Semantic network analysis of bilingual students Arabic/French and monolingual French students

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ARTICLE INFO	ABSTRACT
	The study of semantic networks has already started by [1,2] in their respective studies about partitioned networks and propagation markers networks. These studies are directly related to the field of artificial intelligence for representing and storing in the memory. The psychologists Collins and Quillian [3] who proposed a hierarchical structure for the study of memorization. This model has proven ordered hierarchy in their study about the response time to the sentences: "A canary is it an animal? "A canary is it a bird?" In fact, the study of semantic networks could help us understand how semantic networks are organized in the mental lexicon? What are the types of relations that these words among themselves in the mental lexicon? To answer these questions, we want to make a comparison between the semantic networks of Algerian students bilingual Arabic / French in Algeria and French students in France to apply the technique of free association.

1. Introduction

Word association test research on verbal association plunge its roots in a very old past of the experimental psychology Bourdon [4], Cattell [5], Galton [6], and Trautscholdt [7]. Thus, this technique has become famous thanks to the psychologists and psychoanalysts like R. Roussillon [8] and C.G. Jung [9]. According to [10], free association is a:
"method of expressing without discrimination all the thoughts that come to mind, about different elements: word, number, picture and dream spontaneous".
It is a common method within psychology which has been used to reveal the private world of an individual, including his verbal memories, thought processes, emotional states and personalities etc. In a word association test, stimulus words are projected orally or in written form to the subjects who must respond with the first word which comes to their minds and this word is referred to as a

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response word. Psychologists examine the feature of the response words, and sometimes the amount of time it takes to respond. Word association indicates the interrelation of words in one's mind, which refers to "the link or links that connect different words in some manner in a person's mental lexicon" [11]. In recent studies, researchers found that there is a great deal of consistency in the response words in word association tests produced by subjects, which suggests that speakers of a language have a similar kind of mental connection between words [12]. Thus word association pattern is considered by linguistics researchers as a reflection of the way the words are stored and linked in one's mental lexicon, and word association test is regarded as an important approach in studying mental lexicon. According to [13], the technique of free associations words consist in present topics word "inductor" from which the subjects will produce other words. However, our research is part of a perspective of cognitive psychology whose purpose is in psycholinguistics. The main objective of this heuristic experiment was to get several graphs representations of semantic networks of the mental lexicon of two students groups, to make a comparative study. Knowing that in a semantic networks are units (inductors words) and arcs that connect these (conductors words) to nodes. These nodes represent both the words mentioned by (conductors words), and also to explain the different relations between the (conductor word) and nodes. We suppose that the study of the relations of semantic networks allow us to test the following hypothesis: representations of various nodes of semantic networks in both groups are they influenced by their cultures and personal knowledge of the world?

2. State of art

As regards the technique of free associations, the specialized literature is abundant because it provides to us very extensive study results that have been realized in L1 and L2. For example, in L1, several types of lexical links were examined Neely [14]. The most frequent concern antonymy (hot / cold), synonymy (outdated / obsolete) and hyperonymy (bird / sparrow), but there are also links collocational (get on / stairs) and various associative links (cat / dog). Probably, this facilitation means that the words used in these pairs are strongly associated in memory. However, facilitation by semantic links without associative value has also been demonstrated [15]. In L2, substantially observed the same effects as in L1. The antonym relations, synonyms and hyperonymy facilitate visual identification of the second member of a pair of words built on these relations and collocation relations and association [16]. Regarding the relations by association, several bilingual studies show that this relation is effective within L2 as in L1, but it weakens or disappears when it presents the context and word target word in different languages [16]. These results are valid in presentation conditions that prevent the subject to make predictions about the types of relations that are proposed. However, if the provision of the terms of the mental lexicon does not follow alphabetical order, what is the organization? In this case, the words are not independent of each other. Sometimes it's hard to imagine a term without thinking about those around: can we think about the "cold" water without thinking simultaneously to "warm" and "hot"? But in this context, how are connected words? We must not think that the words of a language cover the reality of a regular, though different from one language to another, like the pieces of a "puzzle". The question is not easy because it can have several words that express the same concept (*leopard* & *panther*). While others are not lexicalized concepts (how is the name a *dead plant*?). Sometimes the meaning of several words is the same when they have one or more characteristics in common (mother, sheep, hen or princess are female beings). Many models have tried to explain these cohabitations words in the mental lexicon, but all converge to two major types of theories: the "atomic globule theory" and the "cobweb theory". The "atomic globule theory" confirms that the words are built from a common set

