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Spatiotemporally varying visual hallucinations: II. Spectral classification and comparison with theory. (English) [Zbl 1412.92037](#)
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Summary: In order to better understand the nature of visual hallucinations, and to test predictions of spatiotemporally oscillating hallucinations from a recent corticothalamic model of visual dynamics, clinical descriptions of hallucinations are used to establish boundaries on the spatiotemporal frequencies observed in various disorders. Detailed comparisons with hallucinations during migraine aura demonstrate that key features are consistent with corticothalamic origin and specific abnormalities, but underline the need for more detailed quantitative data to be obtained on temporally oscillating hallucinations more generally.

For Part I, see [the authors et al., *ibid.* 357, 200-209 (2014); [Zbl 1412.92038](#)].

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References:

- [1] Aghajanian, G.; Marek, G., Serotonin and hallucinogens, *Neuropsychopharmacology*, 21, 2, 16-23, (1999)
- [2] Aurora, S., Pathophysiology of migraine headache, *Curr Pain Headache Rep.*, 5, 2, 179-182, (2001)
- [3] Aurora, S.; Ahmad, B.; Welch, K.; Bhardhwaj, P.; Ramadan, N., Transcranial magnetic stimulation confirms hyperexcitability of occipital cortex in migraine, *Neurology*, 50, 4, 1111, (1998)
- [4] Aurora, S.; Welch, K.; Al-Sayed, F., The threshold for phosphenes is lower in migraine, *Cephalalgia*, 23, 4, 258-263, (2003)
- [5] Aurora, S.; Wilkinson, F., The brain is hyperexcitable in migraine, *Cephalalgia*, 27, 12, 1442, (2007)
- [6] Ayata, C.; Jin, H.; Kudo, C.; Dalkara, T.; Moskowitz, M., Suppression of cortical spreading depression in migraine prophylaxis, *Ann. Neurol.*, 59, 4, 652-661, (2006)
- [7] Barnes, J.; David, A., Visual hallucinations in parkinson's disease: a review and phenomenological survey, *Br. Med. J.*, 70, 6, 727-733, (2001)
- [8] Bigal, M.; Krymchanski, A.; Ho, T., Migraine in the triptan era: progress achieved, lessons learned and future developments, *Arq. Neuro-Psiquiatr.*, 67, 559-569, (2009)
- [9] Borruat, F., Photopsia: an often unrecognized symptom and sensitivity of electroretinography, *Klin Monatsblätter für Augenheilkund.*, 212, 5, 394, (1998)
- [10] Breakspear, M.; Roberts, J.; Terry, J.; Rodrigues, S.; Mahant, N.; Robinson, P., A unifying explanation of primary generalized seizures through nonlinear brain modeling and bifurcation analysis, *Cereb. Cortex*, 16, 9, 1296, (2006)
- [11] Bressler, N.; Gills, J., Age related macular degeneration: new hope for a common problem comes from photodynamic therapy, *Br. Med. J.*, 321, 7274, 1425-1427, (2000)
- [12] Brighina, F.; Piazza, A.; Daniele, O.; Fierro, B., Modulation of visual cortical excitability in migraine with aura: effects of 1 Hz repetitive transcranial magnetic stimulation, *Exp. Brain Res.*, 145, 2, 177-181, (2002)
- [13] Brown, G. C.; Murphy, R. P., Visual symptoms associated with choroidal neovascularization. photopsias and the Charles Bonnet syndrome, *Arch. Ophthalmol.*, 110, 9, 1251-1256, (1992)
- [14] Burke, W., The neural basis of Charles Bonnet hallucinations: a hypothesis, *J. Neurol., Neurosurg. Psychiatr.*, 73, 5, 535, (2002)
- [15] Butler, V. P.; Odel, J. G.; Rath, E.; Wolin, M. J.; Behrens, M. M.; Martin, T. J.; Kardon, R. H.; Gouras, P., Digitalis-induced visual disturbances with therapeutic serum digitalis concentrations, *Ann. Intern. Med.*, 123, 9, 676, (1995)
