

Explaining Theories of Verbal False Memory*

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Abstract—Verbal false memory is one of the most important research fields in cognitive science, especially in language and memory. As to the explaining theories of verbal false memory, researchers have experienced a series of theoretical explorations. They have proposed explaining theories such as the schema-reconstructive framework, the fuzzy-trace theory or the FTT, the source monitoring framework, the memory attribution theory and recently the associative-activation theory or the AAT. This paper intends to make comment on the two most popular explaining theories: the FTT and the AAT. The former has explained verbal false memory with verbatim traces and gist traces, while the latter requires a correlation between concepts and participants' knowledge base and a kind of automation to the activation of the relatedness as well. However, both explaining theories are not completely sufficient to this phenomenon. As far as the FTT is concerned, the gist connecting mechanism is too vague and it is not clear that whether the ability to connect the gist meaning is domain independent or domain dependent, etc. As to the AAT, the automation and the relation between conceptual structure and knowledge base are not persuasive enough. In order to avoid the occurrence of these problems, related concepts of semantic network can be introduced to further supplement the researches and thus, the two explaining theories can be made the most persuasive.

Keywords—verbal false memory; FTT; AAT; verbatim traces; gist traces

I. INTRODUCTION

In the long history of memory studies, false memory is one of the most significant and conspicuous findings. Verbal false memory occurs when the verbal participants claim that certain words that have not actually been presented are as distinct as those that actually appear as equivalents (Yang, Wang & Tang, 2006; Gallo & Roediger, 2002). For the experimental study of verbal false memory, scholars mainly use two experimental methods: proactive interference and retroactive interference (Howe, Gagnon, & Thouas, 2008; Bialystok & Feng, 2010). The former refers to the phenomenon that the old experience interferes with the recall of the new experience, and the latter refers to the phenomenon that the new learning experience interferes with the recall of the old experience (Zhang, 1991). Studies on verbal participants have shown that when they learn lexical items in one language and then represent or reproduce them in another language, their real memory performance

decreases and false memory increases. Similar studies have also shown that lexical items representation in one language reproduced in another one (for example, let Chinese of English learners use English to produce lexical items that are equivalent to Chinese), will also cause participants to produce more false memories (Mao, et al, 2008).

From the perspective of the theoretical model of the interpretation of verbal false memory, the researchers have made some theoretical explorations. In the early stage appeared the schema-reconstructive framework theory and then came the fuzzy-trace theory or FTT, the source monitoring theory and memory attribution theory. In recent years, the associative-activation theory or AAT appeared, too. This paper is intending to comment on the two most popular explaining theories: the FTT and the AAT. The former, led by Payne, Brainerd and Reyna, has explained verbal false memory with verbatim traces and gist traces, while the latter, led by Howe and Blease, requires a correlation between concepts and participants' knowledge base and a kind of automaticity to the activation of the relatedness as well.

II. THE FTT AND THE AAT

The FTT is an interdisciplinary model of cognition, which mainly applies the verbatim traces and gist traces to explain how the false memory appears in language learners. The FTT holds that the encoding of verbatim representations and gist representations of an event is parallel, and the two representations can also be generated at the same time. The process of setting up the gist representation is called gist retrieval, which retrieves meaning and model from stimuli. Brainerd & Reyna (2005) proposed that 1) verbatim trace is easier to be forgotten than gist memory; 2) in the experiment of free recall, recall in the previous stage is usually dependent on the verbatim representation, and recall of the lexical item in the later stage is dependent on the representation of the gist representation.

The AAT is another theoretical model of predicting the verbal false memory. It relies on a direct activation mechanism rather than a direct connection of gist mechanism. With the changing of language learners' experience, exercise and background knowledge, the corresponding activation model will change, which will lead to a faster, more efficient, and more automatic activation of the relationship between concepts in memory (Howe, Gagnon & Thouas, 2008; Howe, Wimmer, & Blease, 2010). The AAT holds that the false memory is the product of the process of associative activation (Howe, 2008). McEvoy, Nelson, & Komatsu

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(1999) proved that the association between lexical item and critical lure is the significant factor to cause false memory. This theory is the same as the activation-monitoring theory of Roediger et al, which shows that a lexical item activates the relevant nodes in mental lexicons (or in background knowledge), and this activation will be further dispersed to the nearby conceptual nodes (Collins & Loftus, 1975; Landauer & Dumais, 1997). Particularly the activated lexical item or concept is not presented, but “mistakenly” activated. The main reason might be that these lexical items and concepts in background knowledge are closely associated with the presented lexical items. Howe, Gagnon, & Thouasan (2008) pointed out that the increase of children's false memory with that of their age may be due to the change of their background knowledge (such as the increase of associative ability, and the reorganization of knowledge, etc.). In addition, personal experience and conceptual practice may also help increase children's automaticity of lexical item association while retrieving or activating the background knowledge.

