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# LANGUAGE REHABILITATION IN CHRONIC POST-STROKE APHASIA: A NEUROSCIENTIFIC PERSPECTIVE

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**Abstract**

This review focuses on language deficits in post-stroke aphasia, their rehabilitation and potential new developments based on current knowledge of human brain function. Language impairments in post-stroke aphasia often become chronic and cause significant communicative difficulties for patients. Though standard rehabilitation methods provide some language improvements, they are usually moderate and often decay over a period of time. These traditional rehabilitation approaches are usually based on existing conventions formed through decades of clinical practice; whilst valuable, they are not often rooted in up-to-date neuroscientific knowledge. In recent decades, human neuroscience has developed at a very high speed, not least due to the advent of non-invasive brain imaging techniques. Currently, it has reached the stage where neuroscientific knowledge can inform clinical practice, and help upgrade the traditional approaches using modern neuroscience tools. Furthermore, traditional practices typically apply the same routines to different patients, even though the nature of the individual deficit — and hence the care needed — are never the same. For instance, aphasic patients demonstrate a massive variety of improvement patterns during natural language recovery. This might be caused by individual differences in the functioning of language neural networks and their dynamics after stroke. Although the problem of individual variability in aphasia is well-known, there is still no comprehensive understanding of all factors that impact this variability. As we highlight in this review, the issue is of high importance for planning language therapy on individual basis. We also analyze neuroscientific underpinnings and clinical efficiency of a language therapy, which is widely used for chronic aphasia rehabilitation — constraint-induced aphasia therapy.

**Keywords:** aphasia, stroke, neurorehabilitation, neurolinguistics, constraint-induced aphasia therapy.

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## Introduction

Aphasia is an acquired speech disorder caused by brain damage, such as traumatic injuries, neoplasms, neural infections, degenerative conditions and cerebrovascular disorders or strokes (Ardilla, 2014). Stroke is the most common type among aphasia etiologies. In turn, speech disorders are among the most common consequences of a stroke. Post-stroke patients demonstrate difficulties in language production, comprehension or both. The impairments vary greatly across subjects according to their types and severities. This raises a complicated problem, both clinically and scientifically. On the one hand, speech impairments in aphasia often become chronic, hence patients with aphasia need speech rehabilitation. On the other hand, there is still no complete understanding of relations between the neural factors associated with aphasia and specific language impairments. The latter is directly related to a lack of explanation of which neurophysiological processes either in normal or in pathological conditions underpin different language functions. Currently, a dominating idea is that language generation and comprehension are served by distributed neural networks in the brain. These networks include well-known "classical" language areas (Broca's and Wernicke's areas) as well as variety of complementary brain areas activating in specific language tasks (Hicock & Poeppel, 2007). However, these general frameworks have still not provided a comprehensive and consistent view describing the processes of generation and perception of speech, localization and temporal dynamics of activity subserving these processes. Understanding the brain mechanisms underpinning the normal language function is a key to understanding its impairments in aphasia and, consequently, for choosing the effective rehabilitation strategies. In this review we briefly summarize the contemporary data on language function and its recovery in aphasic patients. We also analyze the results of application of one of the most promising recently developed strategies of speech rehabilitation: the so-called constraint-induced aphasia therapy, a novel therapy method based on current neuroscientific knowledge and theoretical principles of neuroscience.

## Neural mechanisms of the post-stroke aphasia recovery

Stroke itself is a neurological disorder characterized by a sudden disruption of the blood supply of particular brain areas. The disruption of blood supply causes morphological changes of the tissue in these regions and their functional loss. The functioning of the perilesional and even more distant brain areas is usually affected by stroke as well (Kiran, 2012). There are specific physiological mechanisms in the brain for compensating the morphological and functional damage induced by stroke. After a stroke the engagement of these mechanisms takes place even in the absence of any therapy leading to natural (spontaneous) recovery. Natural recovery results in a partial and in some cases even near-complete restoration of language functions (Pedersen, Vinter, & Olsen, 2004).This recovery occurs in three stages that often overlap (Anglade, Thiel, & Ansaldo, 2014):

- The acute stage: begins immediately after the stroke and lasts for ~7–18 days;

- The sub-acute stage: follows the acute stage and lasts up to 4 months after the stroke;
- The chronic stage: typically begins at 4 months after the stroke.

