data, which are entirely absent in the English edition. Other changes include Chapter III of Part II, in both the Russian and Dutch editions, which is entitled 'Tertiary zones of the cortex and the organization of simultaneous syntheses.' However, in the English edition, the corresponding title is 'Parietal regions and the organization of simultaneous syntheses,' (i.e., 'tertiary zones' was changed to 'parietal regions'.



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Leiden, July 4 1991

Dear Drs. Turnbull and Bagus,

I was pleased to receive your letter which shows that also in South Africa well-informed people are doing research on Vygotsky and Luria.

Let me just briefly answer two of your questions and then come back to you after I have returned from Sweden where I will spend my holidays. This will be by the end of August/ beginning of September.

The Dutch translation of Luria's book indeed contained several more chapters. What happened was that two translators made a crude first translation of the book from the English edition (The Working Brain) and then I was asked by the publisher to check its reliability using the Russian text. In doing so I noticed that several chapters from the Russian book were missing in the English edition and not understanding why this was so I decided to translate them myself into Dutch. So, unfortunately, there is no English version of these chapters, and moreover the publisher lost my Russian original of the book.

No, I do not think you are misguided in your endeavor to establish Vygotsky's contribution to neuropsychology and I think that there are some particularly relevent papers in this connection (but I have to check whether these are available in English).

Fig. 4 – Letter to OT and RB from René van der Veer in 1991.

terms of the rigour of translation scholarship (Petronio, 2002).[2] The translator of *The Working Brain* was Basil Haigh, a British medical practitioner, who specialized in Russian neurophysiology, neuropsychology, and biochemistry. Considering the issue that we have uncovered, it is interesting to note that Haigh was the English translator of several of Luria's books. Unfortunately, Haigh (1919–2005) is no longer alive (see Haigh, 2006, for his obituary), because the issue of his *Working Brain* translation would make an interesting interview question.

There is an even more important issue at stake here. Both sections of Chapter 6 deal with psychological changes after brain damage that can be broadly described as modifications of emotional life, and its spatial embodiment, in either its cortical or subcortical variants. This is presumably the reason why Luria grouped both sections together. A chapter functions, of course, as a story within a story, containing its own message that contributes to the overall narrative of the book. By separating Chapter 6, and locating it without headings, we have lost track of a key location where Luria attempted to portray his insights regarding the brain basis of emotion.

We also offer a further observation, based on the Introduction which Karl Pribram wrote to the English edition of *The Working Brain* (Luria, 1973b, pp. 9–10). In an interesting paragraph, Pribram singles out just *one* theme of the book for more detailed discussion. There are, Pribram says: "chapters in *The Working Brain* which are less satisfactory than others. Neither Luria or I are at all satisfied with the data on the mediobasal zones of the cortex and those on the right hemisphere" (Luria, 1973b, p. 10). This begs the question of why Pribram focuses on, and names with precision, these particular topics, *especially* given that the English edition has these topics separated, and made less obvious by virtue of not having chapter titles? One solution might be that Luria (for whom the original Russian would have been the format in his mind) had corresponded directly with Pribram (see Mecacci, 2005, for more on their close relationship) who then reflected the 'less satisfactory' theme in his Introduction to the English edition?

[2] We are also aware that a related debate has been taking place about the translation of the work of Luria's friend and colleague L. S. Vygotsky (Van der Veer & Yasnitsky, 2016, Yasnitsky, 2012, p. 145; Zavershneva & Osipov, 2012, see also Turnbull & Bagus, 1991).

Luria also makes a remarkable, related, comment in the Conclusion section of English edition. He writes: "That is why some very important chapters, such as motives, complex forms of emotions and the structure of personality are not included in this book. Perhaps they will be added in future editions." (1973b, pp. 341–342). This might read as meaning that "some very important chapters … are not included in this book". That is, that Luria himself had *chosen* to make modifications in the English edition, presumably (for some unknown reason) to place less emphasis on emotion? On this argument, the translation differences are as result of *Luria's* actions, not those of the translator.

This hypothesis cannot, however, be correct, for several reasons. Firstly, the quote reads that the chapters "are not included in this book". However, the chapters *are* included in the English edition, albeit separated and untitled. Secondly, Luria looks forward to having this material "added in future editions". Why would one remove material (which is not actually removed) only to *replace* it in future editions? The final, and most telling, reason is these precise sentences are *also* present in the conclusion section of the Dutch version of the book, and hence the Russian, where they *are* included. Van der Veer's Dutch edition includes a direct translation of the sentences quoted above, some of which will be easily understood by English speakers: "Om deze reden zijn enkele zeer belangerijke hoofdstukken (For these reasons some very important chapters), zoals motivatie, complexe vormen van emoties en persoonlijkheidsstructuur (such as motivation, complex forms of emotions and the structure of personality) niet opgenomen in dit boek (are not included in this book)" (Lurija, 1982, p. 352).

We feel that a better reading of the quote is that Luria apologises that he cannot discuss "*complex* forms of emotions and the structure of personality" (italics added) in the current book. That is, *The Working Brain* contains *some* material on emotions, but the more complicated features of the mind built *from* emotion, such as personality, are poorly understood, and will require the field to further develop. Indeed, Luria was quite correct in this regard – the neuropsychology of (say) personality remains a poorly understood topic even today, though much progress has been made (see Davis & Panksepp, 2018 for more on this).

These comments suggest that Luria was not satisfied with the state of the evidence-base for *precisely* that section of the book which was then separated and made harder to identify. This makes it especially interesting to see, after a long gap, how these previously under-developed parts of the field have developed. Fifty years later, we present the chapter for the first time reunited and translated into English, as it was intended by Luria. The version that we offer is based on a joint translation, from both the Dutch and the Russian. It has been revised and edited by Monica Rosselli and by Alfredo Ardila, one of Luria's students. Unfortunately, Alfredo (1946–2021) is no longer with us to witness the re-birth of this chapter.

After the translation, we offer a brief commentary. With almost half a century of hindsight, we discuss the ways in which Luria's ideas were in some respects prescient, and in other respects less well-informed about the brain basis of feelings. This rediscovery offers an interesting time capsule on the opinions of one of neuropsychology's greatest minds, on a topic which at the time had only a modest empirical foundation.

4. Translation

Chapter 6: the medio-basal cortical zones. The right hemisphere

In this chapter[3] we enter the area of problems that have hardly been studied, and for which we have means that are clearly insufficient, to gain a precise idea of the role of the brain areas named in the title on the organisation of the mental activity of man. Indeed, the whole of neuropsychology is in fact built on data acquired by studying the lateral cortical areas, which form the structures that play the most important role in the reception and processing of exteroceptive information, as well as in the regulation of movements and actions. The medial cortical zones, that consist mostly of structures of the archicortex and to a considerable extent form part of the first functional unit of the brain, are not involved in this aspect of the behaviour.

On the other hand, the overwhelming majority of facts upon which our ideas of the cerebral mechanisms of the conscious activity of man are based, apply to the functions of the dominant left hemisphere that is closely connected with language processes. The right hemisphere and its role in the organisation of the complex forms of behaviour of man remains completely unstudied. Of course, this leads to substantial difficulties in the presentation of the material in this chapter, and we will therefore continue this chapter while fully conscious of the limitations of the information we have.

6.1 The medial cortical zones and their role in the regulation of psychological processes

With respect to their origin and structure, the medial zones belong to the structures of the archicortex and the diencephalon (Filimonov, 1949) and they retain close connections with the nonspecific nuclei of the thalamus and with other nonspecific structures. Earlier authors united all these structures under the name of 'olfactory cortex' (this was not confirmed by later investigations), but later researchers, taking into account their close connection with the structures of the upper brain stem and the hypothalamus, which have a visceral function, preferred to refer to these structures as the 'visceral brain'.

In many works, from the observations of Klüver (Klüver & Bucy, 1938; Klüver, 1952) to the work of Olds (1955–1959), MacLean (1952, 1958) and many others, it was determined that a lesion of these parts of the brain in animals causes considerable changes in the biochemical processes, elementary needs and affects. All this indicates that the main function of these cortical zones lies not so much in their involvement in the contact with the outside world (the reception and processing of information, the programming of actions), but rather in the regulation of the cortical state, the modification

[3] These initial two paragraphs (until the 6.1 heading below) were deleted in the English edition.

of the cortical tone, the impulses and the affective life. In this sense, one can clearly see the medial cortical zones as a system that is superimposed on the structures of the limbic system and the reticular formation. The behavioural disorders that occur in case of lesions to these areas strongly distinguish themselves from the changes in psychological processes that occur with local damage to the convex cortical zones.

