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CSCI 490 Midterm

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**Defining Insight for Visual Analytics**

**1.)** The authors of this paper attempt to define insight in an effort to answer the question, “Is the goal of visualization insight?”. To do this, the authors analyzed insight as it is defined by researchers in data visualization as well as by researchers in cognitive neuroscience. The authors discuss the similarities and differences both of these definitions have, if/how they are related to each other, and which definition data visualization is more correlated with. The truth is, researchers are struggling to agree upon a definition for what insight really is.

The definition of insight which cognitive neuroscience researchers have come to is a phenomenon in which a person suddenly understands a brand-new way of looking at a problems such that the problem itself becomes much more solvable after the insight occurs (note: Here I say insight *occurs*). The authors describe this as an “aha” moment in which someone suddenly understands something on a deeper level. This insight is akin to a student learning a new way of solving a math or programming problem. At first, the problem may seem very difficult, if not impossible. However, after the student remembers there is an algorithm you can use to solve the problem, suddenly the problem becomes much more possible to solve. Notice that this person did not learn new information while trying to solve this problem. This is what the authors call “spontaneous” insight. The insight *occurred* spontaneously.

Spontaneous insight in cognitive science is not a bottom-up process. Rather, it happens seemingly at random and it is difficult to describe the steps taken to arrive at such an insight. Although cognitive scientists have successfully been able to show the neural behavior via EEG and fMRI, they do not know how to promote it’s occurrence, especially in everyday problem-solving outside of laboratory conditions.

Meanwhile, visualization researcher have a more narrow, vague definition of what insight is. Chris North and his colleagues define insight as “complex, deep, qualitative, unexpected, and relevant”. They also define it as “a unit of discovery”. This is what the authors call “normal” insight. Basically, they see insight as a piece of knowledge in which someone can *attain* or *encounter* (note: Here I say insight is *attained*  or  *encountered*). Using the same example of a student solving a math or coding problem, the student will likely not gain “normal” insight by solving this problem. Rather, they will only be using preexisting knowledge to solve this problem.

Cognitive scientists have used imaging technologies such as EEG and fMRI to track brain activity while participants are solving cognitive tasks in order to determine which parts of the brain are activated during both of these definitions of insight. They found that in both cases, the frontal lobe, responsible for working memory, planning, organization, inhibition control, etc., was highly active. Furthermore, in both cases, the temporal lobes, where long-term memory and semantic information is stored, were highly active. However, there were differences observed as well.

In “normal” problem-solving, activity in the temporal lobe was continuous and appeared mostly in the left hemisphere. This indicates that this type of problem-solving involves a “narrow but continuous focus” on information relevant to the problem being solved. In contrast, when participants solved a problem with “spontaneous” insight, the right temporal lobe showed a

sharp burst of activity as opposed to the continuous flow of activity observed in “normal” problem-solving”. Unlike the left temporal lobe, the right temporal lobe is thought to encode information in loosely associated semantic networks. This suggests that spontaneous insight occurs through sudden activation of less clearly relevant information through weak semantic networks, which corresponds to a participant’s sudden shift in perspective when this type of insight occurs.

**2.)** Machine learning and data mining have revolutionized the ways we use and manage data. The stride we have made just in the past decade are truly remarkable. Data is now the new oil and there is a lot of money being invested into the development of better, faster, smarter machines in order to more efficiently mine data. Machines are being taught how to mine data and become smarter through experiential learning as it does this. In other words, over time, these machines become smarter and smarter through experience. There is something to be said about insight here as well.

Machines, while learning, must also both *experience* and *utilize* insight. I believe both of the definitions described in this paper are being used in machine learning and data mining. I believe machines must be able to *gain* new insights as the work in order to learn new, more efficient ways of doing things. Furthermore, insight must also be able to *occur*  to these machines. That is, they must be able to see new ways of doing things based on preexisting knowledge and experience they have. If this isn’t the case, machines will eventually reach a plateau in which they will no longer be able to become any faster or more efficient. Therefore, I feel both “normal” insight and “spontaneous” insight must be able to occur in these machines. While I feel the application of these definitions of insight has expanded and changed within the past decade, I feel that the definitions are still in tact and serve the same purpose they did in 2009.