Vzdělání pro život:
Pohled na Montessori vzdělávání z hlediska neurovědy

Steven J. Hughes PhD, ABPdN
Dětský neuropsycholog / výzkumný výbor AMI
BuildingBetterBrains.com / GoodAtDoingThings.com

Co potřebujete, abyste byli úspěšní

Google

- Známky na vysoké škole jsou jako kritéria přijímání zaměstnanců bezcenné
- Mírně relevantní pouze pro čerstvé absolventy univerzity
- Výsledky testů jsou bezcenné
- Mozkové hlavolamy jsou naprostou ztrátou času

Lazlo Block
Hlavní viceprezident People Operations ve společnosti Google

http://www.nytimes.com/2013/06/20/business/in-head-hunting-big-data-may-not-be-such-a-big-deal.html

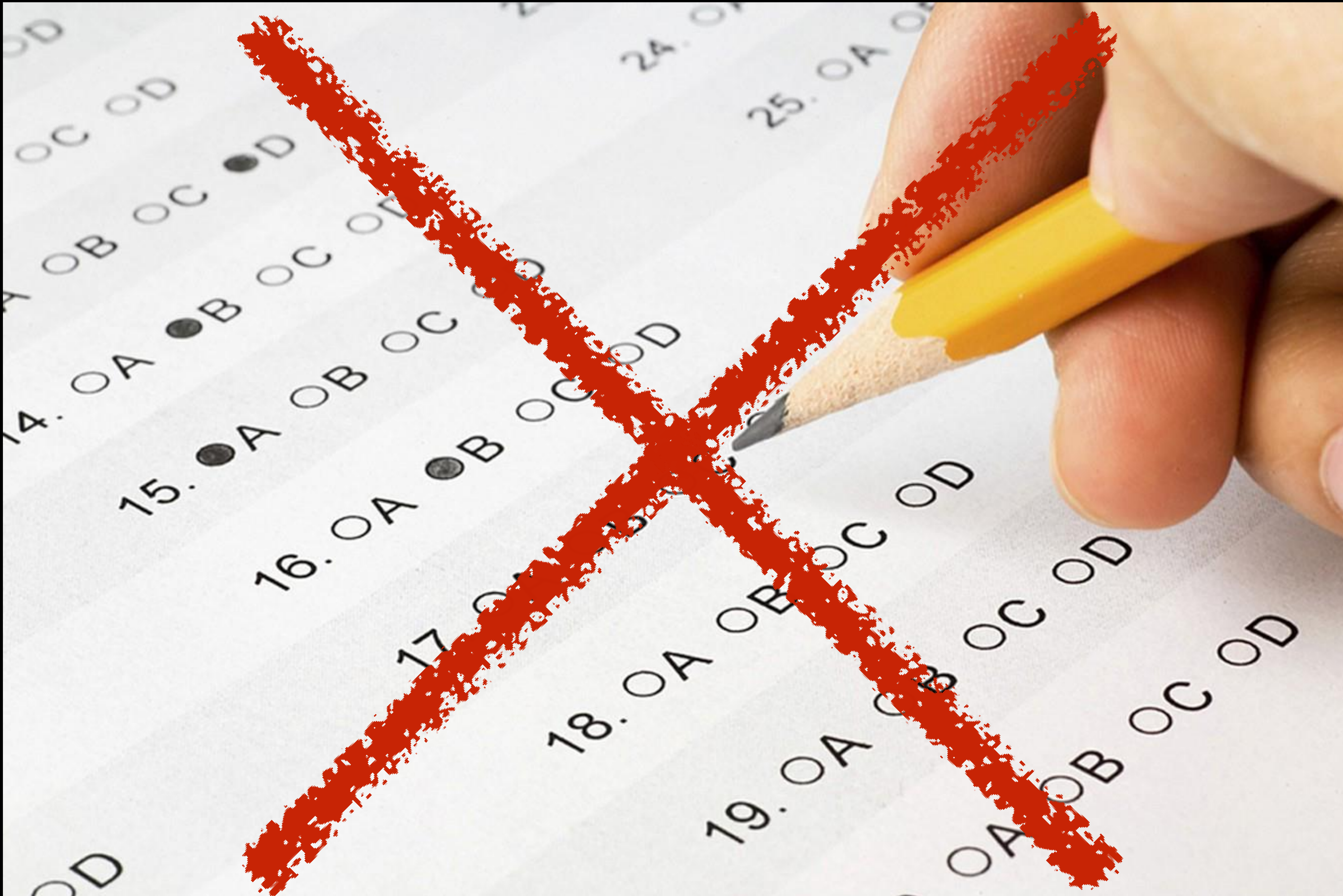
“Dejte mi příklad, kdy jste vyřešili analyticky obtížný problém.”

http://www.nytimes.com/2013/06/20/business/in-head-hunting-big-data-may-not-be-such-a-big-deal.html

1 700 ředitelů společností
v 64 zemích
v 18 hlavních odvětvích

V globální ekonomice musí být lídři i zaměstnanci schopni

- Inovovat
- Analyticky myslet
- Spolupracovat
- Být tvořiví
- Vyhledávat příležitosti
- Zvládat komplikované úkoly
- Efektivně komunikovat



Co potřebujete, abyste byli úspěšní

Přemýšlet?

