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Connectionism and Universal Grammar

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Abstract: *This paper is an attempt to find the role of an innate acquisition device in a connectionist view. Connectionism as used in cognitive models has the aim of focusing on the learning process. In this regard language learning is viewed as increasing the association of stimuli and response. Connectionism also encompasses the hope that learners can become successful and knowledgeable in a second language regardless of their age of learning. Connectionists have challenged the role of innate language knowledge called Universal Grammar. The author came to the conclusion that connectionism rejects the existence of any conventional syntactic representation of Universal Grammar, and any inborn acquisition device especially for language.*

Key words: language knowledge, connectionism, cognitive models, association- networks

Introduction

In language acquisition, the cues which are available, reliable and have a high amount of conflict validity will be acquired before those which do not have the same characteristics (VanPatten, & Benati, 2010).

'Connectionist model', a term coined by Feldmann (1981, cited in Menzel, 2005), is a name used for cognitive models with the aim to increase the connection of detailed information on the neuronal architecture of the brain into modeling (Menzel, 2005). In this regard, the concept of 'connection' clearly refers to the large amount of parallelism of neuronal processes in multiply intertwined networks (Menzel, 2005, Vanoverwalle, & Siebler, 2005). In the education domain of second language acquisition research, the focus of interest in connectionist approaches used to be on product while it is now moved towards focus on acquisition process. With the use of computer technology, connectionist simulations try to summarize the different stages in the development of linguistic structures, and to show the way learners make use of their integrated cognitive architecture to infer and analyze input patterns in a way which permits them to build structural regularities without being forced to resort to symbolic rules (Menzel, 2005).

Connectionism

In order to focus on learning processes psychology has provided two major frameworks: "information processing and connectionism" (Saville-Troike, 2006, p.73). IP claims that learning language is fundamentally the same as learning any other domain of knowledge: such as learning physics, or learning to ride a bicycle, or learning Chinese. Learners do not get involved in any basically different kind of mental activity. The connectionism framework, moreover, suggests that "learning is learning" (Saville-Troike, 2006, p.73), but regards learning processes as "a matter of increasing strength of associations rather than as the abstraction of rules or principles" (Saville-Troike, 2006, p.73).

Connectionism, initiated in the 1980s (Waskan, & Bechtel, 1997, Saville-Troike,

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2006), is a cognitive framework for the focus on learning processes, and since then it has become increasingly influential. It does not consider language learning to make use of innate knowledge or abstraction of rules and principles; therefore, it varies from most other current frameworks for the study of SLA. It is believed that language learning is the result of increasing strength of associations (connections) between stimuli and responses. Since frequency of input is regarded as an important effective factor in learning, it also provides a theoretical foundation for research on language teaching (Saville-Troike, 2006).

As Flower (1994, p. 96) mentions, connectionism is not a theory of "how knowledge is *remembered* but of how it is *constructed* out of memory."

Churchland maintains that connectionism proposes essential and useful new ways of understanding theories and explanations (cited in Betchel, 1994).

Connectionism exemplifies language complexity and its acquisition through very simple neural association processes (Ellis, 2001; cited in Dodigovic, 2005). "Learning occurs through repetitious activities of data sampling, making connections between form and meaning on the foundation of frequency and strengthening neural paths which lead to automaticity" (Dodigovic, 2005, p.20). Therefore, correct amount of practice which takes place in a stimulating environment can even compensate for the lack of brain plasticity that adult L2 learners confront (Dodigovic, 2005).

Connectionism shows characteristics of Piaget's (general nativist) theory of the mind (O'Grady, 2003). Historically, connectionist models are related to learning theory in psychology and empiricism and associationist views in an older philosophical tradition. But what differentiates contemporary connectionist models of language from behaviorist and empiricist is that they take the form of computational simulations (Ingram, 2007).

Moreover, connectionism brings forth the hope that the learners, quite regardless of their age, can be successful and become knowledgeable in mastering a second language (Mac Whinney, 2001) by using their neural circuits within carefully recruited social contexts (such as listening to television, practicing and studying grammar, etc.). In this way the learner will be able to overwhelm the loss of neural plasticity which is related to age, particularly if the first success activates the discharge of stimulating chemicals into their system it can result in even more success (MacWhinney, 2001).

"Connectionist models have the capacity to *learn*, or at least to simulate learning. They are "adaptive "(Ingram, 2007, p.81), and it is because of this characteristic that psychologists have become interested in connectionist models (Ingram, 2007).

Connectionist networks are to some point neurologically plausible that is generally absent in previous approaches to integration and storage of group information (Ajzen, 1991).

"Although connectionist models are highly simplified versions of real neurological circuitry and processing, but it is usually supposed that they show a number of emergent processing properties that real human brains also show. For example, the integration of long-term memory (i.e., connection weights), short-term memory (i.e., internal activation), and outside information (i.e., external activation) is one of these emergent properties" (Rooy, Van Overwalle, Vanhoomissen, Labiouse, & French, 2003, p. 537).

