

PHENOMENAL INFLUENCES ON FRÖHLICH EFFECT

Grazia Caporusso and Riccardo Luccio
Department of Psychology “Gaetano Kanizsa”, University of Trieste
gcaporusso@units.it and rluccio@units.it

Abstract

In the Fröhlich effect, the perceived onset of a moving stimulus is displaced in the direction of the motion. Two experiments were conducted in order to verify if cognitive factors had an influence on the Fröhlich effect. In the first one we studied the rule of the rectangular window in which the stimulus moves through three experimental conditions (without window condition, long window condition, short window condition), whereas in the second one we used an arrow as a stimulus instead of a rectangle.

Our results not only replicated the Fröhlich effect, but they also allowed us to control other factors that had an influence on our experimental setup: stimulus and window characteristics.

One of the most important purposes of the vision system is to localize objects in our environment.

Our attempts to localize moving objects are sometimes accompanied by small but consistent errors, defined spatio-temporal mislocations. These mislocations can regard the initial (ONSET) or final (OFFSET) position of a moving objects. The mislocation of the ONSET of a moving object in the direction of the movement was reported for the first time by O. Phil in 1984 but studied systematically by Fröhlich (1923): when participants were asked to localizes the initial position of a moving target, into a rectangular window, they often indicated a position displaced in the direction of the motion (Fröhlich effect).

Fröhlich explained this illusion in terms of “*sensation time*” (*Empfindungszeit*) that is the time needed to generate a central representation of visual sensation. Since it takes time to generate such a sensation, the mislocation occurs (Fröhlich 1923, 1929) (Figure 1).

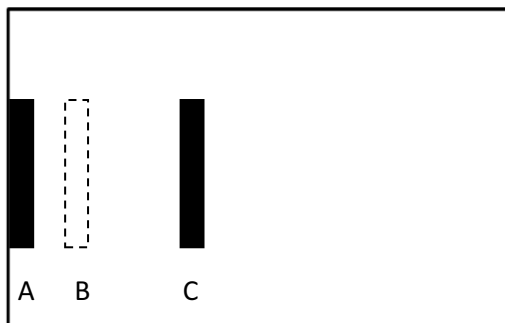


Figure 1 Fröhlich effect. The initial position of the bar entering a window is not perceived at the edge of the window (A) but in a position displaced in the direction of the movement (B). The position C is the offset position of the moving stimulus.

Nowadays the Fröhlich effect has been explained by various accounts. One of these is attentional account. Yet, this account is incompatible with an error opposite to the Fröhlich observation (Thornton, 2002; Actis-Grosso & Stucchi, 2003).

The attentional accounts proposed by Müsseler and Aschersleben (1998) seem to be compatible with the results of this research. The basic assumption of the attentional accounts is that the presentation of a visual stimulus triggers two kinds of processes which take place simultaneously: coding process and attentional process. The first one includes all the operations that serve to create an internal code of stimulus, for example its colour, size,

location and so on; the second one consists in a shift of attentional focus to (toward) the stimulus. Only after this focus shift has been completed, will the result of the coding processes be available for participants' perceptual judgments: changes of the stimulus that occurs during the shift will go unnoticed, thus producing Fröhlich effect. The appearance of a moving stimulus initiates a focus shift toward the stimulus and while this shift is under way, the stimulus moves into the window. The first phenomenal representation of the stimulus will be available only at the end of the focus shift. So the stimulus cannot be perceived in its real onset position but in a later position (Müsseler & Aschersleben, 1998).

Method

The main aim of this research is to investigate if cognitive factors have an influence on the Fröhlich effect. In order to verify it, we have conducted two experiments.