~~Přemýšlet?~~

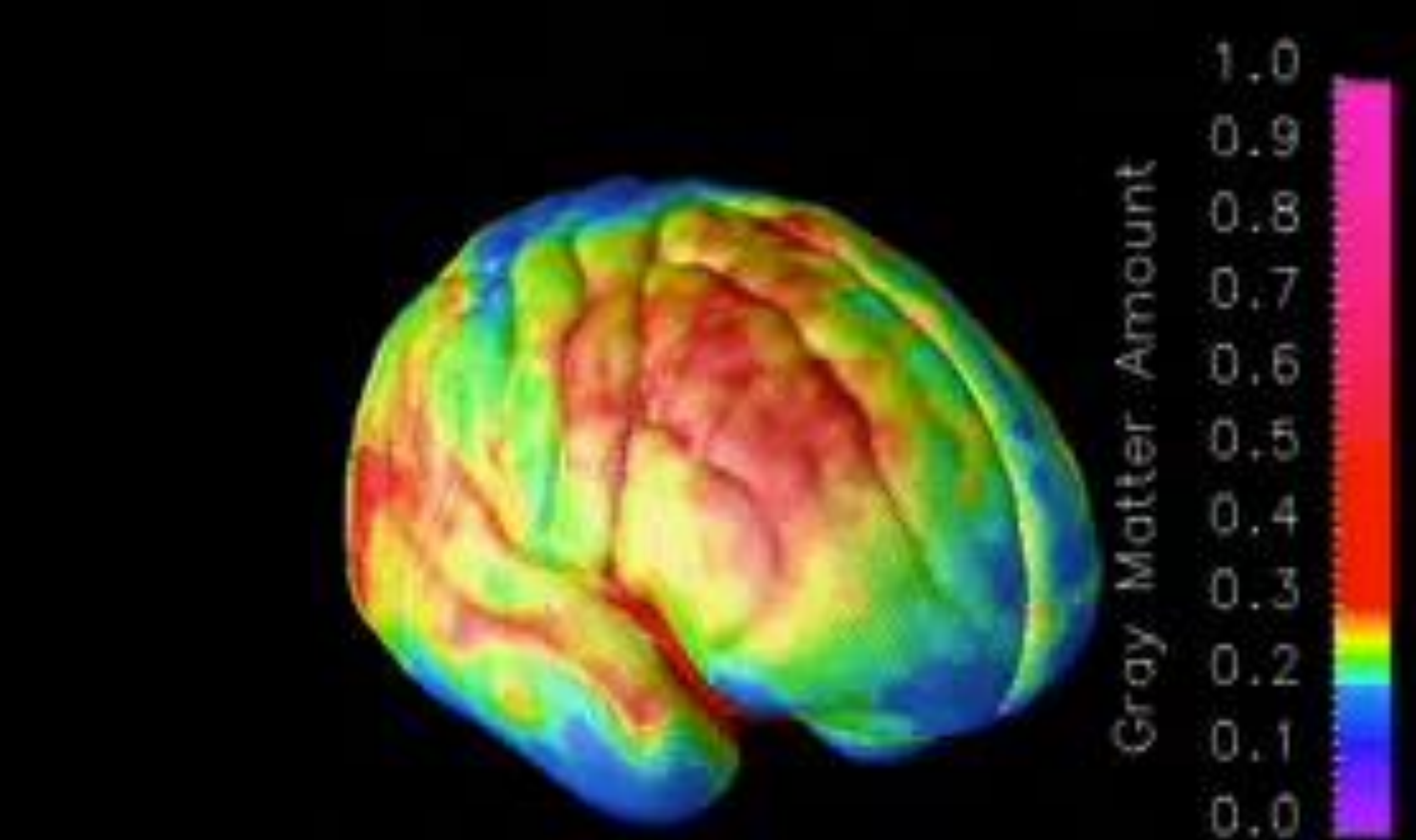
Pamatovat si

Neokortex

- Vytváří smyslovo-motorický model světa
- Zpracuje smyslový signál
- Rozpozná sekvence
- Učiní předpověď o budoucnosti
- Porovná vzory
- Odhalí anomálie

Smyslovo-motorické párování

“Co kdy dělat”



Gotey et a., (2007). Dynamické zobrazení lidského kortikálního rozvoje během dětství a rané dospělosti. PNAS 25. května 2004 roč. 101 č. 21 8174-8179.
http://www.pnas.org/content/101/21/8174.abstract

Namáhavé…

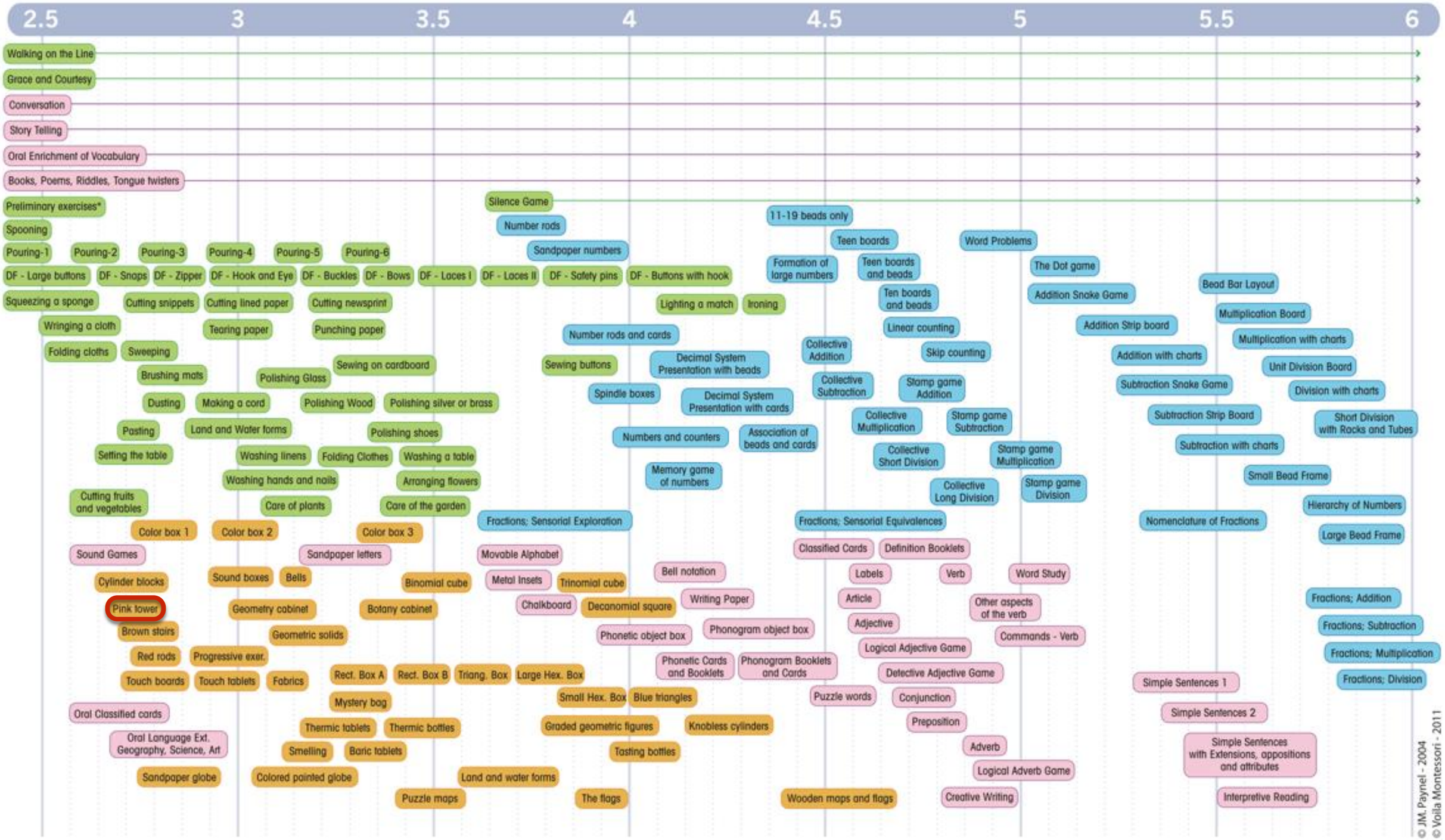
Motivované…

Opakované…

Zkoušené metodou pokusu a omylu…

experimentální
interakce s okolím.

Namáhavé, motivované, opakované, zkoušené metodou pokusu a omylu, experimentální interakce s okolím.

