Cognitive Analysis Grid for IS Research

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The goal of this methodological paper is to build a cognitive analysis (CA) grid to allow the identification of the different cognitive functions involved during an interaction with an information system (IS). After further validation, the CA grid could be applied to any IT task, which could help identify the cognitive processes relevant to that said task and would ultimately allow IS researchers to guide the identification of networks of interest in the brain that are relevant to their theorizing.

I. Conceptualization of the CA grid

The proposed CA grid assess the four steps involved in human cognition, namely reception of stimuli, memory, thinking and expression of response (Lezak, M.D., 2004, 2013). These four steps allow for a clear division between the different human cognitive processes associated with the performance of a task.

- Reception: Both the modality (i.e. visual, auditive, etc.) of stimulus reception and its content (visuo-spatial VS verbal-phonological) will be assessed. This will allow for a) a thorough division of what is processed by the human cognitive system as well as b) the means and neuroanatomical networks of stimulus reception.
- Memory: Three different divisions will be made in terms of memory assessment. Short term memory and long term memory will first of all be differentiated. Explicit and implicit memory will also be differentiated. Explicit memory comprises episodic and declarative memory, while implicit memory is constituted of procedural memory and priming effects.
- Thinking: Given the fact that it would be impossible to evaluate an extensive list of the mental abilities and executive functions used in the neuropsychological literature, a reduction to the twelve major executive functions groups found by Packwood et al. (2011) has been chosen to assess the cognitive manipulations of the information. These functions are: workload, creativity, theory of mind, visual search, time sharing, intentionality, generation of strategy, proneness to interference, discovering changes in rules, affective decision making, verification of hypothesis and initiation.
- Response: The expression of the response also has to be taken into consideration in the cognitive grid. The modality of the human response (motor, verbal, etc.) and the content of this response will be assessed, in the same fashion as in the reception phase.

II. Preliminary Application of the CA Grid

Data from 80 subjects interacting with a music website were used for a preliminary evaluation of the CA Grid (Sénécal et al. 2012). After the experiment, subjects were asked to elicit in writing all the steps involved in purchasing. These steps were then coded by two IT experts in order to have a thorough portrait of the possible behaviors of the subjects during the task. The complete list of steps are then divided in different subtasks (which will subsequently be called task "items"). These items have to be sufficiently partitioned to minimize the risk of overlapping between cognitive functions, but not fragmented to the point where an item is unrepresentative of a concrete part of the whole. The rule of thumb should be that an item has to apply only once in the four categories of processes stated above.

Two coders, who are experts in neuropsychology, performed the subsequent attribution of the cognitive functions comprised in the CA grid for each item of the task. Litigious situations during this process were addressed with the help of an IT expert in order to bring a different point of view. This expert later reviewed the classification of the experts in neuropsychology at the end of the process in order to finalize the classification.

III. Potential contribution of the CA Grid

The completed grid can later be used to guide both behavioral and neurological research questions. Knowing precisely the cognitive composition of a task will also allow NeuroIS researchers to draw more specific neurological hypotheses and benefit from the large body of literature in cognitive neuroscience that has already assessed both the neuroanatomical substrates and the electrophysiology of those cognitive functions. Drawing together subtasks requiring the same type of functions at different steps of the cognitive process will allow to draw precise conclusions on particular cognitive functions used during IS interactions.

References

- Lezak, M.D. (2004) Neuropsychological assessment. Fourth edition. Oxford Press
- Sénécal, S.; Léger, P-M.; Fredette, M.; Riedl, R. (2012), "Consumers' Online Cognitive Scripts: A Neurophysiological Approach," International Conference on Information Systems, December, Orlando, Florida.
- Packwood, S., Hodgetts, H.M. & Tremblay, S. (2011) A multiperspective approach to the conceptualization of executive functions, Journal of Clinical and Experimental Neuropsychology, 33:4, 456-470, DOI: 10.1080/13803395.2010.533157