Software GOLUCA: Knowledge representation in Mental Calculation

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Knowledge representation

Information and concepts are stored in the memory according to a certain organization

Cognitive structure:

 Hypothetical construct that refers to the organization of the relationships between concepts in the semantic or long-term memory

Semantic networks:

• Graphical representation of the cognitive structure.



Pathfinder Associative Networks This representation can be constructed on the basis of a numerical score assigned to the similarity that a subject perceives between concepts, and which corresponds to their semantic distance.

Pathfinder Associative Networks

To assign a similarity score between concepts one begins by choosing the concepts, the subject is then presented in a random order with all the possible pairs of words that represent those concepts, and is asked to assign a score to each pair's similarity or difference.

Pathfinder Associative Networks

	water	living b.	animals	plants	molecul.	motion	heat	phases w	. solid	liquid	gas
water	1										
living beings	0.7567	1									
animals	0.6833	0.7833	1								
plants	0.6767	0.7733	0.6900	1							
molecules	0 2500	03333	0 2433	0 3167	1						
motion	0 3433	05733	0 363 3	0 3167	0 4000	1					
heat	0.2800	0.2000	0.4067	0.3033	0.5967	0.7767	1				
phases of water	0.7833	0.3300	0.1700	0.2700	0.6833	0.7100	0.7933	1			
solid	0.2667	0.2467	0.2833	0.2667	0.3467	0.2267	0.3333	0.7100	1		
liquid	0.8767	0.2500	0.3033	0.3200	0.1867	0.3267	0.3100	0.7833	0.6200	1	
gas	0.3167	0.1967	0.1767	0.1467	0.3267	0.3067	0.2633	0.7833	0.3800	0.6033	1

Pathfinder Associative Networks

- A detailed account of the above can be found in Schvaneveldt (1989), Casas, (2002a, 2002b, 2004) and Casas & Luengo (2004)
- Pathfinder Associative Networks are used in a wide variety of fields of research (Jonassen and others, 1993; Gonzalvo, Cañas y Bajo, 1994; McGaghie, 1996; Eckert, 1997; Chen, 1999; Ramey and others, 2001; Moya and others, 2004)

The procedure described above can be accomplished using computer programs like GOLUCA (Godinho, Luengo and Casas, 2007).

GOLUCA Software







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Method

- Sample: 14 primary school teachers who taught in various courses from 1st to 6th (6 to 12 years old)
- They were asked first to rate subjectively his own capacity for mental calculation, choosing among three levels: "Bad", "Moderate" or "Good".

Method

 Using the software GOLUCA, similarity scores were assigned to each pair consisting of the following 16 terms:

collect, remove, count forward, count backward, counting the missing to reach to, do the double, do the half, subtract as opposite to add, divide as opposite to multiply, seek complementary, count by tens, by hundred, ..., compensate, add, subtract, multiply and divide.

Method

- Using the GOLUCA software, the representations were obtained in the form of **Pathfinder Associative Networks** to reflect the cognitive structure of teachers about the importance of different strategies and the relationship between them.
- By using also the GOLUCA software, we calculated the value of the coherence of each network.
- We ranked coherence according to the following ranges: from 0 to 0.299 "Poor" from 0.3 to 0.499 "Moderate" and from 0.5 to 1 "Good."





Results

Subject	Mental	Coherence	Degree of Coherence
	Calculation Skills		
Subject 1	Bad	,213	Poor
Subject 2	Good	,564	Good
Subject 3	Good	,614	Good
Subject 4	Moderate	,395	Moderate
Subject 5	Moderate	,421	Moderate
Subject 6	Bad	,250	Poor
Subject 7	Good	,491	Moderate
Subject 8	Moderate	,519	Good
Subject 9	Bad	,434	Moderate
Subject 10	Good	,678	Good
Subject 11	Bad	,284	Poor
Subject 12	Bad	,326	Moderate
Subject 13	Moderate	,311	Moderate
Subject 14	Good	,569	Good

Results

		Deg			
		Good	Poor	Moderate	Total
Mental	Good	4	0	1	5
Calculation	Bad	0	3	2	5
Skills	Moderate	1	0	3	4
Total		5	3	6	14

	Value	al	Asymptotic Sig.
	Value	5'	(bliater al)
Pearson Chi-Square	11,643	4	,020
Likelihood ratio	13,474	4	,009
N of valid cases	14		

		Value	Approximate Sig.	
Nominal by nominal	Contingency Coefficient	,674	,020	
N of valid cases		14		

Conclusions

- By using the software GOLUCA, we can obtain Pathfinder Associative Networks that represent the cognitive structure of the subjects in different fields of knowledge
- The graphical representation of knowledge structure allows us recognize what its main elements are.

Conclusions

- Teachers who believe they have good capacity for mental calculation, have cognitive structures more coherent, centered around a few strategies for calculation, but well-organized
- Our proposal is that recognizing these strategies in the most competent individuals, we can convey to students to learn them more effectively.

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