Neurolinguistic Access to the Translation Process Research

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Abstract: The study of neurolinguistics in relation to translation is a new motif of the research in cognitive and neural processing centers of human brain apparatus. This paper deals with the neurolinguistic access to uncover the translation process that is associated with the translator's performance. It also goes beyond the linguistic analysis onto the neurolinguistic description of the translation process. It hypothesizes that the translation is not only a linguistic mediation between S^L and T^L; rather it is associated with neuro - functional perspective of the mental model. Thus, it depends on the analysis of some examples for the relevance of the study. The study comes into conclusion that translation exceeds the linguistic barriers through several brain trans-cortical activities during translation process.

الملخص:تعد دراسة علم اللغة العصبي وعلاقته بالترجمة فكرة جديدة للبحث في مراكز المعالجة العصبية والادراكية للعقل البشري. لذا، يعالج هذا البحث المدخل إلى علم اللغة العصبي للتوصل إلى عملية الترجمة والتي ترتبط مع أداء المترجم. ويتعدى البحث أيضاَ التحليل اللغوي إلى الوصف العصبي اللغوي لعملية الترجمة. ويفترض أن الترجمة ليست فقط وسط لغوي بين اللغة المصدر واللغة الهدف، لكنها ترتبط مع المنحى الوظيفي للأعصاب داخل الأنموذج الذهني. لهذا، فقد شرعت الدراسة بتحليل بعض الأمثلة التي تتناسب والدراسة. توصلت الدراسة إلى أن عملية الترجمة تتعدى الحواجز اللغوية من خلال العديد من النشاطات الدماغية خلال عملية الترجمة.

1. Views of Brain Functions:

The views of the brain's functions provide an abstract theory about the representation of neurolinguistics, description of the brain anatomy, and functional perspective of language processing systems, knowledge and competence about cognitive analysis of language. Here, it is important to consider the principles, functions, and descriptions of semantic/pragmatic and grammatical systems instantiated in the brain, beginning with the idea that knowledge factors, memory, neural networks, and mental representations depend upon complementary conceptual integration of the cortical areas and inter-hemispheric transfer units in the brain hemispheres between S^L and T^L.

This assignment of neurolinguistic description of language is consistent with the fact that the medial temporal lobe of the brain can produce a basis in the acquisition and processing of input/output syntactic, and semantic information in the interaction between two or more languages in the mind (i.e. right hemisphere processing centers) (Rogers and McClelland, 2004: 376). In a classical view, language, in general, consists of the set of words and sentences determined by lexical and grammatical rules of use and the neural networks initiate the processing of information. The new generation of conceptual semantics and pragmatics sees that translation (as a medium of communication between languages) is cognitively registered when individuals hear/read utterances (haptic, echoic and iconic) and identify them as letter figures on papers[1]. In recalling something, the memory of words and sentences appear as conceptual integration and image processors in the mental recognition and

[1] Nowadays, they can also be realized and identified as *letter configurations on the computer screen.*

processing them in terms of neuronal clusters together to understand words and sentences in both S^L and T^L. Functionally, the mind thinks, comprehend during translation, some of the networks in brain are active in the left-hemisphere and right – hemisphere through pragmatic integration of the linguistic inputs/outputs (Pulvermuller, 1999: 253; Schnelle, 2010: 7, cf. Gibbs and Golston, 2006: 250). Theoretical and experimental researchers, however, suggested that the linguistic inputs instigate the cortical areas and patterns of the neural networks, organization of semantic construal and function of cognitive processes in the brain. Biological factors, in fact, generally are identified by researchers as the major determinants of the organization of discourse interaction of TL in the brain hemispheres and its neuro-functional processes. Modern studies have suggested some possible contributions of non-biological influences - mostly of the linguistic nature - they are the contextual factors that may affect the meaning identification and the comprehension phase of the linguistic inputs.

- **Time tries all**

- ستبدي لك الأيام ماكنت جاهلاً

According to the modular system, the cognitive processes of language do not belong to the central nervous system, an input system, and consequently input systems have sub-modular structure. This modular structure is determined by several features (see Mildner, 2008: 75; cf. Evans and Green, 2006: 40):

1. The input system in translation receives information from several sensory units, and processes them in particular ways. For instance:

- **The witness sees an accident** (input visual modality)…

- رأى الشاهد الحادثة

Seeing the accident is associated with different aspects of reactions, it

sometimes related to the person himself. Yet they may be with respect to the knowledge factors, and experience of the world. The visual input in the occipital lobe transcodes the sensory motor cortex in the left-hemisphere to decide the bulk of reaction against the situation in parietal lobe of the brain (figure, 1).

