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Interpreting samples from naming tasks from the perspective of cognitive linguistics

The theses of the PhD dissertation

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THE SUBJECT AND THE STRUCTURE OF THE DISSERTATION

The aim of the dissertation is to examine the performance of healthy people, as well as people who are impaired in their naming ability given in naming tasks in a cognitive semantic perspective.

Examining the answers of the healthy control group has several purpose: identifying and analysing their answer-patterns make it possible to describe these answer-patterns more thoroughly. As according to our previous results, even in the case of naming a simple picture, the participants of the study do not always give the target-word we would expect. This, however, does not mean that the answers reflect upon an incorrect mechanism. This is exactly the other motive of the study: if we have a rich database, consisting of data taken from a large number of healthy people, we may be able to define more subtle categories for the answers, also, we may analyse how three variables, gender, education and age influence the answers.

This is all of utmost importance when evaluating the answers of aphasic patients, as this way we may identify the linguistic deficit, or, in other words, the impact on the naming ability by different parameters which have an influence on language use. The phenomenon is not only a scientific question, but it plays an important role in description linguistic disorders after brain injuries, moreover in many cases determine the aphasia diagnose.

Studying naming abilities has had an important role since the appearance of the first more general aphasia batteries *(Goodglass, Kaplan*, 1972)*:* this function is one of the most important component of the classification of aphasias. It is important to mention, however, that there are certain approaches (for example Mumenthaler, 1989), which exclude naming from the classification categories on purpose, as, according to their perspective, naming disorder is a deficit which can be found in all types of aphasia. At the same time, studying naming abilities and identifying and analysing quantitative and qualitative indices may enable us to get information about the features of the concepts that are in our mind, similarly, they may help to implement a more subtle and more precise diagnostic process in the case of people suffering from language impairment.

For our research we used the Boston Naming Test (*Kaplan, Goodglass, Weintraub,* 2001), which is an internationally renowned and frequently used test for revealing linguistic deficits after brain injuries, in which the subject has to name 60 shematic drawings. According to our previous study (*Tóth,* 2016) although the test can be used in a native Hungarian environment, its feasibility is questionable. Therefore, the main motivation for

using the test is the examination of large-sample Hungarian linguistic data, as well as its integration into international research, in addition, the comparison of conclusions and results of the utility of the test. By the international comparison of the use of the test there is a tendency which has been uncovered, namely that taking the language chosen for the adaptation of the test into consideration is a basic, determining factor *(pl. Kohn, Goodglass,* 1985*; LaBarge, Edwards, Knesevich,* 1986*; Peña-Casanova* et al, *2009)*. From the studies mentioned above, it appears that the special traits of the given language, the type of culturally specific characteristics, as well as the demographic features determine the performance of the participants. We found evidence for these factors in our previous, pilot study on Hungarian language, and this served as the basis for our large-sample study.

According to my previous experiences, I find the consistent use of the taxonomy established for the quantitative and qualitative analysis of the results particularly important when using the test. When comparing the relevant international data, we find that there is a huge heterogeneity in the evaluation of the answers collected with the use of the test. Even though the authors' taxonomy offers a broad system for categorising the errors, our results seem to show that an extension of the evaluation system would be useful. It is indispensable to make a decision about the mechanism of the evaluation, because regardless of the aim of the use of the test (scientific purposes or identifying the real level of performance because of the possibility to define the impaired linguistic system) the method of evaluation influences the results of the test (*Lucas* et al, 2004).

In the dissertation, the data of the test are collected in a naming task, whose most important feature is that in the case of the healthy participants the data are produced as results of a representative, large-sample study. As for the aphasic group – in accordance with the aim of the study – I involved mainly those patients who could be considered to belong to the anomic aphasia-type, but I also involved patients with different types of aphasia where the impairment of naming abilities is a significant symptom.

I identified the type and the severity of aphasias with the help of the Hungarian adaptation of the Western Aphasia Battery (*Osmanné*, 1991), used in clinical environment. By the evaluation of the two groups' results, we will be able to describe the nature of naming abilities in a more subtle and varied way, as we assess and compare the results of different test groups by several variables. With these results of the dissertation, my aim was to eliminate the lack of studies on the particularities of the Hungarian language regarding the evaluation of the performance of the examined populations.