In the first experiment we have studied the role of rectangular window, in which the stimulus moves, on Fröhlich effect through three experimental conditions (independent variable): 1) without window, 2) long window, 3) short window. (Figure 2)

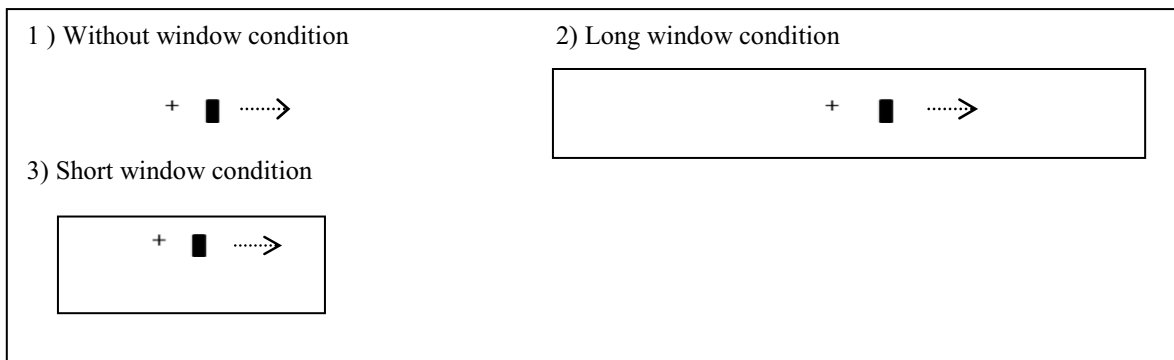


Figure 2. Experimental conditions in experiment one.

The experiment was conducted in a dimly light laboratory room. All the participants had a normal or corrected to normal vision. The experiment was conducted on a Window Office computer connected to a 17'' monitor with a refresh of 60 Hz and a resolution of 1280x800 pixel. As moving stimulus, we have used a rectangle of 0.44 x 0.88 cm. The movement distance was of 4.81 cm in a 382 msec. The subject's head was placed on a chin and forehead rest of 50 cm from the monitor. The participants were instructed to focus their eyesight on the fixation point. The rectangle appeared to the right or to the left of the fixation point. Only foveo-fugal movement was presented. At the end of the movement the rectangle and the fixation point disappeared and a bar appeared. Ascending and descending series of the bar were presented to the subject. The participants' task was to judge if the starting position was before or after the bar. The dependent variable of the experiment was the absolute threshold, calculated as the percentage of response in which the subject saw the onset of the stimulus after the bar. These percentages were transformed in z scores and the straight line that interpolate the dates was calculated. A within subject design was used. 15 students of 25 mean age have participated to the first experiment.

One way ANOVA (3x1) was carried out to verify our assumptions. The results revealed statistically significant differences among the three conditions. In particular, t test showed a statistically significant differences between classic and without right side condition ($t_{(13)} = 5.137$, p.value= 0.000) and between classic and arrow condition ($t_{(13)} = -2.937$, p.value= 0.012). Results are summarized in Figure 3.

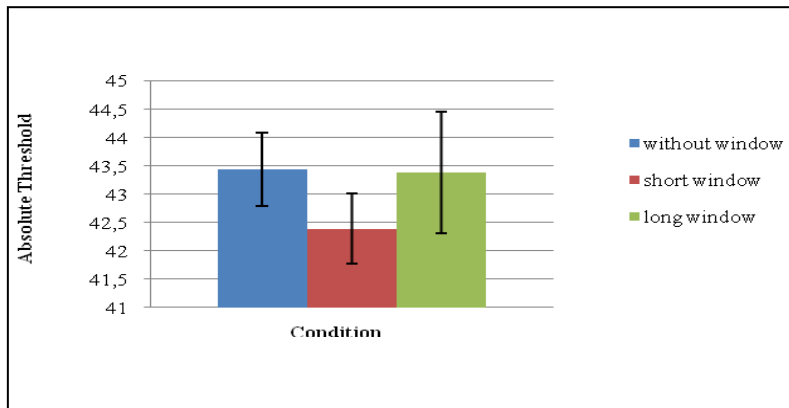


Figura 3. Results of Experiment one.

Apparatus and procedure of the second experiment were the same of the first experiment.

The Fröhlich effect was studied in three experimental conditions (independent variable): 1) classic condition, 2) arrow condition, 3) window without right side condition.