Lesions to the medial (or mediobasal) frontal zones never cause a primary disorder in cognition or action. The visual, auditory and tactile perception of the patient remain intact. The patients with lesions to these systems are able to perform any complex movement, the postural praxis is still correct, they easily place their hand in the correct spatial position, they are well able to master rhythmical structures and can repeat these well. Their speech remains – phonetically and morphologically – unchanged, if we disregard its sluggishness and (sometimes) monotony. Likewise in these patients writing potentially remains intact; we will only see signs of rapid fatigue and fast transition to micrographia. When these patients are reading, hardly any peculiarities are detectable.

The central features that characterise the psychological processes of this group of patients are a clear lowering of tone, a tendency towards an akinetic state, a rapid fatigue. While these patients begin to perform a task in the correct manner, quickly a delay of all reactions is detectable; after this, the slowness of responses increases and the patients often no longer respond to any questions. They fall into an inactive state. Sometimes this state is accompanied by a distinct asthenia of motor function, that leads to symptoms of akinesia, similar to stupor (Bragina, 1966). Their voice becomes weak, 'aphonic'. Appropriate external stimulation can temporarily increase the lowered tone. Against the background of the lowered tone, distinct changes in the patients' affective processes appear.

Contrary to patients with a clear 'frontal syndrome' they show no signs of emotional levity or euphoria. In some cases, the emotional tone lowers and begins to border on indifference, in other cases it will have the character of a depression, of melancholy, fear, accompanied by distinct vegetative reactions; sometimes in these patients a syndrome of 'catastrophic reactions' develops, experiencing 'the end of the world' (Baruk, 1926; Šmar'jan, 1949). These peculiarities in the affective experience form an essential characteristic, that distinguishes the given group from patients with a 'frontal syndrome'. However, the described facts only form the general background for the disturbances of psychological activity that we can observe in milder cases. The central defects in these cases are a consciousness disorder on the one hand and memory defects on the other hand.

Incomparably more often than other patients, the patients of this group show characteristics of poor orientation in the environment. They are often not sufficiently sure of where they are; in the hospital or somewhere on active duty, in the outpatient clinic or at home, visiting someone, or they were 'only lying down to rest', etc. Often they orient themselves poorly in time, and even if they can approximately determine the time of year or the month, they make gross errors when asked what time it is. They report times which deviate significantly from the actual times. They do not recognise the doctor examining them, they mistake him for an acquaintance, claiming that they have met him before. They cannot tell their life history, they mix up the details of the history of their illness, sometimes including confabulations in their story. A patient claims, for example, that his relatives are waiting in the corridor, that he left his house in the morning and was at work, that he just returned from a business trip, etc. Typically, such uncontrolled confabulations, of which the patient doesn't realise that they are not true, are particularly clear when there are lesions to the anterior zones of the limbic area. In patients with deep lesions of the posterior zones of the medial cortex we observe these confabulations far less often.

All these symptoms together form a clear picture of a disorder of consciousness, which in the most severe cases approximates a dream state; its main features are a disturbance of the selectivity of psychological processes that occurs in all spheres of psychological activity (Luria, Khomskaja, Blinkov, Critchley, 1967).

The most obvious symptom of lesions to the medial zones are memory disorders that reflect an overall lowering in cortical tone and that have no modal-specific character, which distinguishes them from the disturbances of memory processes in case of local lesions to the convex zones of the brain. The memory disorders resulting from lesions to the hippocampus and its connections, which have been named in the literature 'the hippocampal circuit' (or 'the Papez circuit'), including the thalamic nuclei, the fornix and the mammillary bodies are well described in the literature (Fig. 96). Bekhterev (1900) has further pointed out that lesions to the interior parts of the temporal areas lead to memory impairment, sometimes reminiscent of Korsakoff's syndrome; Grünthal (1939) noted that such memory disorders can also arise in case of lesions to the mammillary bodies concentrated on the fibres coming from the hippocampus and other deep brain structures.

Finally, already in our time, a series of studies (Scoville, 1954; Penfield & Milner, 1958; Scoville & Milner, 1957; Milner, 1954–1970; Popova, 1964) appeared, which showed that bilateral lesions of the hippocampus inevitably lead to severe memory disorders. Further data were acquired in a series of

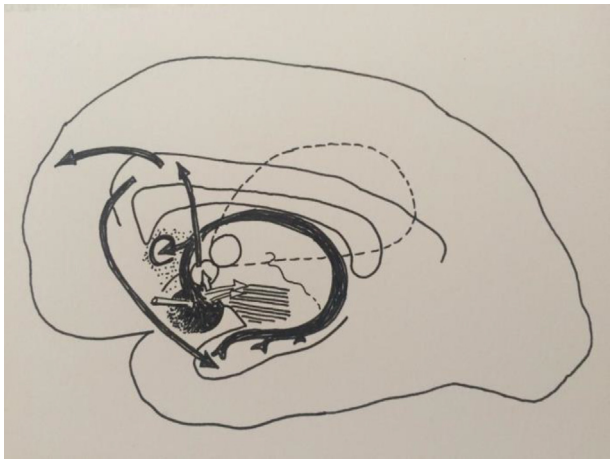

Fig. 96/11 – The hippocampal (or Papez) circuit (Reproduction from the original by O. Turnbull).

studies by us (Kiyashchenko, 1969; Luria, 1971; Luria, Konovalov, & Podgornaya, 1970), dedicated to the detailed analysis of memory disorders in case of deep brain lesions (and in particular lesions to the medial zones of the two hemispheres).

As experience has shown, patients with even relatively light damage to the medial cortical zones (e.g., patients with a tumour in the pituitary gland that goes beyond the boundaries of the sella turcica and in this way or another way influences the medial cortical zones), who do not show any defect of higher psychological processes, often complain of memory impairment, whereby these impairments do not affect only one modality (e.g., only auditory or only visual), but they are not modal-specific in nature. As studies have shown (Kiyashchenko, 1969) these defects are reflected not so much in a primary weakness of the traces, but rather in its increased inhibition by irrelevant, interfering factors, in other words, even the slightest distraction inhibits the existing traces.

In cases of relatively light damage to the deep medial cortical zones this increased inhabitability can only be observed in experiments which require the retention of relatively complex, isolated sequences of elements (words, grammatical forms). When memorizing organised material (sentences, stories) no memory problems occur. Typically, these patients show no obvious symptoms of confusion or disorientation in the environment.

In cases of more severe damage, for example, in severe intracerebral tumours, located on the mid-line and in both hemispheres (a tumour of the septum pellucidum, or the mammillary bodies) the situation is very different. The symptoms of memory impairment, which remain of a modally-non-specific nature, are more severe. The patients are well able to form simple sensorimotor structures (for example, one can easily evoke the contrast illusion in them, whereby one first lets someone touch a big ball with one hand and a small ball with the other hand, and one then places two balls of the same size in his hands).

These patients can remember well the similarity or the difference between the two geometric figures presented at an interval of 1–1.5 min (J. Konorski's experiment); however, if one presents an irrelevant stimulus during this interval, the trace of the first shape disappears and a comparison of both shapes is impossible (Kiyashchenko, 1969). Similar phenomena, but in an even more conspicuous form, also occur in more complex forms of memory. Here, they are evident in the retention of organised structures (sentences, stories, thematic pictures). If, for example, one gives a patient a relatively simple sentence to read, and then a similar sentence, repeating of the first sentence already turns out to be impossible. The same can be seen in experiments which require that complete stories are memorised. The patient can repeat a small coherent text successfully (e.g., Tolstoy's story 'The hen and the golden eggs'), but if one then gives him 1 min to solve maths problems or if one presents him with another story to listen to (for example, Tolstoy's 'The crow and the pigeons'), then recalling the first story becomes completely impossible. That it is not complete extinction of the traces that underlies this memory impairment, but increased inhibition through interfering factors, is clear by the fact that over time traces of the 'forgotten' story can inadvertently emerge in a flow of memories (Kiyashchenko, 1969; Popova, 1964; Luria, 1971, and others.). In the most severe cases, increased inhabitability is also manifested in the actions of the patient: if after a performed action (for example, one asks the patient to draw a certain shape or to put a comb under the pillow) one asks him to perform an interfering task, then the first action seems so completely forgotten that even if one shows the patient the drawing he made, or if one asks him how the comb ended up under the pillow, he cannot remember that he performed the action himself.

