the rats who received control serum 6.56 ± 0.57 per 1000 cells. These two results are significantly different from each other ($p < .02$). The average number of labeled cells in the kidneys of rats who had a uninephrectomy was 20.33 ± 2.5 per 1000 cells. This figure is significantly different from that of the rats receiving nephrectomy serum ($p < .05$).

The medullas of the kidneys from each rat contained less than one labeled cell per 1000 cells, and there was no significant difference in the counts among the three groups. The livers of the rats in all three groups contained between 1 and 2.4 labeled cells per 1000 cells, there being no significant differences between each group.

The results indicate that a substance in the serum of uninephrectomized rats may be responsible for the increase in cell division that occurs during renal compensatory hyperplasia. It is indicated that the substance is not a general growth-promoting factor, since the liver showed no increase in cell division.

The increase in cell division in the kidneys of rats that received nephrectomy serum was significantly smaller than that in the remaining kidney of uninephrectomized rats. This may be due to the fact that the amount of serum was not large enough or injected often enough for maximum growth, or it may mean that factors other than a serum factor are implicated in renal compensatory hyperplasia. Other hypotheses that have been advanced to explain the hyperplasia include an increase in renal blood supply (*8*), increase in excretory load (*9*), and the local stretching of areas of the kidney (*10*). Also the administration of pituitary hormones, thyroxin, testosterone, progesterone, and desoxycorticosterone acetate are each known to increase renal size (*11*).

Williams has reported that an injection of nephrectomy serum into recipient rats did not increase the incidence of mitosis in the kidney (*12*). However, he gave only one injection of the serum which may have been an insufficient amount to cause an increase in cell division.

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References and Notes

1. H. D. Rollason, *Anat. Rec.* **104**, 263 (1949).
2. K. Ogawa, *Texas Rept. Biol. Med.* **19**, 825 (1961).
3. G. Franck, *Compt. Rend.* **251**, 1306 (1960).
4. L. L. MacKay, E. M. MacKay, T. Addis, *J. Nutr.* **4**, 379 (1931).
5. New England Nuclear Corp., Boston.
6. C. M. Blumenfeld, *Anat. Rec.* **72**, 435 (1938).
7. I. Doniach and S. R. Pelc, *Brit. J. Radiol.* **23**, 184 (1950).
8. M. Arataki, *Am. J. Anat.* **36**, 437 (1926).
9. C. Sacerdotti. *Arch. Pathol. Anat. Physiol.* **146**, 267 (1896).
10. H. Idbohrn and A. Muren, *Acta Physiol. Scand.* **38**, 200 (1956).
11. D. J. Goldstein, *Leech* **30**, 115 (1960).
12. G. E. C. Williams, *Lab. Invest.* **11**, 1295 (1962).

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Long-Term Stability of Visually Evoked Potentials in Man

Abstract. *Although the variability of averaged evoked potentials as recorded from cortex in man has been a constant source of concern among investigators, the degree of variability has not received systematic treatment. The authors have accordingly undertaken an exploratory study of reliable differences that may occur in the first 300 msec of the averaged evoked response over long periods of time. Computer analysis of visually evoked responses in seven subjects over several weeks indicated stability of the response of each individual, with reliable intra-individual correlations. Inter-individual differences, however, were large. The evoked responses of different individuals were found to be unique.*

The electrocortical response to a brief stimulus, such as a flash of light or a click, is a complex wave made up of a number of components, frequently referred to as an evoked potential or an evoked response. Increased interest in the study of evoked potentials has resulted from the development of electronic instruments that can extract the wave pattern of brief, minute electrical changes, that follow a stimulus, from ongoing random electrical activity of the brain (*1*). Constructed electronically from many responses, the averaged evoked potential that emerges contains components which were previously invisible. Such a procedure has caused some to question the reliability of the averaged evoked response (*2*). Some measure of reliability is needed if the averaged evoked response is to become a useful tool in neurophysiology.

Shagass and Schwartz demonstrated that the pattern during the first 40-msec period of somatosensory-evoked potentials was reliable, or stable, over intervals of from 1 to 3 hours. Correlations between evoked potentials recorded at these intervals averaged .87 (*3*). A question remains, however, regarding the stability of the averaged evoked potential over much longer periods of time, intervals separated by days or weeks. Equally important is the question of the stability of the later components of the response, those components following the stimulus by 50 or 100 or even 300 msec. The present study was designed to investigate these questions.

Seven subjects, normal male adults, reclined comfortably in a padded chair facing a reflecting hemisphere 70 cm in diameter. The hemisphere was illuminated by a PS-1 Grass photic stimulator lamp, positioned immediately behind and to the left of the subject and aimed at the center of the hemisphere, at a distance of 70 cm. The PS lamp was housed in a fiberboard box to muffle the clicks accompanying light flashes. None of the subjects queried reported that they could hear the clicks. The light flash was of relatively low intensity (2 on the PS intensity range of 1 to 16). The calculated illuminance at the center of the hemisphere was 0.7 lu/7m^2. The duration of the flash was 10 μsec. The center of the hemisphere at eye level was 40 cm from the subject's eyes. The flash produced a uniform surround completely enveloping the subject's face. The visual angle subtended by the reflected flash was approximately 165°.

Subjects were fitted with electrodes attached to 3-mm^2 scratched patches of scalp with collodion. Placements were bilateral, 4 cm anterior and lateral to the inion. All were monopolar to insure knowledge of electrical polarity, with cortical electrodes referred to earground leads.

A Mnemotron computer of average transients (CAT), a multipurpose digital computer, was employed to extract cortical responses to the light flash. Inked plots of the evoked response patterns were made by a Mosley X-Y plotter.