- [16] Capri, G.; Munzone, E.; Tarenzi, E.; Fulfaro, F.; Gianni, L.; Caraceni, A.; Martini, C.; Scaioli, V., Optic nerve disturbances: a new form of paclitaxel neurotoxicity, *J. Natl. Cancer Inst.*, 86, 14, 1099-1101, (1994)
- [17] Carrasco, L.; Ramos, M.; Galisteo, R.; Pisa, D.; Fresno, M.; Gonzalez, M., Isolation of *Candida famata* from a patient with acute zonal occult outer retinopathy, *J. Clin. Microbiol.*, 43, 2, 635-640, (2005)
- [18] Carroll, F., Visual symptoms caused by digitalis, *Trans. Am. Ophthalmol. Soc.*, 42, 243, (1944)

- [19] Chernyshev, O.; Gentry, P., Intravenous valproate sodium (depacon) aborts migraine rapidly preliminary report, *Headache*, 40, 720-723, (2000)
- [20] Cogan, D., *Neurology of the visual system*, (1966), Charles C Thomas Springfield, USA
- [21] Cohen, S. Y.; Bulik, A.; Tadayoni, R.; Quentel, G., Visual hallucinations and Charles Bonnet syndrome after photodynamic therapy for age related macular degeneration, *Br. J. Ophthalmol.*, 87, 8, 977, (2003)
- [22] Coppola, G.; Vandenheede, M.; Di Clemente, L.; Ambrosini, A.; Fumal, A.; De Pasqua, V.; Schoenen, J., Somatosensory evoked high-frequency oscillations reflecting thalamo-cortical activity are decreased in migraine patients between attacks, *Brain*, 128, 1, 98, (2005)
- [23] Crotogino, J.; Feindel, A.; Wilkinson, F., Perceived scintillation rate of migraine aura, *Headache*, 41, 1, 40-48, (2001)
- [24] Devinsky, O.; Desposito, M., *Neurology of cognitive and behavioral disorders*, (2004), Oxford University Press NY, USA
- [25] Engel, J.; Pedley, T.; Aicardi, J.; Dichter, M.; Moshé, S., *Epilepsy: A comprehensive textbook*, (2007), Lippincott Williams & Wilkins Philadelphia, USA
- [26] Etminan, M.; Takkouche, B.; Isorna, F.; Samii, A., Risk of ischaemic stroke in people with migraines systematic review and meta-analysis of observational studies, *Br. Med. J.*, 330, 7482, 63, (2005)
- [27] Ffytche, D. H., Visual hallucinations and the Charles Bonnet syndrome, *Curr. Psychiatr. Rep.*, 7, 3, 168-179, (2005)
- [28] Ffytche, D. H., The hodology of hallucinations, *Cortex*, 44, 8, 1067-1083, (2008)
- [29] Fisher, C. M., Visual disturbances associated with quinine and quinidine, *Neurology*, 31, 12, 1569-1571, (1981)
- [30] Gass, J. D.; Agarwal, A.; Scott, I. U., Acute zonal occult outer retinopathy long-term follow-up study, *Am. J. Ophthalmol.*, 134, 3, 329-339, (2002)
- [31] Gerwig, M.; Niehaus, L.; Kastrup, O.; Stude, P.; Diener, H., Visual cortex excitability in migraine evaluated by single and paired magnetic stimuli, *Headache: J. Head Face Pain*, 45, 10, 1394-1399, (2005)
- [32] Goadsby, P., The vascular theory of migraine - a great story wrecked by the facts, *Brain*, 132, 1, 6, (2009)
- [33] Goadsby, P.; Lipton, R.; Ferrari, M., Migraine - current understanding and treatment, *N. Engl. J. Med.*, 346, 4, 257, (2002)
- [34] Gorji, A., Spreading depression a review of the clinical relevance, *Brain Res. Rev.*, 38, 1-2, 33-60, (2001)
- [35] Grüsser, O. J.; Landis, T., *Visual agnosias and other disturbances of visual perception and cognition*, (1991), CRC Press Boca Raton, USA
- [36] Gupta, V., Migraine, cortical excitability and evoked potentials a clinico-pharmacological perspective, *Brain*, 128, 9, E36, (2005)
- [37] Gutteridge, I. F.; Cole, B. L., Perspectives on migraine prevalence and visual symptoms, *Clin. Exp. Optom.*, 84, 2, 56-70, (2001)
- [38] Hamada, J., The use of antiepileptic drugs for the preventive treatment of migraine, *Brain and Nerve*, 61, 10, 1117, (2009)
- [39] Hazra, M.; Culo, S.; Mamo, D., High-dose quetiapine and photopsia, *J. Clin. Psychopharmacol.*, 26, 5, 546, (2006)
- [40] Henke, H.; Robinson, P.; Drysdale, P.; Loxley, P., Spatiotemporally varying visual hallucinations. I. corticothalamic theory, *J. Theor. Biol.*, (2010)
