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Dynamics, models, and mechanisms of the cognitive flexibility of preschoolers

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References

A

- Akaike, H. (1974). A new look at the statistical model identification. *IEEE Transactions on Automatic Control*, *19*, 716-723.
- Ashby, F.G., Alfonso-Reese, L.A., Turken, A.U., & Waldron, E.M. (1998). A neuropsychological theory of multiple systems in category learning. *Psychological review*, *105*(3), 442-81.
- Ashby, F.G., & Ell, S.W. (2001). The neurobiology of human category learning. *Trends in Cognitive Sciences*, *5*, 204-210.
- Azzalini, A. (1996). *Statistical inference based on the likelihood*. London: Chapman & Hall.

B

- Blair, C., & Razza, R.P. (2007). Relating effortful control, executive function, and false belief understanding to emerging math and literacy ability in kindergarten. *Child Development*, *78*, 647-663.
- Bohlman, N.L., & Fenson, L. (2005). The effects of feedback on perseverative errors in preschool aged children. *Journal of Cognition and Development*, *6*, 119-131.
- Brace, J.J., Morton, J.B., & Munakata, Y. (2006). When actions speak louder than words. Improving children's flexibility in a card-sorting task. *Psychological Science*, *17*, 665-669.
- Brainerd, C.J. (1978). The stage question in cognitive-developmental theory. *The Behavioral and Brain Sciences*, *2*, 173-213.
- Buss, A., & Spencer, J.P. (2008). The emergence of rule-use: A dynamic neural field model of the DCCS. In B.C. Love, K. McRae, & V.M. Sloutsky (Eds.), *Proceedings of the 30th Annual Conference of the Cognitive Science Society* (pp. 463-468). Austin, TX: Cognitive Science Society.

C

- Carlson, S.M. (2005). Developmentally sensitive measures of executive function in preschool children. *Developmental Neuropsychology*, *28*, 595-616.
- Chatham, C.H., Yerys, B.E., & Munakata, Y. (2012). Why won't you do what I want? The informative failures of children and models. *Cognitive Development*, *27*, 349-366.

- Chevalier, N., & Blaye, A. (2008). Cognitive flexibility in preschoolers: the role of representation activation and maintenance. *Developmental Science, 11*, 339-353.
- Cohen, J.D., Dunbar, K., & McClelland, J.L. (1990). On the control of automatic processes: A parallel distributed processing model of the stroop effect. *Psychological Review, 97*, 332-361.
- Cohen, J.D., & Servan-Schreiber, D. (1992). Context, cortex and dopamine: A connectionist approach to behavior and biology in schizophrenia. *Psychological Review, 99*, 45-77.
- Coldren, J.T., & Colombo, J. (2009). Attention as a cueing function during kindergarten children's dimensional change task performance. *Infant and Child Development, 18*, 441-454.

D

- Deák, G.O. (2003). The development of cognitive flexibility and language abilities. *Advances in child development and behavior, 31*, 271-327.
- Diamond, A. (1985). Development of the ability to use recall to guide action, as indicated by infants' performance on AB. *Child Development, 56*, 868-883.
- Diamond, A. (2006a). The early development of executive functions. In E. Bialystock & F.I.M. Craik (Eds.), *Lifespan cognition mechanisms of change (pp. 70-95)*. Oxford, UK: Oxford University Press.
- Diamond, A. (2006b). Bootstrapping conceptual deduction using physical connection: rethinking frontal cortex. *Trends in Cognitive Sciences, 10*, 212-218.
- Diamond, A. (2013). Executive Functions. *Annual Review of Psychology, 64*, 135-168.
- Diamond, A., Barnett, W.S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science, 318*, 1387-1388.
- Diamond, A., Carlson, S.M., & Beck, D.M. (2005). Preschool children's performance in task switching on the dimensional change card sort task: separating the dimensions aids the ability to switch. *Developmental Neuropsychology, 28*, 689-729.