All this makes the observed memory disorders resemble Korsakoff's syndrome. If the lesion lies in the posterior parts of the medial cortical zones, extending to the hippocampus, then the increased inhabitability of the traces can be of a primary nature and may not be accompanied by confabulations (Milner, 1954, 1966, 1968, 1969); if the lesion is located in the anterior zones of these areas and includes the medial zones of the frontal lobes, then the picture changes substantially: the patient uncontrollably mixes both texts presented to him, he contaminates (e.g., when remembering the first sentence or the first story, he inserts elements of the second sentence or the second story) and he is not sufficiently critical of his own actions. In massive lesions in the frontal lobes, which include the medial zones, any attempt to recollect earlier traces will be frustrated by a pathological inertia of the recent traces: after the patient has repeated the second sentence (or the second story), the patient continues to repeat this. In those cases where the pathological process develops against the background of signs of irritability – as in massive mediobasal lesions (tumours, trauma) to the frontal zones or in haemorrhages and spasms in the anterior cerebral arteries, accompanied by rupture of an aneurysm– the picture of the memory disorders becomes even more complex: the patient, who is trying to reproduce the story read to him, begins to weave in uncontrollably emerging, irrelevant associations, and a selective reproduction of the story becomes completely impossible (Luria, 1973a; Luria et al., 1970).

The disorders described lead us to a better understanding of some pathological-physiological mechanisms of Korsakoff's syndrome, and at the same time they raise the question of the relation between disorders of memory and of consciousness, which has preoccupied psychiatrists for many decades, but for which a precise neurophysiological and neuropsychological solution was never found.

6.2 The non-dominant hemisphere and its role in the organisation of psychological processes

The overwhelming majority[4] of facts on which we based our previous chapters, was obtained from the study of t functions of the dominant (left) hemisphere. If we proceed to the problem of the non-dominant (in right-handed people, the right) hemisphere and its role in the organisation of psychological activity, we enter unknown territory, where a relatively small number of precise observations and facts are coupled with fairly dubious hypotheses.

The usual clinical studies of patients with lesions to the right hemisphere give us comparatively limited material to

[4] Again, this initial paragraph (until "fairly dubious hypotheses.") was deleted from the English edition.

judge its functions. Only very recently, thanks to the work of Sperry and Gazzaniga (1967) and Sperry et al. (1969), and of Gazzaniga (1970, 1972) who used the method of cutting through the corpus callosum for the study of the functions of the right hemisphere, new avenues for the study of its functions were found.

Both the classical, clinical studies, and in particular the observation of patients with complete resection of the dominant (left) hemisphere (Smith, 1966), and the observations by Sperry, confirm the statement that any complex psychological function is performed by both, co-operating hemispheres, each of which makes its own contribution to the structure of psychological processes (Anan'ev, 1952).

Despite the extreme lack of reliable data on the functions of the non-dominant hemisphere, one can consider two facts as well established. One of these has long been known and is beyond all doubt, the other fact was established only very recently and needs further verification. The first fact is that the non-dominant hemisphere (in the right-handed, the right), despite its complete anatomical similarity with the left, *has nothing to do with the organisation of language activity* and that lesions to it – sometimes even rather extensive lesions – do not affect the language processes. The non-dominant hemisphere also takes part to a lesser extent in the realisation of complex intellectual functions and is less involved in complex motor actions (Sperry and Gazzaniga, 1967; Sperry et al., 1969). It is characteristic, however, that with intersection of the corpus callosum and when information is presented in the right hemisphere, naming of objects becomes impossible. Maintained is the ability of direct observation of objects and of diffusely distinguishing word meanings (Sperry and Gazzaniga, 1967; Sperry et al., 1969; Gazzaniga, 1970, 1972).

Important data, which indirectly enable us to assess the role of the right hemisphere in the organisation of human psychological processes, are provided by observation of patients with massive damage to the right hemisphere. For example, right-handed people with a lesion to the non-dominant hemisphere do not show clear disorders in active speaking, writing or reading, even if this lesion is located in the temporal, parietal-occipital or premotor area, which in the left hemisphere always leads to severe symptoms of aphasia. The difference between the hemispheres is not restricted to language itself. In patients with a lesion to the corresponding areas of the non-dominant hemisphere, defects cannot be observed in processes based on language either. In these patients, one often cannot detect any serious disruption of logical thinking. Comprehension of logical-grammatical structures and formal, logical operations is retained. Mathematical operations are also retained.[5]

[5] After this paragraph, the English version has a paragraph that does not appear in either the Dutch or Russian version. It may be a novel addition of Haigh's, or may perhaps be from another Luria source that we are unaware of? The English version reads: "These findings suggest that the right hemisphere plays a different role in the organization of mental processes and that the disturbances of mental activity associated with its lesions must be sought in a sphere far removed from the verbal or logical-grammatical organization of consciousness" (Luria, 1973b, p.164).

The second of the facts mentioned above, was established fairly recently in precise, statistical studies by Teuber and his co-workers (Semmes et al., 1960). In these studies, it was shown that the functional organisation of the sensory processes in the non-dominant hemisphere has a considerably less differentiated character than in the dominant hemisphere. A disturbance of skin and deep sensitivity of the right hand is, for example, only due to damage of the postcentral areas of the left hemisphere, while the same disturbance in skin and kinesthesis sensitivity of the left hand can occur with lesions in cortical areas much more spread out over the non-dominant hemisphere. Less functional differentiation of the cortical structures associated with sensory processes is clearly the most important characteristic of the right hemisphere.

However, when investigating the role of the non-dominant hemisphere in the organisation of psychological processes, we encounter a series of difficulties. As studies in recent years have shown (Hécaen & Ajuriaguerra, 1963; Subirana, 1952, 1964, 1969; Zangwill, 1960), the dominance of the left hemisphere in healthy right-handed persons is not as absolute as one might presume and there are many transitional forms from absolute dominance of the left hemisphere through ambidexterity to an absolute dominance of the right hemisphere (which in itself is not so common). Therefore, our judgement whether someone is right- or left-handed is often significantly relative.

Only very recently, thanks to the experiments (Wada, 1949; Wada & Rasmussen, 1960) with injection of sodium amytal in the left and right carotid arteries, this diagnosis is more within our reach. What hypotheses do we now have regarding the role of the non-dominant hemisphere in the organisation of psychological activity? Almost one hundred years ago, Jackson expressed the hypothesis that the right hemisphere has a direct relation with the perceptual processes and is also the device responsible for the more direct, pictorial forms of the relationship with the outside world (Jackson, 1874). Only in the last decades, this hypothesis starts to gain experimental confirmation. Many authors noted that the right hemisphere has a direct relationship with the analysis of the information that a person acquires from his own body and that is not connected with verbal-logical codes.

According to Hécaen (1969), compared with damage to the left hemisphere, damage to the right hemisphere considerably more often (seven times) leads to a disorder in the perception of one's own body, or, as it is called in neurology, to a disturbance of the 'body schema'.

Resembling this symptom, is the symptom of neglecting the contralateral (left) side of the body, which occurs with damage to the right hemisphere ('unilateral spatial agnosia').

This phenomenon, first described by Brain (1941), Mc Fie, Piercy and Zangwill (1950), Critchley (1953), Piercy, Hécaen, and Ajuriaguerra (1960), Benton (1961, 1965, 1967) and Korčažinskaja (1971), and developed further by schools of Zangwill and Hécaen, may manifest itself in various ways. As noted before, with damage to the posterior (and especially the deep) zones of the right hemisphere it manifests itself in a 'left-sided fixated hemianopia' (Luria & Skorodumova, 1950) or in inattention to the left side (Brain, 1941; Critchley, 1953; Holmes, 1919; McFie, Piercy, & Zangwill, 1950). In case of damage to the medial temporal zones of the right hemisphere,

the disorder manifests itself in neglecting the left side of the body. With simultaneous touching of symmetrical parts of the body, the patient who does not have a decreased skin sensitivity, will not notice the touching of the left side of the body, or he will not even notice the left touch when both touches are on the same side of the body (Teuber, 1962; Weinstein, Cole, Mitchell, & Lyerly, 1964).

However, the disturbance of the body perception in these cases is not limited to being unaware of the contralateral side. In many cases, lesions to the right hemisphere lead to such severe disturbances of the body schema, that the patient sees his head, a hand or a foot as disproportionately big or small. Such a disturbance of the body schema and the associated 'dressing apraxia' result from lesions to the non-dominant right hemisphere 4 to 5 times more often than from lesions to the dominant left hemisphere (Hécaen, 1969).