A. The Explanation of the FTT to Verbal False Memory

Why do the participants produce more false memories as they get older? The FTT explained this phenomenon through two kinds of memory traces, that is, verbatim traces and gist traces (Brainerd & Reynolds, 2005). The two traces are different in nature: the verbatim trace is related to the surface information of the lexical item (e.g.: the number of phonemes in the lexical items), while the gist trace is related to the meaning of the lexical information (e.g.: the gist meaning of the lexicon). When the verbatim, which is easy to disappear, is absent, the gist trace is considered to be the main cause of false memory in Deese-Roediger-McDermott (DRM) paradigm. The gist traces are more related to representation than recognition because it is easier for lexical items to activate their verbatim traces in recognition tests. Although the FTT does not clearly define what the gist is (Howe, 2008), it is generally pointed out that the gist refers to the general “theme” of the material presented (Brainerd, Reynolds, & Cecilia, 2008). Therefore, the gist is the theme of the lexical items in the DRM paradigm. When using classified items, the category is the gist. Not only the items have a gist, but a single word also has a gist, which can equally lead to the occurrence of false memory (Reyna & Lloyd, 1997). Although the children have the ability to retrieve the gist, yet their ability increases with age, especially the ability to retrieve items across lexical items (Brainerd & Reyna, 2005). With increasing of age, the likelihood of false memory increases.

B. The Explanation of the AAT to Verbal False Memory

According to the AAT (Howe, 2008; Howe, Gagnon, & Thouas, 2008), children's false memory, just as adults', should increase with the increase of associative strength between lexical items and critical lures. However, their false memory ratios are different, because the association that children activate among concepts is not as automatic as adults. As researches on memory organizations suggest, the number and quality of associative relationships between new and old acquired concepts continue to change significantly

with the development of memory (Bjorklund, 2004). When children gain knowledge and experience through their exposure to language, their conceptual representation and their associative links of related concepts will be stored in a more complete form in the memory (Bjorklund, 2004). Although these changes in conceptual representation organizations will strengthen the relationship between related concepts, the ability that children process these relationships automatically and activate related concepts still depends on their cognitive ability.

The generation of adult false memories in the DRM paradigm is relatively automatic. For them, those related but not presented lexical items (such as critical lures) are primed by the associative links of presented lexicons. For children, it is very difficult to activate these associative links, but with the continuous development of children, the cognitive effort required to deal with and activate these associative links of related concepts is relatively reduced. At the same time, however, the possibility of producing false memories has also increased.

III. THE DIFFERENCES OF EXPLAINING VERBAL FALSE MEMORY BETWEEN THE TWO MODELS

Although there are many similarities between the two theories in explaining false memory, (for instance, true and false memories grow with age; Children and adults produce fewer false memories in the classified vocabulary than in the DRM lexicon), they differ in two aspects. On the one hand, The FTT holds that the semantic structure can be found and the real memory can be improved by comparing the DRM list with the categorized list. Because the categorized list has simple and similar gist meaning, it is easy even for children to find out the obvious semantic structure. Recently, many researches show that five-year old children can adopt categorized list to help improve their real memory. Contrary to the FTT, the AAT holds that even if children and adults simultaneously retrieve semantic information to help improve their real memory, children's false memories will not change and remain lower than adults. In the DRM list experiment, even if children were prompted to integrate the gist information, their false memory rates would not change.

On the other hand, the two theories differ in explaining the development of false memory in language processing tasks. Different from the FTT, the interpretation of associative activation not only requires that the conceptual structure be related to the background knowledge of participants, but also requires that the process of activating the intrinsic relationship among these concepts be an automatic process. Although the fact that the concept, used in the DRM task, appeared in children's background knowledge, the retrieval access to these concepts is not as automatic as the findings in the experiment for adults. Although the frequent occurrence and increase of false memory are related to the automation of activation, even if the concept exists in children's background knowledge, the existence of these concepts cannot guarantee the increase of false memory. Only when the concept retrieval becomes an automatic process can the false memory increase. The automation of extracting memory is gradually formed with

language learners' learning time and proficiency, because the automation is more common in adults than in children (Bialystok & Feng, 2010). In contrast to the FTT, the AAT predicts that adults produce more false memories in inter-linguistic conditions than in intra-linguistic conditions, but this increased false memory does not occur in children. That is to say, regardless of age, the FTT predicts more intra-linguistic false memory than inter-linguistic one, while the AAT predicts the cross linguistic interactive effect in different ages (Howe, et al, 2008; Howe, et al, 2009).

IV. THE DEFICIENCY OF EXPLAINING VERBAL FALSE MEMORY

A. *The Deficiency of the FTT*

According to the FTT, both of the process of verbatim memory and the process of gist memory can encode different types of information in different memory traces. Verbatim traces include lexical meaning and surface information and gist traces include the relation of lexicons and meaning information. The appearance of verbatim traces will reduce the possibility of false memory, while the appearance of gist traces will increase the possibility of false memory. The key to the development of verbal false memory lies in the change of children's ability to deal with the gist. Although children can create two types of traces, this ability increases with age, especially the ability to connect the meaning of different lexicons. With the increase in the ability to deal with the gist, the false memories of these children are naturally more likely to appear. However, the FTT has the following problems in explaining verbal false memory.