The objective of the first chapter of the dissertation is to present the forerunners of the theoretical model of the research and its embeddedness into linguistic sciences. This is why I base my research upon a meaning-definition which is compatible with the approach of the chosen theory, the Hub-and-Spoke model, and is therefore able to handle the role of the referent, which influences meaning, and it can interpret meaning as a relative notion. In the dissertation, the focus is on revealing the organisation of notions, so the further points of the first chapter summarize the linguistic traditions of the chosen frame from a perspective which reflects especially upon the particular features of representations of concepts. This way I review the categorising processes, which make the abstraction of concepts' transmodal characteristics possible, then I present the impairment patterns of this process, and finally I discuss four, frequently examined characteristics of conceptual representations. The defined combination of these characteristics provide the theoretical basis for the Hub-and-Spoke model *(Rogers* és mtsai, 2004*; Patterson* és mtsai, 2007; *Lambon Ralph* és mtsai, 2010*; Lambon Ralph,* 2014*).* In the second chapter of the dissertation, I give a detailed presentation of the model. The third chapter includes the history of the battery that we use for our study, its different versions, modifications and its different cultural adaptations, and finally, the focus is on the diversity of the used categories of errors. The fourth chapter talks about how the definition of aphasia changed, as well as about the different representations and symptoms of aphasia. The fifth chapter contains the hypotheses on which the study is based, while the sixth chapter introduces the participants, the chosen method, the process and the method of data analysis. It is in this chapter that I mention the coding of errors, as we use a double coding system: apart from the coding system proposed by the authors, we also use a coding system which is more suitable for Hungarian linguistic characteristics, which is extended by cognitive linguistic knowledge. In the seventh chapter I present the performance of the healthy and the aphasic group by both coding systems, and finally I compare them. The eighth chapter of the dissertation is the discussion of the results, finally I finish my work with a conclusion.

THE THEORETICAL FRAME OF THE DISSERTATION

As for concepts, The Hub-and-Spoke model (*Rogers* et al, 2004; *Patterson* et al, 2007; *Lambon Ralph* et al, 2010*; Lambon Ralph*, 2014) puts an emphasis on both the role of the brain regions of the modality-specific sources of information (spokes) and the integrative function of the anterior temporalis lobe (hub). The model argues for the importance of the integration of different semantic features, because:

- in the case of a given notion, even though we mostly do not perceive pieces of information coming from different modalities at the same time, these pieces of information must come together in the long-term memory in order to get a coherent notion;
- the characteristics change according to the extent to which the given element is a typical representative of its category;
- the perceptual similarity in itself does not mean that the concepts belong to the same category.

By presuming a so-called semantic hub, the problems listed above could be solved. Nevertheless, it is important to emphasise that this does not mean that the hub represents the conceptual content entirely. While the content is mostly contained by the modality-specific system, the function of the hub is to identify and organise patterns in and between modality-specific systems *(Kemmerer*, 2015*)*. The regarding brain system of this is the anterior temporalis lobe (ATL).

The Hub-and-Spoke theory models the semantic representation, more precisely, it models how the conceptual knowledge can stem from the acquisition and extraction of the statistical structure of our multimodal experiences. It also studies the neuroanatomical background of this, and it can give account of the nature of certain semantic impairments. Basically, it unifies two ideas: the *Meynert-Wernicke* assumption and the embodiment-theory. The model's spoke components can be defined in the following way: our multimodal verbal and non-verbal experiences "serve" as the most important basis for our notions, and these pieces of information are coded by the brain's modality-specific regions, which form a distributed net between different brain regions *(Lambon Ralph* et al, 2017). The model presumes the existence of another system, which is able to connect and integrate these pieces of information. This is the (so-called) transmodal hub, which is probably represented on both hemispheres and can be fundamentally attached to the ATL region. By the combination of the

two types and by presuming a transmodal hub, the model introduces a new perspective (compared to the previously dominant theories relying mostly on divided representations). The model achieves new assumptions based on empirical data and computational model, whose origins are cognitive neuropsychological (the nature of the symptoms of semantic dementia as evidence for the existence of the hub), of cognitive neuroscientifical (the mapping of the regions of the brain), as well as of philosophical (compared to modality-specific representations, it presumes the existence of another level).