- [41] Holroyd, S.; Rabins, P.; Finkelstein, D.; Nicholson, M.; Chase, G.; Wisniewski, S., Visual hallucinations in patients with macular degeneration, *Am. J. Psychiatr.*, 149, 12, 1701-1706, (1992)
- [42] Holz, F.; Spaide, R., *Medical retina*, (2005), Springer Berlin, Germany
- [43] Horton, J.; Hoyt, W., The representation of the visual field in human striate cortex a revision of the classic Holmes map, *Arch. Ophthalmol.*, 109, 6, 816, (1991)
- [44] Kandel, E. R.; Schwartz, J. H.; Jessell, T. M., *Principles of neural science*, (2000), McGraw-Hill NY, USA
- [45] Killer, H.; Buettner, U., Multiple visual hallucinations and pseudohallucinations in one individual patient when the world is turning upside down and the television keeps falling to the ground while dwarfs are parading on the ceiling, *Ophthalmologica*, 219, 2, 115-118, (2005)
- [46] Klüver, H., *Mescal and mechanisms of hallucinations*, (1966), University of Chicago Press Chicago
- [47] Krzystolik, M.; Afshari, M.; Adamis, A.; Gaudreault, J.; Gragoudas, E.; Michaud, N.; Li, W.; Connolly, E.; Neill, C.; Miller, J., Prevention of experimental choroidal neovascularization with intravitreal anti-vascular endothelial growth factor antibody fragment, *Arch. Ophthalmol.*, 120, 3, 338-346, (2002)
- [48] Landis, C., Determinants of the critical Flicker-fusion threshold, *Physiol. Rev.*, 34, 2, 259, (1954)
- [49] Lashley, K. S., Patterns of cerebral integration indicated by the scotomas of migraine, *Arch. Neurol. Psychiatr.*, 46, 331-339, (1941)
- [50] Lauritzen, M., 1987. Cerebral blood flow in migraine and cortical spreading depression. *Acta Neurol. Scand. Suppl.* 113, 1.
- [51] Lauritzen, M., Pathophysiology of the migraine aura the spreading depression theory, *Brain*, 117, 1, 199, (1994)
- [52] Lauritzen, M., Cortical spreading depression in migraine, *Cephalalgia*, 21, 7, 757-760, (2001)
- [53] Lüders, H., *Epilepsy comprehensive review and case discussions*, (2001), Informa HealthCare London, UK
- [54] Madill, S. A.; Ffytche, D. H., Charles Bonnet syndrome in patients with glaucoma and good acuity, *Br. J. Ophthalmol.*, 89, 6, 785, (2005)
- [55] Matsui, H.; Udaka, F.; Tamura, A.; Oda, M.; Kubori, T.; Nishinaka, K.; Kameyama, M., Impaired visual acuity as a risk

- factor for visual hallucinations in parkinson's disease, *J. Geriatr. Psychiatr. Neurol.*, 19, 1, 36, (2006)
- [56] McGuire, W.; Rowinsky, E., Paclitaxel in cancer treatment, (1995), Informa Healthcare London, UK
- [57] Mitchell, J.; Vierkant, A. D., Delusions and hallucinations of cocaine abusers and paranoid schizophrenics a comparative study, *J. Psychol.*, 125, 3, 301-310, (1991)
- [58] Montagna, P., Molecular genetics of migraine headaches a review, *Cephalalgia*, 20, 1, 3-14, (2000)
- [59] Mulleners, W.; Chronicle, E.; Palmer, J.; Koehler, P.; Vredevel, J., Visual cortex excitability in migraine with and without aura, *Headache: J. Head and Face Pain*, 41, 6, 565-572, (2001)
- [60] Muranaka, H.; Fujita, H.; Goto, A.; Osari, S.; Kimura, Y., Visual symptoms in epilepsy and migrainelocalization and patterns, *Epilepsia*, 42, 1, 62-66, (2001)
- [61] Negoro, K., Calcium antagonists in the prophylactic treatment of migraine, *Brain and Nerve*, 61, 10, 1135, (2009)
- [62] Olesen, J.; Thomsen, L.; Lassen, L.; Olesen, I., The nitric oxide hypothesis of migraine and other vascular headaches, *Cephalalgia*, 15, 2, 94-100, (1995)
- [63] Panayiotopoulos, C. P., Elementary visual hallucinations, blindness, and headache in idiopathic occipital epilepsydifferentiation from migraine, *Br. Med. J.*, 66, 4, 536, (1999)
