The $P_{3(00)}$ wave of the averaged evoked potential: A bibliography

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Stimulated by the potential value of a measure of central cortical processing, research on the $P_{3(00)}$ wave of the averaged evoked potential has flourished since the initial studies in the mid-1960s. A compilation of 145 references to articles on the $P_{3(00)}$ wave is listed. The criteria used in developing the bibliography were completeness, currency, and accessibility.

Since Dawson's initial observations of the averaged evoked potential (AEP), a great deal of research has focused on these minute brain potentials. Initially, the general assumption was that the AEP was a cortical representation of the sensory neural impulses evoked by a stimulus. Recent research has indicated that, in addition to signaling cortical reception of sensory stimuli, the AEP also reflects complex aspects of cortical data processing. The components of the AEP associated with this latter function are commonly referred to as the "late components." Among the late components is a large positive wave complex designated by different authors as P_3 or P_{300} .¹ Interest in this component has been high because of its great sensitivity to the manipulation of stimulus and task parameters that seem to require different amounts or kinds of cortical data processing. At the cognitive level, a variety of constructs have been associated with $P_{3(00)}$. Among these are discrimination, uncertainty resolution, information delivery, stimulus relevance, stimulus novelty, and cognitive acts of decision.

Motivated by the potential value of a practical and direct measure of central cortical processing, research on the $P_{3(00)}$ component has blossomed since the initial studies in the mid-1960s. A bibliography seems relevant at this time for several reasons. First, reports are found in a variety of journals of several disciplines. Second, the relatively brief history of $P_{3(00)}$ study and the variety and confusion of terminology used in AEP research make it a difficult task for an individual who is unfamiliar with the area to assemble a bibliography on $P_{3(00)}$. Finally, the authors believe that research in this area is at a point where it would benefit from inputs

from diverse areas of the behavioral and biological sciences. It is hoped that a unified listing of articles will facilitate this interdisciplinary effort.

Standard citation sources were of little help in generation of the bibliography. The sources of references were primarily the search of journals that publish AEP studies, correspondence with persons actively engaged in research, and the reference lists accompanying individual articles. The decision as to what articles to include was difficult; a task not made easier by the aforementioned confusion in AEP terminology and in recording and data processing procedures. Our approach was to review each article for the mention of P_3 , P_{300} , "a late positive wave," or a similar acronym that has been used to designate $P_{3(00)}$. Some articles, especially those appearing before Sutton's 1965 publication, required evaluation of the published AEP curves or tables of component latency to determine their status.

A general criterion for inclusion was accessibility to the reader. As in any research area, unpublished manuscripts circulate among investigators; these were excluded. No effort was made to search foreign language publications; however, to our knowledge, little study of $P_{3(00)}$ has appeared in other than English sources. To be as inclusive as possible, we have cited abstracts of presented papers where available in the published literature. In addition, papers "in press" have been included.

No comprehensive and current review of the $P_{3(00)}$ literature is available but useful summaries or general discussions are to be found in Donchin et al (1973), Sutton (1969), and Karlin (1970).

The effort has been made to make the present bibliography as complete a listing of the literature on $P_{3(00)}$ as possible. Nevertheless, the best of effort is doomed to some measure of failure; for this, we apologize. General comments and the contribution of references by the reader will be most welcome.