The gnostic disorders that occur with a lesion to the right hemisphere in right-handed people may also extend to the field of visual space; they are then reflected in the loss of the capacity for normal orientation in space: the familiar spatial relationships of objects begin to appear strange to the patient. These defects often hinder the patient in performing the required constructions and are manifested in constructive agnosia and apraxia (Hécaen and Angelergues, 1963; Piercy et al., 1960; Benton, 1961, 1967, 1969).

Finally, as noted by many authors (Hécaen and Angelergues, 1963; de Renzi et al., 1968; Kimura, 1963; Kok, 1967), a lesion to the right hemisphere (and especially its posterior zones) often results in a unique disorder in the recognition of objects, characterised by loss of a sense of familiarity with them. In these cases, the direct recognition of individual objects (not in a particular logical code), such as faces, is disturbed. This phenomenon, described by Bodamer (1947), Hoff and Potzl (1937), Hécaen and de Ajuriaguerra (1952), Čhlenov and Bein (1958), was given the name 'prosopagnosia'. A disturbance of visual perception, such as occurs with damage to the right hemisphere, is also characterised by a typical uncontrolled nature of the search behaviour of the patient in assessing an object. The disorder therefore takes the form of 'paragnosia' (uncontrolled guessing) rather than of real visual agnosia.

The gnostic disorders resulting from lesions to the right hemisphere are considerably less modal-specific in nature and instead are of a global, polysensory nature (De Renzi & Spinnler, 1966; Hécaen, 1969).

Also belonging to the functions of the right hemisphere is, apparently, the overall perception of one's own personality; therefore, a frequent symptom of damage to the right hemisphere is not perceiving one's own defects, which has been long known among clinicians as 'anosognosia'. This phenomenon means that the patient, even when paralysed, as it were 'does not notice' his own defect. If the patient does not perceive the left side of space or does not recognise objects, he does not know this and therefore he does not try to compensate his defects. This lends the behaviour of a patient with a lesion to the right hemisphere a series of characteristics, that make it resemble that of a patient with 'frontal syndrome'. However, a patient with damage to the right hemisphere distinguishes himself by a series of essential characteristics, namely, in the first place, much better preservation of intentions and plans for behaviour.

The symptom 'anosognosia' apparently occurs because the right hemisphere is not related to those forms of analysis of one's own behaviour, which presuppose the involvement of complex language processes. The nature and the internal mechanisms of this symptom still require further study.

The described symptoms of a lesion to the right hemisphere lead us to the last group of symptoms that are particularly clear in deep lesions. I am referring to serious changes in personality and consciousness: because in patients with a lesion to the right hemisphere the analysis of signals from one's own body is disturbed, their perception of the immediate situation as a whole is distorted and an adequate assessment of this defect is lacking. In these patients we very often see symptoms of disorientation in the environment, a confusion of direct consciousness. They mask this disorder by using their retained speech. This nevertheless provides the possibility to extensively observe the defects of the patient.

Thus, in a whole group of patients with deep lesions (tumours and aneurysms) in the right hemisphere observed by us, a serious loss of direct orientation in space and time became apparent. For example, they thought they were simultaneously located in Moscow and in another city and they found nothing contradictory in this view. That the verbal–logical processes remain intact in these patients with a serious disturbance of direct self-perception and self-assessment, sometimes leads to a flood of words taking the form of empty chatter and masking the real defects to some extent.

These completely unstudied syndromes of a lesion to the right hemisphere lead us to one of the main problems – the role of the right hemisphere in direct consciousness.

The syndromes of a lesion to the right hemisphere have not nearly been studied enough. Only in the most recent years research on the role of this hemisphere in the consolidation of memory traces, in the direct realisation of psychological processes, and at the level of direct experiences has started. This research, led by Simernickaja and her co-workers is still in progress.

With the analysis of the role of the non-dominant hemisphere in the functional organisation of psychological activity we conclude the second, analytical part of our book to move on to the third, synthetic part, in which an overview will be provided of the cerebral organisation of specific forms of mental processes of man and the role played in their development by various local brain systems.

As stated, the presentation of psychological processes as complex functional systems, depending on the collaboration of a whole complex of cerebral zones, each of which making its own contribution in the development of the whole mental process, is central in this book.

In the previous part, the functions of the individual brain zones and their influence on the structure of the higher psychological processes were described. The next (final) part of the monograph is devoted to the analysis of those systems of brain zones upon which the various forms of concrete psychological activity depends, that is, to a modern presentation of the cerebral organisation of psychological processes.

We will consecutively discuss the cerebral organisation of perception, motor skills and actions, attention, memory, speech and its various forms and, finally, the cerebral organisation of complex forms of intellectual activity.

5. Afterword

There are a number of issues raised by Luria's chapter, especially in the light of the last several decades of neuropsychology.

5.1. *Emotion, and the medial cortical zones*

The section which Luria labels as "The medial cortical zones and their role in the regulation of psychological processes" can be read as being largely on emotion and motivation. Here, the most striking theme is the prescient nature of his diagnosis, including comments on the way in which neuropsychology *had* developed, and *needed* to develop. As Luria argues (perhaps with a little exaggeration) that: "the whole of neuropsychology is in fact built on data acquired by studying the lateral cortical areas", because of their role in "the reception and processing of exteroceptive information, as well as in the regulation of movements and actions".

Neuropsychology needed, on Luria's argument, more of a focus on internal or viscerally-oriented aspects of the brain. Indeed, Luria references earlier authors as using the term "visceral brain". In this regard alone, Luria's work can be seen as forward-looking, and broadly compatible with recent developments in the field of affective neuroscience (Cory & Gardner, 2002; Damasio & Carvalho, 2013; Panksepp, 1998). Importantly, affective neuroscience has offered substantial evidence of emotion as developmentally *primary* (i.e., it appears first, in phylogenetic and ontogenetic terms) and hierarchically *pre-eminent* (i.e., earlier developed systems are more powerful, and their damage compromises all other systems above them in the hierarchy (Panksepp, 1998, see; Turnbull & Salas, 2021). Thus, in functional terms, Luria's general observations are astute: neuropsychology has focused on perception, cognition and action, but has not been sufficiently viscerally or emotionally-directed (c.f. Turnbull, 2001).

What then of Luria's observations on *where* in the brain these functions might be located? Given that *The Working Brain* was published in 1973, one might expect that Luria might have been influenced by the (then) small but growing body of work on lateral hemispheric differences in emotion perception and production, or the paradoxical emotional reactions of patients after right hemisphere lesions (e.g., Gainotti, 1972; Ross & Mesulam, 1979; Ross, 1981; see Borod, 2000 or Ross, 2021, 2023 for review). This literature identified the right hemisphere as important for the more 'cognitive' elements of emotion expression and perception, including modulation of speech through affective prosody, producing a range of prosodic disorders analogous to the aphasic syndromes (Ross, 2021, 2023). Critically, however these right lateralised systems do not mediate the powerfully experienced or 'subjective' component of emotion, which produces, for example, overwhelming fear or profound depression.

It was, notably, only in the 1990's when the important role of subcortical and deep subcortical brain regions, such as the hypothalamus, amygdala and peri-aqueductal grey, reached a more general awareness in the field. This arrived with, for example, the broader recognition of work such as that of Panksepp (1998) or LeDoux (1992), and a growing awareness that cortical lesions (of whichever hemisphere) do not affect the foundational experience of emotions (Damasio et al., 2013; Turnbull & Evans, 2006; Turnbull & Salas, 2021).

Here, again Luria is prescient. Time and again he mentions "the structures of the upper brain stem and the hypothalamus, which have a visceral function". He cites key pioneers such as Klüver, Olds, and MacLean, and points out that "lesion of these parts … causes considerable changes in the biochemical processes, elementary needs and affects". As a result, "lesions to the medial (or mediobasal) frontal zones never cause a primary disorder in cognition or action." He points this out in various domains (visual, auditory, tactile, complex movements, postural praxis, spatial position, ability to master rhythmical structures), including notably that "speech remains – phonetically and morphologically – unchanged, if we disregard its sluggishness and (sometimes) monotony".

In this way, Luria uses the classical tool of dissociation to clarify that, in contrast to intact *cognitive* abilities, the central features of impairment are "a clear lowering of tone, a tendency towards an akinetic state, a rapid fatigue and inactive state [with] symptoms of akinesia, similar to stupor … [where] contrary to patients with a clear 'frontal syndrome' they show no signs of emotional levity or euphoria".