- Diamond, A., Churchland, A., Cruess, L., & Kirkham, N.Z. (1999). Early developments in the ability to understand the relation between stimulus and reward. *Developmental Psychology, 35*, 1507–1517.
- Diamond, A., & Kirkham, N. (2005). Not quite as grown-up as we like to think: Parallels between cognition in childhood and adulthood. *Psychological Science, 16*, 291-297.
- Diamond, A., & Lee, K. (2011). Interventions shown to aid executive function development in children 4 to 12 years old. *Science, 333*, 959-964.
- Diamond, A., Lee, E.Y., & Hayden, M. (2003). Early success in using the relation between stimuli and rewards to deduce an abstract rule: Perceived physical connection is key. *Developmental Psychology, 39*, 825-847
- Diamond, A., & Taylor, C. (1996). Development of an aspect of executive control: Development of the abilities to remember what I said and to “Do as I say, not as I do”. *Developmental Psychobiology, 29*, 315-334.

E

- Eckstein, S.G. (1999). A dynamical model of cognitive growth in a population: spatial tasks and conservation. *Journal of Mathematical Psychology, 43*, 34-70.
- Eckstein, S.G. (2000). Growth of cognitive abilities: Dynamic models and scaling. *Developmental Review, 20*, 1-28.
- Espinet, S.D., Anderson, J.E., & Zelazo, P.D. (2013). Reflection training improves executive function in pre-school-age children: Behavioral and neural effects. *Developmental Cognitive Neuroscience, 4*, 3-15.

F

- Fahlman, S.E., & Lebiere, C. (1990). The cascade-correlation learning architecture. In D.S. Touretzky (Ed.), *Advances in neural information-processing systems, Vol. 2*. Los Altos, CA: Morgan Kaufmann.
- Fisher, A., Thiessen, E., Godwin, K., Kloos, H., & Dickerson, J. (2013). Assessing selective sustained attention in 3- to 5-year-old children: Evidence from a new paradigm. *Journal of Experimental Child Psychology, 114*, 275-294.

- Fisher, K.W., Pipp, S.L., & Bullock, D. (1984). Detecting developmental discontinuities: Methods and measurement. In R.N. Emde & R.J. Harmon (Eds.), *Continuities and discontinuities in development* (pp. 95-122). New York: Plenum Press.
- Flavell, J.H. (1971). Stage-related properties of cognitive development. *Cognitive Psychology*, 2, 421-453.
- Flavell, J.H., Flavell, E.R., & Green, F.L. (1986). Development of knowledge about the appearance-reality distinction. *Monographs of the Society for Research in Child Development*, 51, 1-87.

G

- Gilmore, R. (1981). *Catastrophe theory for scientists and engineers*. New York: Wiley.

H

- Hanania, R. (2010). Two types of perseveration in the dimension change card sort task. *Journal of Experimental Child Psychology*, 107, 325-336.
- Huang-Pollock, C.L., Maddox, W.T., & Karalunas, S.L. (2011). Development of implicit and explicit category learning. *Journal of Experimental Child Psychology*, 109, 321-335.
- Huizinga, M., Dolan, C.V., & Van der Molen, M.W. (2006). Age-related changes in executive function: developmental trends and a latent variable analysis. *Neuropsychologica*, 44, 2017-2036.

J

- Jansen, B.R.J., & Van der Maas, H.L.J. (2001). Evidence for the phase transition from rule I to rule II on the balance scale task. *Developmental Review*, 21, 450-494.
- Johansen, M.K., & Palmeri, T.J. (2002). Are there representational shifts during category learning? *Cognitive Psychology*, 45, 482-553.
- Johnson, J.S., Spencer, J.P., & Schöner, G. (2008). Moving to higher ground: The dynamic field theory and the dynamics of visual cognition. In F. Garzón, A. Laakso, & T. Gomila (Eds.) *Dynamics and Psychology* (special issue). *New ideas in Psychology*, 26, 227-251.

- Jordan, P.L., & Morton, J.B. (2008). Flankers facilitate 3-year-olds' performance in a card-sorting task. *Developmental Psychology, 44*, 265-274.
- Jordan, P.L., & Morton, J.B. (2007). *Continuous variation in 3-year-olds' card sorting performance as a result of parametric manipulations of post-switch conflict*. Poster presented at the biennial meeting of the society for Research in Child Development, Boston, MA.