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- Gardiner, M. F., Walter, D. O., & Moore, G. Information transmission and auditory evoked potentials. *The Physiologist*, 1967, 10, 176.
- Goff, W. R. Evoked potential correlates of perceptual organization in man. In C. R. Evans and T. B. Mulholland (Eds.), *Attention in neurophysiology: An international conference*. London: Butterworths, 1969. Pp. 169-193.
- Goff, W. R., Matsumiya, Y., Allison, T., & Goff, G. D. Cross-modality comparisons of averaged evoked potentials. In E. Donchin and D. B. Lindsley (Eds.), *Average evoked potentials: Methods, results, and evaluations*. Washington, D.C.: U.S. Government Printing Office, 1969, NASA SP-191. Pp. 95-141.
- Gross, M. M., Begleiter, H., Tobin, M., & Kissin, B. Auditory evoked response comparison during counting clicks and reading. *Electroencephalography & Clinical Neurophysiology*, 1965, 18, 451-454.
- Groves, P. M., & Eason, R. G. Effects of attention and activation on the visual evoked cortical potential and reaction time. *Psychophysiology*, 1969, 5, 394-398.
- Haider, M. Neuropsychology of attention, expectation, and vigilance. In D. I. Mostofsky (Ed.), *Attention: Contemporary theory and analysis*. New York: Appleton-Century-Crofts, 1970. Pp. 419-423.
- Haider, M., Spong, P., & Lindsley, D. B. Attention, vigilance and cortical evoked-potentials in humans. *Science*, 1964, 145, 180-182.
- Harter, M. R., & Salmon, L. E. Intra-modality selective attention and evoked cortical potentials to randomly presented patterns. *Electroencephalography & Clinical Neurophysiology*, 1972, 32, 605-613.
- Hartley, L. R. The effect of stimulus relevance on the cortical evoked potentials. *Quarterly Journal of Experimental Psychology*, 1970, 22, 531-546.
- Hillyard, S. A. The CNV and the vertex evoked potential during signal detection: A preliminary report. In E. Donchin and D. B. Lindsley (Eds.), *Average evoked potentials: Methods, results, and evaluations*. Washington, D.C.: U.S. Government Printing Office, 1969, NASA SP-191. Pp. 349-354.
- Hillyard, S. A. The psychological specificity of the contingent negative variation and late evoked potential (P300). *Electroencephalography & Clinical Neurophysiology*, 1971, 31, 302.
- Hillyard, S. A., Krausz, H. I., & Picton, T. W. Scalp distributions of the late positive wave (P₃) in six different decision tasks. *Electroencephalography & Clinical Neurophysiology*, 1974, 36, 211.
- Hillyard, S. A., Squires, K. C., Bauer, J. W., & Lindsay, P. H. Evoked potential correlates of auditory signal detection. *Science*, 1971, 172, 1357-1360.
- Hirsh, S. K. Vertex potentials associated with an auditory discrimination. *Psychonomic Science*, 1971, 22, 173-175.
- Jenness, D. A. Auditory evoked response differentiation with discrimination learning. (Doctoral dissertation, Columbia University). Ann Arbor, Mich: University Microfilm, 1970. No. 71-17.
- Jenness, D. A. Stimulus role and gross differences in the cortical evoked response. *Physiology & Behavior*, 1972, 9, 141-146.
- Jenness, D. A. Auditory evoked-response differentiation with discrimination learning in humans. *Journal of Comparative & Physiological Psychology*, 1972, 80, 75-90.
- John, E. R. *Mechanisms of Memory*. New York: Academic Press, 1967.
- Karlin, L. Cognition, preparation, and sensory-evoked potentials. *Psychological Bulletin*, 1970, 73, 122-136.
- Karlin, L., & Martz, M. Response probability and sensory evoked potentials, motor potentials, and reaction time. In S. Kornblum (Ed.), *Attention and performance IV*. New York: Academic Press, 1973. Pp. 175-184.