Using today's terminology, one firstly notes Luria's use of the older term 'frontal syndrome', which has now been replaced with the term dysexecutive – reflecting the partial de-coupling of executive abilities and the frontal lobes (Stuss, 2011; Stuss & Alexander, 2000). Luria then proceeds to describe the many aspects of executive function, typically associated with the dorsal lateral surfaces. This complex issue has been much investigated over recent decades, producing a range of classificatory terms, such as response inhibition, selective attention, task setting, working memory and cognitive flexibility (Diamond, 2013; Miyake & Friedman, 2012; Stuss, 2011). Luria argues (correctly) that these abilities remain *intact* after mediobasal lesions.

Luria then describes a contrasting range of other abilities, more closely linked to motivation, which are now well-described as being *impaired* after medio-basal frontal lesions. These might be variously described today as deficits in intentionality, initiation, energization, self-regulation or task setting (Diamond, 2013; Miyake et al., 2000; Stuss, 2011), or as mood control and motivational drive within the framework of the default mode network (Raichle, 2015). In brief, the essence of Luria's distinction remains valid today, though the details and classification of executive abilities have changed (and, alas, still remain less than ideally clear).

Thus far, Luria's thinking shows great foresight, at least as regards the overall shape and direction of travel: that neuropsychology should focus more on emotion, and that the anatomical basis of this might be in a range of medial, subcortical and deep subcortical brain regions. The past few decades of neuropsychology have indeed seen such a shift, and the structures suggested by Luria are indeed critically important for emotion.

Where, then, might Luria have been less prescient, and what has happened in the last half century of emotion neuroscience that he did not predict? A prominent example might be the role of emotion in decision-making, introduced as the 'somatic marker' hypothesis by Bechara and Damasio

in the 1990s (Bechara, Damasio, Damasio, & Anderson, 1994, Damasio, 1996). They described patients with lesions to the ventro-mesial frontal lobes, who often showed normal intelligence, with near or near-to-normal performance on a range of executive tasks (Bechara et al., 2000). In contrast, the patients displayed difficulties in learning from past mistakes, entering repeatedly into inappropriate relationships and unsuitable business agreements, as in the famous Phineas Gage case (Harlow, 1848). Such patients represent, in many respects, the dissociation that Luria describes, between cognitive and visceral functions. However, Luria was a few decades too early to see the role of emotion in decision-making, found especially when humans are faced with choices made complex by ambiguous contingencies and uncertain consequences (Kahneman, 2003, see Turnbull et al., 2014 for review). Luria would no doubt have been interested to follow this new research strand, given that it is based on anatomical and embodiment principles with which he was very familiar.

A further area of great progress has been in affective neuroscience, and that especially derived from animal work: where experimental techniques such as electrical stimulation, targeted lesion studies, and focal pharmacological interventions (Panksepp, 1998; Dalgleish, Dunn, & Mobbs, 2009) have allowed a level of precision which would not have been available to Luria's human lesion study approach. In general, this literature has revealed that there are a *range* of basic emotion systems mediated by these subcortical and deep subcortical structures. While there is some disagreement on the exact number, it is likely to be in the range of 4–7 discrete emotions, including fear, anger, sadness, and an important class of positive emotion, variously described as wanting, interest, expectancy or SEEKING (Damasio & Carvalho, 2013; 2010; Panksepp, 1998, 2005; see also Watt, 2007).

Secondly, there are clear developments in showing that these individual emotions are organized in a hierarchy, such that the more foundational elements (for example in the upper brain stem) seem dedicated to the core *experience* of emotion, while higher levels of the system (for example in the amygdala) are dedicated to functions such as emotional memory (LeDoux, 1992; 1996; Panksepp & Solms, 2012; Panksepp & Watt, 2011, Turnbull & Salas, 2021). The highest levels of these systems seem to involve the role of emotion in complex decision-making, where the importance of the ventro-mesial frontal lobes, discussed above, is a clear link to the human lesion literature.

Finally, there has been a growing interest in the elements of emotion which *are* cortically mediated, including lateral frontal areas, which seem to be involved in the control and management of emotion systems, typically described as emotion *regulation* (Salas et al., 2014; Turnbull & Salas, 2021). Elements of these findings *are* present in Luria's chapter. For example, Luria describes patients who confabulate, by reporting that "relatives are waiting in the corridor, that he left his house in the morning and was at work, that he just returned from a business trip, etc". Typically, such uncontrolled confabulations, which the patient does not realise to be false, are particularly clear when there are lesions to the "anterior zones of the limbic area". This is an account of confabulation which any modern neuropsychologist would recognise, including even the description of the lesion site as anterior limbic or medial frontal (c.f. Schnider, 2013). All that Luria's account might lack is the reference to the emotional *tone* of these poorly regulated confabulations, which we now know (consistent with Luria's example) to be often positively biased in their valence (see Turnbull & Salas, 2017 for review).

5.2. *The non-dominant hemisphere*

What then of Luria's observations on what he calls "The non-dominant hemisphere and its role in the organisation of psychological processes"? Here, Luria's survey is again in most respects accurate, and consistent with modern neuropsychology – though here there has been no equivalent of the revolution of affective neuroscience. Luria's list of neuropsychological disorders after non-dominant hemisphere lesions will be entirely familiar to modern readers. He opens with a 'functional systems' statement, typical of Luria's style, on hemispheric specialisation: "any complex psychological function is performed by both, co-operating hemispheres, each of which makes its own contribution to the structure of psychological processes". Here he also makes comments on language lateralisation that seem entirely familiar. One minor issue is Luria's suggestion that there is "complete anatomical similarity" between the hemispheres – which, since the early 1970s, has been over-taken by findings of a few modest, but fairly reliable, inter-hemispheric differences in anatomy (such as the famous *planum temporale*, Geschwind & Levitsky, 1968. See Vigneau et al., 2006 for more on this topic).

Luria then surveys a range of neuropsychological disorders of the non-dominant hemisphere, generating what would still be a reasonable list in modern neuropsychology. There are several paragraphs on spatial disorientation, including constructional apraxia, and a few (fairly brief) comments on disorders of body schema, tactile sensitivity and dressing apraxia. Luria also right-localises the lesion site for prosopagnosia (a statement which remains factually accurate), but also right-localises object recognition in *general*, which seems less accurate in the light of modern findings (Feinberg & Farah, 2003; Rapp, 2015).

There is also a large section dedicated to what Luria describes as 'unilateral spatial agnosia', or "left-sided fixated hemianopia', these days typically described as hemi-spatial neglect. Again, this remains accurate – though Luria's account focuses on neglect as resulting from lesions to "the posterior (and especially the deep) zones of the right hemisphere". This remains true, though research in the last few decades have identified a number of other sites which also produce neglect (Corbetta & Shulman, 2011). Interestingly, Luria suggests that what we would now describe as 'personal' neglect (failure to attend to contralesional body parts) results from damage to the "medial temporal zones of the right hemisphere". This differential lesion site is an interesting suggestion, given that dissociations between peri-personal and distant object neglect have been reported (e.g., Bisiach, Perani, Vallar, & Berti, 1986), but it is less clear that a medial temporal lesion site is the cause.

There is also an interesting section on anosognosia, which describes the classic elements of unawareness. Interestingly, this is described by Luria as suggesting that the right hemisphere is "apparently" responsible for "the overall perception

of one's own personality". He opines that the "nature and the internal mechanisms of this symptom still require further study". It seems safe to say that this issue remains unresolved (Orfei et al., 2007; Pia, Neppi-Modona, Ricci, & Berti, 2004; Turnbull, Fotopoulou, & Solms, 2014). This is related to the most mysterious theme in Luria's chapter, the role of the right hemisphere in what he calls "direct consciousness". The example which he provides is a patient who "thought they were simultaneously located in Moscow and in another city and they found nothing contradictory in this view". In some respects, the disorder is similar to that of confabulations after medial frontal lesions described by Paterson and Zangwill (1944), the classic example being a patient who believed that he was simultaneously in Edinburgh (where he was hospitalised) and Grimsby (his family home). This disorder is usually referred to as reduplicative paramnesia (Ardila, 2016; Hakim, Verma, & Greiffenstein, 1988). It is not clear whether Luria regards this as an entirely novel, but under-investigated, feature of right hemisphere lesions. An alternative account might be that this spatial reduplication reflects the combined effects of two deficits described above: an impairment of visuo-spatial cognition, together with the impairment of self-awareness which underpins anosognosia. Again, there are echoes of this spatial-plus-emotion argument in modern neuropsychology (Turnbull et al., 2014).