APHASIA

Results of recent studies related to aphasias, language skills and cognitive functions in a wider sense have led to a paradigm shift (*Csépe*, 2016). A developmental curve is delineated in this thesis, taking into account the roots of this paradigm shift originated in the 19th and 20th centuries, representing mutual definiteness of cognitive functions. This developmental curve can easily be tracked further in the definitions of aphasias (*Whitaker*, 2007). The clinical-functional approach serves as an aphasic typology. For the time being, this is the most popular approach in clinical practice in our country, since this perspective also provides ground for research, and the tools of this classic approach are at our disposal to identify the level and nature of language impairment. But then again, one can clearly see that current studies consider connectionist aspects as well. The classic idea is complemented by the neurolinguistic approach, which aims to identify the components of language and their damage patterns. This has resulted in a perspective shift and study models now deem a strong bond and mutual definiteness between linguistic abilities and cognitive functions.

OBJECTIVES

As the primary aim of the study, behavioural answers were gathered during a naming test from healthy people and from aphasic people with impaired naming abilities, in order to fit the results into a cognitive semantic frame to provide reasons for the network language model through idiosyncrasies of the Hungarian language.

The Boston Naming Test served as the basis of this study (*Kaplan et al*, 2001). There are no standard values determined for the Hungarian version, but the taxonomy drawn by the authors seems to be eligible for multiview analyses: on the one hand, to compare our results with those of international studies using similar systems. On the other hand, to provide an

appropriate frame to a more detailed description of answers of healthy group, and to provide a good basis for comparing the linguistic skill profiles of healthy group and aphasic patients with impaired naming abilities.

The purpose of this study was to apply the test to a representative, large sample size from a cognitive semantic perspective. Sampling was matched to the KSH database from 2011 to determine the enrolment of healthy people. One can create a more comprehensive, more detailed picture of their performance during a naming test by evaluating their answers in the test's taxonomy. Furthermore, the effects of gender, age and level of education on giving answers can be evaluated. An additional aim of the study is to enrol people with acquired language disorders and to identify the differences in their answers put into taxonomy by means of a qualitative analysis in order to be able to compare the performances of these two study groups.

However, answers were not evaluated only by the test's original taxonomy throughout the study. During the analysis of healthy subjects, it has become outlined that the appearance of new categories based on recent cognitive linguistic knowledge would allow of a more precise evaluation of answers by complementing the original scale. Hence, data coding was performed in a double system: on the one hand, data were coded according to the original taxonomy. On the other hand, a modified system was used that includes several sub-categories. In addition, data analysis was extended to the identification of error-types related to demographic factors, which – considering the relevant literature (*Halai, Woollams and Lambon Ralph,* 2018) – makes this work a stopgap regarding the characteristics of Hungarian.

HYPOTHESES OF THE STUDY

Performance of healthy people

1. Performance of healthy participants is influenced by age, namely, the ratio of correct answers is decreased with the age.

2. Performance of healthy participants is influenced by gender. In accordance with international data it is presumed that men perform better in a naming test.

3. Performance of healthy participants is affected by their level of education, namely, the higher the educational level is the better the ratio of correct answers will be.

4. Besides correct answers, healthy participants will use other options (see in „Methods" chapter), mostly descriptions and answers that are related to and are in a close semantic relation with the target word.

Performance of people with aphasia

5. Performance of aphasic patients is not affected significantly by demographic factors.

6. Performance of aphasic patients is determined by the linguistic skill profile.

7. In the case of aphasic patients "other answers" show high heterogeneity.

Comparison of the performances of healthy people and people with aphasia

8. Comparing the performances of healthy participants and aphasic patients it is assumed, that:

a) regarding the performance of healthy participants, the ratio of correct answers will be higher,

b) there will be no significant differences regarding the ratio of "other answers" between the two groups.

METHODS

Participants

Introduction of healthy subjects

In total, 337 people were enrolled in the study. Age groups were defined with help of the KSH database. The 15 different age groups are the following: 1. age 18-20, 2. age 20-24, 3. age 25-29, 4. age 30-34, 5. age 35-39, 6. age 40-44, 7. age 45-49, 8. age 50-54, 9. age 55-59, 10. age 60-64, 11. age 65-69, 12. age 70-74, 13. age 75-79, 14. age 80-84, 15. above 85. Educational levels are also based on the KSH database: 1. did not finish the first year of elementary school, 2. finished 1-8. years of elementary school, 3. secondary school without graduate but with vocational certificate, 4. passed the (European) graduate, 5. college/university degree.