Each stage has specific physiological restoration mechanisms. The main mechanism of the acute stage is reperfusion (Kiran, 2012). Reperfusion is a resumption of the blood supply in the infarcted tissue. Typically, at this stage, an area called penumbra surrounds the infarcted tissue (Olsen, Larsen, Herning, Skriver, & Lassen, 1983). This area is dysfunctional due to low blood supply but it is not completely destroyed. If the reperfusion takes place successfully, then this area usually recovers.

Physiological restoration continues at the sub-acute stage where it becomes especially intense (Saur et al., 2006). Resolution of diaschisis and perilesional cellular changes are the mechanisms that drive the recovery at this stage (Kiran, 2012). Diaschisis (von Monakow, 1906) is a dysfunction caused by the disinhibition of a distant brain area due to the hypometabolism in the damaged proximal area. Resolution of diaschisis (restoration of physiological inhibition) usually occurs after the restoration of metabolism in the perilesional areas and the emergence of additional input from undamaged brain areas. This process is usually accompanied by the second restoration mechanism: re-activation of the perilesional areas due to intense neuronal growth processes in them (Carmichael, 2006; Cramer, 2008; Komitova, Johansson, & Eriksson, 2006). These cellular processes initiate neuroplastic change in the perilesional cortex that increases the inhibition of the contralateral areas and help the resolution of diaschisis. These plastic alterations are also supposed to underlie the functional reorganization of the whole bilateral neural language network in the sub-acute stage (Kiran, 2012). The most significant mark of this reorganization is the change in the language lateralization after stroke, and the increased role of the right hemisphere. It is quite well-known that patients recovered after a severe left-hemispheric stroke often loose language function after a new right-hemispheric stroke (Levine & Mohr, 1979; Basso, Gardelli, Grassi, & Mariotti, 1989). The other evidence comes from studies with non-invasive brain stimulation, which show that suppression of the right hemispheric language areas using, for example, Transcranial magnetic stimualtion, TMS (Winhuisen et al., 2005) in patients with sub-acute aphasia, causes difficulties in language processing. This can be interpreted as an evidence of reorganization of the language neural networks and namely the shift of language dominance to the right in these patients. This idea will be discussed further in more detail. Briefly, the sub-acute stage is characterized by intensive plasticity processes, especially in perilesional cortical areas. These processes trigger the reorganization of the whole brain language network with a change of the lateralization from the left to the right and appearance of new patterns of language activation.

By the onset of the chronic stage the patterns of language activity observed in patients usually stabilize. A meta-analysis of 12 neuroimaging studies (Turkeltaub, Messing, Norise, & Hamilton, 2011) with different language tasks and paradigms, including in total 104 aphasic patients and 129 control subjects, showed a bilateral language activation pattern consistent across multiple studies. This pattern included spared parts of the left ventrolateral prefrontal cortex, left middle temporal gyrus and their right-hemispheric homologues as well as areas in the left middle frontal gyrus and in the right sensorymotor cortex. The stabilization of these newly formed patterns means that processes of natural recovery driven by neural plasticity are usually completed by the chronic stage. These new patterns are characterized by the language lateralization shift to the right in most cases and the involvement of additional areas, non-specific for the language processing in healthy subjects.

One question regarding the process of the natural recovery is the functional significance of the physiological processes happening across the stages of this recovery. In other words, what is the direct impact of these physiological changes onto language abilities in aphasic patients and is it delivered? How are these physiological changes and clinical improvements connected mechanistically?

There are several accounts of the impact that the reorganization of language networks has on the post-stroke language recovery. These might be summarized as three basic hypotheses (Hamilton, Chrysikou, & Coslett, 2011). According to the perilesional hypothesis, language recovery is the result of the reactivation in spare language areas adjacent to the lesion (Hillis et al., 2006; Meinzer et al., 2008; Szaflarski, Allendorfer, Banks, Vannest, & Holland, 2013). The laterality-shift hypothesis proposes that the main recovery mechanism is a shift of language functions to the homotopic areas in the right hemisphere (Musso et al., 1999; Winhuisen et al., 2005; Turkeltaub et al., 2012). On the contrary, the disinhibition hypothesis postulates that post-stroke activity in the right hemisphere is caused by the loss of transcallosal inhibition and might be even deleterious for language recovery (Blank, Bird, Turkheimer, & Wise, 2003; Martin et al., 2004; Thiel et al., 2006). This diversity of existing accounts, which are to a degree mutually exclusive, shows that the exact roles of the left and the right hemispheres in the aphasia recovery remain unclear. To understand their roles correctly, one needs to look for some additional variables making an impact on the recovery process.