In sum, Luria's 'lost' chapter offers a fascinating insight into one of neuropsychology's greatest minds, working at the boundaries of his knowledge base. Luria understands that there are domains – especially related to emotion and personality – that are clinically important. He is able to locate the brain areas responsible for these, in general terms. However, he lived a few decades too early for the detailed knowledge needed to link specific emotions to particular brain areas, to organise this material into a sensible hierarchy, or to see how these emotions interact with, and shape, cognition. We suspect that Luria would be delighted that his vision of the neuropsychology of feelings and space was broadly correct, and he would no doubt be fascinated to see the many ways in which the field has moved on to identify the specifics of how emotions are generated and managed.

CRediT authorship contribution statement

O.H. Turnbull: Writing – review & editing, Writing – original draft, Project administration, Methodology, Investigation, Conceptualization. **C.E. Salas:** Writing – review & editing, Project administration, Investigation. **A. Ardila:** Writing – review & editing, Investigation. **R. Bagus:** Writing – review & editing, Conceptualization. **M. Rosselli:** Writing – review & editing, Investigation, Conceptualization.

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REFERENCES FROM THE LURIA TRANSLATION

Anan'ev, B. G. (1952). Paired working of the cerebral hemispheres. In S. A. Petrushevski (Ed.), *I. P. Pavlov and the philosophical bases of psychology, Izd. Akad. Pedagog. Nauk*. Moscow: RSFSR (in Russian).

Baruk, H. (1926). *Les troubles mentaux dans les tumeurs cérébrales: étude clinique, pathogénie, traitement*. Gaston Doin.

Bekhterev, V. M. (1900). Demonstration Gehirns mit Zerstörung der vorderen und inneren Thelie der Hirnrinde beider Schläferlappens. *Z. Neurol., 19*.

Benton, A. L. (1961). The fiction of the "Gerstmann syndrome". *Journal of Neurology, Neurosurgery, and Psychiatry, 24*.

Benton, A. L. (1965). The problem of cerebral dominance. *Canadian Psychology, 6*.

Benton, A. L. (1967). Constructional apraxia and the minor hemisphere. *Confinia Neurologica, 27*.

Benton, A. L. (1969). Disorders of spatial orientation. In P. J. Vinken, & G. W. Bruyn (Eds.), *Handbook of clinical neurology* (Vol. 3). Amsterdam: North Holland Publishing Company.

Bodamer, I. (1947). Die Prosopagnosie. *Archiv fur Psychiatrie und Nervenkrankheiten, 79*.

Bragina, N. N. (1966). *Clinical syndromes of a lesion of the hippocampus and neighbouring regions* (Doctoral dissertation). Moscow (Russian): USSR, Acad. Med. Sci.

Brain, W. R. (1941). Visual disorientation with special reference to lesions of the right cerebral hemisphere. *Brain: a Journal of Neurology, 64*.

Členov, L. G., & Bein, E. S. (1958). Agnosias for faces. *Zh. Nauropat. i Psikhiat., 58* (in Russian).

Critchley, M. (1953). *The parietal lobes*. Arnold.

De Renzi, E., & Spinnler, H. (1966). Facial recognition in brain-damaged patients: An experimental approach. *Neurology, 16*(2 Part 1), 145–152.

De Renzi, E., Faglioni, P., & Spinnler, H. (1968). The performance of patients with unilateral brain damage on face recognition tasks. *Cortex, 4*(1), 17–34.

Filimonov, I. N. (1949). *Comparative anatomy of the mammalian cerebral cortex, Moscow* (in Russian).

Gazzaniga, M. S. (1970). *The bisected brain* (Vol. 2). Appleton-Century-Crofts.

Gazzaniga, M. S. (1972). One brain – Two minds? *American Scientist, 60*(3), 311–317.

Grünthal, E. (1939). Über das Corpus mamillare und den Korsakowschen Symptomencomplex. *Confinia Neurologica, 2*.

Hécaen, H. (1969). Aphasic, apraxic and agnostic syndromes in right and left hemisphere lesions. In P. J. Vinken, & G. W. Bruyn (Eds.), *Handbook of clinical neurology* (Vol. 4). Amsterdam: North Holland Publishing Company.

Hécaen, H., & Ajuriaguerra, J. (1963). *Les gauchers. Prévalence manuelle et dominance cérébrale*. Paris: Presess Universitaires de France.

Hécaen, H., & de Ajuriaguerra, J. (1952). *Méconnaissances et hallucinations corporelles: intégration et désintégration de la somatognosie*. Masson.

Hoff, H. & Potzl, O. (1937). Ueber eine optisch-agnostische Störung des Physiognomie-Gedächtnisses. *Zeitschrift für die Gesamte Neurologie und Psychiatrie*, 195, 367–395.

Holmes, G. (1919). Disturbances of vision by cerebral lesions. *British Journal of Ophthalmology, 1*.

Jackson, J. H. (1874). On the nature of the duality of the brain. In *Selected writings of John Hughlings Jackson* (Vol. 2, p. 1932). Hodder & Stoughton.

Kimura, D. (1963). Right temporal lobe damage, perception of unfamiliar stimuli after damage. *Archives of Neurology, 8*.

Kiyashchenko, N. K. (1969). *Structure of memory disturbances in local brain lesions*. Moscow: Candidate Dissertation, Moscow University (in Russian).