One hundred flashes, 2 to 3 seconds apart, were delivered to each subject during a recording session. The CAT was set to analyze the brain activity from the left visual cortex for a period of 2 seconds after each flash.

The subjects presented a variety of

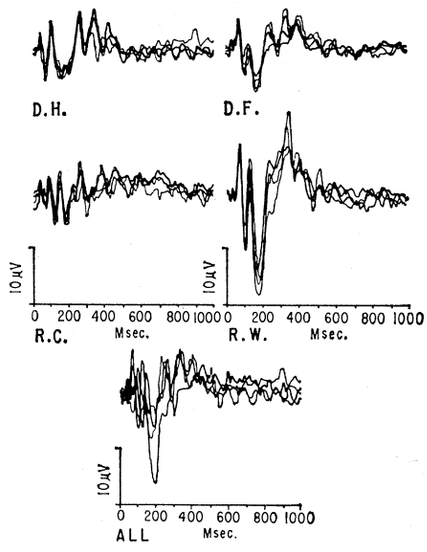

Fig. 1. Reliability and individuality of the evoked potentials. The first four illustrations show the superimposition of four averaged evoked responses recorded at weekly or longer intervals from subjects D.H., D.F., R.C., and R.W. The fifth shows the superimposition of the evoked responses of all four subjects.

brain-wave (electroencephalographic) patterns. Two had predominantly alpha patterns, two had predominantly beta patterns, and the remaining three had mixed alpha and beta patterns. Averaged evoked potentials were obtained from four subjects on four different occasions and from three subjects on three different occasions. Individual recordings were taken at weekly or longer intervals.

Inked plots of the resulting averaged evoked potentials yielded a complex wave consisting of eight distinct components in the first 300 msec of the response. These components were repeatedly observed with all subjects.

A base line for each plotted evoked response was established by drawing a horizontal line which touched the base of the largest positive deflection. Twenty-five ordinates erected from the base line, equally spaced over 300 msec, intersected the various components of the evoked response. A measure in millimeters was made of the distance from the base line to the point at which the vertical lines intersected the evoked response. Thus each of the ordinate values was expressed as a distance from the largest positive deflection of the evoked response.

Pearson product-moment correlations were then computed to determine the degree to which ordinate values of the evoked response obtained from one recording session were related to those obtained from other recording sessions.

To determine the degree to which inter-individual evoked responses were related, a mean for each of the 25 ordinates was computed for each subject from the values obtained from his repeated recordings. The mean ordinate values of each subject were then correlated with those of other subjects.

An analysis of the data indicated that those components of an individual's averaged evoked potential occurring in the first 300 msec were highly reliable over long periods of time, in this instance, intervals separated by a week or longer. Test-retest correlations of the averaged evoked response of each of the seven subjects ranged from .72 to .99, with a median correlation of .88. Inter-individual correlations proved to be much smaller, ranging from —.29 to .92, with the median correlation being .37.

These relationships between evoked responses can be portrayed graphically. Figure 1 illustrates that an individual's evoked response recorded at one time more closely resembles his own evoked response at other times than it does the evoked responses of other individuals. Each of the first four illustrations shows the superimposition of four evoked responses, recorded at weekly or longer intervals, from each of four subjects. An evoked response from each of the subjects is shown superimposed in the fifth illustration.

It should be noted that disparity among the responses occurs after about 300 msec in most cases. These later components are often characterized by rhythmic waves of an alpha frequency. An attempt was made in the present study to determine if the resting alpha frequency was related to the frequency of these rhythmic late components. A correlation between the average alpha and after-discharge frequencies of 17 additional subjects, whose evoked potential showed an after-discharge, was .58 ($P =< .02$). The correlation indicated that those with faster alpha frequencies tended to have faster after-discharge frequencies.

The variation in the response from different individuals deserves comment. Some reasonable possibilities are that it may be due to individual differences in scalp and skull thickness, the distance from excitatory areas of cortex to recording electrodes, or simply background frequency. This latter possibility was investigated. A rank order correlation was computed for frequencies of brain activity and amplitudes of the averaged evoked responses. It was not significant. However, the two "fastest" brains, predominantly beta rhythm background frequency, ranked first and second in amplitude of early components of the evoked response.

From these data it would appear that the earlier components of the averaged evoked response are reliable and stable over a period of weeks, as attested by the reliable intra-individual correlations. Although individuality is clearly reflected in the evoked response, its source is obscure and must await further investigation.

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References

1. G. D. Dawson, *Electroenceph. Clin. Neurophysiol.* **6**, 65 (1954).
2. R. G. Bickford, R. F. Galbraith, J. L. Jacobsen, *ibid.* **15**, 720 (1963).
3. C. Shagass and M. Schwartz, *J. Neuropsychiat.* **2**, 262 (1961).

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Dedifferentiation and Redifferentiation of Cells in *Hydra viridis*

Abstract. *The interstitial cell of the green hydra is formed by dedifferentiation of specialized gastrodermal cells. Similarly, the epidermal epitheliomuscular cells are probably formed by direct differentiation of algae-laden digestive cells that lose their algae and enclosed food droplets, migrate to the periphery of the animal, and begin the mucous secretion characteristic of epidermal cells.*

The origin of cells comprising a regenerate has been studied in all the major phylums. Invariably, such studies are complicated by the presence of so-called embryonic cells in the regenerating organism, which obscure the results. These cells, according to the animal in which they are found, have been designated interstitial cells, archeocytes, formative cells, neoblasts, mesenchyme cells, totipotent cells, plus a variety of less common names. They are usually characterized by a highly basophilic cytoplasm, lack of cytoplasmic organelles, and, except in vertebrates, the ability to migrate from dis-