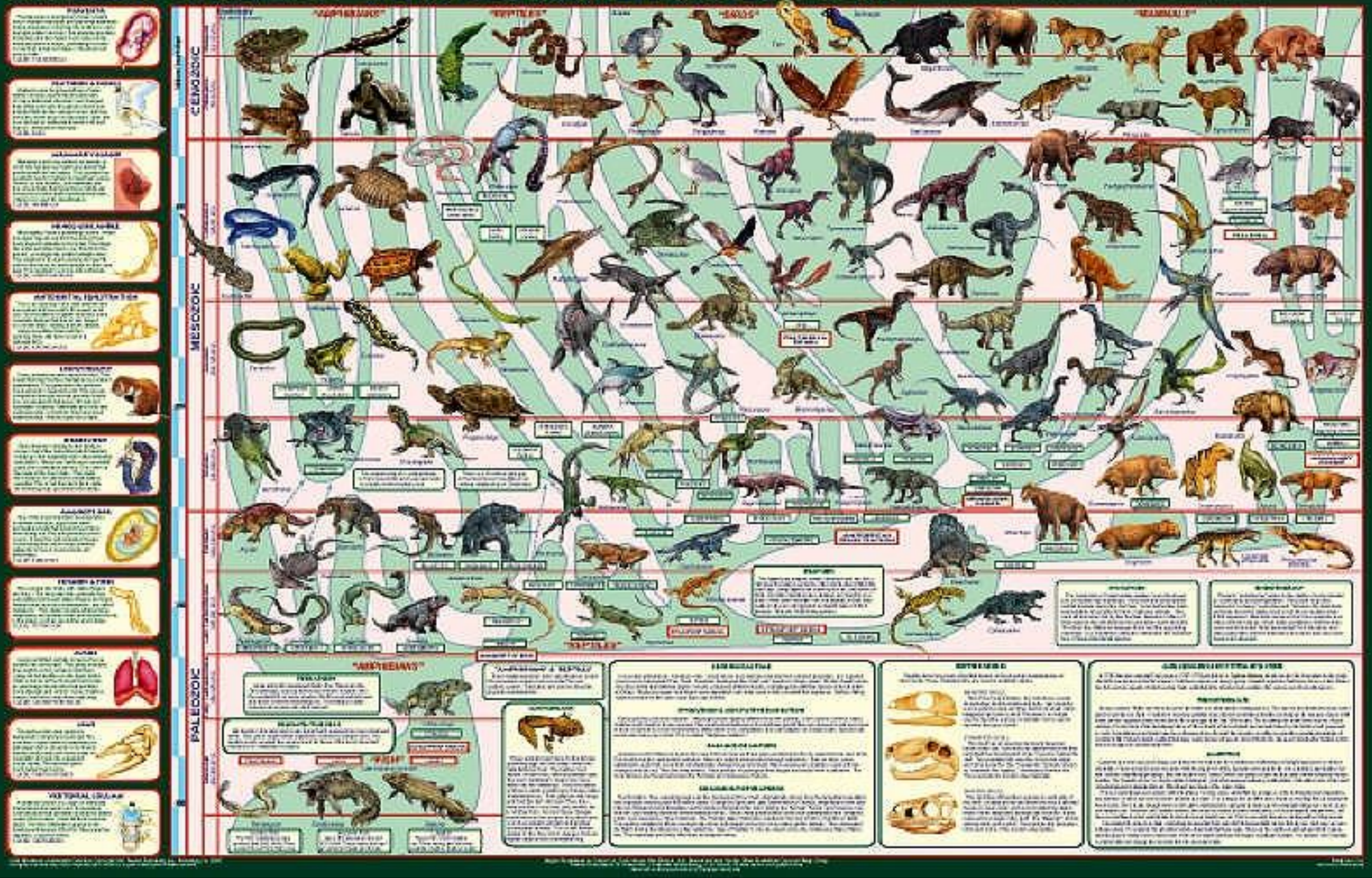


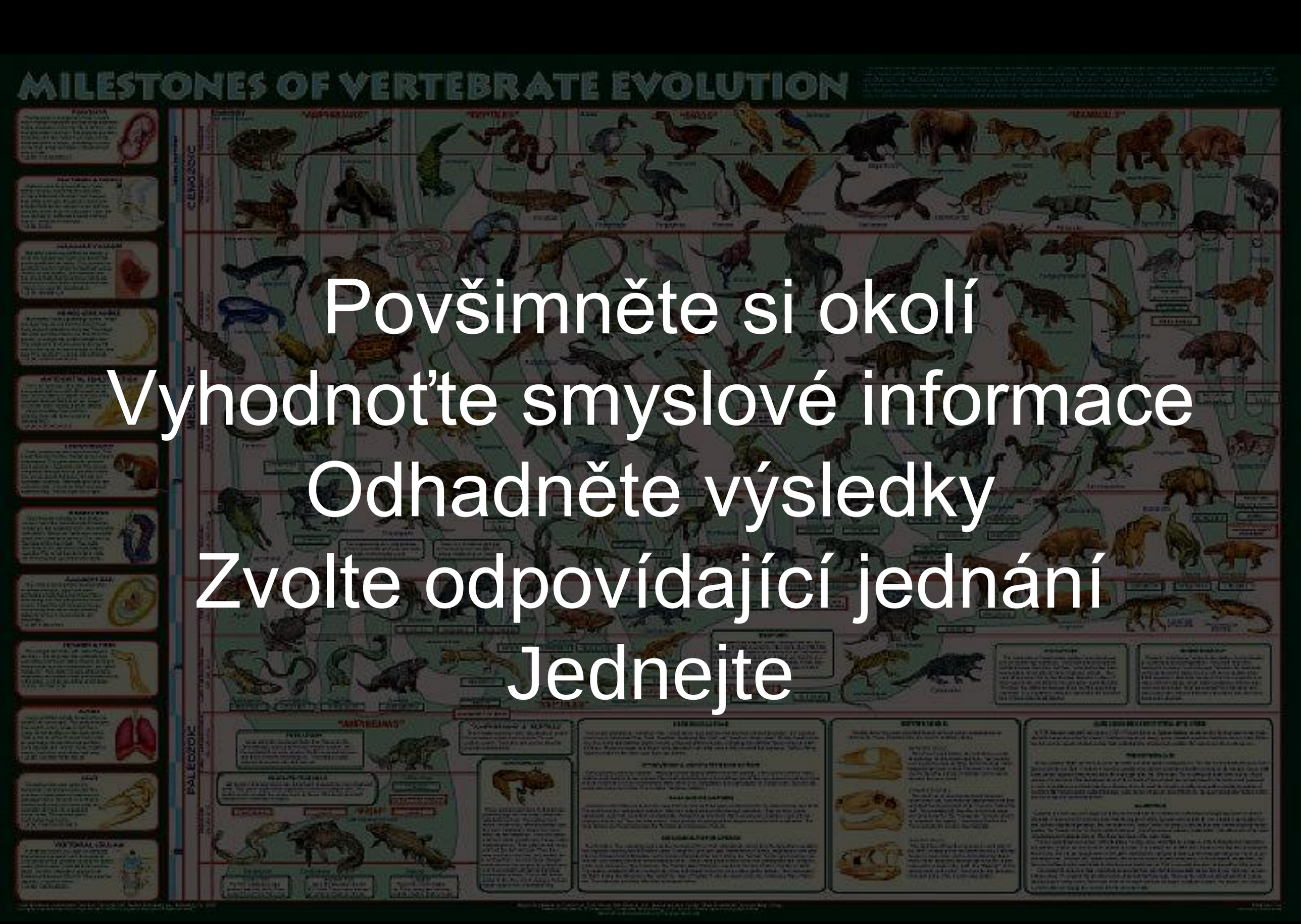
*Preliminary exercises: Walking, Standing, Sitting down and getting up, Unrolling and rolling a mat or protector, Carrying a tray ,Carrying and looking at a book, Carrying a table, Carrying a chair, Carrying scissors, Carrying a pitcher, Carrying a bucket, Opening and closing a door, Opening and closing drawers, Opening and closing bottles or boxes, Washing hands at the sink… Pouring -1; grain, Pouring -2; water from pitcher to pitcher, Pouring -3; water from pitcher to glass, Pouring -4; water from pitcher to different glasses, Pouring -5; water from pitcher to marked glasses, Pouring -6; from teapot to cup and sauce.

Practical Life | Language | Math | Sensorial

Vzdělání pro život.

