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08-23; O: 2016-08-26; 5•5 (x >~ O: 2016-09-30

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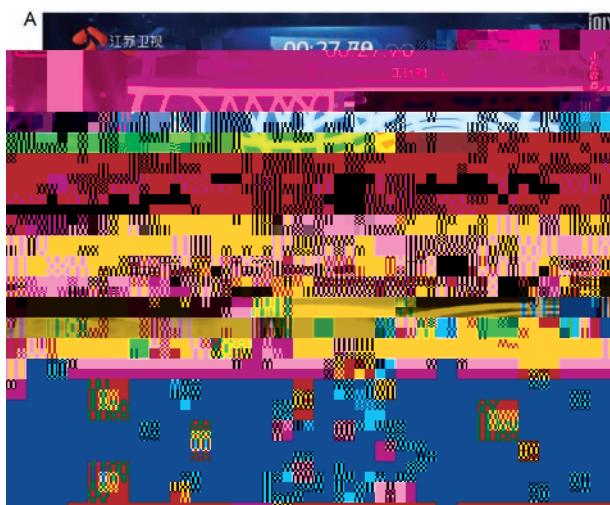
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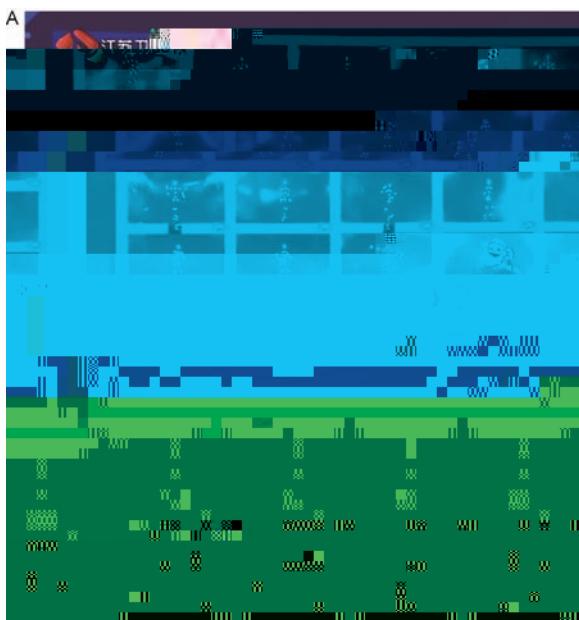
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- 1 Zhou X, Marslen-Wilson W. Phonology, orthography, and semantic activation in reading Chinese. *J Mem Lang*, 1999, 41: 600
- 2 Soulières I, Hubert B, Rouleau N, et al. Superior estimation abilities in two autism spectrum children. *Cogn Neuropsychol*, 2002, 19: 261–276
- 3 Falter C M, Braeutigam S, Nathan R, et al. Enhanced access to visual processing of perceptual simultaneity in autism spectrum disorders. *J Autism Dev Disord*, 2013, 43: 185–196
- 4 Snyder A. Explaining and inducing savant skills: privileged access to lower level, less-processed information. *Philos Trans R Soc Lond B Biol Sci*, 2009, 364: 1399–1405
- 5 Miller L K. The savant syndrome: intellectual impairment and exceptional skill. *Psychol Bull*, 1999, 125: 31
- 6 Treffert D A. The savant syndrome: an extraordinary condition. *Autism: past, present, future*. *Philos Trans R Soc Lond B Biol Sci*, 2009, 364: 1351–1357
- 7 Heaton P, Wallace G L. Annotation: The savant syndrome. *J Child Psychol Psychiatry*, 2004, 45: 899
- 8 Karni A, Sagi D. Where practice makes perfect in texture discrimination: evidence for primary visual cortex plasticity. *Proc Natl Acad Sci USA*, 1991, 88: 4960–4970
- 9 Poggio T, Fahle M, Edelman S. Fast perceptual learning in visual hyperacuity. *Science*, 1991, 251: 1021–1018
- 10 Dosher B A, Lu Z L. Mechanisms of perceptual learning. *Vision Res*, 1999, 39: 319–321
- 11 Adini Y, Sagi D, Tsodyks M. Context-enabled learning in the human visual system. *Nature*, 2002, 415: 797–800
- 12 Ball K, Sekuler R. A specific and enduring improvement in visual motion discrimination. *Science*, 1982, 218: 699–702
- 13 Harris J A, Harris I M, Diamond M E. The topography of tactile learning in humans. *J Neurosci*, 2001, 21: 1066–1073
- 14 Wright B A, Buonomano D V, Mahncke H W, et al. Learning and generalization of auditory temporal interval discrimination in humans. *J Neurosci*, 1997, 17: 3958–3963
- 15 Schwartz S, Maquet P, Frith C. Neural correlates of perceptual learning: a functional MRI study of visual texture discrimination. *Proc Natl Acad Sci USA*, 2002, 99: 17137–17142
- 16 Schoups A A, Vogels R, Orban G A. Human perceptual learning identifying the oblique orientation: retinotopy, orientation specificity and monocularity. *J Physiol*, 1995, 483: 797
