Chapter XLV
Attention Facilitation via Multimedia Stimulation

Diego Liberati
Italian National Research Council, Italy

ABSTRACT

This chapter is about the effects on perception of joint sensory stimulation. It shows that by combining various simultaneous stimuli, it is possible to elicit a psychophysiological effect that is different from the sum of the responses of each stimulus alone; in particular, a new cortical response is elicited besides the ones pertaining to each stimulation modality. This is believed to be particularly useful when designing mobile interfaces because of their needs to be maximally informative while minimally intrusive. Moreover, no technologic additional requirements are necessarily needed, besides proper synchronization protocols, with respect to standard technology, once more showing that often improving is a question of properly combining existing knowledge.

INTRODUCTION

When designing mobile interfaces, not only the technical problems related to Information and Communication Technologies should be taken into account. Proper interfaces to the operator of the mobile apparatus should also be addressed in order to be able to better capture the operator's attention in a surrounding that could be less favorable to concentration than a steady position. For instance, visual modality, which is the usual main kind of interaction in order to grasp a lot of information in little time, is less easy to use when moving than when in a comfortable fixed surrounding. In fact, besides vestibular-kinetics, possible discomfort originating from mismatch of relative movements perceived from the eyes looking to the screen with respect to motion perceived from vestibular system, care has to be put in not distracting the operator from possible other tasks such as driving a vehicle, for which the priority should be preserved for safety reasons.

Studies on stimuli perception in joint modalities are thus starting to also be of interest for mobile interfaces, whose messages could as well be of a combined acoustic, visual, and even tactile (think of low noise and/or very low-frequency vibration) nature. In this chapter, particular attention will be devoted to the fact that a combination of a pair of such kind of stimulation, when administered together, can produce an effect that is different from the superposition of the single effects of each stimulus alone, thus exhibiting a nonlinear facilitating action on the target's attention. Only the effect of visual and tactile stimulations together will be reported, because of the fact that the time of their arrival in the brain cortex for processing is comparably of the order of a hundred milliseconds after the stimulus, thus making easier the study of a joint administration than also including brain stem acoustic potentials whose speed to the cortex is very much faster (Reagan, 1972). A psychophysiology-related model for addressing such neural interaction when multisensory stimuli are administered has thus been developed (Liberati, Bedarida, Brandazza & Cerutti, 1991a) in order to quantitatively measure the nonlinear effect on brain activation when multiple sensorial stimulation is additively provided, as in multimedia technology. Some of the effects on our perception of the joint stimulation, also made possible by multimedia technology, are analyzed and discussed. It is, in fact, easily seen that for instance joint visual and tactile stimulation, besides specific brain responses at specific areas at characteristic time, do provide a late activation of the visual cortex, mediated via the tactile one, at a time delay typical of cognitive processes, thus useful, for instance, in capturing attention.

BACKGROUND

Our interaction with the world is mediated through the sensorial systems, allowing us to acquire information from the surroundings. Human perception is based on the psychophysiological properties of such interaction, even to make us interact with possibly mobile information devices in an increasingly easy way.

It is well known that electrical potentials (Reagan, 1972) as well as their magnetic correlate (Liberati, Narici, Santoni & Cerutti, 1992a) are measurable on the skull as the evoked effect of sensorial stimulation. Their topographic (Liberati, DiCorrado & Mandelli, 1992b) relevance (Liberati, 1992c) with respect to the background electrical activity of the unstimulated brain needs to be captured via quite sophisticated algorithms discriminating signal from noise, such as stochastic parametric identification (Cerutti, Baselli, Liberati & Pavesi, 1987; Liberati, Cerutti, DiPonzio, Ventimiglia & Zaninelli, 1989) and Kalman filtering (Liberati, Bertolini & Colombo, 1991b). Such tools do allow monitoring the psychophysiological effect (Chiarenza, Cerutti, Liberati & Mascellani, 1987) of even multimedia stimulation (Liberati et al., 1991a), also implying a coordination of brain activity in space and time (Liberati, Cursi, Locatelli, Comi & Cerutti, 1997).

MAIN FOCUS OF THE CHAPTER

In order to study the psychophysiological correlate of multimedia stimulation, a very simple experiment can be devised (Liberati et al., 1991s). It is s common clinical routine to acquire brain potentials evoked from separate visual, acoustic, or so-called somato-sensory (a sort of tactile) potentials. The idea is thus to try to combine more than one of such kind of stimulation in order to evaluate if the measurable effect on the brain is just the superposition of the single effects as it would be if the system were linear (i.e., no special sensitivity to joint stimulation would be exhibited, which would be strange based on everyday subjective experience) or instead increased (or even decreased). Now the time at which the brain presents the maximum response to each of the