- **The same person reacted** (shouting, runway, asking for help, etc...)

The visual input system in the cortex transcoded cognits in the occipital-temporal lobes of the brain and branched to the phonological, perception – action control in the parietal lobe, articulation in sensory motor cortex as response to the situational features of the event[2]. During reading a text, the language system translates information from the visual modality to the phonological or speech representation modality (see figure, 1).

2. Language Processing is one-way, bottom-up or top-down in the visual module of figure – ground relations, which means that higher cognitive modules do not affect the lower ones (e.g., discourse context does not affect phonemic processing (see Talmy, 2000: 113), but the phonemic level affect the overall discourse. In cases of ambiguities in the discourse, word meanings are activated and forwarded to process higher levels (i.e. contextual clues), and ambiguity is resolved by context only after word meanings have reached the level of context.
3. Each module (higher, lower or medial) has its place in a particular region of the brain. Hence, modular models are at the same

[2] There are some other additional zones working within the activation of such reaction.

time predominantly localistic, they may be transcended via the modular systems. This system of relations has a property of being relative modular process. The modules are shifted from one aspect to another (i.e. bottom – up/top-down), but not up-bottom/down-top (see Talmy, 2000: 113; see Evans and Green, 2006: 178).

Translation is particularly a task that requires analysis and encoding of input words and sentences into working memory in the S^L, and selective retrieval of the corresponding words and sentence structures in T^L (cf. Bell, 1991: 124). A control system of perception – action modular must supervise the process (Bergen and Feldman, 2008: 325). With regard to its neuronal underpinnings, translation performance as a neurolinguistic phenomenon has been rarely a studied topic. In the first study of translation, it is found that the same brain regions are activated for both modular units within across - language word generation and for both semantic and phonological search in the cognitive system, specifically the left inferior temporal gyrus and the dorsolateral prefrontal cortex (Diamond and Shreve, 2017: 489) as in the following figure:

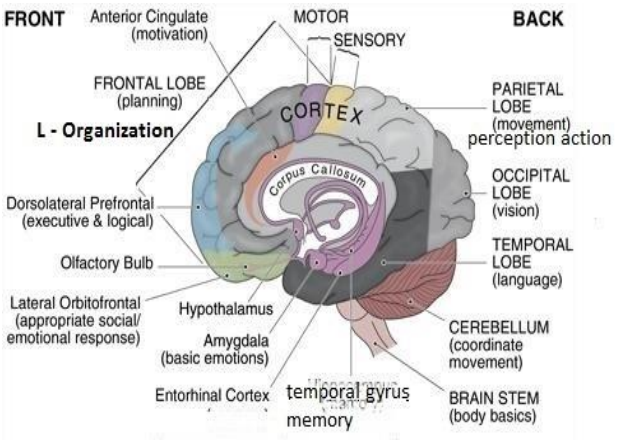

Figure (1) Linguistic Locations in the Brain

2. Trans-cortical Functions in Translation Process:

The specific neural activations in translation process are usually triggered by the lexical search and conceptual access of the S^T inputs, and the working

memory statuses. This can be seen in the following example:

- **Out of the frying – pan into the fire[3].**

- كالمستجير من الرمضاء بالنار.

The analysis would be in the following figure:

Out of the frying – pan into the fire					Metaphor (semantic and pragmatic) construal in temporal gyrus and prefrontal cortex
Lexical input	Lexical input	Lexical input	Lexical input	Lexical input	Mental knowledge in temporal gyrus
Syntactic unit		Syntactic unit		Syntactic unit	Grammatical form input in syntactic parsing gyrus (event effect, dynamic time and space, cognitive effort).