- Karlin, L., Martz, M. J., Brauth, S. E., & Mordkoff, A. M. Auditory evoked potentials, motor potentials and reaction time. *Electroencephalography & Clinical Neurophysiology*, 1971, 31, 129-136.
- Karlin, L., Martz, M. J., & Mordkoff, A. M. Motor performance and sensory-evoked potentials. *Electroencephalography & Clinical Neurophysiology*, 1970, 28, 307-313.
- Klinke, R., Fruhstorfer, H., & Kinkeneller, P. Evoked responses as a function of external and stored information. *Electroencephalography & Clinical Neurophysiology*, 1968, 25, 119-122.
- Kopell, B. S., Wittner, W. K., & Warrich, G. L. The effect of stimulus differences, light intensity, and selective attention on the amplitude of the visual average evoked potential in man. *Electroencephalography & Clinical Neurophysiology*, 1969, 26, 619-622.
- Kopell, B. S., Zarccone, V., De La Pena, A., & Dement, W. C. Changes in selective attention as measured by the visual averaged potential following REM deprivation in man. *Electroencephalography & Clinical Neurophysiology*, 1972, 32, 322-325.
- Lehtonen, J. B. Functional differentiation between late components of visual evoked potentials recorded at occiput and vertex: Effect of stimulus interval and contour. *Electroencephalography & Clinical Neurophysiology*, 1973, 35, 75-82.
- Leifer, L. J., Otto, D. A., & Huff, E. M. Evoked potential correlates of a probability learning task-topographic analysis. VIII International Congress of Electroencephalography & Clinical Neurophysiology, 1973, 34 (Extra Number), 741.
- Leifer, L. J., Hart, S. G., Huff, E. M., & Strawbridge, P. Evoked potential correlates of a probability learning task-behavioral analysis. VIII International Congress of Electroencephalography & Clinical Neurophysiology, 1973, 34 (Extra Number), 730.
- Leifer, L. J., Hart, S. G., Otto, D. A., & Huff, E. M. Evoked potential correlates of a probability learning task-behavior/P300 analysis. VIII International Congress of Electroencephalography & Clinical Neurophysiology, 1973, 34 (Extra Number), 730.
- Levit, R. A., Sutton, S., & Zubin, J. Evoked potential correlates of information processing in psychiatric patients. *Psychological Medicine*, 1973, 3, 487-494.
- Lewis, E. G., Dustman, R. E., & Beck, E. C. The effects of alcohol on visual and somato-sensory evoked responses. *Electroencephalography & Clinical Neurophysiology*, 1970, 28, 202-205.
- Lindsley, D. B. Average evoked potentials-Achievements, failures and prospects. In E. Donchin and D. B. Lindsley (Eds.), *Average evoked potentials: Methods, results, and evaluations*. Washington, D.C.: U.S. Government Printing Office, 1969, NASA SP-191. Pp. 1-43.
- Lindsley, D. B., Wilson, G. F., & Seales, D. M. Evoked potentials and information processing. *Electroencephalography & Clinical Neurophysiology*, 1974, 36, 213.
- Lombroso, C. T. The CNV during tasks requiring choice. In C. R. Evans and T. B. Mulholland (Eds.), *Attention in neurophysiology*. New York: Appleton, 1969. Pp. 64-69.
- MacKay, E. M. (Ed.). Evoked brain potentials as indicators of sensory information processing. *Neuroscience Research Program Bulletin*, 1969, 7, 181-276.
- Mast, T. E., & Watson, C. S. Attention and auditory evoked responses to low-detectability signals. *Perception & Psychophysics*, 1968, 4, 237-240.
- McAdam, D. W. Changes in somato-sensory evoked potentials during the contingent negative variation (CNV). *Electroencephalography & Clinical Neurophysiology*, 1968, 24, 286.
- McAdam, D. W., & Rubin, E. H. Readiness potential, vertex positive wave, contingent negative variation and accuracy of perception. *Electroencephalography & Clinical Neurophysiology*, 1971, 30, 511-517.
- McCallum, W. C. Slow potential changes in a vigilance situation.

