

# Light intensity dependence of the distinct bump types in *Limulus* ventral nerve photoreceptor

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The macroscopic receptor current (RC) in the photoreceptor of *Limulus* ventral nerve consists of three distinct components [1]. The current-time integral of the first component (C1) is a linear, but the one of the second component (C2) is a supralinear function of the light intensity [2,3]. On the microscopic level, statistical investigations have revealed at least two types of elementary RC's (so called "bumps", c1 and c2), which are the cell's response to single absorbed photons [4]. If the RC consists of quantum sized bumps [5], one can expect the same linear (supralinear) slope for the number of c1 (c2)-bumps. The aim of our study was to measure the intensity dependence of the number of these distinct bumps in the low intensity range.

Fig. 1 demonstrates that the rise time  $t_r$ , normalized to the amplitude, is a useful parameter to separate the two bump types.

The number of c1 and c2-bumps evoked by short flashes were calculated after separation. The number of spontaneously occurring bumps has been subtracted. Overlapped bumps were analysed by dividing the total current-time integral by the mean current-time integral of single bumps.

The plot of the number of both c1 and c2-bumps vs. the light intensity on log-log scale (Fig. 2) reveals a linear correlation with a slope close to one.

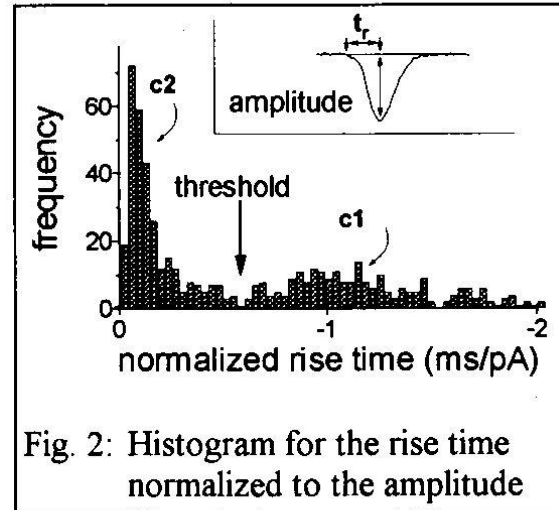


Fig. 2: Histogram for the rise time normalized to the amplitude

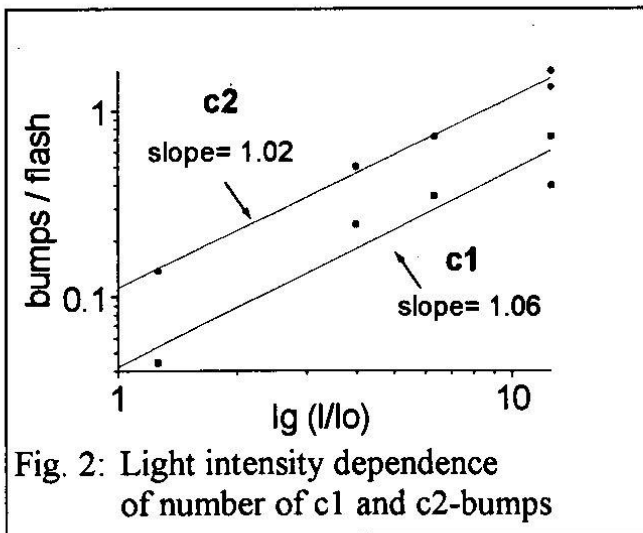


Fig. 2: Light intensity dependence of number of c1 and c2-bumps

The result of a slope  $\approx 1$  for the c2-bumps at low intensities raises the question of why and how the light intensity dependence changes with increasing stimulus intensity.

One possible explanation for the supralinear behaviour might be a *facilitation*. Bumps which occur first may improve the condition for the enzyme cascade for subsequent bumps. Thus, bumps should increase in size. A further hypothesis is to assume interactions between the enzyme cascades activating c1 and c2.

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- [2] Stieve, Schlösser (1989) *Z Naturforsch* 44c:999-1014
- [3] Reuß (1991) *Thesis*, RWTH-Aachen
- [4] Nagy et al. (1993) *Eur Biophys J* 22:341-350
- [5] Yeandle et al. (1973) *J Gen Phys* 61:552-571

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