of "atoms sense" (in fact semantic primitives), and that the words are linked because the speakers created them. First, the appellation is seen as an assembly of pieces; secondly, they are considered full with their characteristics and form a network (theories of verbal meanings). In fact, the consensus is not total, and the researchers are now turning to the second type of representation words in memory, which has been in evidence. However, no experiment has shown conclusively the existence of semantic primitives.

Furthermore, over the past decade, researchers are particularly interested to the study of memory disorders in adults. In this direction, [17] has compared the responses the responses of dementing and non-dementing older adults on word association. They suggest that the level of response variability in word association is influenced by age. [17] measured between-participant variability in two ways. Firstly, by examining the proportion of each participant's responses that were the second most popular response to each item and secondly by counting the number of unique responses each participant gave (unique in that no other individual in the cohort gave that response to that stimulus). They found no contribution of participant age to either measure. They did find differences however in the words that were given as the most popular (or dominant) responses. There was only 60.5% overlap in the three most popular responses to stimulus items across the two cohorts. [17] also examined variability across cohorts in terms of the type of response given. Following [18] criteria, they classified responses as either paradigmatic or syntagmatic. Paradigmatic responses were those that shared form class with the stimulus item as well as sharing features in terms of meaning (e.g., boy-girl, wise-clever, carrot-vegetable). Syntagmatic responses were those from a different form class than the stimulus item and as such they were words that could co-occur with the stimulus in a sentence (e.g., phone±ring, formal±dress, blue±sky). [17] found that the majority of responses were paradigmatic, and that the proportion of paradigmatic responses was not influenced by age. This finding is important as several studies have revealed a reduction in the proportion of paradigmatic responses in older adults with dementia of the Alzheimer's type suggesting that such a reduction might be a marker of a breakdown in semantic memory.

3. Bilingual lexicon

The manner which some person use two or more languages is an extraordinary ability, because it can`t let us indifferent. This fascinating phenomenon cannot exist in a `` bilingual brain or multilingual``. This in itself implies some independence in the mental structure of the two languages of the bilingual. Nevertheless, the knowledge of a language can interfere in the use of another. These interferences concern often the phonological and syntactic processing levels. Thus, in the case of late bilingualism, the emphasis with which a bilingual speaks his second language is the result of interference from the phonological structure of his native language. Similarly, the structure of sentences in his second language can be influenced by the particular grammar of their native language. Or, studies on language acquisition in very young children show that it's the first year of life that this system specializes in the native language [19,20]. However, such problems are reduced or disappear when the bilingual subject has acquired his second language at an early age [21,22]. In this sense, we want to know how the lexical representations are structured in the bilingual subject? In other words, verbal fluency we usually remark in bilingual-it allows us to mention the existence of a completely separated data processing or rather the existence of a partial processing of the information? Of course, the latter hypothetical structure must express the possibility of interference between the two languages of the bilingual. Moreover, in the recovery phase, some aphasic patients can use only one of their two languages and some days, other days only the other language [23]. Other data were provided by the intracranial electrical stimulation technique. Indeed, the stimulation