BIBLIOGRAPHY

- Adams, J. C., & Benson, D. A. Task-contingent enhancement of the auditory evoked response. *Electroencephalography & Clinical Neurophysiology*, 1973, 35, 249-257.
- Barlow, J. S. Some observations on the electrophysiology of timing in the nervous system. *Electroencephalography & Clinical Neurophysiology*, 1969, 27, 545.
- Begleiter, H., & Platz, A. Cortical evoked potentials to semantic stimuli. *Psychophysiology*, 1969, 6, 91-100.
- Begleiter, H., Porjesz, B., Yerre, C., & Kissin, B. Evoked potential correlates of expected stimulus intensity. *Science*, 1973, 179, 814-816.
- Benson, D. A., & Teas, D. C. Human auditory-evoked response: Specific effects of signal strength and performance criterion. *Perception & Psychophysics*, 1972, 11, 203-208.
- Bostock, H., & Jarvis, M. J. Changes in the form of the cerebral evoked response related to the simple reaction time. *Electroencephalography & Clinical Neurophysiology*, 1970, 29, 137-145.
- Chapman, R. M. Evoked responses to relevant and irrelevant visual stimuli while problem solving. *Proceedings of the American Psychological Association*, 1965, 1, 177-178.
- Chapman, R. M. Human evoked responses to meaningful stimuli. *Proceedings of the 18th International Congress of Psychology*, 1966, 6, 53-59.
- Chapman, R. M., & Bragdon, H. R. Evoked responses to numerical and non-numerical visual stimuli while problem solving. *Nature*, 1964, 203, 1155-1157.
- Clark, D. L., Butler, R. A., & Rosner, B. S. Dissociation of sensation and evoked responses by a general anesthetic in man. *Journal of Comparative and Physiological Psychology*, 1969, 68, 315-319.
- Clark, D. L., Butler, R. A., & Rosner, B. S. Are evoked responses necessary? A reply to Donchin and Sutton. *Communications in Behavioral Biology*, 1970, 5, 105-110.
- Connors, C. K. Cortical visual evoked response in children with learning disorders. *Psychophysiology*, 1971, 7, 418-428.
- Corby, J. C., & Kopell, B. S. The effect of predictability on evoked response enhancement in intramodal selective attention. *Psychophysiology*, 1973, 10, 335-346.
- Davis, H. Enhancement of evoked cortical potentials in humans related to a task requiring a decision. *Science*, 1964, 145, 182-183.
- Davis, H., Mast, T., Yoshie, N., & Zerlin, S. The slow response of the human cortex to auditory stimuli: Recovery process. *Electroencephalography & Clinical Neurophysiology*, 1966, 21, 105-113.
- Davis, H., & Zerlin, S. Acoustic relations of the human vertex potential. *Journal of the Acoustical Society of America*, 1966, 39, 109-116.
- Debecker, J., & Desmedt, J. E. Rate of intermodality switching disclosed by sensory evoked potentials averaged during signal detection tasks. *Journal of Physiology*, 1966, 185, 52-53.
- Donald, M. W. Direct-current potentials in the human brain evoked during timed cognitive performance. *Nature*, 1970, 227, 1057-1058.
- Donald, M. W. Parallel specific and non-specific late components in the somatic evoked response. *Electroencephalography & Clinical Neurophysiology*, 1972, 33, 450.
- Donald, M. W., & Goff, W. R. Attention-related increases in cortical responsivity dissociated from contingent negative variation. *Science*, 1971, 172, 1163-1166.
- Donald, M. W., & Goff, W. R. Contingent negative and sensory evoked responses: Their interaction and relationship to auditory discrimination. In W. C. McCallum and J. R. Knott (Eds.), *Event related slow potentials of the brain: Their relations to behavior*. *Electroencephalography & Clinical Neurophysiology*, 1973, Suppl. 33.
- Donchin, E. Averaged evoked potentials and uncertainty resolution. *Psychonomic Science*, 1968, 12, 103.