Klüver, H. (1952). Brain mechanisms and behaviour with special reference to the rhinencephalon. *Lancet*.
Klüver, H., & Bucy, P. C. (1938). An analysis of certain effects of bilateral temporal lobectomy in the rhesus monkey. *The Journal of Psychology, 5*.
Kok, E. P. (1967). *The visual agnosias*. Leningrad: Meditsina (in Russian).
Korčažinskaja, V. I. (1971). *Unilateral spatial agnosia in local brain lesions* (Candidate dissertation). Moscow: USSR Acad. Med. Sci. (in Russian).
Luria, A. R. (1963). *Restoration of function after brain injury*. Oxford: Pergamon Press.
Luria, A. R. (1971). Memory disturbances in local brain lesions. *Neuropsychologia, 9*.
Luria, A. R. (1973a). *Neuropsychology of memory* (Vol. 1). Moscow: Pedagogika Publishing House (in Russian).
Luria, A. R., Homskaya, E. D., Blinkow, S. M., & Critchley, M. (1967). Impairment of selectivity of mental processes in association with lesions of the frontal lobe. *Neuropsychologia, 5*.
Luria, A. R., Konovalov, A. N., & Podgornaya, A. Y. (1970). *Memory disturbances in the syndrome of aneurysm of the anterior communicating artery*. Moscow: Moscow University Press (in Russian).
Luria, A. R., & Skorodumova, A. V. (1950). The phenomenon of fixed hemianopia. In *Collection in memory of S. V. Kravkov, Moscow* (in Russian).
McFie, J., Piercy, M., & Zangwill, O. L. (1950). Visual spatial agnosia associated with lesions on the right hemisphere. *Brain: a Journal of Neurology, 73*.
MacLean, P. D. (1952). Some psychiatric implications of psychophysiological studies of the fronto-temporal portion of the limbic system. *Electroencephalography and Clinical Neurophysiology, 4*.
MacLean, P. D. (1958). The limbic system with respect to self preservation and preservation of the species. *The Journal of Nervous and Mental Disease, 127*.
Milner, B. (1954). The intellectual functions of the temporal lobe. *Psychological Bulletin, 51*.
Milner, B. (1958). Psychological defects produced by temporal love excision. In *Research Publications — Association for Research in Nervous and Mental Disease* (Vol. 36).
Milner, B. (1962). Les troubles de la mémoire accompagnant des lésions hippocampiques bilatéreales. In *Physiologie de l'hippocampe, Paris*.
Milner, B. (1966). Amnesia following operation on the temporal lobes. In C. W. M. Witty, & O. L. Zangwill (Eds.), *Amnesia*. Butterworth.
Milner, B. (1968). Visual recognition and recall after right temporal lobe excision in man. *Neuropsychologia, 6*.
Milner, B. (1969). Residual intellectual and memory deficits after head injury. In A. E. Walker, W. F. Caverners, & M. Critchley (Eds.), *The late effects of head injury*. Thomas.
Milner, B. (1970). Memory and the medial temporal regions of the brain. In K. H. Pribram, & D. E. Broadbent (Eds.), *Biology of Memory* (pp. 29–50). New York: Academic Press.
Olds, J. (1955). Physiological mechanisms of reward. In *Nebraska symposium on motivation*. University of Nebraska Press.
Olds, J. (1958). Selective effects of drives and drugs on "reward" system of the brain. In G. E. W. Wolstenholme, & C. M. O'Connor (Eds.), *Neurological Basis of behaviour, Ciba foundation Symposium*. Churchill.
Olds, J. (1959). Higher functions of the nervous system. *Annual Review of Physiology, 21*.
Penfield, W., & Milner, B. (1958). Memory deficit produced by bilateral lesions of the hippocampal zone. *Archives of Neurology and Psychiatry, 74*.
Piercy, M. F., Hécaen, H., & Ajuriaguerra, J. (1960). Constructional apraxia associated with unilateral cerebral lesions. *Brain: a Journal of Neurology, 85*.
Popova, L. T. (1964). *Disturbance of mnestic processes in patients with some local brain lesions*. Candidate Dissertation, First Moscow Medical Institute (in Russian).
Scoville, W. B. (1954). The limbic system in man. *Journal of Neurosurgery, 11*.
Scoville, W. B., & Milner, B. (1957). Loss of recent memory after bilateral hippocampal lesions. *Journal of Neurology, Neurosurgery, and Psychiatry, 20*.
Semmes, J., Weinstein, S., Ghent, L., & Teuber, H. L. (1960). *Changes in somatic sensation after penetrating brain wounds in man*. Harvard University Press.
Šmar'jan, A. S. (1949). *Cerebral pathology and psychiatry*. Moscow: Medgiz (in Russian).
Smith, A. (1966). Speech and other functions after left (dominant) hemispherectomy. *Journal of Neurology, Neurosurgery, and Psychiatry, 29*.
Subirana, A. (1952). La droiterie. *Schweizer Archiv für Neurologie und Psychiatrie, 69*.
Subirana, A. (1964). The relationship between handedness and language function. *International Journal of Neurology, 4*.
Subirana, A. (1969). Handedness and cerebral dominance. In P. J. Vinken, & G. W. Bruyn (Eds.), *Handbook of clinical neurology* (Vol. 4). North Holland Publishing Co.
Sperry, R. W., & Gazzaniga, M. S. (1967). Language following surgical disconnection of the hemispheres. In C. H. Millikan, & F. L. Darley (Eds.), *Brain mechanisms underlying speech and language*. Grune & Stratton.
Sperry, R. W., Gazzaniga, M. S., & Bogen, J. E. (1969). Interhemispheric relationships: The neocortical commissures; syndromes of hemisphere disconnection. In P. J. Vinken, & G. W. Bruyn (Eds.), *Handbook of clinical neurology* (Vol. 4). North Holland Publishing Co.
Teuber, H. L. (1962). Effects of brain wounds implicating right or left hemispheres in man. In V. B. Mountcastle (Ed.), *Interhemispheric reactions and cerebral dominance*. Johns Hopkins Press.
Wada, J. (1949). A new method for determination of the side of cerebral speech dominance. *Medical Biology, 14*.
Wada, J., & Rasmussen, T. (1960). Intercarotid injection of sodium amytal for the lateralization of cerebral speech dominance. *Journal of Neurosurgery, 17*.
Weinstein, E. A., Cole, M., Mitchell, M. S., & Lyerly, O. G. (1964). Anosognosia and aphasia. *Archives of Neurology and Psychiatry, 10*.
Zangwill, O. L. (1960). *Cerebral dominance and its relation to psychological function*. Oliver & Boyd.

References from the surrounding text

Ardila, A. (1992). Luria's approach to neuropsychological assessment. *International Journal of Neuroscience, 66*(1–2), 35–43.
Ardila, A. (2016). Some unusual neuropsychological syndromes: Somatoparaphrenia, akinetopsia, reduplicative paramnesia, autotopagnosia. *Archives of Clinical Neuropsychology, 31*(5), 456–464.
Bechara, A., Damasio, A. R., Damasio, H., & Anderson, S. W. (1994). Insensitivity to future consequences following damage to human prefrontal cortex. *Cognition, 50*, 7–15.
Bechara, A., Damasio, H., & Damasio, A. R. (2000). Emotion, decision making and the orbitofrontal cortex. *Cerebral Cortex, 10*, 295–307.

Bisiach, E., Perani, D., Vallar, G., & Berti, A. (1986). Unilateral neglect: Personal and extra-personal. *Neuropsychologia, 24*(6), 759–767.
Borod, J. C. (2000). *The neuropsychology of emotion*. Oxford: Oxford University Press.
Caramazza, A., & Coltheart, M. (2006). Cognitive neuropsychology twenty years on. *Cognitive Neuropsychology, 23*(1), 3–12.
Corbetta, M., & Shulman, G. L. (2011). Spatial neglect and attention networks. *Annual Review of Neuroscience, 34*, 569–599.
Cory, G. A., & Gardner, R. (Eds.). (2002). *The evolutionary neuroethology of Paul MacLean: Convergences and frontiers*. Greenwood Publishing Group.
Damasio, A. R. (1996). The somatic marker hypothesis and the possible functions of the prefrontal cortex. *Philosophical Transactions of the Royal Society of London (Biology), 351*, 1413–1420.
Damasio, A., & Carvalho, G. B. (2013). The nature of feelings: Evolutionary and neurobiological origins. *Nature Reviews Neuroscience, 14*(2), 143.
Damasio, A., Damasio, H., & Tranel, D. (2013). Persistence of feelings and sentience after bilateral damage of the insula. *Cerebral Cortex, 23*(4), 833–846.
Davis, K. L., & Panksepp, J. (2018). *The emotional foundations of personality: A neurobiological and evolutionary approach*. New York: W.W. Norton & Co.
Diamond, A. (2013). Executive functions. *Annual Review of Psychology, 64*, 135–168.
Dalgleish, T., Dunn, B. D., & Mobbs, D. (2009). Affective neuroscience: Past, present, and future. *Emotion Review, 1*(4), 355–368.
Feinberg, T. E., & Farah, M. J. (2003). *Behavioral neurology and neuropsychology*. McGraw-Hill Professional.
Gainotti, G. (1972). Emotional behavior and hemispheric side of the lesion. *Cortex, 8*(1), 41–55.
Geschwind, N., & Levitsky, W. (1968). Human brain: Left-right asymmetries in temporal speech region. *Science, 161*(3837), 186–187.
Goldstein, K. (1939). *The organism: A holistic approach to biology derived from pathological data in man*. Urzone Inc.: New York, NY, USA; American Psychological Association (APA): Washington, DC.
Harlow, J. (1848). Passage of an iron rod through the head. *Boston Medical and Surgical Journal, 39*, 389–393.
Haigh, P. (2006). Obituary: Basil Haigh. *British Medical Journal, 332*, 123. https://doi.org/10.1136/bmj.332.7533.123-a
Hakim, H., Verma, N. P., & Greiffenstein, M. F. (1988). Pathogenesis of reduplicative paramnesia. *Journal of Neurology, Neurosurgery, and Psychiatry, 51*, 839–841.
Heilman, K. M., Scholes, R., & Watson, R. (1975). Auditory affective agnosia: Disturbed comprehension of affective speech. *Journal of Neurology, Neurosurgery, and Psychiatry, 38*, 69–72.
Jackson, J. H. (1888). Remarks on the diagnosis and treatment of diseases of the brain. *Bmj: British Medical Journal, 2*, 111–117.
Kahneman, D. (2003). A perspective on judgement and choice. *American Psychologist, 58*, 697–720. https://doi.org/10.1037/0003-066X.58.9.697
Kolb, B., & Wishaw, I. Q. (2003). *Fundamentals of human neuropsychology*. New York: Macmillan.
LeDoux, J. E. (1992). Emotion and the amygdala. In J. P. Aggleton (Ed.), *The amygdala: Neurobiological aspects of emotion, memory, and mental dysfunction* (pp. 339–351). New York, NY, US: Wiley-Liss.
LeDoux, J. E. (1996). *The emotional brain: The mysterious underpinnings of emotional life*. New York: Simon & Schuster.
Libon, D., Swenson, R., & Ashendorf, L. (2013). Edith Kaplan and the Boston process approach: A tribute to an original thinker. In L. Ashendorf, R. Swenson, & D. Libon (Eds.), *The Boston Process approach to neuropsychological assessment. A Practitioner's guide. New York: Oxford*.
Luria, A. R. (1973b). *The working brain: An introduction to neuropsychology*. London: Penguin Books.
Lurija, A. R. (1982). *Grondslagen van de neuropsychologie*. Deventer: Van Loghum Slaterus.
Luria, A. R., & Majovski, L. V. (1977). Basic approaches used in American and Soviet clinical neuropsychology. *American Psychologist, 32*(11), 959–968.
Mecacci, L. (2005). Luria: A unitary view of human brain and mind. *Cortex, 41*, 816–822.
Mikadze, Y. V., Ardila, A., & Akhutina, T. V. (2019). AR Luria's approach to neuropsychological assessment and rehabilitation. *Archives of Clinical Neuropsychology, 34*(6), 795–802.
Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*(1).
Miyake, A., & Friedman, N. P. (2012). The nature and organization of individual differences in executive functions: Four general conclusions. *Current Directions in Psychological Science, 21*(1), 8–14.
McCarthy, R. A., & Warrington, E. K. (1990). *Cognitive neuropsychology: A clinical introduction*. Academic Press.
McDonald, S. (2017). Emotions are rising: The growing field of affect neuropsychology. *Journal of the International Neuropsychological Society, 23*(9–10), 719–731.
Orfei, M. D., Robinson, R. G., Prigatano, G. P., Starkstein, S., Rüsch, N., Bria, P., … Spalletta, G. (2007). Anosognosia for hemiplegia after stroke is a multifaceted phenomenon: A systematic review of the literature. *Brain, 130*(12), 3075–3090.
Panksepp, J. (1998). *Affective neuroscience: The foundations of human and animal emotions*. Oxford University Press.
Panksepp, J. (2005). On the embodied neural nature of core emotional affects. *Journal of consciousness studies, 12*(8–9), 158–184.
Panksepp, J., & Solms, M. (2012). What is neuropsychoanalysis? Clinically relevant studies of the minded brain. *Trends in Cognitive Sciences, 16*(1), 6–8.
Panksepp, J., & Watt, D. (2011). What is basic about basic emotions? Lasting lessons from affective neuroscience. *Emotion Review, 3*(4), 387–396.
Paterson, A., & Zangwill, O. L. (1944). Disorders of visual space perception associated with lesions of the right cerebral hemisphere. *Brain: a Journal of Neurology, 67*(4), 331–358.
Petronio, S. (2002). The new world and scholarship translation practices: Necessary changes in defining evidence. *Western Journal of Communication, 66*(4), 507–512. https://doi.org/10.1080/10570310209374752
Pia, L., Neppi-Modona, M., Ricci, R., & Berti, A. (2004). The anatomy of anosognosia for hemiplegia: A meta-analysis. *Cortex, 40*(2), 367–377.
Raichle, M. E. (2015). The brain's default mode network. *Annual Review of Neuroscience, 38*, 433–447.
Ramachandran, V. S. (2002). *Encyclopedia of the human brain, four-volume set*. Academic Press.
Rapp, B. (2015). *Handbook of cognitive neuropsychology: What deficits reveal about the human mind*. London: Psychology Press.
Ross, E. D., & Mesulam, M. M. (1979). Dominant language functions of the right hemisphere? Prosody and emotional gesturing. *Archives of Neurology, 36*(3), 144–148.
Ross, E. D. (1981). The aprosodias. Functional-anatomic organization of the affective components of language in the right hemisphere. *Archives of Neurology, 38*(9), 561–569.

