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ABSTRACT

One theory of visual communication maintains three things. It holds that attention is a process for obtaining information, that it is a transaction between the visual and the viewer, and that the success of a visual communication is determined by the amount and relevance of information conveyed. Current research aims at evaluating "attention-getters" and training "attention-givers." The measurement of the former proceeds indirectly through the measurement of occipital alpha rhythms in the brain which are associated with changes in visual control related to changes in attention. Results show that attentional response to a stimulus varies with its relevance and fades with repetition, approaching zero after 30 presentations. Training sessions with biofeedback methods indicate that subjects can learn to modify and control occipital alpha rhythms. Individuals appear to undergo unique and incommensurable experiences, but there is disagreement on how control over the rhythms is achieved, and there is no evidence as yet which substantiates the position that successful biofeedback attention training helps an individual to learn better. (Author/PB)

Attention and Visual Communication

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Attention is to the visual what a question is to the verbal. It is a process for getting information. When there is something new to learn, we may ask a question and decide if the answer is relevant to our needs. Or we may know that the answer will be relevant no matter what it is. In both cases we ask a question. Similarly, we pay attention to novel visuals to see if they are relevant to our needs. Or, we may recognize that they are relevant even though they are familiar. In either case of novelty or relevance we pay attention.

The reverse is also true - if the verbal material is familiar or irrelevant we don't ask questions. If the visual is familiar and not relevant we don't pay attention to it. Thus, the amount of information (novelty or uncertainty) and the degree of relevance to one's needs, plans and feelings are important determinants of the success of a visual communication. If the viewer does not pay attention to it, the most creative and potentially effective communication is wasted.

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Attention is a transaction between the visual and the viewer. The visual is an "attention-getter", the viewer an "attention-giver". It would be important to sort out effective visuals from the rest by evaluating the attentional reactions which they evoke in the viewer. On the other hand to get the most out of visual presentations, some viewers may require training in how to "pay attention". These two themes of evaluating the "attention-getter" and training the "attention-giver" are the main themes of our research.

The measurement of such a private process as "visual attention" is formidable. We can pay attention quite intently yet not be doing anything that is identifiable. True, our eyes are usually involved in visual attention. By their fixations, focussing processes and their movements, they reflect the process of attention. But the behavior of the eye is not easily measured and when it is measured, the very instrumentation required may cause shifts of attention to it, away from the visual being evaluated.

Our approach to this problem is an indirect one. Large scale changes in attention are associated with large-scale changes in visual control functions. These in turn are associated with large-scale changes in the brain rhythms recorded from the posterior scalp - the occipital alpha rhythms. Summarizing the extensive literature, both seeing and looking cause a temporary suppression of the alpha rhythm. By seeing I mean all those processes by which information gets into the visual cortex, the input side of things. By looking I mean the processes which control the receptor - its position, its movement, the focus of the lens, and closure of the eyelids. Actually when we see we also are looking. However, we can look without seeing (in the darkness). Visual attention in the usual sense involves seeing and looking together and is usually associated with a definite (though temporary) suppression of the alpha rhythm.

Let me show you a slide which shows the alpha rhythm coming and going as a visual stimulus is turned off and on. When alpha rhythms