Introduction of subjects with aphasia

In total, 54 aphasic patients were enrolled in the study. By the time of testing, every patient was hospitalized at the Center for Neurorehabilitation of the Department of Neurology, Faculty of Medicine, Albert Szent-Györgyi Clinical Center at the University of Szeged**,** where they were participating in a complex rehabilitation program. Patients participated voluntarily after becoming familiar with the informed consent. The most important inclusion criterion was the ability to take part in the naming test, i.e. being capable of spontaneous, verbal expressions without any help. That was the reason why patients with global aphasia were not enrolled in the study: they cannot take part in the test yet. The different age and educational level groups are determined in exactly the same manner as it was described in the previous paragraph. This means people were divided into 15 separate age groups and 5 educational level groups.

In accordance with clinical routine, the level of language disorders were assessed by the Hungarian adaptation of Western Aphasia Battery (*Osmanné*, 1991). Patients with aphasia were classified into the following aphasia categories: 6 people (11.1%) with Broca-aphasia, 5 people (9.3%) with transcortical motor aphasia, 4 people (7.4%) with Wernicke-aphasia, 1 patient (1.9%) with transcortical sensory aphasia, 5 participants (9.3%) with conduction aphasia and 33 patients (61.1%) with anomic aphasia. Distribution of severity was the following: 4 people (7.4%) of moderately severe aphasia, 24 people (44.4%) of moderate aphasia and 26 people (48.1%) of mild aphasia. Differentiation among the different types of

aphasia is beyond the scope in this thesis. However, it intends to provide a detailed description of linguistic strategies applied by patients with impaired naming abilities.

Materials

A common and internationally applied method, the Boston Naming Test was used throughout the study. A spiral-bound notebook with 60 A/5 sized schematic outline drawings was handed to the study subjects during the test. While turning the pages in their own pace, they were asked to name the elements. The instruction towards healthy people was the following: "Please name the pictures!", while in the case of patients with aphasia, the instruction was simplified depending on the patient's linguistic condition: "What's in the picture?".

The authors' taxonomy provides a broad spectrum, comprehensive system for quantitative and qualitative analyses (*Goodglass, Kaplan, Barresi,* 2000).

Required steps for the Hungarian version

After purchasing the test, each elements were translated in order to prepare the Hungarian version. The Országh dictionary was used for translation (*Országh*, 1997). Based on the records, the answers were totalized and then coded in an Excel table. However, during classification the answers I realized it could make sense to use another taxonomy concurrently with the aforementioned one, which is based on cognitive semantic knowledge and includes multiple aspects. The core concepts of the new system were introducing new categories and keeping the original ones but complementing them at certain points. It is important to note that this current study (and hence the demand of taxonomy modification) stems from the altered goal of the test. The aim of this study was not only to verify the test's feasibility but to investigate the answering strategies of healthy participants and to compare their performance with those who have aphasia. The analyses have highlighted possibilities of more detailed differentiations between certain types which could contribute to the achievement of more precise pictures of mental representations in the patients' minds.

RESULTS

Performance of healthy subjects in the highlight of the two types of coding

The correlation between age and performance is weak but significant, and negative, i. e. the higher the age the lower the performance. Both coding methods lead to these results, being in accordance with data presented in previous literature (e.g. *Van Gorp et al.,* 1986; *Worrall et al.,* 1995; *LaBarge et al.,* 1986; *Nicholas et al.,* 1989; *Tallberg,* 2005). According to the original coding, the following inherent answer types come by aging: perceptual errors, verbal paraphasias, circumlocutions and answers not related to the target. In the case of modified coding, the results were the following: perceptual errors, verbal paraphasia, uncertain answers, fewer types of answers, circumlocution and answers not related to the target.

In the case of gender characteristics, we have found significant differences in both coding methods, in accordance with previous works in this field (*Tombaugh, Hubley,* 1997; *Welch et al,* 1999), men had better performance than women. This probably relates to the qualities of presented elements as it is presumed by *Randolph* et al (1999). As a further result of the original coding, women seem to use circumlocution more often, which can be identified as a causal factor concerning the different linguistic strategies of the two genders. This is supported by the results pertaining to perceptual errors (i. e. significance in the case of women) which may refer to the fact that women are quicker in association and assigning relevance to a picture (or to a part of it), that is to say women try to solve the task with more creativity. In the case of modified coding regarding other answer types we have found significant differences in three types, namely women had more errors (perceptual error, circumlocution, uncertain answer) which further supports the aforementioned suggestion with the appearance of the uncertain category. Foreign word substitution was more specific to men.