K

- Karbach, J., & Kray, J. (2009). How useful is executive control training? Age differences in near and far transfer of task-switching training. *Developmental Science, 12*, 978-990.
- Katada, N., & Nishimura, N. (2009). Stochastic resonance in recurrent neural network with Hopfield-type memory. *Neural Processing Letters, 30*, 145-154.
- Kharitonova, M., Chien, S., Colunga, E., & Munakata, Y. (2009). More than a matter of getting 'unstuck': flexible thinkers use more abstract representations than perseverators. *Developmental Science, 12*, 662-669.
- Kharitonova, M., & Munakata, Y. (2011). The role of representations in executive function: investigating a developmental link between flexibility and abstraction. *Frontiers in Psychology, 2*, 347.
- Kirkham, N.Z., Cruess, L., & Diamond, A. (2003). Helping children apply their knowledge to their behavior on a dimension-switching task. *Developmental Science, 6*, 449-476.
- Kloo, D., & Perner, J. (2003). Training transfer between card sorting and false belief understanding: helping children apply conflicting descriptions. *Child Development, 74*, 1823-1839.
- Kloo, D., & Perner, J. (2005). Disentangling dimensions in the dimensional change card-sorting task. *Developmental Science, 8*, 44-56.
- Kohlberg, L. (1963). The development of children's orientations toward a moral order: I. sequence in the development of moral thought. *Vita Humana, 6*, 11-33

M

- Marcovitch, S., & Zelazo, P.D. (2000). A generative connectionist model of the development of rule use in children. In *Proceedings of the Twenty-second Annual Conference of the Cognitive Science Society* (pp. 334-339). Hillsdale, USA: Lawrence Erlbaum Associates.
- Mascalzoni, E., Regolin, L., Vallortigara, G., & Simion, F. (2013). The cradle of causal reasoning: newborns' preference for physical causality. *Developmental Science*, *16*, 327-335.
- Medin, P.L., & Schaffer, M.M. (1978). Context theory of classification learning. *Psychological Review*, *85*, 207-238.
- Milner, B. (1964). Some effects of frontal lobectomy in man. In J.M. Warren & K. Akert (Eds.), *The frontal granular cortex and behavior*. New York: McGraw-Hill.
- Moffit, T.E., Arsenaault, L., Belsky, D., Dickson, N., Hancox, R.J., Harrington, H.L., Houts, R., Poulton, R., Roberts, B., Ross, S., Sears, M., Thomson, W.M., Caspi, A. (2011). A gradient of childhood selfcontrol predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences, USA*, *108*, 2693-2698.
- Morton, J.B., & Munakata, Y. (2002). Active versus latent representations: A neural network model of perseveration, dissociation and decalage. *Developmental Psychobiology*, *40*, 255-265.
- Müller, U., Dick, A.S., Gela, K., Overton, W.F., & Zelazo, P.D. (2006). The role of negative priming in preschoolers' flexible rule use on the dimensional change card sort task. *Child Development*, *77*, 395-412.
- Munakata, Y. (1998). Infant perseveration and implications for object permanence theories: A PDP model of the AB task. *Developmental Science*, *1*, 161-184.

N

- Nosofsky, R.M., Palmeri, T.J., & McKinley, S.C. (1994). Rule plus-exception model of classification learning. *Psychological Review*, *101*, 53-79.

P

- Patalano, A.L., Smith, E.E., Jonides, J., & Koeppel, R. (2001). PET evidence for multiple strategies of categorization. *Journal of Cognitive, Affective, and Behavioral Neuroscience, 1*, 360-370.
- Perner, J. & Lang, B. (2002). What causes 3-year-olds' difficulty on the dimensional change card sorting task? *Infant & Child Development, 11*, 93-105.
- Piaget, J. (1954). *The construction of reality in the child*. New York: Basic.
- Piaget, J., & Inhelder, B. (1969). *The psychology of the child*. New York: Basic Books.
- Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral and Brain Sciences, 1*, 515-526.