MILESTONES OF VERTEBRATE EVOLUTION



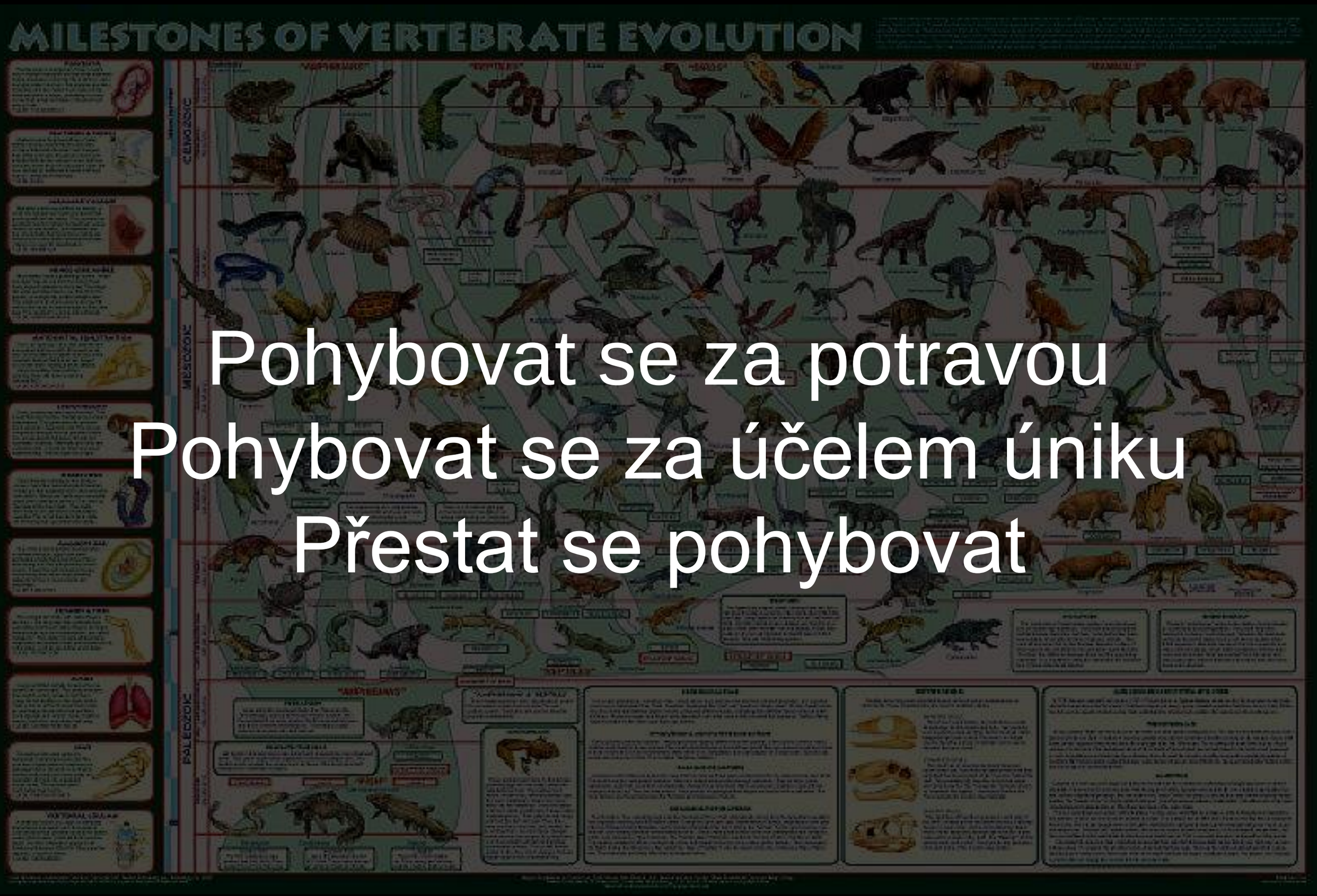


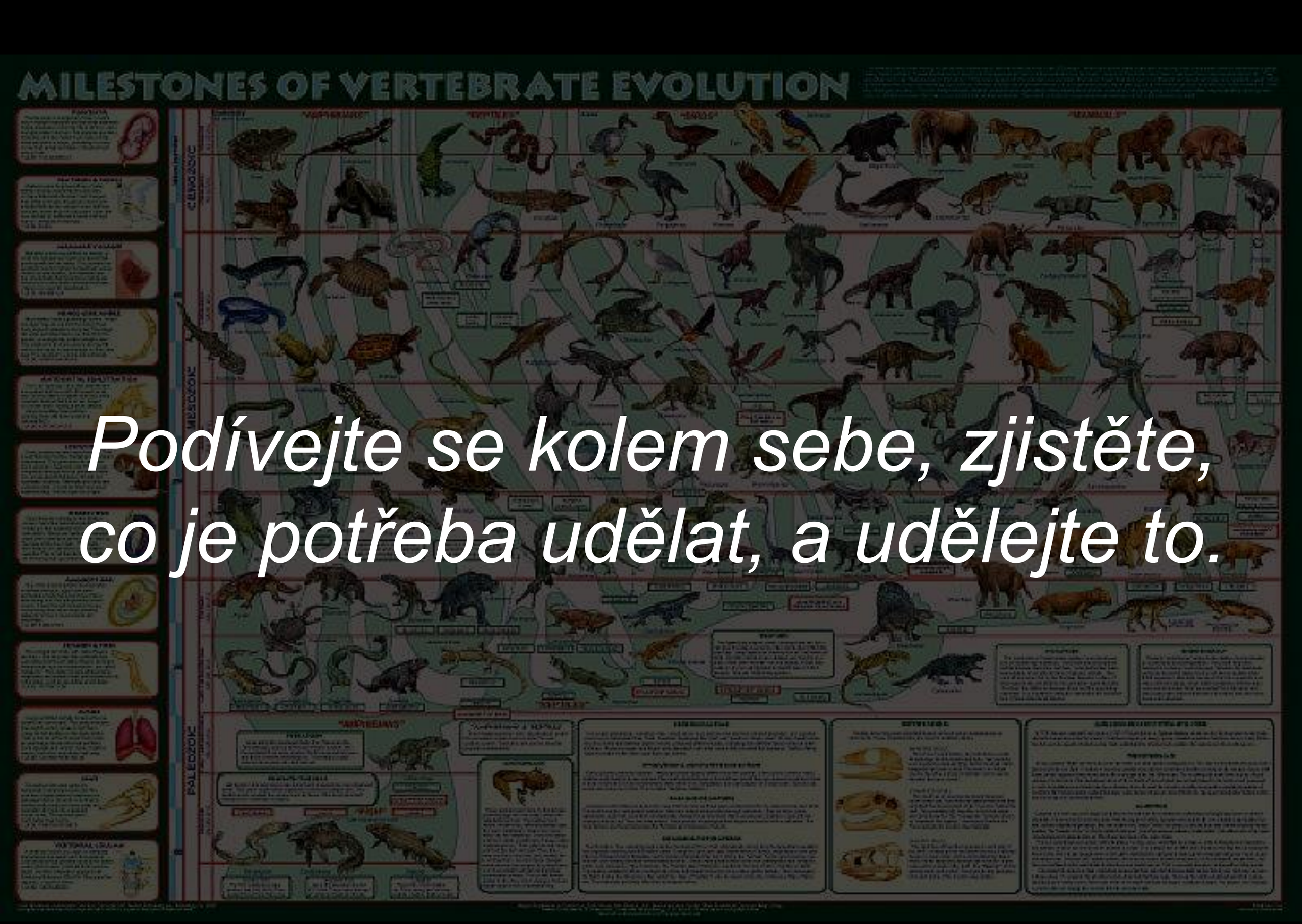
Povšimněte si okolí
Vyhodnoťte smyslové informace
Odhadněte výsledky
Zvolte odpovídající jednání
Jednejte