In the highlight of education we have found weak but significant, positive relations in both coding methods, as it is already concluded in the vast majority of previous literature (*Tombaugh, Hubley,* 1997; *Welch et al.,* 1996; *Worrall et al.,* 1995; *Borod et al.,* 1980; *Nicholas et al.,* 1989). According to the original coding method, the following error categories show negative correlation with higher education: perceptual error, no answer, verbal paraphasia, circumlocution, neologism, while in the case of the modified version, these are the following: perceptual error, no answer, circumlocution, verbal paraphasia, fewer answers and neologism. Based on our results it seems that the higher education the study subjects have, the

more efforts they make to accomplish the task, since giving no answers, words that are not related or using avoiding strategies are not typical and they try to provide as precise namings as they can.

Considering the ratio of other answer types, there is a significant, negative, moderately strong relation between the element's serial number and the ratio of correct answers. This confirms - with regards to the Hungarian language too – that the test includes more and more difficult elements, since the bigger the serial number of the test item is, the less frequent element has to be named. According to the original version subjects try to describe the given element, or they give no answer if they are unable to name it. When they can, verbal paraphasias and perceptual errors are common, just as three surprising types of answers that are more of aphasic answer types: answer not related to the target, neologism, phonemic paraphasia. The order of answer types in the modified version – depending on the strength of relation – is the following: circumlocution, no answer, verbal paraphasias, perceptual errors, association, phonemic paraphasia, answer not related to the target, uncertain answers, neologisms.

The number of other answer options was significantly high in the case of four elements: canoe, scroll, prop, abacus. The reason is probably that these elements are less common in the Hungarian language. Moreover, in the case of the kayak element, performance can be affected by the fact that the sport itself is frequently called kayak-canoeing in our country. Namely, the differentiation of this notion is an especially unsteady area which can clearly be affected or specified by personal interests.

Overall, it seems that in the case of difficulties of finding the target word even healthy subjects, according to the Hub-and-Spoke model (*Rogers et al,* 2004; *Patterson et al,* 2007; *Lambon Ralph et al,* 2010; *Lambon Ralph,* 2014), invoke the most easily available or most common elements of the transmodal representation of the given notion (circumlocution, verbal paraphasia).

Regarding other answers, circumlocution is the most common type. Among healthy participants no answer is the next in line after circumlocution, verbal paraphasias and perceptual errors are typical, followed by types that are not expected from healthy individuals (e.g. neologism). This might lead to the conclusion that ceiling effect should not be expected even from answers given by healthy subjects. Hence, we have investigated the distribution of answers within some further main categories. The high ratio of verbal paraphasias to other answer types should be emphasized, just as the frequency of co-ordinating structures within

this main category. The latter means that the answer that appears dominantly belongs to a basic category, which has the most common attributes as its main feature (*Rosch*, 1978). In other words the background of consequent errors might be as it follows. The study individuals presumably identify the most salient, most informative features (this should be the content of transmodal hub). However, the difficulty of achieving the target word is increased by the decreasing frequency-attributes of test elements. Hence, the most similar and close (in terms of semantic characteristics) element will be named. The uncertain main category shows a similar pattern. Those answers dominate in which two co-hyponym expressions appear as an answer.

Circumlocution (though shows some difference in its content) is a common strategy according to both coding systems if the healthy individual is not able to precisely name the given element. This means that the study subjects access several characteristics of the concept, namely the characteristics that constitute the concept (spokes) appeared adequately, which is interpreted as a compensatory strategy. Certain relevant elements of the encyclopedic knowledge will be highlighted.

In respect of these results the primary statement of the Hub-and-Spoke theory should be emphasized. The analysis of performance of healthy participants provides further evidence for the existence of transmodal representation of concepts since the most answers can be resulted by consequent errors. It seems, the identification of the most crucial features have happened however, an element with close semantic relation to the target word is invoked instead of the target word itself.