Figure (2) Trans-cortical Processes

The translation process elicited the activation in the cortical areas, in addition to the increases and decreases in the cortical activity, interpreted as reflecting both perception - action control and inhibitory mechanisms of dynamic time and space (context). With regard to the lateralization, translation has elicited predominantly left - sided brain activities, the direction of translation also plays a role from the mother tongue (L_1) into a nonnative language (L_2), a more widespread neuro-functional activation is observed, encompassing the left ventrolateral prefrontal cortex, inferior temporal and premotor cortex (Lehtonen *et al*, 2005: 607; see also Osterhout, *et al*, 2008: 515). Pulvermüller (1999: 225) commented on three fundamental assumptions about trans-cortical functioning in translation process, which can be summarized as follows:

[3] Al – Bayati (1986: 83).

i. Co-activated neurons become associated in terms of perception – action control in the parietal lobe of the brain.

ii. Associations of cortical areas can occur between adjacent or distant neurons; that is, the entire cortex is an associative memory.

iii. If neurons become associated, they will develop into a functional unit, a neuronal clusters assembly.

In a naive understanding, it may appear to us that pieces of input words and sentences are realized and kept in the brain like being printed in a storage space. This storage memory space is usually defragmented into long term memory (LTM) and short term memory (STM)[4] with their substantiations. The storage system in memory deals not with words and sentences, but as abstract entities, they are linguistic formal (LF) and linguistic meaning (LM), as in:

- **Too many cooks spoil the broth**[5]

كثرة الطباخين يفسدون الحساء (LF)
قائدان في سفينة واحدة تغرق (LM)

Many linguists refuse the assumption that our mind images everything that is relevant for speaking or understanding. They emphasize that when we speak a correct language (in L_1 and L_2) we have no conscious image of all aspects of meanings and the rules that determine grammatical correctness. Indeed for understanding the normal words and sentences in temporal gyrus, the system of grammatical parsing is somehow operative and communicative in the neural network. The rules of grammar and the rules of lexical word relations can at best be represented structurally in the manner of an abstract system of description of situations, aspects, manners, etc. (Schnelle, 2010: 9;

[4] Short term memory is also called working memory (WM)

[5] Al – Bayati (1986: 83).

see Osterhout, *et al*, 2008: 515; see also Knickerbocker and Altarriba, 2011: 454). Talmy (2000:7) suggests that the fundamental design feature of language is of two subsystems in the conceptual structure[6] of the mental model, which can be designated as the grammatical and the lexical units. To develop this account further, we must first note that we take a sentence (or other portion of discourse) to evoke in the listener a particular kind of communication; here termed a cognitive representation (CR). The grammatical and lexical subsystems in a sentence seem generally to specify different portions of a CR. Together; the grammatical elements of a sentence (i.e., sense relations, and reference relations) determine the majority of the structure of the CR, while the lexical elements together contribute the majority of its content, as in:

- **Pathogens can cause an increase of the hormones onset in humans.**
- **تسبب الأمراض الجينية زيادة هرمونية في جسم الإنسان.**

Across the spectrum of both languages, the lexical elements and syntactic parsing specify a crucial set of conceptual structure. This set is highly restricted by certain concepts appear in this view (Talmy, 2000: 7). The mental system is similar to other systems of rules (as in grammatical ones) as in the learned intuitive competence of the rules of "*chess*". Consequently, grammarians concluded that the linguistic system – rules are best understood as a spontaneously functioning formal system structure in the mind and specific kind of mental entity[7] (formally mental entity).

[6] Conceptual structuring system includes configurationally system, attention gate system, perspective system, utterance force dynamic system (Evans, 2007: 37).

[7] Translation is also a transfer entity. It is entity –related transfer phenomenon.

3. Implicit Pragmatic Knowledge:

Pragmatic competence has been demonstrated to be implicit or explicit ability for the individual to understand and communicate in a fluent way (except for some aspects of the lexicon, such as the sounds of words which we recognize, and their semantic referential meanings[8], which we know and which are therefore explicit), but nobody has yet demonstrated **and /or even investigated**) whether pragmatic ability is implicit or explicit. It is probably both some of it is implicit (and we would therefore refer to these aspects as pragmatic competence), and some of it is explicit (and we would refer to those aspects as meta-pragmatic knowledge that is relative to the communicative interactions). Some examples draw upon explicit knowledge and others on implicit:

I just ***got wind of*** your marriage. Congratulations (Spears, 2000: 151). Context: to hear about something.

- سمعت أخبارزواجك ....مبارك

1. The president **called** the meeting to order shortly (Spears, 2000: 182). Context: to start meeting officially:

- دعى الرئيس إلى عقد اجتماع قريب

2. Bob ***has egg on his face***. (Spears, 2000: 182). Context: he wore jeans to the party and everyone else wore formal clothing.

- شعربوب بالخجل لأنه ارتدى بنطال الجينز أما الآخرون فكانوا في البزة الرسمية.