Problem one: the gist link mechanism plays an important role in the emergence of false memory, but the FTT does not accurately describe the gist link mechanism. How is the gist link mechanism operated or even measured? How does the gist link mechanism develop?

Problem two: In the process of lexical coding, the possibility of connecting different lexicons in the same category is not clear. Even if they have the ability to connect different lexicons, they do not have a retrieval strategy that performs the same lexicon at the same time. That is to say, this lack of executive ability is independent of the ability of children to connect meaning when coding and storing, but is related to the ability to use information effectively when searching for lexical items.

Howe (2008) points out that the retroactive interference on children's related lexical concepts is significantly reduced when the lexical information is received in memory regardless of age. And Marche, et al (2009) also claimed that there was no significant difference between age and coding semantic knowledge. However, other studies have found that even children around the age of 7 can encode semantic relationships in the lexicon-retrieval process, but are more difficult than older children around the age of 13. The two views are, therefore, not consistent in terms of the possibility of connecting different lexical items in the same category.

Problem three: The FTT does not clearly explain why semantic similarity of different lexical items in the

categorized list only affects real memory but has no effect on false memory. Brainer et al (2008) confirms that when semantic similar lexicons in the categorized list are blocked in presentation (similar to the DRM paradigm), the real memory of both adults and children increases, but their false memory is not significantly affected. That is to say, even if the lexical items in the categorized list are presented to the participants (especially children), but not the DRM lexical items, these lexicons will not have any effect on the false memory of the participants (Howe, et al, 2009).

Problem four: The FTT ignores whether the ability to connect the gist meanings is domain independent, that is, the domain that does not depend on the category to which the lexical item belongs. According to the description of Brainerd, Reyna, & Ceci (2008), the ability to retrieve the gist meaning may be domain dependent, which depends on the category domain in which lexical items are subordinate, but the ability to connect the meaning of similar lexical items is domain independent, no matter what category they belong to. However, the reason for the consistency of this interpretation and the result of the study on the participants' memory study is also not clear, especially in the study of false memory (Metzger et al., 2008).

B. *The Deficiency of the AAT*

The AAT points out that the generation of false memory not only requires that the conceptual structure be related to the participants' background knowledge, but also requires that the activation of the internal relations of these concepts be an automatic process. From this point of view, the AAT is undoubtedly more explanatory than the FTT represented by Brainer, Reyna and Payne. It no longer focuses on the verbatim trace and the gist trace. Howe, et al., introduces the concepts of associative link and automation. Although the AAT is more explanatory than the FTT, there are still some problems.

Problem one: In the interpretation of false memory, the relationship between the conceptual structure and the participants' background knowledge is not clear. Howe (2008) and Bjorklund (2004) only point out that there is the correlation in the related researches, but the specific relevance is not clear. Not in all cases, the participants' background knowledge will lead to more false memory. Metzger et al. (2008) points out that there are positive associations and negative associations between conceptual structure and participants' background knowledge. Positive association increases true memory and reduces false memory, while negative association reduces true memory and increases false memory. This actually belongs to the category of negative associations. Furthermore, the rate between false memory and true memory is also directly affected by associative strength. The stronger the associative strength is, the less false memory will appear, and vice versa (Howe, et al., 2009).

Problem two: The concept of automation is too general to be graded. Howe et al introduced the concept of automation into the AAT to explain the generation of false memory, which is undoubtedly very persuasive, but neglects the

detailed and accurate explanation of the concept of automation. The difference of the associative strength of the nodes among lexical items in background knowledge leads to the difference of the automation of concepts to be activated. Lexical items that have been repeated many times or have appeared more recently are more automatic when activated than those that have not. In fact, the automation of the nodes composed of lexical items in the activation network can be summarized into three different levels: strong automation, automation and weak automation. The concepts and items in strong automation domain are rarely activated wrongly, while those that are in automation domain and weak automation domain in the activation network are easy to be wrongly retrieved.

V. CONCLUSION

There have been a series of theoretical explorations in the interpretive research of false memory, but the two most persuasive and accepted theories are the FTT and the AAT. The former uses the verbatim trace and the gist trace to explain the false memory, but it has the problem of whether the ability of explaining the concept of gist link mechanism and the ability of connecting the gist meaning are domain independent or domain dependent. The latter, combined with the concept of automation, explained the generation of false memory through the connection between the conceptual structure and the participants' background knowledge. But there are still some problems such as insufficient analysis of concepts.

In order to avoid the shortcomings of these two interpretations, the researchers can introduce the concepts of semantic networks (such as the hierarchical network model and the decentralized activation model) as a supplement to the two interpretations, because whether it is from the verbatim trace or gist trace in the FTT, or from the relationship between conceptual structure and background knowledge or automation in the AAT, they can be explained by the relevant models of semantic network theory in detail one by one, which will make the interpretation force to the maximum degree of persuasion.

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