of certain sites can prevent speech production. Though, interesting way, the excitement of some sites interfere whatever the language, while other sites selective way affects the first or second language [24]. These observations suggest that the two languages do not recruit exactly the same brain areas. In this context, the question of how these languages organized in the brain such that the correct target language is selected at a particular occasion. Knowing that, even a proficient bilingual person must select words from the target language, whereas those from the non-target language should be ignored. In fact, bilinguals are successful in selecting the intended language, but sometimes a word of the non-target language intrudes and a cross-language speech error arises. This common observation indicates that in the bilingual brain words from the different languages compete with each other. Such interference between languages can be characterized as language conflict. Indeed, bilinguals could handle a potential language conflict in two ways. First, words of both languages become activated, and an effective mechanism then selects words from the target language out of the set of activated target and non-target language representations. Second, there might be a mechanism that blocks the non-target language completely, such that normally non-target language representations do not become activated at all. Electrophysiological and neuroimaging data have been interpreted in favor of the latter option [25]. Finally, according to [26], bilingual subjects develop a control system that consists of inhibiting one language and use the other. This finding showed that bilinguals were faster than monolinguals, when it comes to multi-task.
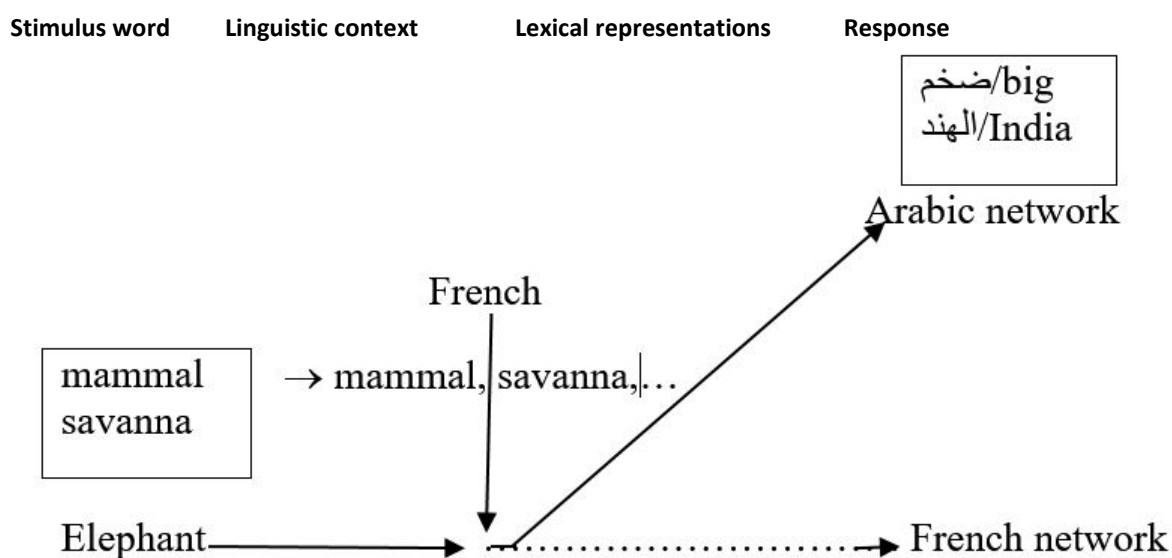

Fig. 1. Hypothesis by language entry

All the theoretical points view and the previous results of the experiments which presented above open the way to a question directly linked to the structure of the bilingual lexicon. This information could be represented either at individual lexical representations, either in the organization of these representations. Both assumptions concerning representation of linguistic information in the bilingual subject related to the field of research is to know when to linguistic information is used when it comes to oral expression or free association, for our study. In this context, we can distinguish two possible times during the method of free association. Both these two moments are summed up in two stages: during *access* (Fig. 1) and while *selecting* (Fig. 2). Indeed, the linguistic context, information about the language one expects to receive, can direct sensory information to the lexical representations of one or the other language.

Moreover, in the selection phase (Fig. 2), the lexical representations must also be organized by language, but in this case sensory information would contact the lexical representations of both

languages. Thus, linguistic information cannot influence the first phase of access to the lexicon, because this information comes only during the selection procedures among all the lexical candidates.
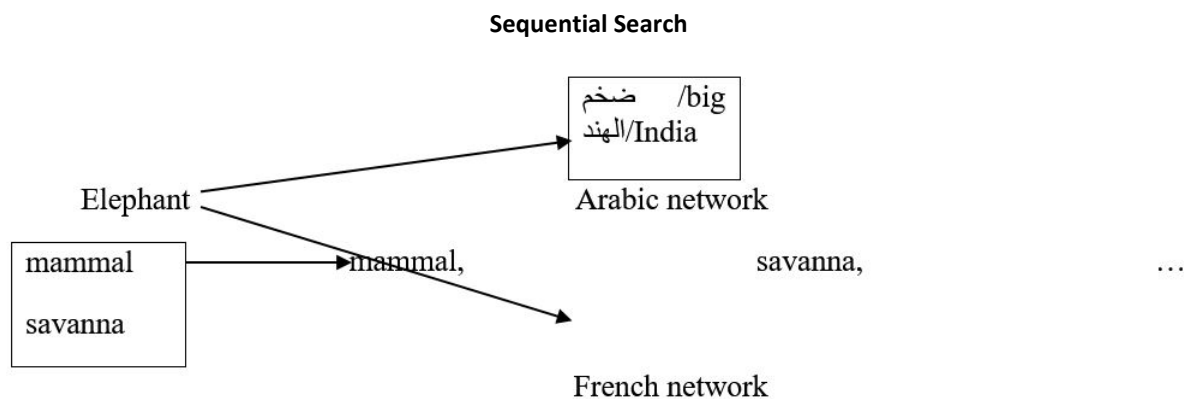
Sequential Search