There is no obvious distinction between memory and processing as there is in traditional models (Rooy et al., 2003).

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Connectionists and corpus linguists work together up to the point that sometimes they are the same person such as MacWhinney (1995, 1998; cited in Ellis, 1999).

Although, there exist different connectionist models, they have a number of characteristics in common, the most important of which is that linguistic knowledge is symbolized as a series of associations among forms, instead of a series of formal rules (Plunkett, 1995, cited in Leeman, 2007).

Connectionist Architecture

Mostly, connectionist models are referred to as neural networks, for they have some of the necessary characteristics of a biological neural network. A connectionist model consists of a number of simple processing units (artificial neurons) that are thoroughly interconnected by their inputs and their outputs. Connections between units can be stimulating or restraining. In deciding on whether or not to "fire" a processing unit unites all of the stimulating and restraining influences that are operating upon it at a given time. Therefore, there is not a clear analogy regarding the behavior of the neurons in a biological network (Ingram, 2007).

Connectionism represents a computational model using idealized neural hardware. Moreover, it shows the power of computational learning methods (Chater, & Redington, 1999).

Connectionism is a cover term and encloses a number of network architectures. Parallel distributed processing (PDP), developed by Rumelhart,
McClelland, and Hinton (1986, cited in Seidenberg 2007), is one of these approaches. At the heart of PDP a generally biologically inspired neural network exists. The network consists of nodes which are connected through pathways. It is through activation or use of these, that pathways become strengthened or weakened. Since the network (i.e., the learner) is capable of making connections, and connections take place through exposure to repeated patterns therefore learning happens. By regular association, the association becomes stronger. New links and connections are formulated, and new connections are formed between larger and larger units until complexes of networks are made (Gass, & Selinker, 2008).

Researchers use connectionist modeling in order to simulate neural networks in the brain. When language data are understood in the connectionist neural network models, particular connections in the networks are strengthened, while others are weakened. Nothing is constant. So, a connectionist model of language is changing continuously, therefore it can be best described through the dynamic relationships among the network connections. In this regard, language is regarded as a "statistical ensemble" of components acting reciprocally (Cooper, 1999; cited in Larsen-Freeman, 2004, p.241).

Learning takes place through adjusting the connection weights on the points of contact between processing units called synapses. One of the theories which have been standing for a long time regarding the way learning is thought to modify synaptic pathways in the brain is simulated in this way, i.e. through facilitating some connections and inhibiting others. As connectionist models appear to model neural activity in the brain, they have seemed attractive to some. On the other hand, others avoid these neurological analogies and criticize that it is too early to make claims about the way brain works (Ingram, 2007).

It is contended that the connectionist architecture has neural plausibility, in other words it is said that it can probably reproduce the way our brain works. Therefore, it can be said that connectionism originates both in the early neural network tradition and in the symbolic tradition of the 1970s. All the critical

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developments within the symbolic tradition, such as Rumelhart's (1975) schema theory or Rosch's (1978) both cited in (Bechtel & Abrahamsen, 1991) prototype theory, also belong to the connectionist tradition, where they can be given disputably better implementations. For example, in connectionist architecture through given connection strengths and associative activation, the flexibility and adaptability of schemata are easier to achieve. With this flexibility, connectionist networks have the capability "to account for typicality effects and to satisfy what are called *soft constraints*." On the contrary, traditional symbolic models (taking the classical approach to categorization) "work on the all-or-none basis and can satisfy *hard constraints* only" (Zalewski, 2010, p. 95).That is, the rule is not applied even in the absence of one condition. When it is said that a connectionist system can satisfy soft constraints, it means that when multiple constraints compete, by meeting as many of them as possible it finds the best solution to a situation, even if none of the conditions are met completely (Zalewski, 2010).

Connectionism and Knowledge

In a connectionist perspective, meaning is a process of the global state of the system and emerges in the interaction (Han & Larsen-Freeman, 2005; cited in Han, 2008; Varela, Thompson, & Rosch, 1991). The article 'a' is recognized as an indefinite article due to the knowledge we have about the knowledge between letter strings and linguistic forms. We infer that a cloth might have been used when we hear 'the table was cleaned' because of knowledge we have about the kinds of instruments that are used for cleaning the table. In many models these kinds of knowledge are stored in tables (McClelland, 1988).

Therefore, regarding connectionist models of information processing, knowledge is implicit, that is it cannot be separated from the mechanisms that fulfill processing (Sagarra, 2008).

Particularly, those cognitive psychologists who work within connectionist models of memory have proposed that knowledge does not accumulate in high-order complex chunks (e.g. the schema for bedroom), but in networks that are mutually connected units which relate to low-level concepts (e.g. side table, headboard, duvet). In this framework, schemata are not regarded as separate entities but they relate to groups of units in knowledge networks which have the tendency to be activated at the same time (e.g. the 'schema' for bedroom arises when needed from the simultaneous activation of the units relating to headboard, duvet, bed, etc.) (McClelland et al., 1986; cited in Byram, 2000).