In the second condition an arrow (1.88 x 0.66 cm) was used as a stimulus instead of the rectangular. (Figure 3)

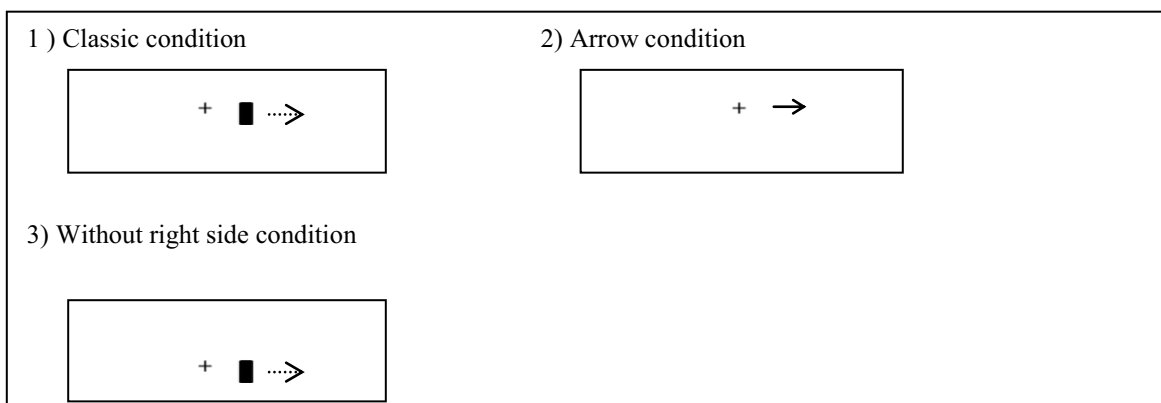


Figura 4. Experimental conditions in experiment two.

Yet, in the second experiment the moving object was presented only to the right of the fixation point. A between subjects design was used. 60 subjects (n=20 under each condition) of 25 mean age have participated to the experiment. One way ANOVA (3x1) was carried out in order to verify our assumptions.

The results showed statistically significant differences among the three conditions: $F_{(2,42)} = 4.040$, $p < .05$. In particular, t test showed a statistically significant differences between classic and without right condition and between classic and arrow condition. Results are summarized in Figure 5.

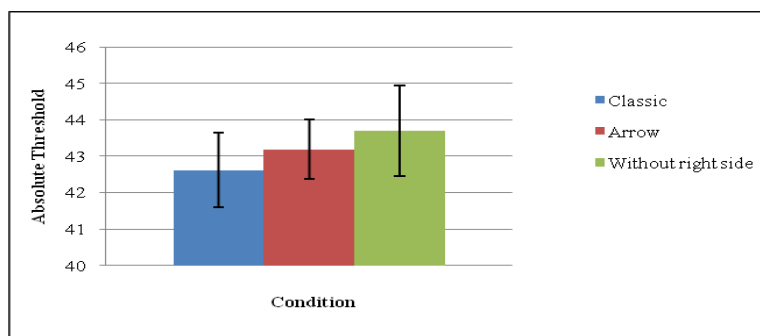


Figura 5. Results of experiment two.

Discussion

The results of our experiments revealed that the subjects tend to mislocalise the initial position of a moving stimulus in the direction of movement.

In the first experiment, the majority of errors were observed in the without window condition and in the long window condition. In these conditions there is, probably, an extension of the visual field that causes the loss of reference points for the subjects. This effect exists only when the stimulus is presented to the right of the fixation point. When the stimulus is presented to the left of the fixation point, the subjects appeared to be confused and give their answer with great difficulty. Because of the high dates' variability, any statistical analysis has been conducted. To explain this variability, we have supposed an influence of cultural factors. So the question is: what would happen with subjects as Arabic people who traditionally read from right to left? Future research is needed to verify it.

Because of these results in the second experiment, the moving stimulus was presented only to the right of the fixation point.

The results of second experiment revealed that the Fröhlich effect seems to be influenced not only by attentional mechanisms but also by cognitive factors.

The arrow, probably owing to its physiognomic characteristics, seems to increase the Fröhlich effect. The effect is greater also in the without right side condition: the lack of the right side causes an extension of the visual field.

Our results support partially the attentional mechanism theory by Müsseler and Aschersleben (1998). Yet, the attentional theory cannot explain the confusion of the subjects when the stimulus was presented to the left of the fixation point and the greater displacement of the initial position of the moving stimulus when it was an arrow.

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