Fig. 2. Hypothesis 2: Select by language in lexical candidates.

This procedure seems to us simplistic because it presents two completely disjoint languages. While both Arabic and French lexicons exist separately because of language (phonological, morphological, and syntactic). These differences do not easily allow a language transfer between these languages. This means that bilinguals Arabic / French should put more time when switching from Arabic to French or vice versa as their second language (French) is a cognitive load. But we notice, in the case of switching code, bilingual subjects quickly from one language to another. However, the reality of the mental lexicon is much more complex. This is due to the dynamic and interactive nature of the mental lexicon. Thus, we noted that in the case of the bilingualism French/English. It quickly accesses the most frequent words in a language other regardless of their mother tongue [27].

4. Mental lexicon

All teachers and educationalists insist on the importance of vocabulary to establish meaningful communication. Several lexical researches has attracted more and more interest among psycholinguists. Thus, the study of the mental lexicon has attracted the attention of researchers over the past thirty years. The concept of mental lexicon generally refers to the set of words (or lexical unities) constituting the language of a community or of an individual. Many theories use this concept to reflect the organization of words, semantic memory containing concepts [3]. In the early designs, this lexicon was likened to a kind of dictionary, where words were described as independent units each other. [28] has the mental lexicon as a system composed of independent functional units: logogenes (or system "word generation"), where each corresponds to a word logogene. The treatment system is modular, conceptualized as a system of "arrows boxes". The boxes represent autonomous systems containing information that are clean and operating them specifically. Thus, the processing performed on this information can only be achieved when the previous processing is completed, this does not preclude the possibility of parallel processing of different information. For if the words were stored independently, any dictionary, "The Larousse" dictionary for example, would be useless if the words were inscribed in the human mind at random, without organizing principle. Thus, tens of thousands of words known by the subject become inaccessible if they were not arranged in a functional principle.

"We feel that the words are there, inside us, available in physical form we emit or receive. (...) The words are not in our head like plums in a bag, especially since it would take several bags, one for the words to hear, one for words to read, one for the words to pronounce, one for words to write, etc., and a whole system of relations between these bags." [29]

Today, researchers agree that often the words of the mental lexicon of the native language (L1) ranges from 20,000 to 150,000 words, but most estimates are around 50,000 words [30]. In addition, the mental lexicon has at least three different storage levels: level of memory concepts; the level of lemmas ("lexical items for unspecified phonological form [but] semantically and syntactically specified" [31]); and the level of lexical - phonological and orthographic representations of words. Levelt's model is too general inasmuch as it takes into account all the operations of language production, preferred model [32], to represent the L1 mental lexicon.
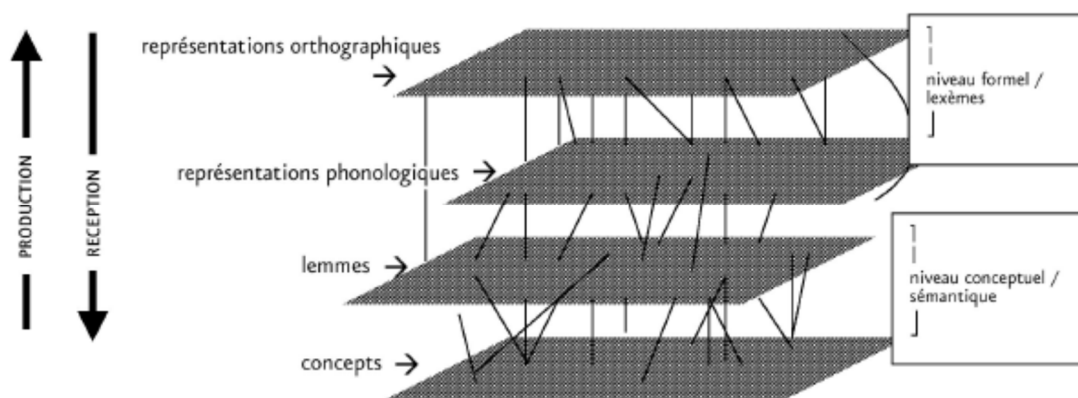

