

Cognitive Factors Affected When Online Access Is Degraded Or Disrupted



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Abstract

There is increasing reliance on the Internet for work and pleasure. The cognitive effects of disruption or degradation to network speed were examined. Performance generally decreased as online access was disrupted and these changes were accompanied by changes in arousal and affective responses such as anger and frustration.

Introduction

Use of the Internet for all aspects of life is now ubiquitous. In recent years Internet connection speed has increased and users have come to expect fast information transfer. Correspondingly, Internet applications have become more image intensive to exploit faster connections to produce richer and more complex displays. As the use of the Internet has increased so users rely on network connections to be maintained and at a constant high speed. This research examined the effects on cognitive performance when online access was either degraded or disrupted in order to find out what parts of the cognitive apparatus were more vulnerable to changes in network speed. This work is part of a new and emerging construct called cyber-cognition or the understanding of cognitive processes specific to online interaction.

Method

The approach was to perform a critical literature review of published academic papers supplemented by seven in-depth interviews from subject matter experts. Searches were carried out across a number of databases including PsychINFO, PsychARTICLES, and Google Scholar. Citations from research papers were also searched to try to find relevant papers. Over 60 published research papers formed the basis of this study.

Conclusions

A degradation or interference to online access can cause a disruption to cognitive performance almost always resulting in reduced information processing. A variety of behaviours have developed to cope with online degradation and these behaviours are often accompanied by increased negative affect.

Results

Information Theory and Web Optimisation. Internet communication is based on information theory (e.g. Shannon, 1948). The Internet has become a semantically aware paradigm or the “semantic web” (Preuveneers & Berbers, 2008). The increase in network bandwidth has led to web sites being able to deliver media rich pages that previously they were unable to (Danaher, Jazdzewski, McKay, & Hudson, 2005). Bandwidth bottlenecks can be identified so that strategies can be put in place to avoid a degradation in web site interaction leading to end user frustration.

Perception. Signal detection theory (Green & Swets, 1966; McNichol, 2005) can be applied to performance when detecting items from a degraded network condition. Variations in signal:noise ratio applied to perceptual detection have been described in normal participants (Scase, Braddick, & Raymond, 1996) and also in a variety of pathologies (Scase, Foster, Honan, Heron, Gulliford, & Scarpello, 1990).

Attention. Attentional shifts or switches can occur away from the task in question toward a distractor. Desjarlais (2013) performed an eye movement monitoring study to investigate the role of different levels of attention on learning whilst participants did an information searching exercise and found that the Internet exploration behaviours differed between learners with high and low levels of attention.

Task Disruption. Xia and Sudharshan (2002) studied the effect of interruptions on Internet shopping. They examined the effect of interruption frequency, timing, consumer knowledge and goal type on the time spent on a decision task as well as satisfaction with the decision process and choice made. They found that under some circumstances interruptions could produce increased online viewing time whereas under others it could result in decreased viewing time.

Decision Making. Decision making can be affected if the flow of information was not optimal. If there was considerable disruption then there could be changes due limitations in short term memory processes. As the Internet has grown so has the amount of information available to users. The communication of information has led to “pathologies of information” (Bawden & Robinson, 2009) including information overload and too much choice. Bawden and Robinson (2009) provide evidence that this overload has effects on the health, personal relationships, job satisfaction and decision making of users.

Emotion. Paradoxically, disruptions in online access could cause increases in arousal which in some cases could lead to increases in performance. Affective reactions in response to changes in online access were varied. Some individuals showed frustration, anxiety and confusion. Others showed anger which has been described as “web rage” (Roper Stratch, 2000). Affective reactions were less in younger people and also less in people with more experience to technology.

The experience of frustration was examined by Lazar, Bessiere, Ceaparu, Robinson, & Shneiderman (2004) and Ceaparu, Lazar, Bessiere, Robinson, & Shneiderman (2004). They asked 111 participants to keep a time diary detailing mood and computer experience. When users had a frustrating experience they completed a “frustrating experience form” describing what happened and how much time was lost. Lazar, Bessiere, Ceaparu, Robinson, & Shneiderman (2003) and Ceaparu, Lazar, Bessiere, Robinson, & Shneiderman (2004) found that the most-cited cause of frustration on the Internet was to do with dropped connections (disabled access) followed by long download times (degraded access). Sundar and Wagner (2002) measured skin conductance or galvanic skin response in participants as they viewed an image being downloaded over networks with different bandwidths. They found that slow downloads caused greater arousal than did fast downloads. They proposed that this effect could be harnessed by web designers to improve the involvement of audiences on websites.

Location Specific Effects. Users in different countries and from different cultural backgrounds adopt a range of strategies and behaviours to cope with variations in Internet connection speeds and also Internet disruption. Chen, Subramanian, & Toyama (2009) examined how users’ web search and browsing behaviour differed with a slow connection in India. These users experienced low bandwidth and intermittent connections. They found that when searching users generally only looked at the first page of results, they tended to open several windows at a time and commonly multi-tasked with other (non-web) activities. Pejovic, Johnson, Zheleva, Belding, & Parks (2012) examined Internet use (via wireless networks) in sub-Saharan Africa. They found that online behaviour was impacted because of the cost of the connection and also because of low connectivity speeds. Such international differences in Internet access could be the basis of a “digital divide” (Hassler & Jackson, 2010) impacting on the cultural, economic and educational development of communities.

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