Potřebuje potravu

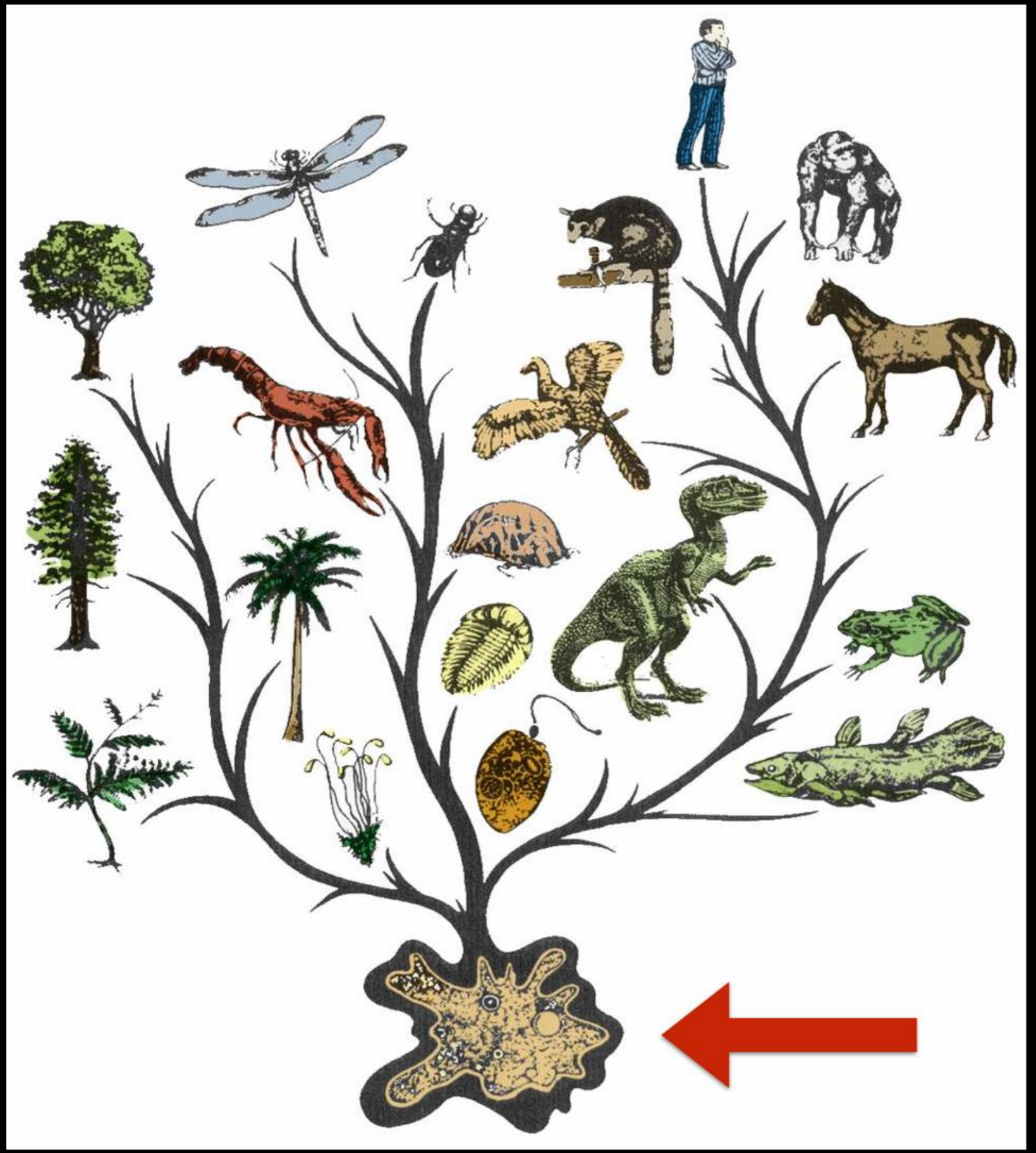
Může být potravou

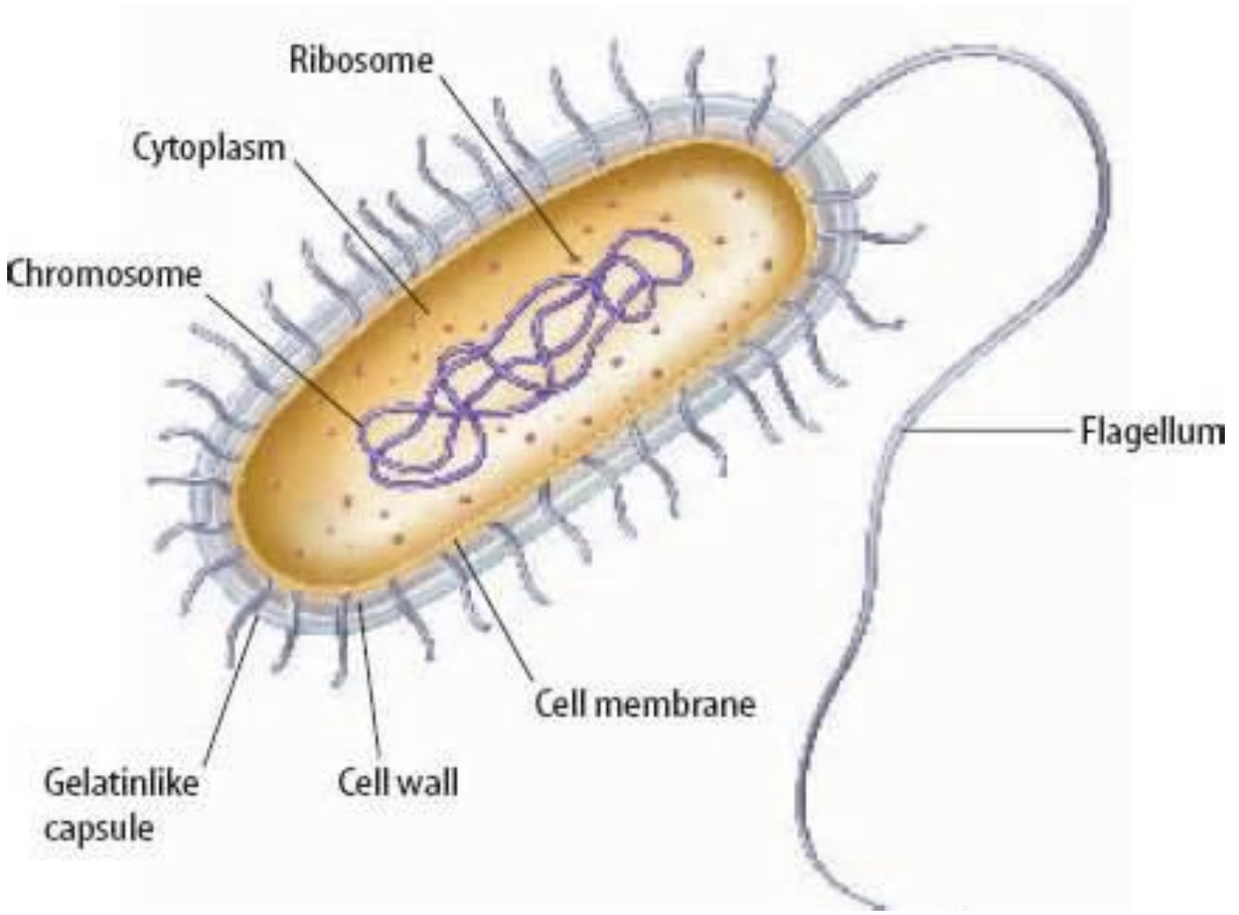
Je schopný pohybu


MILESTONES OF VERTEBRATE EVOLUTION
CENOZOIC
MESOZOIC
PALEOZOIC
Pohybovat se za potravou
Pohybovat se za účelem úniku
Přestat se pohybovat



Podívejte se kolem sebe, zjistěte, co je potřeba udělat, a udělejte to.