Anglade et al., 2014, attempted to sum up these hypotheses and to identify the relationships between changes in the patterns of activation and clinical dynamics, considering additional factors. In their review, these authors suggest that the right-hemispheric recruitment is effective only in a critical time window during the recovery after a left-hemispheric stroke, and the efficiency of this recruitment is different depending on the extent of lesion. According to these parameters – the stage and the lesion size – the authors identify three categories of patients with different patterns of recovery and different outcomes in the chronic stage. They conclude that the contributions of the left and right hemispheres depend on the initial lesion severity. Namely, the right hemisphere's involvement is more beneficial in the most severe cases with extended left-hemispheric damages, whilst in mild-to-moderate cases the main role in the recovery belongs to the left hemisphere.

The first important outcome of this analysis is that patients with aphasia demonstrate a wide range of individual differences in the neural recovery potential. Almost complete recovery happens when the left hemispheric language functions are relatively intact. Hence, maintaining and restoring the left-hemispheric function seems to be most beneficial for successful language recovery in aphasia. The more functionally severe the damage in the left hemisphere is, the greater the impact on the right hemisphere becomes, and the outcome of the recovery is worse. In the most severe cases, the right hemisphere appears to be the only functional resource for speech in such patients. These patients acquire strong chronic language impairments that are difficult to overcome. They have a low recovery potential and neurorehabilitation techniques cannot be particularly effective in such cases.

The second important outcome of this work is that there is a group of chronic patients with partial functional recovery. These patients might have some spare functional resources of the left hemisphere. These spare resources give an additional recovery potential for these patients, which may not have been completely used during the spontaneous natural recovery stage. Though these patients do not demonstrate severe speech impairments, they still have mild-to-moderate language difficulties. A potential reason for this is that the engagement of these intact left-hemispheric resources requires an additional special cognitive effort from these patients, which they are unable or unwilling to make. This leads to a so-called learned non-use syndrome, when the ability is not completely lost, but a person avoids using this ability because it is too demanding. This suggestion is based on the data from many stroke patients for whom speech becomes a very effortful (but not impossible) activity. They compensate for this difficulty by the active use of non-verbal signals (e.g. gestures) and a conscious reduction of verbal communication (Croteau & Le Dorze, 2006). This group of patients appears to be the most promising target group for successful language neurorehabilitation because of their existing untapped recovery potential. However, for this rehabilitation to be effective, a special approach is needed, which would enable the reactivation of these latent functional resources in the left hemisphere.

## Constraint-induced aphasia therapy as a tool to promote language recovery in the chronic stage

Constrained-induced approach to rehabilitation was initially developed for motor deficits by Taub (Taub, 1994; Taub, Uswatte, & Mark, 2014). In his research on forced-use neurorehabilitation, Taub observed a learned deficit in patients with paralyzed limbs (Taub, 1994), and a special therapy was developed to overcome this learned non-use by restricting the use of compensatory strategies and encouraging the recovery in the affected limb. This therapy was successfully applied for restoring the patients' motor functions. The main principles of this therapy are specifically constrained afferentation and massed practice. These principles are derived from the studies with animals paralyzed due to damaged somatosensory tracts (Jenkins, Merzenich, Ochs, Allard, & Guic-Robles, 1990; Recanzone, Merzenich, Jenkins, Grajski, & Dinse, 1992), which demonstrated that forced intensive use of a damaged limb could cause an afferent flow rise. As a result of this increase, cortical representation of the limb expanded. The same effect was discovered in humans (Elbert et al., 1994; Braun, Schweizer, Elbert, Birbaumer, & Taub, 2000). These results mean that cortical reorganization occurs in response to specific constrained afferentation associated with the intensive use of the damaged part of the body and restricted use of other parts (i.e. intact limb).