The performance of aphasic patients in the highlight of the two types of coding

In the case of aphasic patients, the severity of linguistic impairment influenced the ratio of correct answers, this means that patients who have more severe aphasia achieved worse results according to the data of both types of coding. The following assumptions are true for both the original and the modified version of coding: the aphasia quotient (AQ) is of course in a significant, positive, strong connection with the precision of the ability of naming, similarly to certain subtests of the WAB, which also show correlation with the proportion of correct answers. Regarding the original version, interestingly, the comprehension sub-task had the strongest, while the naming subtest shows the weakest correlation with correct answers. In the modified version, it was the naming sub-task which showed the strongest correlation, the background of which might be the extension of the acceptable answers belonging to the

correct category. The results (AQ) in the WAB show negative correlation with the following types of answers: no answer, phonemic cue and standard cue (original coding). This is not surprising, as it is exactly the lack of these categories which means that the examined person is able to give an independent answer. The modified coding showed the same direction of correlation with the following: error after phonemic cue, no answer, phonemic cue, standard cue, answer not related to the target. This means that in the case of a higher AQ, in other words in the case of a higher level of linguistic ability, the participants, after the support of the lexical access, do not show errors and they do not require help either. As a further result, in the case of a better linguistic ability, it is less characteristic for answers not connected to the target to appear, so the errors regarding semantic features become more consequent, and they begin to be more similar to the strategies of healthy participants, as we have seen above.

We could not prove in either type of coding systems the influence of demographic factors in the case of aphasic patients.

By examining the types of other answers, we found a significant, negative and strong connection between the ordinal number of the element and the proportion of correct answers, and, similarly to healthy participants, in this case also, as the elements became more difficult, we found examples for no answer and circumlocution, furthermore verbal paraphasia and neologisms and phonemic cue appeared. Modifying gives a similar picture: no answer, circumlocution, verbal paraphasia, modality-change, neologism, association, error after phonemic cue. Types which are characteristic of aphasia show that when the person tries to answer, there are many options with which they can convince the leader of the study that they can access some kind of information about the element in question.

Comparing healthy and aphasic groups in the highlight of the two types of coding

By comparing the performance of the two groups with special emphasis on the correct answers, it becomes clear that the healthy group achieved significantly better results according to the results of both coding systems.

The average performance of the aphasic and the healthy group in more and more difficult tasks showed positive, strong correlation, according to both types of coding. This means that there is indeed a correlation between the performance of the two groups, as the same elements were the most difficult to name for both groups. This allows us to draw the conclusion that this depends not (only) on the linguistic condition, but it seems that it is rather the impact of the elements of the test which have an influence on the performance. The lack

of the adaptation of test items may be in the background of this condition, in other words, certain elements are equally hard to access for participants who are Hungarian native speakers. We could also see that for both groups, we identified four linguistic elements which provided extremely few correct answers.

We conducted more examinations in order to compare the proportion and division of different answers. During these examinations, we found that certain answer types do not appear in the same proportion according to the original coding system. The modified version, however, brought new results: the groups did not differ much in the proportion of the error types. This means that if the categorising criteria of the rest of the answers is more subtle, it is possible to confirm statistically that the two examined groups deal with those elements which proved to be more difficult in a similar way, therefore, the groups solve the problems which stem from the increasing difficulty of the task in a similar way. We could see this result most remarkably in the case of two of the main categories: verbal paraphasia and circumlocution, which can serve as evidence firstly for the assumption that the examined aphasic patients use a similar strategy when faced with difficulties during a naming task, secondly for the assumption that the difference in the performance of aphasic and healthy participants can be grasped by quantitative indices.

If we suppose that according to the appearance of certain answer types there is rather a quantitative difference, it can serve as an argument for the preserved transmodal representation of the Hub-and-Spoke model (*Rogers* et al, 2004; *Patterson* et al, 2007; *Lambon Ralph* et al, 2010*; Lambon Ralph*, 2014). What also supports this assumption is our result that aphasic people prefer co-ordinate structures also in the case of uncertain naming.

Furthermore, it is remarkable that in the newly introduced category of modality-changing, when facing difficulty with accessing the target word, the participants tried to make it clear for the leader of the study that they know certain characteristics of the notion by information coming from different modalities (miming, "writing").