Ross, E. D. (2021). Disorders of vocal emotional expression and comprehension: The aprosodias. In K. M. Heilman, & S. E. Nadeau (Eds.), *Handbook of clinical neurology: Disorders of emotion in neurologic disease* (Vol. 183, pp. 63–108) (3rd series); chap. 4.

Ross, E. D. (2023). Affective prosody and its impact on the neurology of language, depression, memory, and emotions. *Brain Sciences, 13*, 1572. https://doi.org/10.3390/brainsci13111572

Salas, C. E., Casassus, M., & Turnbull, O. H. (2016). A Neuropsychoanalytic approach to case studies. *Clinical Social Work*, 1–14. https://doi.org/10.1007/s10615-016-0596-z

Salas, C. E., Casassus, M., & Turnbull, O. H. (2017). A neuropsychoanalytic approach to case studies. *Clinical Social Work Journal, 45*(3), 201–214.

Salas, C. E., Radovic, D., Yuen, K. S., Yeates, G. N., Castro, O., & Turnbull, O. H. (2014). "Opening an emotional dimension in me": Changes in emotional reactivity and emotion regulation in a case of executive impairment after left fronto-parietal damage. *Bulletin of the Menninger Clinic, 78*(4), 301–334.

Salas, C. E., Gross, J. J., & Turnbull, O. H. (2019). Using the process model to understand emotion regulation changes after brain injury. *Psychology & Neuroscience, 12*(4), 430.

Schilder, P. (1936). The image and appearance of the human body. *The Journal of Nervous and Mental Disease, 83*, 227–228.

Stuss, D. T., & Alexander, M. P. (2000). Executive functions and the frontal lobes: A conceptual view. *Psychological Research, 63*, 289–298.

Stuss, D. T. (2011). Functions of the frontal lobes: Relation to executive functions. *Journal of the International Neuropsychological Society, 17*, 759–765.

Stringer, A. Y., Cooley, E. L., & Christensen, A. L. (2002). *Pathways to prominence in neuropsychology: Reflections of twentieth-century pioneers*. Psychology Press.

Schnider, A. (2013). Orbitofrontal reality filtering. *Frontiers in Behavioral Neuroscience, 7*, 67.

Solms, M. (1999). Controversies in Freud translation. *Psychoanalysis and History, 1*, 28–43. https://doi.org/10.3366/pah.1999.1.1.28

Turnbull, O.H. & Evans, C.E.Y. (2006). Preserved complex emotion-based learning in amnesia. *Neuropsychologia*, 44, 300–306.

Turnbull, O. H. (1996). Neuropsychological rehabilitation: Modern approaches, and their debt to Aleksandr Luria. In S. Della Sala, C. Marchetti, & O. H. Turnbull (Eds.), *An interdisciplinary approach to the rehabilitation of the neurological patient. A cognitive perspective* (pp. 33–46). Pavia: PI-ME Press.

Turnbull, O. H., & Salas, C. E. (2021). The neuropsychology of emotion and emotion regulation: The role of laterality and hierarchy. *Brain Sciences, 11*, 1075. https://doi.org/10.3390/brainsci11081075

Turnbull, O. H. (2001). Cognitive neuropsychology comes of age: A review of B. Rapp (2001). *Handbook of cognitive neuropsychology*. *Cortex, 37*, 445–450.

Turnbull, O. H., & Bagus, R. (1991). The translation of the Luria Neuropsychological Investigation into Zulu: Its relationship to the work of A.R. Luria and L.S. Vygotsky. *South African Journal of Psychology, 21*(1), 61–63.

Turnbull, O. H., Fotopoulou, A., & Solms, M. (2014). Anosognosia as motivated unawareness: The 'defence'hypothesis revisited. *Cortex, 61*, 18–29.

Turnbull, O. H., & Salas, C. E. (2017). Confabulation: Developing the 'emotion dysregulation' hypothesis. *Cortex, 87*, 52–61.

Turnbull, O. H., Bowman, C. H., Shanker, S., & Davies, J. L. (2014). Emotion-based learning: Insights from the Iowa Gambling task. *Frontiers of Psychology*, 5(Article 162), 1–11. https://doi.org/10.3389/fpsyg.2014.00162

Van der Veer, R., & Yasnitsky, A. (2016). Translating Vygotsky: Some problems of transnational Vygotskian science. In A. Yasnitsky, & R. van der Veer (Eds.), *Revisionist revolution in Vygotsky studies* (pp. 143–174). London: Routledge.

Vigneau, M., Beaucousin, V., Hervé, P. Y., Duffau, H., Crivello, F., Houdé, O., et al. (2006). Meta-analyzing left hemisphere language areas: Phonology, semantics, and sentence processing. *NeuroImage, 30*, 1414–1432.

Watt, D. (2007). Towards a neuroscience of empathy: Integrating affective and cognitive perspectives. *Neuropsychoanalysis, 9*(2), 119–140.

Yasnitsky, A. (2012). The complete works of L.S. Vygotsky: *PsyAnima complete Vygotsky* project. *Dubna Psychological Journal, 3*, 144–148.

Zavershneva, E. Y., & Osipov, M. E. (2012). Primary changes to the version of 'The historical meaning of the crisis in psychology' published in the collected Works of L.S. Vygotsky. *Journal of Russian and East European Psychology, 50*(4), 64–84.