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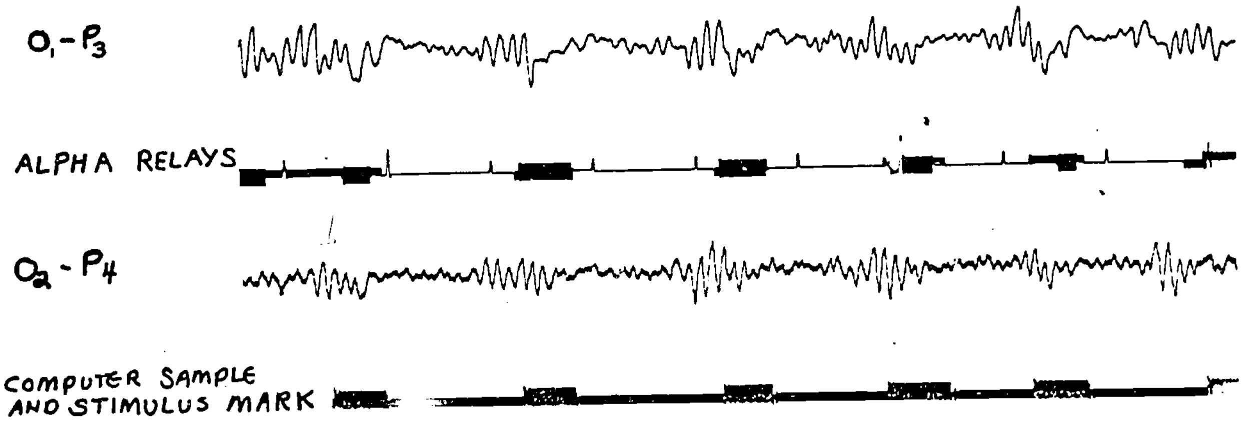
occur, the stimulus was turned on. Notice that the alpha is suppressed. Now the person is in darkness, not seeing and not looking and alpha returns. The stimulus is presented again and the process repeats. Actually, in our work electronic apparatus determine when alpha is there and automatically controls the presentation of the stimulus. I won't be able to present the technical features of the biofeedback method here. We have found that the feedback method reduces the unwanted, unpredictable variation in the brain rhythm response and permits a rapid accumulation of data.

When the biofeedback method is used, the stimulus and the EEG are coordinated. The EEG becomes a series of alpha "bursts" with intervals



Slide 1

of little or no alpha in between. The stimulus is going ON and OFF; ON when alpha is there; OFF when alpha drops below a critical level. The duration of these intervals is not constant, but depends upon the degree of relevance and novelty of the stimulus. With the first presentation the response is quite long - we call this the impact of the stimulus; as it is repeated, the durations of alpha blocking become shorter and shorter. Meanwhile alpha bursts are becoming slightly longer. We call this the fadeout. These descriptive labels have other names in neurophysiology, i.e., activation and habituation. The series of alpha and no-alpha intervals can be measured and put on a graph which we call an alertograph. We use a computer to display these alertographs, so we can use a visual appraisal of attentional impact and fadeout. Here is an example of such

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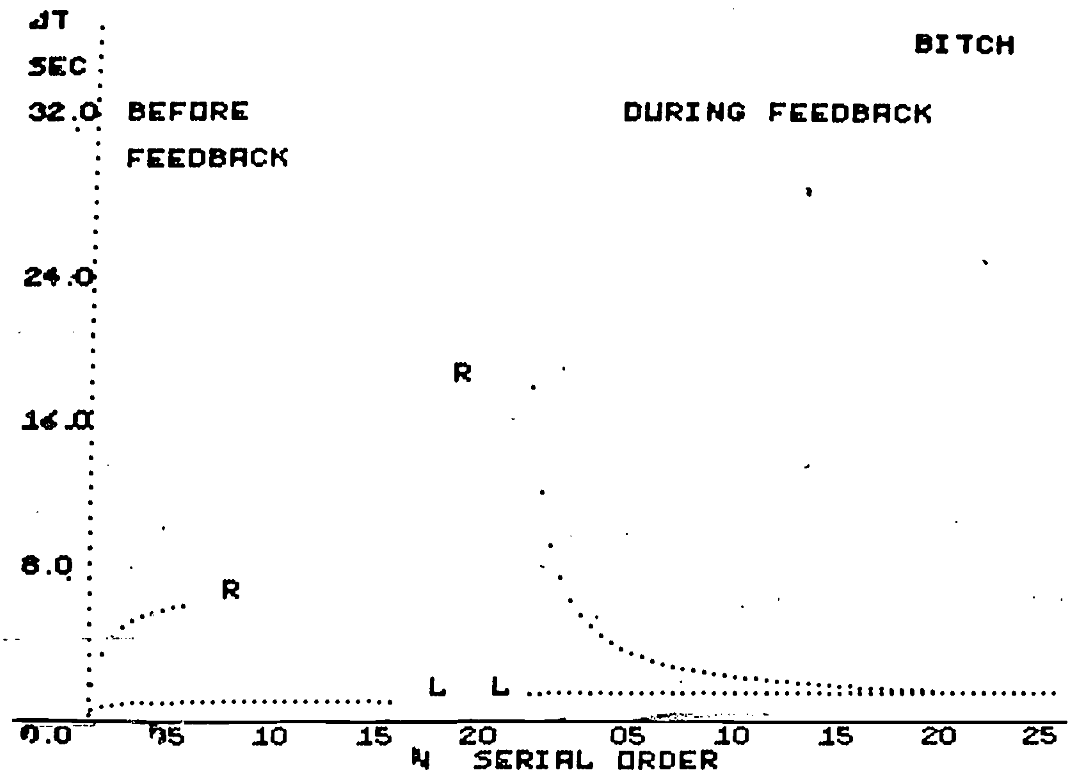
a display. It's from a patient who was brain damaged on one side. Impact and fadeout for the word "bitch" is on the "good" side; the side which is damaged is much less responsive.