- Donchin, E. Data analysis techniques in average evoked potential research. In E. Donchin and D. B. Lindsley (Eds.) *Average evoked potentials: Methods, results, and evaluations*. Washington, D.C.: U.S. Government Printing Office, 1969, NASA SP-191. Pp. 199-236.
- Donchin, E., & Cohen, L. Averaged evoked potentials and intramodality selective attention. *Electroencephalography & Clinical Neurophysiology*, 1967, 22, 537-546.
- Donchin, E., & Cohen, L. Anticipation of relevant stimuli and evoked potentials: A reply to Näätänen. *Perceptual & Motor Skills*, 1969, 29, 115-117.
- Donchin, E., & Cohen, L. Further reply to Näätänen. *Perceptual & Motor Skills*, 1969, 29, 270.
- Donchin, E., Gerbrandt, L. A., Leifer, L., & Tucker, L. Is the contingent negative variation contingent on a motor response? *Psychophysiology*, 1972, 9, 178-188.
- Donchin, E., Kubovy, M., Kutas, M., Johnson, R., & Herning, R. I. Graded changes in evoked response (P300) amplitude as a function of cognitive activity. *Perception & Psychophysics*, 1973, 14, 419-324.
- Donchin, E., & Lindsley, D. B. (Eds.). *Average evoked potentials: Methods, results, and evaluations*. Washington, D.C.: U.S. Government Printing Office, NASA SP-191, 1969.
- Donchin, E., & Smith, D. B. D. The contingent negative variation and the late positive wave of the averaged evoked potential. *Electroencephalography & Clinical Neurophysiology*, 1970, 29, 201-203.
- Donchin, E., & Sutton, S. The "psychological significance" of evoked response: A comment on Clark, Butler, and Rosner. *Communications in Behavioral Biology*, 1970, 5, 111-114.
- Eason, R. G., Harter, M. R., & White, C. T. Effects of attention and arousal on visually evoked cortical potentials and reaction time in man. *Physiology & Behavior*, 1969, 4, 283-289.
- Ellingson, R. J., Lathrop, G. H., Danaby, T., & Nelson, B. Variability of visual evoked potentials in human infants and adults. *Electroencephalography & Clinical Neurophysiology*, 1973, 34, 113-124.
- Ellis, R. R. The CNV phenomenon and selective attention. *Electroencephalography & Clinical Neurophysiology*, 1969, 27, 664.
- Ertl, J. Evoked potentials, neural efficiency, and I.Q. In L. D. Proctor (Ed.), *Proceedings of an international symposium on biocybernetics of the nervous system*. Boston: Little, Brown, 1969. Pp. 419-428.
- Ford, J. M., Roth, W. T., Dirks, S. J., & Kopell, B. S. Evoked potential correlates of signal recognition between and within modalities. *Science*, 1973, 181, 465-466.
- Friedman, D., Hakerem, G., Sutton, S., & Fleiss, J. L. Effect of stimulus uncertainty on the pupillary dilation response and the vertex evoked potential. *Electroencephalography & Clinical Neurophysiology*, 1973, 34, 475-484.
- Fruhstorfer, H. Habituation and dishabituation of the human vertex response. *Electroencephalography & Clinical Neurophysiology*, 1971, 30, 306-312.
- Fruhstorfer, H., & Bergstrom, R. M. Human vigilance and auditory evoked responses. *Electroencephalography & Clinical Neurophysiology*, 1969, 27, 346-355.
- Fruhstorfer, H., Soveri, P., & Järvillehto, T. Short-term habituation of the auditory evoked response in man. *Electroencephalography & Clinical Neurophysiology*, 1970, 28, 153-161.
- Gardiner, M. F. Changes in evoked electrical activity at the scalp of man associated with change in a stimulus-analysis task: A study employing step-wise discriminant analysis (Doctoral dissertation, University of California, Los Angeles) Ann Arbor, Mich: University Microfilm, 1969. No. 70-2204.
- Gardiner, M. F., & Walter, D. O. Differences between human evoked potentials elicited by the same acoustical stimuli during loudness discrimination tasks and pitch discrimination tasks. In E. Donchin and D. B. Lindsley (Eds.), *Average evoked potentials: Methods, results, and evaluations*. Washington, D.C.: U.S. Government Printing Office, 1969, NASA SP-191. Pp. 335-342.