R

- Rabiner, L.R. (1989). A tutorial on hidden Markov models and selected applications in speech recognition. *Proceedings of IEEE, 77-2* (pp. 267-295).
- Ramscar, M., Dye, M., Witten, J., & Klein, J. (2009). Two routes to cognitive flexibility: learning and response conflict resolution in the dimensional change card sort task. In N.A. Taatgen, & H. van Rijn (Eds.), *Proceedings of the 31th Annual Conference of the Cognitive Science Society* (pp. 3169-3174). Austin, TX: Cognitive Science Society.
- Ramscar, M., Dye, M., Gustafson, J.W., & Klein, J. (2013). Dual routes to cognitive flexibility: learning and response conflict resolution in the dimensional change card sort task. *Child Development, 84*, 1308-1323.
- R Development Core Team (2009). *R: A language and environment for statistical computing*. R Foundation for Statistical Computing, Vienna, Austria. URL: <http://www.R-project.org>
- Rueda, M.R., Checa, P., & C6mbita, L.M. (2012). Enhanced efficiency of the executive attention network after training in preschool children: immediate changes and effects after two months. *Developmental Cognitive Neuroscience, 2*, S192-S204.

S

- Scheffer, M., Bascompte, J., Brock, W. A., Brovkin, V., Carpenter, S.R., Dakos, V., Held, H., van Nes, E.H., Rietkerk, M., & Sugihara, G. (2009). Early-warning signals for critical transitions. *Nature*, *461*, 53-59.
- Scheibehenne, B., Rieskamp, J., & Wagenmakers, E.J. (2013). Testing Adaptive Toolbox Models: A Bayesian Hierarchical Approach. *Psychological Review*, *120*, 39-64.
- Schmittmann, V.D., Dolan, C.V., Van der Maas, H.L.J., & McNeal, M.C. (2005). Discrete Latent Markov Models for Normally Distributed Response Data. *Multivariate Behavioral Research*, *40*(4), 461-488.
- Schwarz, G. (1978). Estimating the dimensions of a model. *Annals of statistics*, *6*, 461-464.
- Smith, L.B., & Yu, C. (2012). Visual attention is not enough: Individual differences in statistical word-referent learning in infants. *Language, Learning and Development*, *00*, 1-25.
- Snyder, H.R., & Munakata, Y. (2010). Becoming self-directed: abstract representations support endogenous flexibility in children. *Cognition*, *116*, 155-167.
- Son, J.Y., Smith, L.B., & Goldstone, R.L. (2008). Simplicity and generalization: short-cutting abstraction in children's object categorizations. *Cognition*, *108*, 626-638.
- Stedron, J.M., Sahni, S.D., & Munakata, Y. (2005). Common mechanisms for working memory and attention: The case of perseveration with visible solutions. *Journal of Cognitive Neuroscience*, *17*, 623-631.

T

- Thom, R. (1975). *Structural stability and morphogenesis*. Reading, MA: Benjamin
- Thorell, L.B., Lindqvist, S., Bergman, S., Bohlin, G., & Klingberg, T. (2009). Training and transfer effects of executive functions in preschool children. *Developmental Science*, *12*, 106-113.
- Towse, J.N., Redbond, J., Houston-Price, C.M.T., & Cook, S. (2000). Understanding the dimensional change card sort perspectives from task success and failure. *Cognitive Development*, *15*, 347-365.