The reader of above examples may invoke implicit knowledge and/or explicit knowledge within the communicative interaction. The construal of these depends on the individual's knowledge factors and the degree of mental representation to construe the cues of the text. Some persons may recall

[8]Hatim (2013: 114) explains the semantic representation (whether a word is abstract, too abstract, concrete, or even what a word invoke) serves as rich source of inferential hypotheses.

the implicit knowledge, while others seek explicit ones. Hence, Hatim (2013: 115) sees that in translation, the interaction between the original utterance and original context should not be pre-orchestrated for the target reader. It should be given free rein as one way of facilitating inference. It is obvious that some cognitive computation takes place and what is less obvious is whether that cognitive computation is conscious or not. In some cases, the pragmatic competence has not been developed in almost mental representation and precision action controllers as in childhood. The indirectness in utterances would be interpreted as direct. The pragmatic competence relies on implicit cultural conventions, some pragmatic knowledge relative to the procedural memory, and hence may be expected to be sub-served by specific cortical areas in the brain (Ingram, 2007: 34; Paradis, 2009: 54). The default interpretation of a word or expression as literal or nonliteral depends on its degree of conventionality. Some meanings may occur more frequently than their literal counterparts, and hence constitute the default case, that is, the statistically most likely meaning of the word or expression; they would therefore require an unusual context to be interpreted literally. However, the default interpretation of the words used in most nonconventional metaphors is the literal one. Conventional metaphors and idiomatic expressions, may, therefore, not be as vulnerable as novel metaphors and nonconventional indirect speech acts (Paradis, 2009: 54):

1. **Is there any salt on the table?** - هل هناك ملح على الطاولة؟

as opposed to

2. **Can you pass me the salt?** - هلا ناولتني الملح

If we assume that what causes the right hemisphere to be involved is the need in

unusual circumstances to infer a meaning other than the one provided by the grammar, then when a common indirect speech act or frozen metaphor has turned into an idiomatic expression and thus become the default interpretation, it is the literal interpretation that needs a specific context in order to be selected. Another dimension that may have to be considered is the transparent/opaque nature of indirect speech acts, from:

1. **It's getting cold in here**

   - أشعر بالبرد هنا

as a request to shut the window (opaque: no reference to 'shut' or 'window' to

2. **Do you know what time it is?**

   لا أعرف مالوقت الآن

as a request for the time (transparent) (Paradis, 2009: 54).

4. Cognits and Neural Network Organization in Translation Process:

Translation is the analysis and interpreting interactive cooperation. It leads to the suggestions about how the biological activity of the neural networks. It might correspond to the mental interpretations and mutual relations between brain functions and cross - linguistic performances. It is appropriate to interpret the functional neural networks as pieces of organization that correspond to the pieces of the mental competences that are pieces of knowledge[9], as in:

- **The spirit is willing, but the flesh is weak.**

  - الروح تو اقة، ولكن الجسد ضعيف

They are pieces of knowledge about things, events or situations, and language rules of use, the experience of participants and discourse interactions are usually called mental categorization or characteristics. Hence, the corresponding mental relations could be functionally called

[9]Cognitio in Latin

cognitive networks and their mentally corresponding knowledge pieces are categories or characteristics of perception - action or thought. This can be:

وإذا كانت النفوس كباراً تعبت من مرادها الأجسام

The pairing of a network and its functional knowledge pieces might be given the name (cognit). Cognits are concepts that have dependency on the knowledge pieces, conceptual structures, neuronal networks and memory in the understanding of the situations of the linguistic input/output. Fixing contexts do not yet avoid mental and organizational confusions[10] (Schnelle, 2010: 12). On the other hand, structured connection between mental and knowledge representations of the neural network organization however takes into account the local structure (i.e. rules of use in individual's knowledge) that exists in the neural networks of the individual's brain. Neuronal networks[11] are modeled as nodes which are linguistically meaningful; they enter into neural computation in the mental model. The activation of each neural node in the brain networks depends on the firing each neuron in the linguistic interaction. Though single neuron either fire or not, neuronal groups contain networks of neurons that are fired at different times[12] and spaces. Making the group active to a higher degree depends on the proportion of firing at a given temporal and spatial relations (i.e. contextual factors) (Schnelle, 2010: 12; cf. Plaut, 2003:143).