- Electroencephalography & Clinical Neurophysiology, 1974, 36, 217.
- McCallum, W. C., & Knott, J. R. (Eds.), Event related slow potentials of the brain: Their relations to behavior. (Proceedings 2nd International Conference on CNV). Electroencephalography & Clinical Neurophysiology, Suppl. 33, 1973.
- Näätänen, R. Selective attention and evoked potentials. *Annales Academiae Scientiarum Fennicae*, Helsinki, 1967, B151, 1-226.
- Näätänen, R. Anticipation of relevant stimuli and evoked potentials: A comment on Donchin's and Cohen's "averaged evoked potentials and intramodality selective attention." *Perceptual & Motor Skills*, 1969, 28, 639-646.
- Näätänen, R. Anticipation of relevant stimuli and evoked potentials: A reply to Donchin and Cohen. *Perceptual & Motor Skills*, 1969, 29, 233-234.
- Näätänen, R. Evoked potential, EEG, and slow potential correlates of selective attention. In A. F. Sanders, (Ed.), *Attention and performance III*. Amsterdam: North-Holland, 1970. Pp. 178-192.
- Nielson, D. W., Teas, D. C., & Idzikowski, R. P. Variation in cortical evoked responses as a function of performance criterion. *Perception & Psychophysics*, 1970, 8, 29-32.
- Ohlrich, E. S., & Barnet, A. B. Auditory evoked responses during the first year of life. *Electroencephalography & Clinical Neurophysiology*, 1972, 32, 161-169.
- Papahostopoulos, D., & Crow, H. J. The "P300" component of the cortical evoked response and its relationship with the contingent negative variation. *Electroencephalography & Clinical Neurophysiology*, 1974, 36, 217.
- Paul, D. D., & Sutton, S. Evoked potential correlates of response criteria in auditory signal detection. *Science*, 1972, 177, 362-364.
- Paul, D. D., & Sutton, S. Evoked potential correlates of psychophysical judgements: The threshold problem. A new reply to Clark, Butler, and Rosner. *Behavioral Biology*, 1973, 9, 421-433.
- Picton, T. W., & Hillyard, S. A. Human auditory evoked potentials. II. Effects of attention. *Electroencephalography & Clinical Neurophysiology*, 1974, 36, 191-200.
- Picton, T. W., Hillyard, S. A., & Galambos, R. Auditory evoked potentials during vigilance. *Electroencephalography & Clinical Neurophysiology*, 1974, 36, 214.
- Picton, T. W., Hillyard, S. A., & Galambos, R. Cortical evoked responses to omitted stimuli. In M. N. Livanov (Ed.), *Major problems of brain electrophysiology*. Moscow: USSR Academy of Sciences, in press.
- Picton, T. W., Hillyard, S. A., Krausz, H. I., & Galambos, R. Human auditory evoked potentials: I. Evaluation of components. *Electroencephalography & Clinical Neurophysiology*, 1974, 36, 179-190.
- Picton, T. W., & Low, M. D. The CNV and semantic content of stimuli in the experimental paradigm. Effects of feedback. *Electroencephalography & Clinical Neurophysiology*, 1971, 31, 451-456.
- Posner, M. I. Psychobiology of attention. In C. Blakemore and M. S. Gazzaniga (Eds.), *The handbook of psychobiology*. New York: Academic Press, 1974.
- Posner, M. I., Klein, R., Summers, J., & Buggie, S. On the selection of signals. *Memory & Cognition*, 1973, 1, 2-12.
- Pribam, K. H. *Languages of the brain: Experimental paradoxes and principles in neuropsychology*. Englewood Cliff, New Jersey: Prentice-Hall, 1971.
- Regan, D. *Evoked potentials in psychology, sensory physiology and clinical medicine*. London: Chapman & Hall, 1972.
- Ritter, W., Simson, R., & Vaughan, H. G., Jr. Association cortex potentials and reaction time in auditory discrimination. *Electroencephalography & Clinical Neurophysiology*, 1972, 33, 547-555.