V

- Van Bers, B.M.C.W., Visser, I., van Schijndel, T.J.P., Mandell, D.J., & Raijmakers, M.E.J. (2011). The dynamics of development on the Dimensional Change Card Sorting task. *Developmental Science*, *14*, 960-971.
- Van Bers, B.M.C.W., Visser, I., & Raijmakers, M.E.J. (in press). *Preschoolers can form abstract rule representations regardless of cognitive flexibility*. *Journal of Experimental Child Psychology*.
- Van Bers, B.M.C.W., Visser, I., & Raijmakers, M.E.J. (2014). *The distinctive effects of exogenous factors on preschoolers' DCCS performance*. Manuscript submitted for publication.
- Van de Pol, F., & Langeheine, R. (1990). Mixed Markov latent class models. *Sociological Methodology*, *20*, 213-248.
- Van der Maas, H.L.J., & Molenaar, P.C.M. (1992). Stagewise cognitive development: An application of catastrophe theory. *Psychological Review*, *99*, 395-417.
- Van der Maas, H.L.J., & Raijmakers, M.E.J. (2009). Transitions in cognitive development: Prospects and limitations of a neural dynamic approach. In John P. Spencer, Michael S.C. Thomas & James L. McClelland (Eds.), *Toward a unified theory of development, connectionism and dynamic systems theory re-considered* (pp. 299-312). New York: Oxford University Press.
- Van der Maas, H., Raijmakers, M., Hartelman, P., & Molenaar, P. (1999). Reaction time recovery after perturbation. In G. Savelsbergh, H. van der Maas & P. van Geert (Eds.), *Non-linear developmental processes, Vol. 175* (pp. 159-168). Amsterdam: Royal Netherlands Academy of Arts and Sciences.
- Van der Maas, H.L.J., & Straatemeier, M. (2008). How to detect cognitive strategies: commentary on 'differentiation and integration: guiding principles for analyzing cognitive change'. *Developmental Science*, *11*, 449-453.
- Van Geert, P. (1991). A dynamic systems model of cognitive and language growth. *Psychological Review*, *98*, 3-53.

- Van Geert, P. (1998). A dynamic systems model of basic developmental mechanisms: Piaget, Vygotsky, and beyond. *Psychological Review*, *105*, 634-677.
- Visser, I. (2007). *Depmix: An R-package for fitting mixture models on mixed multivariate data with Markov dependencies*. R-package manual and introduction into Dependent Mixture models.
- Visser, I. (2011). Seven things to remember about hidden Markov models: a tutorial on Markovian models for time series. *Journal of Mathematical Psychology*, *55*, 403-415.
- Visser, I., & Speekenbrink, M. (2010). DepmixS4: An R-package for hidden Markov models. *Journal of Statistical Software*, *36*, 1-21.

W

- Wagenmakers, E.J., Molenaar, P.C.M., Grasman, R.P.P.P., Hartelman, P.A.I., & Van der Maas, H.L.J. (2005). Transformation invariant stochastic catastrophe theory. *Physica D*, *211*, 263-276.
- Wickens, T.D. (1982). *Models for behavior: Stochastic processes in psychology*. San Francisco: W.H. Freeman and Company.
- Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, *13*, 103-128.

Y

- Yerys, B.E., & Munakata, Y. (2006). When labels hurt but novelty helps: children's perseveration and flexibility in a card-sorting task. *Child Development*, *77*, 1589-1607.

Z

- Zeeman, E.C. (1976). Catastrophe Theory. *Scientific American*, *234*, 65-83.
- Zelazo, P.D. (2006). The Dimensional Change Card Sort (DCCS): A method of assessing executive function in children. *Nature Protocols*, *1*, 297-301.

- Zelazo, P.D., Carlson, S.M., & Kesek, A. (2008). The development of executive function in childhood. In: Nelson, C., Luciana, M. (Eds.), *Handbook of Developmental Cognitive Neuroscience* MIT Press, Cambridge, MA.
- Zelazo, P.D., & Frye, D. (1997). Cognitive Complexity and Control: A theory of the development of deliberate reasoning and intentional action. In M. Stamenov (Ed.), *Language structure, discourse, and the access to consciousness* (pp. 113-153). Amsterdam and Philadelphia: John Benjamins.
- Zelazo, P.D., Frye, D., & Rapus, T. (1996). An age-related dissociation between knowing rules and using them. *Cognitive Development*, 11, 37-63.
- Zelazo, P.D., Müller, U., Frye, D., & Marcovitch, S. (2003). The development of executive function in early childhood. *Monographs of the Society for Research in Child Development*, 68 (3), serial No. 274.