[10]There is still a fundamental problem for understanding of linguistic categories and neurolinguistic analyzable networks. Researchers sought to find solutions through tests and experiments about conceptual representation of the linguistic inputs/outputs correlations.

[11] Each network contains (10 – 100) neurons group/cluster (Schnelle, 2010: 8).

[12]These processes are occurred within the cortical areas of the frontal and prefrontal cortex (see section 2.3.1).

The modeling of neural computation is done over networks with nodes, correlations, degrees of synaptic strength, and time lapses at different synapses (Lakoff, 2006:18; Plaut, 2003:143). The neural networks organize the production and reception of the language utterances generated by their dynamic network power (i.e. activates appropriate action states given intentional and pragmatic conditions) (Ingram, 2007:9; Lakoff, 2006: 18).

Hence, language in the brain relies on the networks of local clustered and connected neurons transmitters of knowledge piece/factors. Typically, elementary knowledge pieces, such as contextual features and linguistic categories, are cognitively represented by simple and local clusters (i.e. language interaction) of dynamic time and space organization. Complex knowledge, such as structures of words, phrases and sentences in different contexts are cognitively represented by distributed and interactive networks of cluster modules (Rollins, 1998: 32, Evans, 2006: 22). The term cognit is highly associated with neural mechanisms that are understood as the dynamic and rarely static such as some culture-specific concepts in the world languages. It is capable of generating the activity binding the linguistic features, units, and categories linguistic units. In the neurolinguistic studies, it is clear that there are two types of configurations of neural networks and clusters (Schnelle, 2010:16):

I. **Neural Networks**: there is integration, signal transition and transmission by neural automatic self - organizing networks of cognits that are unconsciously generated as clusters of knowledge and memory, as happens in the case of naïve and complicated syntactic parsing and semantic construal within dynamic time and

space systematizations. It is the relation between the linguistic inputs/outputs and the brain functioning perspectives, the nervous system of competence and performance, the cortical areas, and automatic neural systems of L-processing (i.e., the neuronal productive unit of cognits). The following example requires several processing scenario steps of the neural networks:

بِسْمِ اللَّهِ الرَّحْمَٰنِ الرَّحِيمِ ﴿ "يَا أَيُّهَا الَّذِينَ آمَنُواْ إِذَا قُمْتُمْ إِلَى الصَّلاَةِ فاغْسِلُواْ وُجُوهَكُمْ وَ أَيْدِيَكُمْ إِلَى الْمَرَ افِقِ وَامْسَحُواْ بِرُؤُوسِكُمْ وَأَرْجُلَكُمْ إِلَى الْكَعْبَيْنِ وَإِن كُنتُمْ جُنُبًا فَاطَّهَّرُواْ وَإِن كُنتُم مَّرْضَى أَوْ عَلَى سَفَرٍ أَوْ جَاء أَحَدٌ مَّنكُم مِّنَ الْغَائِطِ﴾ (القرآن الكريم: المائدة/6) صدق الله العظيم

Oh you who believe! <u>If you wish to pray, wash your faces, your hands as far as the elbows</u>, partially wipe your heads with water and wash your feet as high as ankles. If you be <u>ritually impure, you shall purify yourselves</u>. But if you are on travel, <u>or if one of you comes from the low land</u> (Glorious Qur'an: trans. by Kassab, 1994: 174).

Each underlined construction depends on the neural mappings; it implies figurative tropes that have several steps inferred via neural underpinnings. The translator resorts to keep the sanctity of the Qur'anic text and transfer the closest image of (**جُنُبًا فَاطَّهَّرُواْ**) into (**ritually impure, you shall purify yourselves**). This knowledge implies all links between units on the one hand and macro knowledge structures and inference making process on the other that are mediated by cognition. Cues in memory can only be reproduced in translating process by specific perception – action, and controlled by cortical area (parietal lobe). (**أَوْ جَاء أَحَدٌ مَّنكُم مِّنَ الْغَائِطِ**), the translator refers to the concept of S^L with (**or if one of you comes from the low land**), as (**الغائط**) is the (**low land**) as it is the place to answer the call of nature. Thus, such elite textual work about expressive identity and emotiveness influence the

emotional charge in sensory areas (Ahmed, 2011:36).

