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Deepening the Role of the User: Neuro-Physiological Evidence as a Basis for Studying and Improving Search

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ABSTRACT

In this paper, the potential for expanding the set of scientific evidence and insights associated with the users' role during the search process is explored. As it is intended to be a position paper and not a systematic survey, a comprehensive review of literature is not presented here. However, the authors draw on some early stage research, in this emerging area, to describe and explain the generation of neuro-physiological evidence using three types of modalities. The modalities and the associated methods described here, presented in order of increasing complexity, include Eye-tracking, EEG, and fMRI. The paper concludes with a few critical observations regarding the promises and perils of using neuro-physiological approaches in studying search and search behavior.

General Terms

Experimentation, Human Factors, Measurement.

Author Keywords

Neuro-physiological methods; Eye-tracking; EEG; fMRI.

1. INTRODUCTION

With the emergence of the CHIIR as a new venue and an important milestone in the continued development of the IR field, it is appropriate to take a reflective view and investigate new potential avenues of research and scholarship that the CHIIR may catalyze and help advance. We argue that the CHIIR marks a deepening of interest in understanding the role and the influence of humans in the search process and therefore it behooves us to bring up some additional areas or topics that have not thus far found appropriate outlets in the mainline IR venues or even in the well-established HCI-oriented forums. One such area is neuro-physiological (NP) methods in explicating the search process, particularly interpreting human-responses to search tasks and the influence of search complexity on search outcomes. In this paper, we begin by broadening the conceptualization of the search process by using humans' psycho-physiological condition as a frame for understanding search. We then use three particular modalities, namely Eye-tracking, EEG, and fMRI, as examples of NP methods to discuss the utility of such methods in elucidating the search process. Then we present an example of application of NP methods. Following this, critical advantages and disadvantages of NP methods are described. Finally, the paper ends with a set of

aims for advancing the area of HII&R by integrating NP methods into the field of IR.

2. BACKGROUND

Search has largely been examined and studied in a manner which is agnostic to the human's psycho-physiological condition. That is in most IR studies that engage humans, the particular psychological or physiological condition of the humans are not directly measured and it is not the central focus of those studies. Yet, we must recognize that search is no longer an occasional activity that humans engage in. Humans no longer rely on search only to address specialized or complex information needs. Humans now conduct search frequently, under a variety of circumstances, and often as the first response when faced with an information need. It is therefore not a stretch to claim that search activity is now routine, highly personal, and interweaved with everyday activities of millions of users. A number of factors could be the cause for this change, but it is highly likely that wide-scale availability of computers and relatively affordable mobile devices promote more searching. It is well known that humans go through a wide variety of psycho-physiological conditions as they experience their world in the course of a single day, an hour, or even a few minutes. Hence, the psycho-physiological conditions of users are highly likely to trigger, shape, and influence humans' search behavior and performance. Imagine how a muted response from an otherwise jolly friend can quickly reveal something is off and can become a powerful signal indicating that the friend is experiencing a "down period". Now imagine how the same type of a psychological response, expressed in abnormal typing behavior or uncommon errors, detected by software could become a signal for tracking and understanding the human's condition. There is strong likelihood that specific NP conditions and tracking them may open up a new window to understand humans' behavior as they engage in searching. Given the fact that search has now become a significant activity of everyday behavior, it potentially is an untapped and underleverage source of insights and observation for humans' psycho-physiological condition.

2.1 NP Responses as a Two-way Street

It should be apparent from the discussion above that the psycho-physiological conditions of users both shape and in turn is shaped by their human-computer interaction (HCI) experience. To amplify our understanding of the role of the user in the interaction process, it is important that *the identification of specific NP responses is conducted in isolation from efforts that focus on shaping or changing the NP responses by manipulating the interaction*.

In other words to establish the actual roots and the patterns of NP responses, research on NP methods, must begin by establishing reliable "healthy" or "normal" baseline responses to common search tasks. It is important to start with baseline responses and a carefully selected set of search tasks so that the corresponding NP responses can be predicted accurately and consistently from the