Fig. 3. The mental lexicon in L1

This mapping is a simplification of the reality it seeks to describe. First, the filling of the "planes" of the network is too symmetrical, because the units are stored at each level information already grouped into bundles (see the model of the mental lexicon proposed by [33] or [34]. Psycholinguistic research of oral language reveals the complexity of each part - semantics and formal - this simplified model: the "phonological level" would include syllables subnets, a "prosodic frames", etc. [35,36], and it remains to be done to sort out all components of syntactic-semantic networks. For the purposes of our consideration of the mental lexicon of two languages, storage, separate or integrated. This question was already raised in the 50s [37].

Furthermore, studies have hypothesized about the existence of a relationship of polysemy between the words belonging to two foreign languages. Thus, [39] shows that if presented to subjects first the word `` *four*`` (which, with different sense, available in English and French), then they will react faster that both French 'in English words having a meaning connected to "*four*" in both languages (like French. *cooker*, English. *five*). The presentation of a single form thus leads all activating two meanings and two semantic networks (in two languages). This suggests that the storage of the forms and meanings of these is common and not separated. [38] have shown that the lexicons of two languages have an integrated storage. In a test of lexical decision where he asked several topics read belonging words in different languages, the slowdown observed in the reactions of these subjects when they have to go from one language to another, does not exceed the middle notes differences reaction time for each language concerned. [39] shows the same in the field of phonological aspects of words. Thus, in a test lexical decision, the reaction time of Dutch learners to recognize the French words is longer when the phonology of these words corresponds to that of a word "*dier*" significant "*animal*" in Dutch that the recognition, of the French word to say is slowed. If such interference exists, it shows that the two lexicons are simultaneously active.

5. Experience and result

In our experience, we designed the following experimental protocol: First, we took Algerian students aged 20 to 18 years, bilinguals Arabic / French and 20 monolingual French students aged 18. Before starting our experience, we explained to each group the interest of our research which consists to compare the mental lexicon of student completely unknown attracted and motivated each group. Then we provided each student a sheet on which is a list of ten different words. These words belong to three different categories: names of animals, objects and adjectives. Each student must transcribe the first three words that come to mind in front of each word "inductor". The required time allocated to this task was ten minutes; this time is relatively short because, we want to get immediate and spontaneous responses.

This experience allows us to get several types of relations inside each semantic network such as inclusion of relations in a field, endogenous relations, etc. In this article, we consciously wanted to limit ourselves only to these two relations because we prefer to talk about other relations in a future article.

5.1. The inclusion relation

This is a fundamental link that corresponds to the type of knowledge and it allows to discerning between the relation of inclusion and belonging. According to the process of the answers of subjects, each word is connected to another word through a semantic relation which expresses the type of these relations in a semantic network. For example, in Fig. 1, among the words evoked by the two groups of students, we find that the stimulus "brush" is associated with the word "hair", expressing the concept of "compound" and "artist" expressing the idea of "belonging".
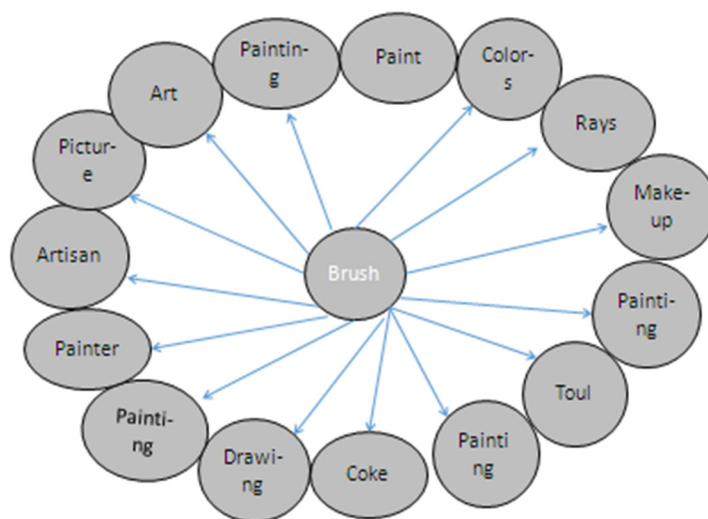
Fig. 4. Semantic network of Brush among bilingual Arabic/French students