- Ritter, W., & Vaughan, H. G., Jr. Averaged evoked responses in vigilance and discrimination: A reassessment. *Science*, 1969, 164, 326-328.
- Ritter, W., Vaughan, H. G., Jr., & Costa, L. D. Orienting and habituation to auditory stimuli: A study of short term changes in average evoked responses. *Electroencephalography & Clinical Neurophysiology*, 1968, 25, 550-556.
- Rohrbaugh, J. W., Donchin, E., & Eriksen, C. W. Decision making and the P300 component of the cortical evoked response. *Perception & Psychophysics*, in press.
- Roth, W. T. Auditory evoked responses to unpredictable stimuli. *Psychophysiology*, 1973, 10, 125-138.
- Roth, W. T., & Kopell, B. S. P300—An orienting reaction in the human auditory evoked response. *Perceptual & Motor Skills*, 1973, 36, 219-225.
- Rubin, E. H., & McAdam, D. W. Slow potential concomitants of the retrieval process. *Electroencephalography & Clinical Neurophysiology*, 1971, 32, 84-86.
- Ruchin, D. S., & Sutton, S. Visual evoked and emitted potentials and stimulus significance. *Bulletin Psychonomic Society*, 1973, 2, 144-146.
- Satterfield, J. H. Evoked cortical response enhancement and attention in man. A study of responses to auditory and shock stimuli. *Electroencephalography & Clinical Neurophysiology*, 1965, 19, 470-475.
- Schechter, G., & Buchsbaum, M. The effects of attention, stimulus intensity, and individual differences on the average evoked response. *Psychophysiology*, 1973, 10, 392-400.
- Shagass, C. *Evoked brain potentials in psychiatry*. New York: Plenum Press, 1972.
- Sheatz, G. C., & Chapman, R. M. Task relevance and auditory evoked responses. *Electroencephalography & Clinical Neurophysiology*, 1969, 26, 468-475.
- Shelburne, S. A., Jr. Visual evoked responses to word and nonsense syllable stimuli. *Electroencephalography & Clinical Neurophysiology*, 1972, 32, 17-25.
- Shelburne, S. A., Jr. Visual evoked responses to word and nonsense syllable stimuli. *Electroencephalography & Clinical Neurophysiology*, 1972, 32, 17-25.
- Small, J. G., & Small, I. F. Interrelationships of evoked and slow potential responses. *Diseases of the Nervous System*, 1970, 31, 459-464.
- Smith, D. B., Donchin, E., Cohen, L., & Starr, A. Auditory averaged potentials in man during selective binaural listening. *Electroencephalography & Clinical Neurophysiology*, 1970, 28, 146-152.
- Spong, P., Haider, M., & Lindsley, D. B. Selective attentiveness and cortical evoked responses to visual and auditory stimuli. *Science*, 1965, 148, 395-397.
- Spong, P., & Lindsley, D. B. Cortical evoked responses and attentiveness in man: Differential effects of selective attentiveness and general alertness level. *Electroencephalography & Clinical Neurophysiology*, 1968, 24, 393-398.
- Squires, K. C., Hillyard, S. A., & Lindsay, P. H. Cortical potential evoked by confirming and disconfirming feedback following an auditory discrimination. *Perception & Psychophysics*, 1973, 13, 25-31.
- Squires, K. C., Hillyard, S. A., & Lindsay, P. H. Vertex potential evoked during auditory signal detection: Relation to decision criteria. *Perception & Psychophysics*, 1973, 14, 265-272.
- Suchard, D. W. Evoked amplitude change related to intelligence and arousal. *Psychophysiology*, 1973, 10, 445-452.
- Sutton, S. The specification of psychological variables in an average evoked potential experiment. In E. Donchin and D. B. Lindsley (Eds.), *Average evoked potentials: Methods, results and evaluations*. Washington, D. C: U.S. Government Printing Office, 1969, NASA SP-191. Pp. 237-298.
- Sutton, S. The sensitivity of the evoked potential to