In addition to a visual display we use statistics which describe the best-fitting alertograph for a quantitative analysis. With these methods we have been able to study various kinds of visuals, with various schedules of presentations and our general results are:

1. For all kinds of visual spots of colored lights, slides of scenic views, pictures of people, real people, TV, and film strips, it takes about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Slide 2

30 presentations to induce a fadeout of the attentional response.

2. Visuals differ in their impact; the more familiar and the less relevant, the less impact they have.

3. All visuals converge to similar fadeout levels after 30 presentations.

4. The time it takes for fadeout to occur is variable. It takes much longer for the attention reactions to dissipate with novel and relevant stimuli. This means that there are longer intervals between stimuli and the time required to get 30 presentations of the stimulus is longer. This may mean that attentional fadeout is dependent on the number of instances one has seen and looked at the visual, not simply the total exposure time.

5. If the stimulus is changed, there is a new impact-fadeout, i.e. a new stimulus resets the attentional system. However, if this resetting is repeated, it occurs less and less as the subject gets used to the fact of stimulus change.

6. Subjects can voluntarily reset their attentional response without special training. However, there are big individual differences and without the training, a person is not as effective at resetting as he would be after training.

I would like to describe the way we train an attentional response using a biofeedback method. In our approach, the emphasis is on voluntary control to shift from more to less attention or from less to more, rather than learning to hold a low level or a high level. The training sessions require practice for 2 min. to maintain a low level of visual attention, than a much higher level for two min. then a lower level, etc. The subject receives feedback by means of a tone which tells him alpha is there or not. The practice is to keep the one ON (alpha) as much as possible, then to keep it OFF, then ON. This corresponds to a lower and a higher level of attention according to our interpretation.

With the children we are studying we are making the task easier by selecting feedback stimuli which facilitate the EEG state required. For alpha training the child closes his eyes, and hears a tone which is ON when alpha is ON; OFF when alpha is OFF. For no-alpha (attention) training, he opens his eyes and watches a TV which is on when there is little or no-alpha and off when alpha occurs. Later on the task is made more difficult. I cannot report on results with children because the study is not complete. Results have been obtained with adults by ourselves and others which are:

1. The occurrence of occipital alpha can be modified by biofeedback training.

2. Most subjects in the laboratory learn to suppress alpha on cue or when they want to. A smaller number learn to increase alpha over the amount which would occur without training, as well as learning to suppress alpha. Some subjects don't learn either.

3. To suppress alpha, subjects report a variety of techniques which in general are in the realm of more alert, attentive, activated states.

4. To produce more alpha, subjects report a variety of techniques which are in the direction of less visual attention, less alertness to visual stimuli and less activated.

5. No consistant thought content emerges in either state, - each individual has their unique subjective experience.

Scientists disagree on the question of how the subject achieves control with biofeedback training.

6. There is no evidence yet that biofeedback attention training will help a child to learn better. We hope to answer this question by more research.

In conclusion, it is also clear that information-producing displays of any degree of complexity can be connected to the EEG attentional reaction and be controlled by it. This includes various kinds of teaching machines which may or may not include a computer. However, the ultimate utility of such student-machine interactions needs verification by more research.