As for the Algerian subjects, they associated the word to the field of "painting" from which the nomination of "painting", "painter", "tool", "picture", "color", "drawing". It should be noted that we were intrigued by the semantic networks associated with the following words "tool, makeup", implying that several among bilingual semantic networks as "drawing", but also "makeup", "artisan". They could be interconnected and overlap each other according to the customary practices. This is

aesthetics, which the French subjects were not referred. In other words, if we continue to expand the semantic network of each word for two groups, we see that it is difficult to stay in one area, because the words are related to personal practices.
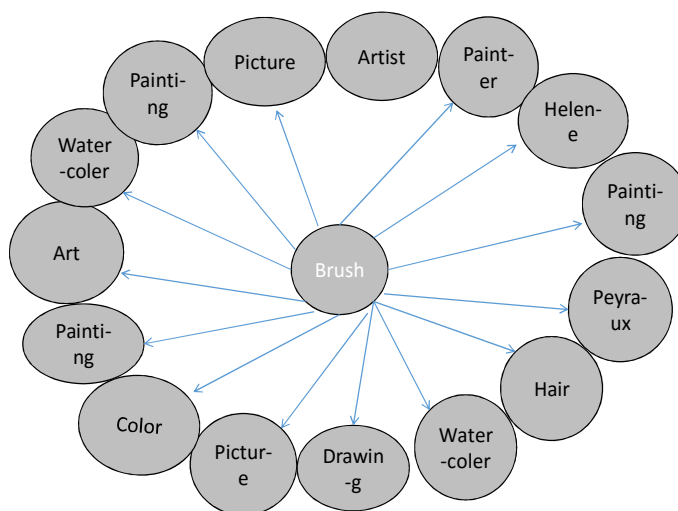
Fig. 5. Semantic network of Brush among monolingual French students

5.2. Endogenous relations

The role of these relations was supposed to think about how to expand the representations associated with mental lexicon to get a general model of semantic networks? In this case, we assume that the words used in our daily life are endogenous to our culture and history.

In other words, our mental lexicon is it placed in a background related to our history and culture?

The explanation of these figures requires "Enactivist" theory or "Embodied Cognition" [40-44], which consist to say that the words are rooted in a web of meaning. Thus, Fig. 2 of Algerian subjects present the words evoked by the "conductor" word "husband" are: "love, happiness, responsibility, unity, security".

This web of meanings is part of the socio-cultural aspects. For [45], this phenomenon means that depending on how the words are linked together they become significant. While, the same "conductor" word have evoked in French subjects "wife, lover, mistress, eglize, live together".

This is explained by the significantly similar words are activated to form a semantic network that can be expressed by socio-cultural representations characterizing a given society. It is in this sense that E. Benveniste allows us to summarize:
"We discerned that the mental categories and laws of thought are, to a large extent that reflects of the distribution of linguistic categories" [46]

Moreover, we observe in Fig. 2 that the "conductor" word "husband" evokes: "spouse, security, protection". This web meaning is constructed from socio-cultural representations related to the role of "husband". We understand that the "husband" is supposed to ensure the protection of the couple. In addition, we perceive the influence of religious culture in the following web meaning with the same "conductor" word "husband": "women, children, church". We deduce the "husband" is a man who has a "woman, child and they go to church". In this context, A. Martinet concludes:
"We measure how far it is the language we speak determines the vision that each of us has the world" [47]

Furthermore, the words evoked by the "conductor" word "barrage" are seen in Fig 3. They have been extremely intrigued by them because their web meaning refer to two different representations related to worldviews and heterogeneous "imaginary".