- psychological variables. *Electroencephalography & Clinical Neurophysiology*, 1971, 31, 302.
- Sutton, S., Braren, M., Zubin, J., & John E. R. Evoked-potential correlates of stimulus uncertainty. *Science*, 1965, 150, 1187-1188.
- Sutton, S., & Paul, D. D. Evoked potential correlates of the detectability of low intensity signals. In A. Fessard and G. Leland (Eds.), *Average evoked responses and their conditioning in normal subjects and psychiatric patients*. Paris: Institut National de la Santé et de la Recherche Medicale, 1972. Pp. 79-92.
- Sutton, S., & Tueting, P. The sensitivity of the evoked potential to psychological variables. In P. H. Venables and M. J. Christie (Eds.), *Research in psychophysiology*. New York: Wiley, in press.
- Sutton, S., Tueting, P., Zubin, J., & John, E. R. Information delivery and the sensory evoked potentials. *Science*, 1967, 155, 1436-1439.
- Tanguay, P. E., Lee, J. C. M., & Ornitz, E. M. A detailed analysis of the auditory evoked response wave form in children during REM and stage 2 sleep. *Electroencephalography & Clinical Neurophysiology*, 1973, 35, 241-248.
- Tece, J. J. Attention and evoked potentials in man. In D. I. Mostofsky (Ed.), *Attention: Contemporary theory and analysis*. New York: Appleton-Century-Crofts, 1970. Pp. 331-365.
- Tece, J. J. Contingent negative variations and individual differences: A new approach to brain research. *Archives of General Psychiatry*, 1971, 24, 1-16.
- Tece, J. J. Contingent negative variation (CNV) and psychological processes in man. *Psychological Bulletin*, 1972, 77, 73-108.
- Tueting, P. A. Uncertainty and averaged evoked response in a guessing situation. (Doctoral dissertation, Columbia University), Ann Arbor, Mich: University Microfilm, 1968. No. 69-3097.
- Tueting, P. A., & Sutton, S. The relationship between prestimulus negative shifts and poststimulus components of the average evoked potential. In S. Kornblum (Ed.), *Attention and performance IV*. New York: Academic Press, 1973, 185-207.
- Tueting, P. A., Sutton, S., & Zubin, J. Quantitative evoked potential correlates of the probability of events. *Psychophysiology*, 1971, 7, 385-394.
- Vaughan, H. G., Jr. The relationship of brain activity to scalp recordings of event-related potentials. In E. Donchin and D. B. Lindsley (Eds.), *Average evoked potentials: Methods, results, and evaluations*. Washington, D.C: U.S. Government Printing Office, 1969, NASA SP-191. Pp. 45-75.
- Vaughan, H. G., Jr., & Ritter, W. The sources of auditory evoked responses recorded from the human scalp. *Electroencephalography & Clinical Neurophysiology*, 1970, 28, 360-367.
- Waszak, M., & Obrist, W. D. Relationship of slow potential changes to response speed and motivation in man. *Electroencephalography & Clinical Neurophysiology*, 1969, 27, 113-120.
- Weinberg, H., Walter, W. G., & Crow, H. J. Intracerebral events in humans related to real and imaginary stimuli. *Electroencephalography & Clinical Neurophysiology*, 1970, 29, 1-9.
- Weitzman, E. D., & Kremen, H. Auditory evoked responses during different stages of sleep in man. *Electroencephalography & Clinical Neurophysiology*, 1965, 18, 65-70.
- Wilkinson, R. T., & Haines, E. Evoked response correlates of expectancy during vigilance. In A. F. Sanders (Ed.), *Attention and performance III*. Amsterdam: North-Holland, 1970. Pp. 402-413.
- Wilkinson, R. T., & Lee, M. V. Auditory evoked potentials and selective attention. *Electroencephalography & Clinical Neurophysiology*, 1972, 33, 411-418.
- Wilkinson, R. T., & Morlock, H. C., Jr. Auditory evoked response and reaction time. *Electroencephalography & Clinical Neurophysiology*, 1967, 23, 50-56.
- Williams, H. L., Tepas, D. I., & Morlock, H. C., Jr. Evoked responses to clicks and electroencephalographic stages of sleep in man. *Science*, 1962, 138, 685-686.
- Wilson, L. E., Harter, M. R., & Wells, H. H. Evoked cortical potentials and discrimination problem-solving in humans. *Electroencephalography & Clinical Neurophysiology*, 1973, 34, 15-22.
- Zubin, S., & Sutton, S. Assessment of physiological, sensory, perceptual, psychomotor, and conceptual functioning in schizophrenic patients. *Acta Psychiatrica Scandinavica*, 1970, 46, Suppl. 219, 247-263.

NOTE

1. The rationale for these acronyms are: P_3 indicates that the wave is the third major positive deflection of the AEP complex, while P_{300} designates the wave as positive in polarity with a latency of about 300 msec. We will use, in this paper, the designation $P_3(00)$ which has been used elsewhere (Donchin et al, 1974) and, we think, is a reasonable compromise.

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