Ribosome
Cytoplasm
Chromosome
Flagellum
Cell membrane
Gelatinlike capsule
Cell wall

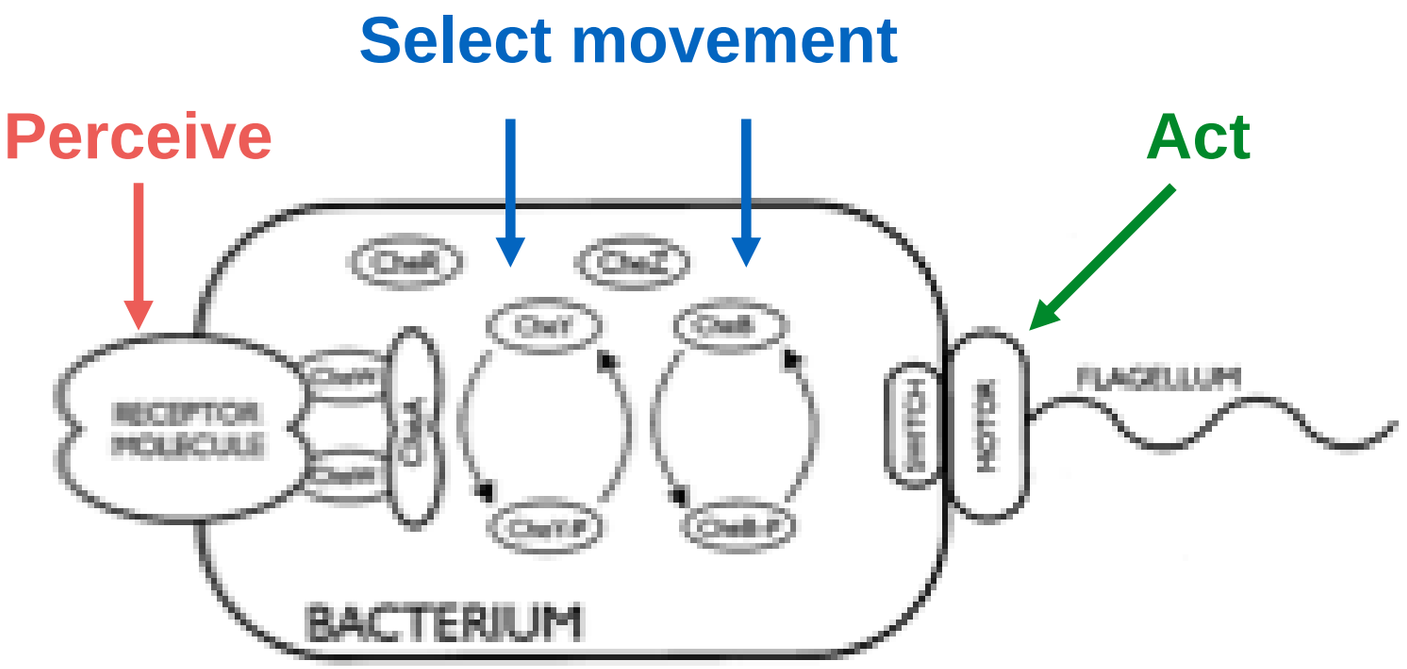
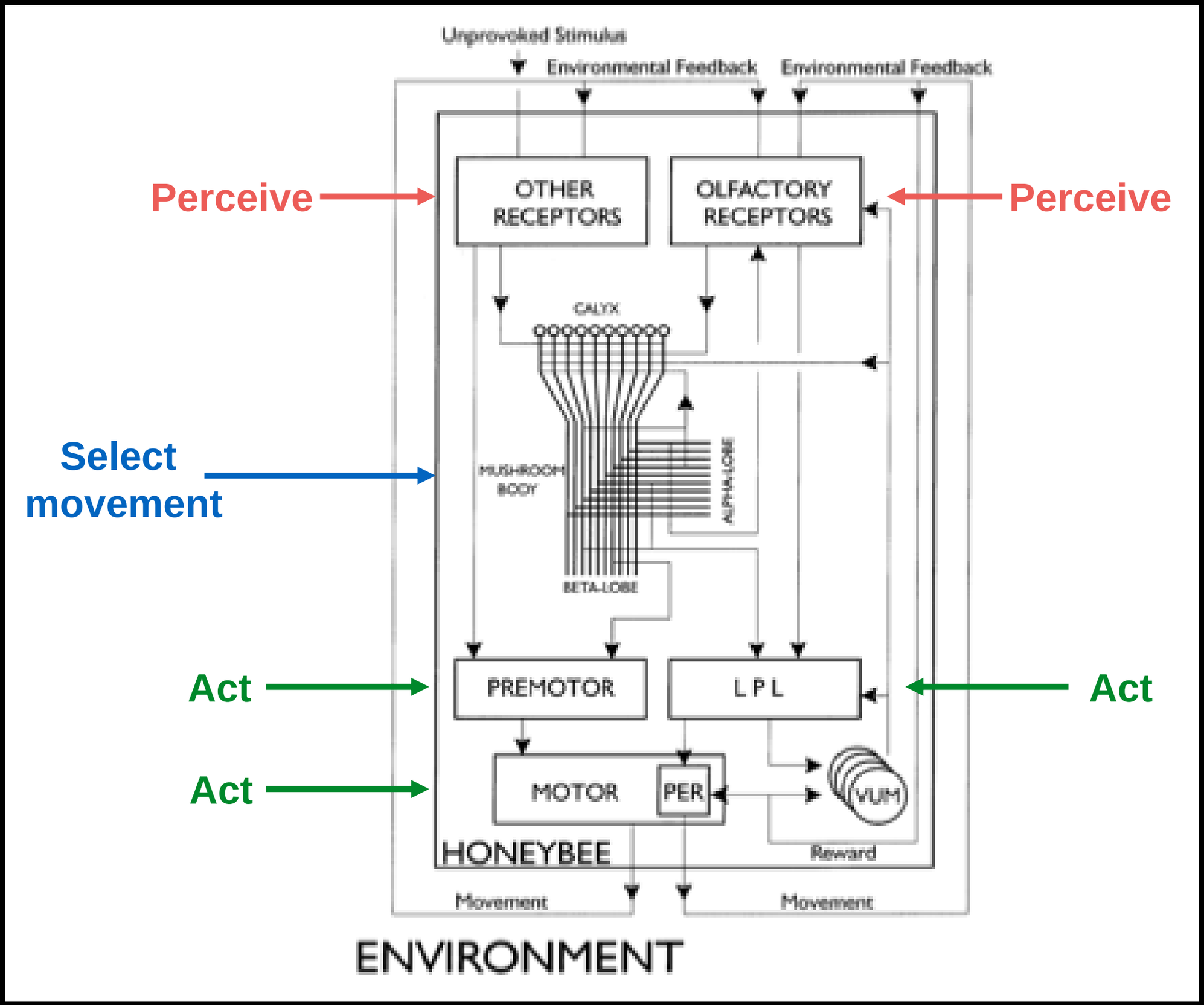
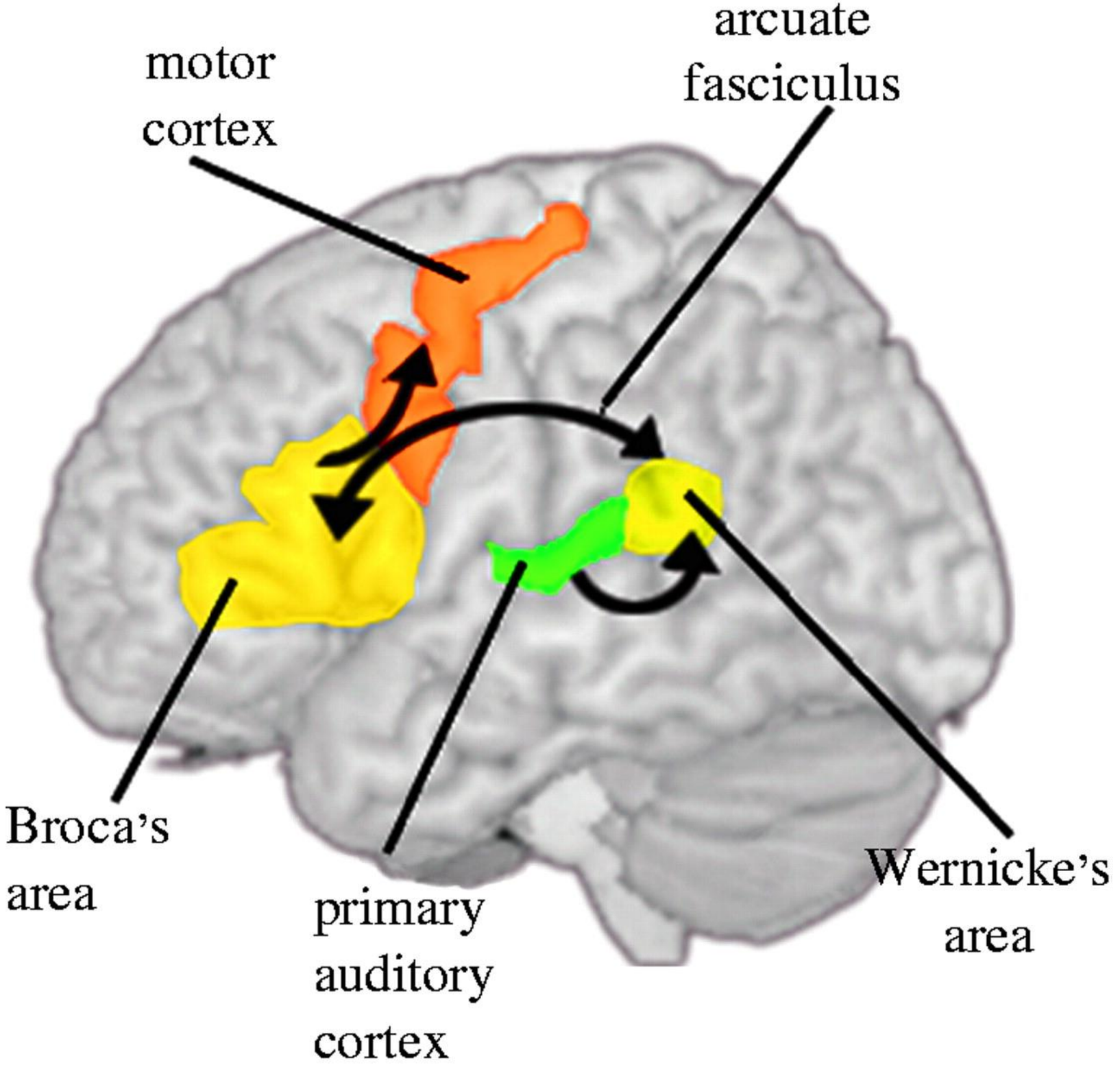