In this case, we remark a memory tormented of Algerian subjects through the words evoked: "water, stock, life, prohibition, security, squirrel, police, terrorists, barrier control, stop, problems". On the other hand, we remark a more quiet spirit among French subjects from their evocations: "water reserves, great, river, EDF-GDF, fall, groundhog, stop, ecology, water, river, beaver, swimming, lake".

We conclude that all these words of Algerian subjects are attached to verbal images in conjunction with a particular reality. They refer to a "security" situation that Algerian subjects had to know or to live. Therefore, the relations between these words are woven and interconnected differently a web of meaning "endogenous". According to E. Benveniste:
"We believe a universe that our language was first modeled [...] The language structure that the individual receives from his entourage is primarily responsible for the way organizes his world" [48].

Thus, in the same logic, A. Martinet emphasizes:
"Each language has a particular organization of data of experience [...] A language is a communication tool that human experience is analyzed differently in each community" [47].
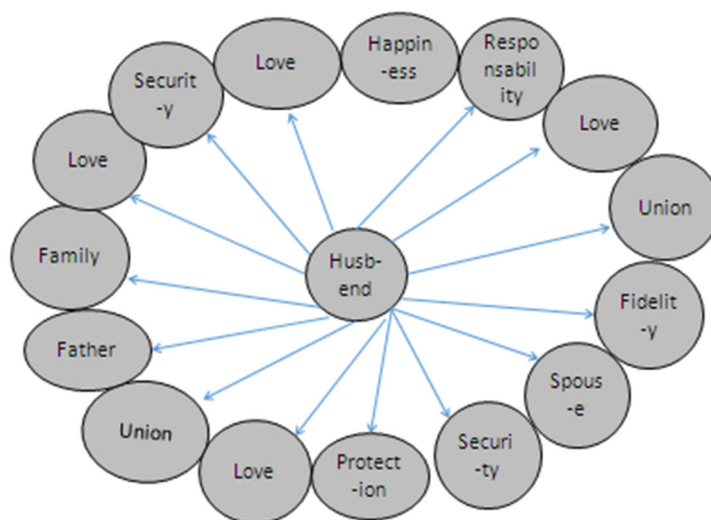

Fig. 6. Semantic network of Husband among bilingual Arabic/French students

Finally, it is important to signalize that semantic memory stores the words to categories. The categorization function is already known since Aristotle postulated that the categorization relation was the basis of any sense of relations between words. This is explained by the fact that all thing or object was belonged to a category. For example, the word "elephant" belongs to the category of "mammals", which it belongs to the category of "animals".
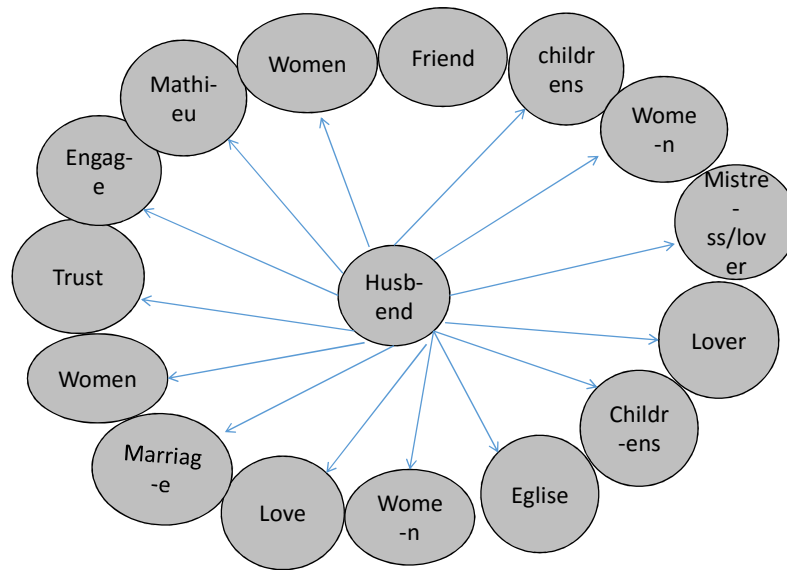
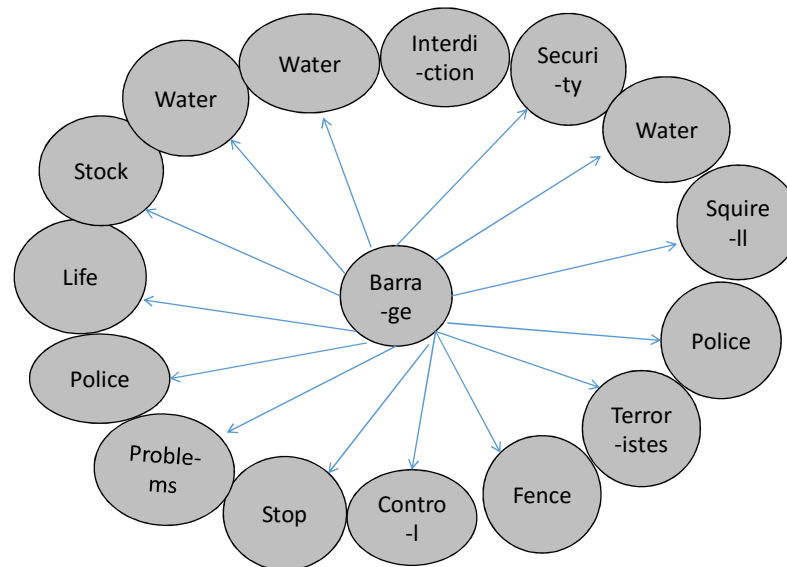**Fig. 7.** Semantic network of Husband among monolingual French students