Other studies provide evidence that behavioral experience, such as exercise and/or interaction with an enriched environment, increase neurogenesis. This increase was shown, for example, by van Praag et al. (2000). In their experiment, rats placed in an enriched environment (e.g. promoting more sensory and motor experiences) demonstrated an increased neurogenesis in the hippocampus dentate gyrus as opposed to those placed in a standard environment. This highlights a direct interaction between behavioral experience and cortical reorganization. This is directly linked with the principle of massed practice importance for rehabilitation. In constraint-induced therapy this principle is applied in the following way: the treatment is intense, it is carried out daily and includes different experience modalities.

This treatment based on the forced-use model was further developed by Pulvermüller to specifically target language deficits, in an approach that became known as Constraint-Induced Aphasia therapy (CIAT), or Intensive Language-Action Therapy (ILAT). Patients receiving CIAT are placed in a situation of a game. Two or three patients and a therapist take part in this game. All of them have a part of a double set of cards with pictures of different objects. The goal of each participant is to collect his or her own double set of cards as soon as possible. All participants are seated around a table with visual barriers preventing them from seeing each other's cards and from using their hands to gesture. As a result, to reach their target and to collect their set, they have to talk to each other asking for specific cards: the only way to win in the game is to use verbal communication. This is how the principle of constrained afferentation works in this therapy. The principle of massed practice is realized directly as well: patients undergo an intensive course of therapy during 10 consecutive days with three hours sessions each day (Pulvermüller et al., 2001).

Since CIAT was first introduced, a number of studies assessed its effectiveness in language recovery after stroke (Meinzer, Rodriguez, & Rothi, 2012). Most of them used standard clinical assessment scales (such as Boston Diagnostic Aphasia Examination – BDAE, Western Aphasia Battery – WAB, Aachen Aphasia Test – AAT) and they showed a positive effect of CIAT on language recovery even in chronic stage. For example, in the study by Pulvermüller et al. (2001) the results of moderate-to-severe patients after constraint-induced therapy and after standard aphasia therapy were compared. The improvements were measured using Boston aphasia testing. The results showed that there were improvements in the constraint-induced group in 3 of 4 tests: the Token test, ($p = .04$), the naming test ($p = .02$), and the language comprehension test ($p = .02$) tests. In the standard therapy group, however, improvements were observed only in one of the tests. The comparison of the total scores of the two groups is also presented in the study, showing greater improvement in the constraint-induced group, although the statistical significance is not mentioned.

The other study by Maher et al. (2006), showed that constraint-induced therapy is at least as effective as another therapy with the same intensity, but without limitations onto means of communication. In this study two groups of chronic aphasia patients underwent either constraint-induced or Promoting Aphasic Communicative Effectiveness (PACE) therapy (Davis, 2005). The improvements were measured using the standard Western aphasia battery test. The ANOVA showed a significant change between pre- and post-treatment sessions ($p$ = .004). On the other hand, no significant effect of group was found suggesting that both types of therapy are almost equally effective.

The samples in studies assessing CIAT efficiency are usually quite heterogeneous (Meinzer et al., 2012), implying that any group effects (particularly where no statistical significance is available) might be driven by the results of just several patients most successfully improved. These samples are usually relatively small, and often lack control groups, which limits the possibility to generalize the results.

Long-term effects of CIAT were studied by Meinzer et al. (2005). In this study, the standard constraint-induced therapy was compared with a modified CIAT procedure. This modified protocol involved additional exercises and daily home tasks for patients. Although, the results did not show significant differences between the two protocols, the study is interesting because of its rather detailed analysis of the standard CIAT outcomes, both short- and long-term. In the standard protocol, 12 chronic patients with aphasias of different types and severity participated. The outcome was a measurement using the standard Aachen Aphasia Test, which includes 5 subscales: Token Test, picture naming test, repetition and comprehension tests and a written language assessment. The group profiles for each test were collected before therapy, just after the therapy and at a 6-month follow-up. A general improvement, defined as a weighted average of all the subscales, was compared. The analysis showed significant general improvement ($p$ = .0001). Individual subscales were also analyzed, showing significant improvements as well. The comparison with the 6-months follow-up showed the stability of improvements for the general improvement index and for all subscales. A total of 85% of the patients improved after therapy. On the other hand, the sample was still quite heterogeneous, and the duration of aphasia, the age of participants and their individual variability need more precise analysis.