"Implicit knowledge of language may be stored in connections among simple processing units organized in networks" (Rumelhart and McClelland, 1987, p. 196). Although it is possible to describe the behavior of such networks (at least approximately) as having a connection to some system of rules, Rumelhart, & McClelland (1987) recommend that an explanation of the complete structure of the phenomena of language use can best be made in models that make reference to the characteristics of the underlying networks.

Connectionism and Universal Grammar

A common acknowledgement exists among cognitive psychologists that humans, and actually all animals, have a powerful learning mechanisms that picks up regularities from the environment. According to Williams (2004) "many believe that regularities are learned as an unavoidable condition of encoding individual events in memory, through learning procedures that can be extensively grouped as

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"superpositional" (p. 203). Events are shown in a way similar to groups of features, and as the act of showing consecutive events are "superimposed" on each other, common features and fundamental generalizations are excerpted. Exemplar-based memory models (Hintzman, 1986) and connectionist networks (McClelland & Rumelhart, 1985) are computational instances of this principle. Typically, such models do not pay attention to conscious states because learning is supposed to take place unconsciously, and as a certain by-product of the way in which events are encoded in the memory (Williams, 2004).

Within SLA, the concept of an innate knowledge source that is language specific (i.e. Universal Grammar or UG) has been challenged by connectionists, and although the theory of connectionism has progressed in SLA, there are still only a few empirical connectionist researches on SLA. The major figure applying connectionism to SLA is Ellis (Van Patten, & Benati, 2010).

Van Patten (2004) mentions that without any doubt, the previous descriptions of a UG-based account of acquisition and a connectionist account are restricted and not complete. However, they can be used to show that even two theories as divergent as UG and connectionism depend on or suggest a necessary role for input in the formation of a linguistic system. For UG, part of the data needed for grammar construction can be found in the processed input (the rest, in the principles of UG itself). For connectionism, data needed for the formation of nodes and associations between them are to be found in the input. Therefore, both of the theories assume a role for input, but they assume completely different mind-brain mechanisms that make use of that input.

According to the connectionist view the human memory is able to build prototypical representations based on emerging regularities in the large amount of associations in input and preexisting representational associations. Therefore, in connectionist view learning is content- and structure sensitive; the emergent inferred and transferable structure is finally drawn on active competition between the various cues that are available in the input (Ellis 2001; cited in Jarvinen, 2005). Connectionism does not assume any role for innate predetermined linguistic universals, which are the basis of generativist accounts, taken from Chomsky's *Universal Grammar* theories (The Minimalist Program being the latest version, Chomsky 1996). Universal Grammar is a theory of a confined number of universal principles and related parameters which each have two (or more) parameter values. These parameter values are initiated by salient cues in the linguistic environment. In learning a second language, parameter-resetting may be an awkward process, for changing the already existing L1 settings for new values on the basis of the second language input is needed. According to UG, when the parameter setting is successfully completed, suddenly new parameter values will emerge. The role of Universal Grammar in second language acquisition is to a great extent controversial *(*Jarvinen, 2005).

On the other hand, recent work in connectionism rejects the existence of conventional syntactic representations, of Universal Grammar, and of an inborn acquisition device particularly for language. It is claimed that language acquisition is not essentially different from any other type of learning and can occur through the use of the same mechanisms as are required for interaction with the environment in general (O'Grady, 2003).

Opposite to UG-based accounts of language acquisition that put much emphasize on the importance of internal linguistic

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constraints, connectionist models regard linguistic environment as a significant element (Leeman, 2007).

Conclusion

Connectionist research is founded within the scientific field, especially in the field of cognitive science (Medler, 1998). Connectionism constructs an important nonlinguistic approach to studying language acquisition. It has got important links with psychology and general learning. Briefly, connectionism is an approach which is based on examples, which means that learning occurs as a result of the examples that one is exposed to in the input. From these various examples, patterns and regularities emerge to form language rules. But the theory maintains that these patterns and rules are not factual, and what actually exists in the mind/brain of the learner is a system of weighted connections, with weight referring to the relative strength of the connections (VanPatten, & Benati, 2010).

The connectionist system replicates the human "rule-like" behavior, but without having any rules. On the contrary, frequency or regular interactions are the process through which connectionist models learn. These data help to remind that regular, and rule-like behavior does not indirectly suggest rule-generation. Instead regularity effects can be generated from consistency. Therefore, another name for regularity is frequency (Ellis, & Schmidt, 1998).

Connectionist studies are important for they directly show how language learning takes place (Ellis, 2003), however, for some areas of language and language acquisition connectionist modeling might not be the fastest way. Even for researchers who are deeply committed to bio-logically plausible and realizable explanations, connectionism is not the only way for the study of language development. So most researchers must look beyond connectionism (Hahn, 1999).

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