Fig. 8. Semantic network of Barrage among bilingual Arabic/French students

6. Conclusion

The technique of free associations has demonstrated the existence of different semantic networks inside each figure. These semantic networks form links that are influenced by the personal history and the cultural features [49] of each group. In this regard, we assume that a cognitive process occurs in semantic memory which includes the words as semantic networks. Actually we can't show it here. This study also allows us to verify our hypothesis through the application of "Enactivist" theory [50].
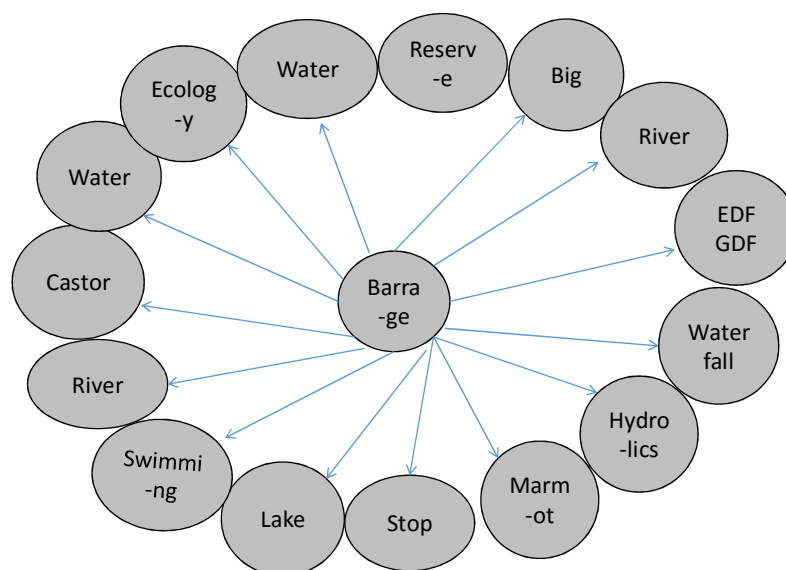
Fig. 9. Semantic network of Barrage among monolingual French students

Furthermore, we prefer to remain modest compared to its results because, we expect to take more subjects participating in the next experiment before generalizing these results. However, the only criticism for this technique, despite its effectiveness, is that it depends on the mental state of the subject and the contingency. Finally, it is nevertheless too early to conclude on this point. We have barely started work in this regard, and it is necessary to continue research on the effect of formal proximity between words of different languages in the bilingual must allow us to refine our concept in the evocation of words in the bilingual situation.

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