Unfortunately, there are very few studies investigating the functional effects of CIAT and their underlying mechanisms. A more thorough functional assessment is required to examine the plasticity mechanisms underlying the recovery after CIAT. For instance, Pulvermüller et al. (2005) investigated effects of CIAT using behavioral and EEG data obtained in a sample of nine aphasia patients. All of them had chronic aphasia of different types. Behavioral and EEG data were collected in two sessions during a lexical decision task (LDT) held before and after therapy. The participant's task in LDT is to recognize visual stimuli such as words or pseudowords (64 words and 64 pseudowords were used in this study). Behavioral results after the therapy showed decreased response times and faster response times for words than for pseudowords. The EEG activity elicited by words and pseudowords before and after CIAT showed a post-therapy increase in word-related evoked potentials with latency 250–300 ms and no change in pseudoword responses. Authors conclude that these changes refer to word-processing improvement, particularly to improvements in semantic memory processes. This result may also be explained by a change in the level of attention to linguistic stimuli (note that attention processes are accompanied by a well-known P3 potential, which coincides with the latency above), which would suggest a significant role of domain-nonspecific (non-linguistic) systems, such as attention and executive control, in language recovery. The authors also reported a bilateral change of activity sources for words compared to pseudowords, which corresponded to the improvement dynamics. The low-resolution EEG used, however, does not allow the precise localization of the sources, so the suggestion about the role of the two hemispheres in language recovery needs more examination.

However, another functional neuroimaging study by Richter et al., 2008 showed that a down-regulation of functional activity in the right hemisphere was associated with post-therapeutic improvements. This study explored brain activation in right-hemispheric areas and left-hemispheric perilesional areas in response to language tasks in chronic non-fluent aphasic patients before and after CIAT. For functional assessment, the authors used two tasks: word reading and word-stem completion. fMRI and behavioral data were acquired during these tasks in a group of aphasics group and a healthy control group. They found that initially (before therapy) aphasics showed greater activation than controls in the right inferior frontal gyrus (IFG) and right insular cortex (IC) during the reading task. Activation in precentral gyrus (PCG) was also greater in aphasics during the word-stem completion task. The authors calculated correlations of behavioral changes (pre- vs. post-therapy improvements) with activation changes. This analysis showed significant correlations between behavioral improvements and the relative decrease of activation in right-hemispheric areas, including both IFG and IC. Behavioral improvements also correlated with the initial activation in the right IFG/IC. No significant correlations between left IFG/IC or perilesional frontal regions and behavioral improvements were found, meaning that these results somewhat contradict the hypothesis about the crucial role of the left hemisphere in language recovery. It is suggested in the review by Meinzer et al., 2012, that such controversies may be explained by vastly different samples including patients with different aphasia severity, lesion location and extent. This question therefore needs more investigation, including the evaluation of the role of domain-general functions such as cognitive control and attention. When these patients have to articulate something or listen to speech during CIAT therapy they need to exercise an extra cognitive effort, which may be reflected by the activation of non-linguistic networks, whose contribution should still be evaluated.

To obtain a strong evidence of the plastic changes following CIAT and its efficiency for treatment of different types of post-stroke aphasia, more experimental research is required. This future research should give answers to the questions about the role of individual differences in therapy-related language improvements and their sustainability. It should also provide evidence of network reorganization, and address questions concerning a possible impact of different functional systems. Long-term effects and their factors are also in need of more thorough investigation.

## Conclusions

Language rehabilitation in chronic post-stroke aphasia still needs a strong neuroscientific basis for choosing efficient treatment strategies. Neurophysiological processes occurring in the brain after stroke still remain poorly understood. Currently, natural plasticity mechanisms are considered to be the main driver of spontaneous post-stroke recovery in aphasia. However, the efficacy of these mechanisms is limited, and their contribution is largely restricted to a relatively short period of the sub-acute stage. As a result of this spontaneous recovery, language functions may be restored almost completely in some cases, but in many cases only a partial compensation of speech abilities takes place and aphasia becomes chronic.

The model of bilateral reorganization of language neural networks (Anglade et al., 2014) provides a valuable insight into the underpinnings of such a variance in the outcomes. Depending on many factors, but mainly on the severity of lesion in the left hemisphere and the stage post-stroke, the pattern of language activation in the brain changes in different ways. In mild cases, the language activation pattern returns to normal after the subacute stage case. In moderate and sever cases the right hemispheric activation still appears to play a significant functional role even in the chronic stage. Better recovery, however, is associated with the left hemispheric activity; in some cases, it is likely that this hemisphere holds some latent functional resources contributing to recovery.