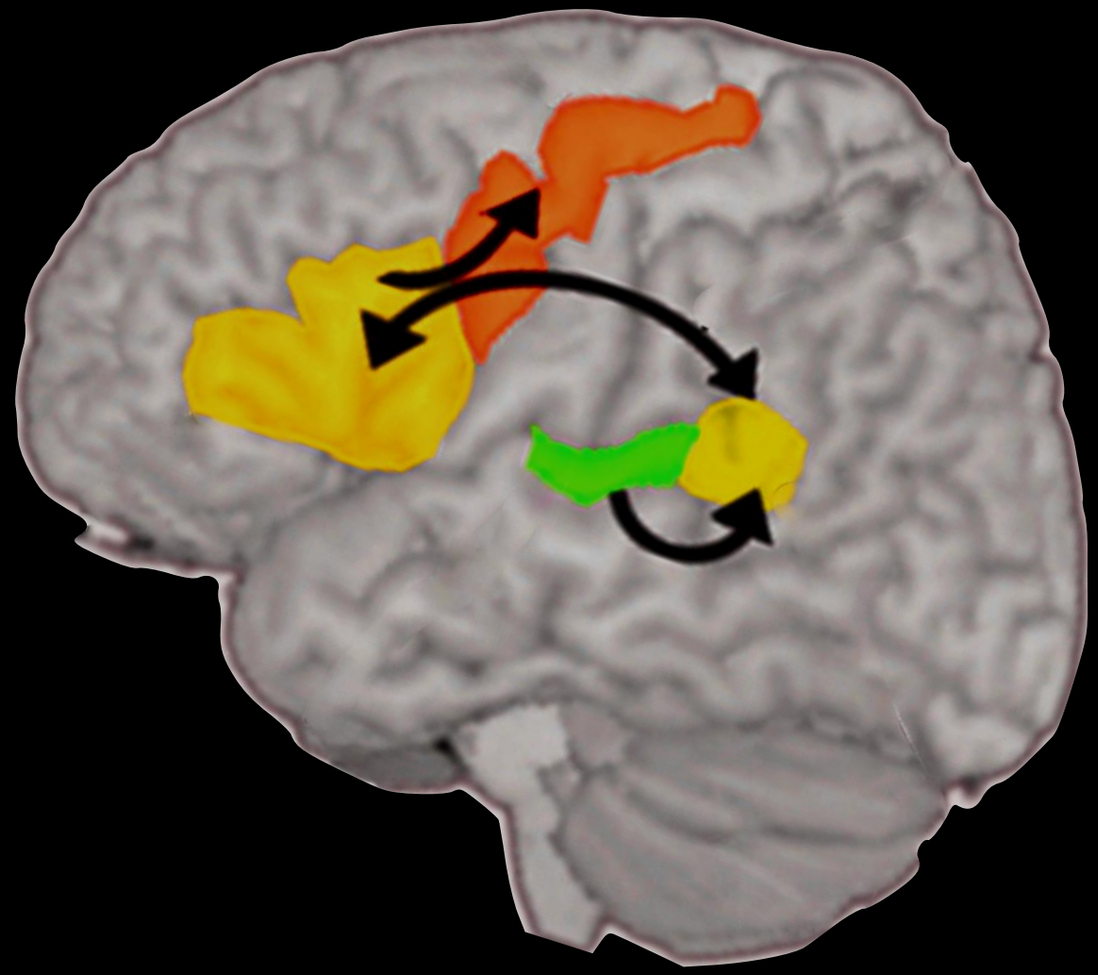
Fig. 1. The behavior-determining components in the *E. coli* bacterium are indicated in this highly schematic diagram, in which no effort has been made to faithfully reflect the relative sizes. The direction of rotation of the creature's flagellum is determined by the concentrations of the various molecular species, these concentrations mediating a primitive form of memory. The bacterium gains information about its surroundings through its own movements.