All in all, the results show that we found evidence for the assumption that the core of representations of notions remains stored in the case of aphasia. Based on these results, in the present theoretical framework we can conclude that in the case of linguistic impairment, the naming disorders originate the impaired ability to connect the adequate word-form to the stored representations of concepts.

CONCLUSION

Current studies on the mapping of the functional neuroanatomical background of linguistic ability reflect upon the field's different aspects and they operate with fundamentally different methodologies, and use different definitions. Although the multidisciplinary approach seems to be fruitful, in many cases the dialogue between different scientific fields does not even start or starts too late. One of the most important aim of this work is to show the influences that fields representing the cognitive approach, but working on different aspects of linguistic ability have on each other.

The frame of the dissertation is a model whose theoretical declarations have been proven by the results of a number of empirical studies (Hub-and-Spoke model: *Rogers* et al, 2004; *Patterson* et al, 2007; *Lambon Ralph* et al, 2010*; Lambon Ralph,* 2014). The aim of the research presented in the dissertation is to analyse data collected in naming situations from a cognitive linguistic perspective. With this study, we had the opportunity to examine the declarations of the Hub-and-Spoke model through Hungarian linguistic data, and by involving aphasic patients, we managed to describe linguistic impairment in a more subtle way.

According to the Hub-and-Spoke model (*Rogers* et al, 2004; *Patterson* et al, 2007; *Lambon Ralph* et al, 2010*; Lambon Ralph,* 2014), the representation of concrete nouns is made possible not only by the activation of modality-specific regions (spokes), but there is also an indispensable amodal, integrative system (hub), which can be connected to the anterior, ventral part of the temporal lobe. The function of the latter is to connect and integrate the modality-specific features and permit subtle differentiation to be able to make decisions about the categorisation of a given entity. These two systems provide the meaning of the concepts (Kemmerer, 2015). Followers of the model describe semantic memory to be an amodal, dynamic system, whose efficiency depends on the harmonised and precise work of the stored knowledge and the cognitive control processes *(Lambon Ralph* et al, 2017). Many approaches confirm this dichotomy: with the differentiation of stored representations and the processes (*Koenig, Grossman*, 2007; *Koenig, Smith, Grossman*, 2010).

Our results show that even healthy participants use a qualitatively differentiated linguistic strategy. Their performance does not show a ceiling effect, this is why in this study we cannot draw a clear line by the simple qualitative analysis of the responses between the performance of healthy and moderate or mild aphasic patients – later the quantitative indices may show the differencies. The new result of the dissertation is the identification and the

comparison of the typical answers of the two examined groups, as well as the examination of these answer-types regarding demographic factors.

We assume that in the case of both groups, according to the declarations of the Hub-and-Spoke theory (*Rogers* et al, 2004; *Patterson* et al, 2007; *Lambon Ralph* et al, 2010*; Lambon Ralph,* 2014), the identification of the salient and frequent elements of notions occur (depending on demographic factors), the access of the concepts also proceed, so the content of the transmodal hub may be preserved even in the case of aphasia. Besides verbal paraphasias the other frequent answer-type was circumlocutions in the case of both groups. We could conclude that this shows the access to the most salient characteristics by highlighting the most relevant components of the accessible encyclopaedic knowledge.

Our results therefore support the idea that the most important characteristics are preserved even in the case of aphasia, however, we cannot talk about an "all or nothing"-principle when analysing the ability of naming even in the case of healthy people. The more subtle analysis can allow us to make conclusions about the strategies of answering. From the similarity of the patterns of the answers between the two groups we may deduce that as a result of the cognitive reorganisation after stroke, more and more subtle linguistic operations can be performed, and the identified pattern may be a common, human cognitive strategy to decrease the difficulties that appearing in a naming task.

Our results prove that the impaired linguistic abilities of anomic aphasic patients is not the result of the loss of linguistic elements, but the access to these elements, depending on the severity of aphasia. According to the performance of healthy and aphasic patients, the difference between the performances of the two groups can be grasped with quantitative indices.

Besides the aims of the dissertation, our results allow us to conclude that using the original version of the Boston Naming Test (*Kaplan et al,* 2001) in a Hungarian environment is questionable, especially because of cultural and linguistic differences. It seems that from a diagnostic point of view, a version which takes the frequency indices of the Hungarian language into consideration would be more effective.

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