- 17 Ahissar M, Hochstein S. The reverse hierarchy theory of perceptual learning. *Trends Cogn Sci*, 2004, 8: 454–464
- 18 Li W, Piëch V, Gilbert C D. Perceptual learning and top-down influences in primary visual cortex. *Nat Neurosci*, 2004, 7: 651–657
- 19 Schoups A, Vogels R. The reverse hierarchy theory of perceptual learning. *Trends Cogn Sci*, 2004, 8: 454–464

- 29 Culham J C, Cavanagh P, Kanwisher N G. Attention response functions: characterizing brain areas using fMRI activation during parametric variations of attentional load. *Neuron*, 2001, 32: 737–745
- 30 Howe P D, Horowitz T S, Morocz I A, et al. Using fMRI to distinguish components of the multiple object tracking task. *J Vis*; 20 1–11
- 31 Jovicich J, Peters R J, Koch C, et al. Brain areas specific for attentional load in a motion-tracking task. *J Cogn Neurosci*; 20 1048–1058
- 32 Johansson G. Visual perception of biological motion and a model for its analysis. *Percept Psychophys*, 1973, 14: 201–211
- 33 Kozlowski L T, Cutting J E. Recognizing the sex of a walker from a dynamic point-light display. *Percept Psychophys*, 1977;50: 5
- 34 Cutting J E, Kozlowski L T. Recognizing friends by their walk: Perception without familiarity cues. *Bull Psychon Soc*, 1979; 353–356
- 35 Walk R D, Homan C P. Emotion and dance in dynamic displays. *Bull Psychon Soc*, 1984, 22: 437–440
- 36 Cutting J E, Moore C, Morrison R. Masking the motions of human gait. *Percept Psychophys*, 1988, 44: 339–347
- 37 :»!õ, )»91. +O(TM) Ø Đ (© 2 W » f5 ' ¼ PG F Ø, ' OE+X . ó\*60 –F ..., 2011, 19: 301–311
- 38 Dittrich W H, Lea S E G, Barrett J, et al. Categorization of natural movements by pigeons: Visual concept discrimination of biological motion. *J Exp Anal Behav*, 1998, 70: 281–299
- 39 Regolin L, Tommasi L, Vallortigara G. Visual perception of biological motion in newly hatched chicks as revealed by an imprinting procedure. *Anim Cogn*, 2000, 3: 53–60
- 40 Simion F, Regolin L, Bulf H. A predisposition for biological motion in the newborn baby. *Proc Natl Acad Sci USA*, 2008, 105: 809
- 41 Pavlova M, Krägeloh-Mann I, Sokolov A, et al. Recognition of point-light biological motion displays by young children. *Percept* 2001, 30: 925–933
- 42 Bonda E, Petrides M, Ostry D, et al. Specific involvement of human parietal systems and the amygdala in the perception of biological motion. *J Neurosci*, 1996, 16: 3737–3744
- 43 Saygin A P. Superior temporal and premotor brain areas involved for biological motion perception. *Brain*, 2007, 130: 2452–2461