

Old Problems and New Technology

An Evolutionary Perspective on Emotion in HCI

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CCS Concepts: • **Human-centered computing** → **Natural language interfaces**; • **Computing methodologies** → **Philosophical/theoretical foundations of artificial intelligence**; • **Social and professional topics** → **User characteristics**.

Additional Key Words and Phrases: speech-based technology, interdisciplinarity, social science, humanities, conceptualization, methodology

1 WHAT DO I KNOW ALREADY?

With a background in media psychology and evolutionary psychology, I am accustomed to a biologically grounded perspective that asks for the – speaking in evolutionary terms – ultimate reasons for human experience and behavior. Human beings represent the outcome of a long-lasting process of natural selection. A considerable and rather recent portion of this process occurred when humans existed in nomadic, small groups of hunter-gatherers. Compared to this phylogenetic episode, the short time that has passed since the emergence of modern communication technology resembles the blink of an eye. Within about five generations, verbal communication ceased to be an exclusive domain of interpersonal, face-to-face interaction. It became possible to communicate across space, time, and to large audiences. Just within the last generation, computers were enabled to interact with their users via natural language interfaces in everyday situations. Thus, verbal communication first became detached from the spatial and temporal co-presence of other human beings, and could then occur entirely without a human interaction partner. Because this short, recent period represents a negligible duration for evolutionary processes, the use of modern media technology is presumed to still function based on the archaic mechanisms that constitute the human mind's evolved capacity. Therefore, psychological and communication research has considered the evolved functioning of the human mind in their study of human experience and behavior during interaction with modern media technology. So far, numerous studies have used the frameworks of media equation [7, 8] and computers are social actors (CASA) [4–6] to gather evidence on the social mechanisms that are active during HCI situations.

2 HOW DO I STUDY THE PHENOMENON?

Applying an evolutionary perspective involves asking for the ultimate reasons for an organism's given behavior. To this end, researchers need to hypothesize what adaptive problem of our ancestral environment could have been addressed by this behavior, and how the organism's behavior could have increased the fitness to survive and reproduce in this environment [3]. For emotional aspects of human experience and behavior, Bischof [1] offered a biologically grounded explanation for the emergence of emotion. Bischof models emotions as an evolved mechanism that enables higher organisms to produce appropriate solutions to adaptive problems. While there is – in principle – a variety of mechanisms that can produce adaptive behavior, the model comprehends emotions as a particularly versatile and flexible mechanism that enables organisms to show, for example, complex social behavior. While such adaptive problems may have threatened the organism's capacity to survive and reproduce within the ancestral environment, remnants of these problems – or even the very same problems – can still be found in today's modern environment. It can be argued [10] that the evolved mechanism of emotion is active during media use, as well, which includes the use of advanced interactive media [2]. Bischof's model is rarely used for empirical research, but it offers an informative

approach to understanding emotions. Further, it can be used to corroborate existing emotion theories. For example, the component process model of emotion [9] describes emotion as the result of different appraisal steps, with the very first step being the decision if a given stimulus has subjective relevance. Here, we can link subjective relevance to the evolved nature of the emotion system and hypothesize that adaptive problems will most likely be recognized as relevant events. Conversely, if emotions are experienced in a given situation, researchers can investigate if an adaptive problem was present, leading to respective appraisals of the situation. By relying on the established component process model as a framework for experimental studies, it is possible to use standardized emotion self-report measures, and to employ observational methods such as coding of facial actions, as well.

3 WHAT I WOULD LIKE TO KNOW?

So far, Bischof's explanation has been applied to model the use of non-interactive and interactive entertainment media [2, 10]. Since emotions can be a factor in the interaction with speech-based technology, it would be very interesting to apply the model's theoretical framework to this domain, as well. With regard to HCI research, I am interested in the design implications that result from an evolutionary perspective on emotions in the human factor in HCI. Today's HCI situations in everyday life revolve around problems of rather low relevance, such as information on weather and time, or for entertainment purposes. However, with the increasing sophistication and proliferation of speech-based, artificial intelligence technology in professional settings, it can be assumed that future HCI situations will involve tasks of high subjective relevance for the users, and of high objective relevance for their employers. Examples may include the use of 5G-enabled, AI-driven augmented-reality systems in manufacturing or maintenance work, where any error will consume valuable resources. For these settings, it may be of considerable future interest to ask how findings from interpersonal, social interaction in workplace-settings translate to equivalent HCI situations, and how evolved psychological mechanisms shape the interaction processes in HCI in high-stake situations.

4 WHAT DO I WANT TO LEARN FROM DIFFERENT DISCIPLINES?

Apart from the technical aspects of implementing sophisticated HCI work-place situations, I am very interested in the perspectives of other disciplines on emotion in HCI. This includes the respective disciplines' view on emotion in the human factor in HCI, but also the inclusion of simulated emotion in speech-based technology. I am really looking forward to the interdisciplinary exchange with other researchers about their respective experiences, and to learning how they expect future technology to change our interaction with AI.

5 WHAT DO I WANT TO TEACH OTHER DISCIPLINES?

I would like to present and explain Bischof's model for the emergence of emotion, and share this biologically grounded perspective on human behavior. As a very condensed summary, Bischof argues that emotions represent a crucial advancement in higher organisms since they disempower the rather absolute need for the fulfillment of biological drives. Emotions serve as a buffer between current needs of an organism on the one hand, and the production of behavior on the other hand. Therefore, the cognitive systems for planning and production of behavior are now subject to the more diverse and gradual influence by emotions, instead of being influenced by inflexible drives. This way, the cognitive system enjoys greater liberty in producing a wider range of possible solutions to an adaptive problem. This flexibility, together with, for example, proper display systems for an organism's internal emotional state, are an important aspect in the complex functioning of social animals. We can merge this perspective with current appraisal theories of emotion in order to derive hypotheses for specific HCI situations, and then design experimental studies for empirical testing.

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