II. Conceptual Networks: there are symbolic guided maxims and cognits escorted by the organizations of mental images and conceptual integrity from conscious and creative thought[13]. It is highly associated with perception of higher levels and lower levels mental activities such as thinking, reasoning, retrieving, the integration of mental images, cognitive efforts, and developing expertise of the linguistic interaction. These acts of integration access are complex automatic interactions of conceptual sub/components. They exist as partially non-conscious and/or subconscious due to the nature of complexity of the activity. They are also components of the mental scanning to the vents effects and contextual factors in specific time and space (see Schnelle, 2010:16). The following example:

"Vaccines are prepared from harmful viruses or bacteria; they are administered to patients to provide immunity to specific diseases" (Phillip, 2001: 378).

يتم تحضير مادة التطعيم من الفايروسات أو البكتيريا الضارة وحقنها في المرضى بغية زيادة مناعتهم ضد الأمراض.

In translating S^T into T^T, it activates images related to the active linguistic and semiotic[14] retrieval and reasoning of inputs and outputs. General perception functions the linguistic inputs into series of situations and constituents during particular inference mechanisms and macro knowledge constituents (**harmful viruses or bacteria ≈ الفايروسات أو البكتيريا الضارة**). The cognitive system operates pattern recognition on the basis of knowledge background to extract the significant features description in terms of perceptual primitives (cf. Green, 2011: 235).

[13] These types of L - processing are well - known in creative works of art and music as well as in their interpretation of pictures.

[14] (see Chandler, 2007: 7)

Both neural networks and conceptual ones are intertwined in cognition of human mental model to constitute the patterns of L-processing and transfer phenomena. Indeed, conscious selection of suitable lexical alternatives, neurocognitive aspects and the specifying dynamic time and space in event effects of the texts must be a per se access in translation. Lehtonen *et al*, (2005: 610) sees that studies are needed to resolve what influence different task-related and participant-related factors, such as working memory or bilingual language competence, the degrees of cognitive load and performance level have on the patterns of neural activation of cognits during translation (cf. Green, 2011: 235).

4. The Visuospatial Sketchpad in Translation Process:

It involves a short-term capacity and control processes responsible for registering visual and spatial information and its restoration by repetition, or practice (i.e. routine and adaptive expertise) (see Robinson, 2004: 23). The visuospatial sketchpad is also included in long-term memory organizations, and these are subsystems functionally associated with each other. Researchers consider visuospatial sketchpad as a control process of the recalling saved data in the working memory of the translator. It has been found that difficulties in working memory are manifested as the ability to hold a series of lexical entries in the working memory. The visuospatial sketchpad is usually potentiated due to the activation of parietooccipital areas of both hemispheres. Right - hemisphere results in a poorer nonverbal visuospatial short-term memory, whereas to homologous areas in the left - hemisphere result in aspects in short-term memory of visually presented language material (Mildner, 2008: 151; cf. de Vega and Marshark,

1996:52). Although the term working memory has its roots in the classical term short term memory, it seems that the more general model of the relationship between memory and cognition has been adopted. Working memory is involved in processing language data, in LF - cognits and LM - cognits understanding of utterances, but also in cognitive processes in general (Mildner, 2008: 152). Example:

If the blind lead the blind, both shall fall into the ditch (Baalbaki, 1986: 86).

- قد ضل من كان العميان تهديه.

The brain hemispheres are potentiated very actively during translation process. The left - hemisphere is supposedly preoccupied with recognition, parsing and construal of S^T, whereas the primary role of the right - hemisphere is control of attention gate and monitoring visuospatial sketchpad of nonverbal communication and pragmatic dimension of the input message, and the wider context in other words of overall communication. In this example, the tertiary zone is activated in the left hemisphere of cognitive process of reception, production and retrieval process of data storage system. The cognitive processes of reception/production, the behavioral aspects, and the cultural dimension have been retrieved. Other trans-cortical areas elicit the activation of prefrontal cortex and temporal and temporal gyrus, the PD has also been activated in the superior temporal gyrus, right-hemisphere.

5. Conclusions:

1. Translation process has seldom been subjected to the type of scrutiny by scholars in the field of translation. Hence, the new generation of translation studies has focused on this type as one of

the most scientific fields of human communication.

2. Translation is not merely a linguistic process, but it is rather a cognitive task and neural processing procedure by the translator.
3. Translation process research is relative to the cognitive sciences especially neurocognitive processes involved in the translation task.
4. Translation is innately a neurocognitive system of human brain; it is purely neuro-functional processing by which several trans-cortical areas are associated to form the transfer phenomenon from S^L into T^L.

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