From this perspective, the following two issues seem crucial in language neurorehabilitation. It appears necessary to stratify patients with aphasia into different subtypes, which could be grouped according to the parameters of the relative functional input of the left and the right hemisphere into recovery. Such a stratification could be helpful for the precise evaluation of therapeutic effects and thus customized individual therapy approaches. For this purpose, a thorough investigation of individual patient data is paramount. Efficient rehabilitation methods should then promote recovery in those patients who still have an unused functional recovery potential.

Constraint-induced aphasia therapy (CIAT), developed specifically for chronic aphasics, applies the principles of forced use and massed practice that are believed to activate this latent neuroplasticity potential in chronic patients. Although the data shows its efficiency in most cases, some important questions remain open. Its efficiency is comparable with standard language therapy methods with the same amount of training, and the results vary greatly across subjects. It is important to determine what initial features of neural language networks (common and individual) are associated with better improvements after this therapy. Long-term sustainability of CIAT effects and their neural basis also need detailed exploration.

A possible direction for further fundamental and clinical research is to combine this therapy with additional therapeutic means. For instance, non-invasive brain stimulation might be one such way forward (Shah, Szaflarski, Allendorfer, & Hamilton, 2013). Methods of non-invasive brain stimulation such as repetitive transcranial magnetic stimulation (rTMS) or transcranial direct current stimulation (tDCS) are believed to modulate cortical excitability of a stimulated brain region and probably of regions connected to it. This causes changes of cortical inhibition or excitation, which might stimulate any dormant neuroplasticity resources to use this naturally untapped potential for improved recovery that would not take place spontaneously otherwise. As a result, for aphasic patients, the stimulation might facilitate the effects provided by the speech therapy.

Further studies will also require more neuroimaging data on the recovery process in poststroke aphasia, allowing a more direct assessment of the neural dynamics underpinning the language function during the recovery process, either natural or induced by different kinds of therapeutic interventions.

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# Реабилитация речи при хронической постинсультной афазии: нейронаучный подход

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## Резюме

Настоящий обзор посвящен речевым нарушениям при постинсультной афазии, их реабилитации, а также разработке новых реабилитационных подходов, основанных на современных знаниях о функционировании мозга человека. Речевые нарушения при постинсультной афазии зачастую хронифицируются и приводят к серьезным коммуникативным проблемам у пациентов. Стандартные подходы к речевой реабилитации помогают в некоторой степени улучшить речевые способности у пациентов, однако зачастую эти улучшения умеренные и неустойчивые. Традиционные подходы к реабилитации обычно основываются на клинических практиках, сформировавшихся на протяжении десятилетий. При всей их несомненной ценности, эти практики редко основываются на современных нейробиологических знаниях. В последние десятилетия развитие нейронаук шло с очень высокой скоростью, большую роль в этом сыграло появление неинвазивных методов нейровизуализации. В настоящее время развитие нейронауки находится на той стадии, когда накопленные знания могут обогатить клиническую практику, обновить традиционные подходы к реабилитации за счет использования современного научного инструментария. Важно отметить также, что в традиционной клинической практике, как правило, одни и те же подходы применяются к разным пациентам, несмотря на то что характер речевых нарушений очень индивидуален, следовательно, и подход к восстановлению никогда не может быть одинаковым. В частности, пациенты с афазией демонстрируют очень разную динамику речевых функций в ходе спонтанного восстановления после инсульта. Это может быть вызвано высокой степенью индивидуальных различий в функционировании речевых нейросетей у разных пациентов. Проблема индивидуальных различий у пациентов с афазией известна давно. Однако до сих пор нет полного понимания факторов, влияющих на столь большую степень индивидуальных различий. В нашем обзоре делается особый акцент на том, что вопрос индивидуальных различий имеет огромное значение для планирования языковой терапии на индивидуальной основе. Также мы проанализируем с точки зрения нейронаучного подхода эффективность речевой терапии, которая широко используется для реабилитации пациентов с хронической афазией, — ограничивающей речевой терапии. Мы сформулируем вопросы для дальнейшего исследования.

**Ключевые слова:** афазия, инсульт, нейрореабилитация, нейролингвистика, ограничивающая речевая терапия.

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