- [64] Panayiotopoulos, C. P., Visual phenomena and headache in occipital epilepsy a review, a systematic study and differentiation from migraine, *Epileptic Disord.*, 1, 4, 205-216, (1999)
- [65] Parsons, A.; Strijbos, P., The neuronal versus vascular hypothesis of migraine and cortical spreading depression, *Curr. Opin. Pharmacol.*, 3, 1, 73-77, (2003)
- [66] Pietrobon, D.; Striessnig, J., Neurobiology of migraine, *Nat. Rev. Neurosci.*, 4, 5, 386-398, (2003)
- [67] Reggia, J.; Montgomery, D., A computational model of visual hallucinations in migraine, *Comput. Biol. Med.*, 26, 2, 133-141, (1996)
- [68] Roberts, J.; Robinson, P., Modeling distributed axonal delays in mean-field brain dynamics, *Phys. Rev. E*, 78, 5, 51901, (2008)
- [69] Robinson, P. A.; Rennie, C. J.; Rowe, D. L., Dynamics of large-scale brain activity in normal arousal states and epileptic seizures, *Phys. Rev. E*, 65, 4, 41924, (2002)
- [70] Schott, G. D., Exploring the visual hallucinations of migraine aura: the tacit contribution of illustration, *Brain*, 130, 6, 1690, (2007)
- [71] Seidman, A. D.; Barrett, S.; Canezo, S., Photopsia during 3-h paclitaxel administration at doses ≥ 250 mg / m^2 , *J. Clin. Oncol.*, 12, 8, 1741-1742, (1994)
- [72] Shields, K.; Goadsby, P., Propranolol modulates trigeminovascular responses in thalamic ventroposteromedial nucleus a role in migraine?, *Brain*, 128, 1, 86, (2005)
- [73] Siegel, R. K., Cocaine hallucinations, *Am. J. Psychiatr.*, 135, 3, 309, (1978)
- [74] Silberstein, S.; Lipton, R.; Dodick, D.; Freitag, F.; Mathew, N.; Brandes, J.; Bigal, M.; Ascher, S.; Morein, J.; Wright, P., Topiramate treatment of chronic migraine a randomized, placebo-controlled trial of quality of life and other efficacy measures, *Headache: J. Head and Face Pain*, 49, 8, 1153-1162, (2009)
- [75] Spitzberg, D., Acute anterior uveitis secondary to quinidine sensitivity, *Arch. Ophthalmol.*, 97, 10, 1993, (1979)
- [76] Stein, G.; Wilkinson, G., *Seminars in general adult psychiatry*, (2007), Royal College of Psychiatrists Publications London, UK
- [77] Tan, C. S.; Sabel, B. A., Dynamic changes in visual acuity as the pathophysiologic mechanism in charles Bonnet syndrome (visual hallucinations), *Eur. Arch. Psychiatr. Clin. Neurosci.*, 256, 1, 62-63, (2006)
- [78] Tan, C. S.H.; Sabel, B. A.; Goh, K. Y., Visual hallucinations during visual recovery after central retinal artery occlusion, *Arch. Neurol.*, 63, 4, 598-600, (2006)
- [79] Tan, W.; Walsh, T., Ocular toxicity secondary to paclitaxel in two lung cancer patients, *Med. Pediatr. Oncol.*, 31, 3, (1998)
- [80] Tatlıpınar, S.; Kadayıfçılar, S.; Eldem, B.; Türkçüoğlu, P., Prevalence of photopsias and charles Bonnet syndromeevaluation of eighty cases with low vision, *Neuro-Ophthalmol.*, 25, 4, 193-197, (2001)
- [81] Tfelt-Hansen, P., Triptans vs other drugs for acute migraine. are there differences in efficacy? A comment, *Headache*, 48, 4, 601-605, (2008)
- [82] Tyler, C. W., Some new entoptic phenomena, *Vis. Res.*, 18, 12, 1633-1639, (1978)
- [83] Tzourio, C.; Tehindrazanarivelo, A.; Iglesias, S.; Alperovitch, A.; Chedru, F.; d'Anglejan Chatillon, J.; Bousser, M., Case-control study of migraine and risk of ischaemic stroke in Young women, *Br. Med. J.*, 310, 6983, 830, (1995)
- [84] White, N., The treatment of malaria, *N. Engl. J. Med.*, 335, 11, 800-806, (1996)
- [85] Wilkinson, F., Auras and other hallucinationswindows on the visual brain, *Prog. Brain Res.*, 144, 305-320, (2004)
- [86] Wilson, S., On the retino-cortical mapping, *Int. J. Man-Mach. Stud.*, 18, 4, 361-389, (1983)

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