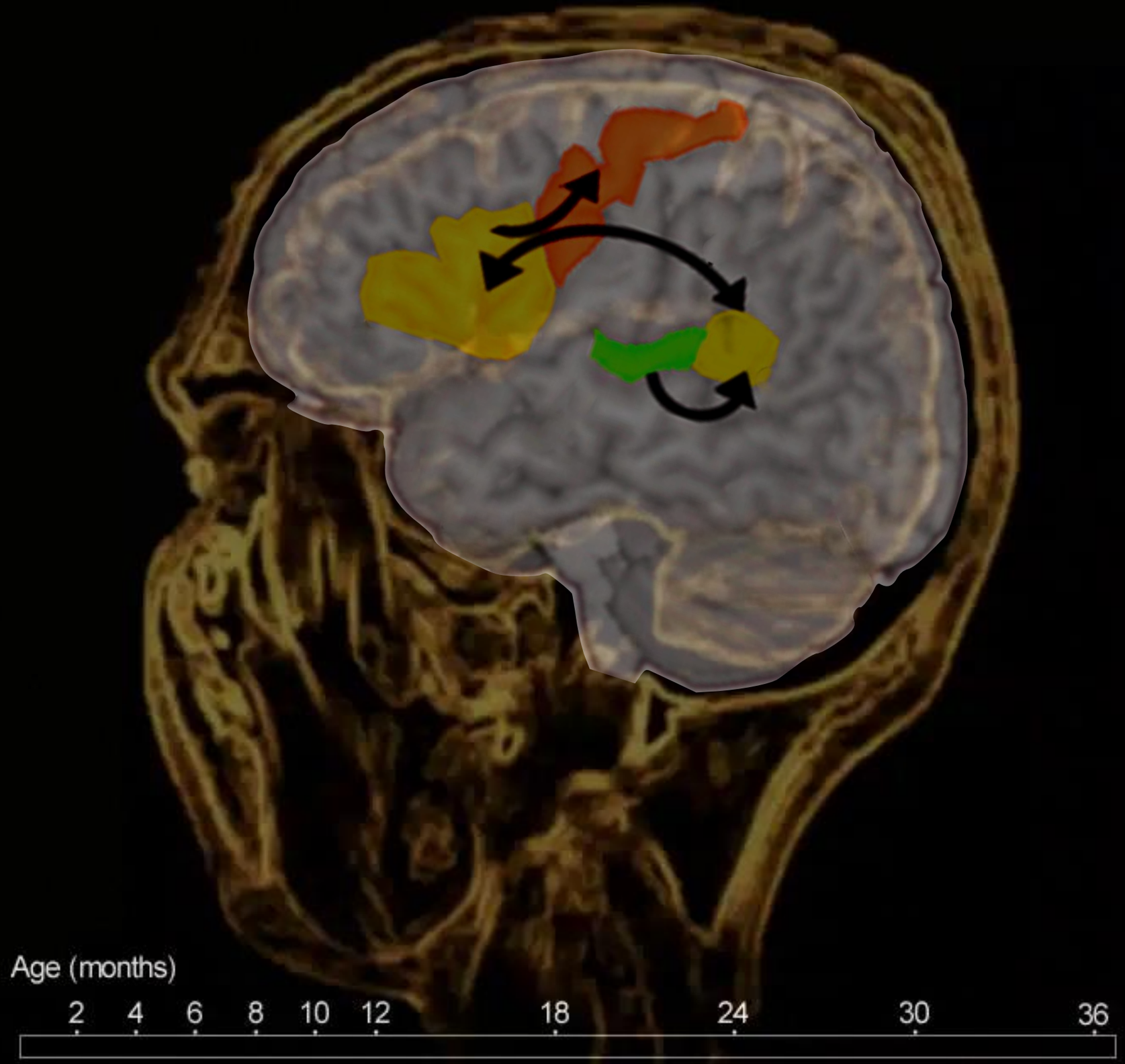

Unprovoked Stimulus
Environmental Feedback
Environmental Feedback
Perceive
OTHER RECEPTORS
OLFACTORY RECEPTORS
Perceive
CALYX
Select movement
MUSHROOM BODY
ALPHA-LOBE
BETA-LOBE
Act
PREMOTOR
L P L
Act
Act
MOTOR
PER
VUM
HONEYBEE
Reward
Movement
Movement
ENVIRONMENT

Komunikovat



Marslen-Wilson, W. D., & Tyler, L. K. (2007). Morphology, language and the brain: the decompositional substrate for language comprehension. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *362*(1481), 823-836.



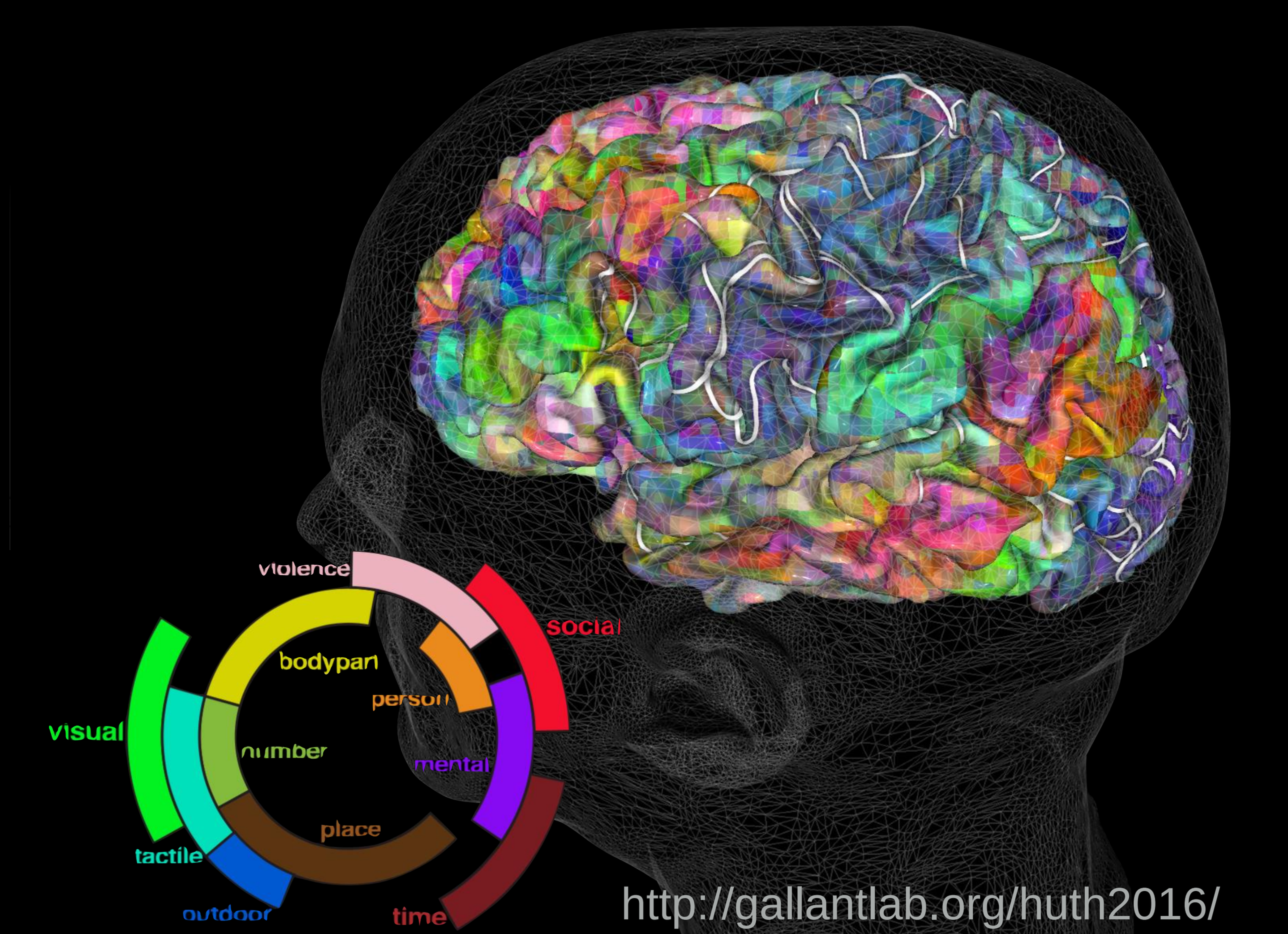


Myelination of Language-Related Areas in the Developing Brain

J. Pujol et al. **Neurology 2005**

Myelination of Language-Related Areas in the Developing Brain

J. Pujol et al. **Neurology 2005**



http://gallantlab.org/huth2016/

Teaching by Listening: The Importance of Adult-Child Conversations to Language Development

WHAT'S KNOWN ON THIS SUBJECT: It is well known that adult language input is important to healthy child language development. This knowledge has motivated advice that parents should read to their children regularly.

WHAT THIS STUDY ADDS: The results of this study provide evidence that adult-child conversations are at least as important as adult language input. We present empirical evidence and offer theoretical reasons for this contention.

CONTRIBUTORS: Frederick J. Zimmerman, PhD,[a] Jill Gilkerson, PhD,[b] Jeffrey A. Richards, MA,[b] Dimitri A. Christakis, MD, MPH,[c] Dongxin Xu, PhD,[b] Sharmistha Gray, PhD,[b] and Umit Yapanel, PhD[b]

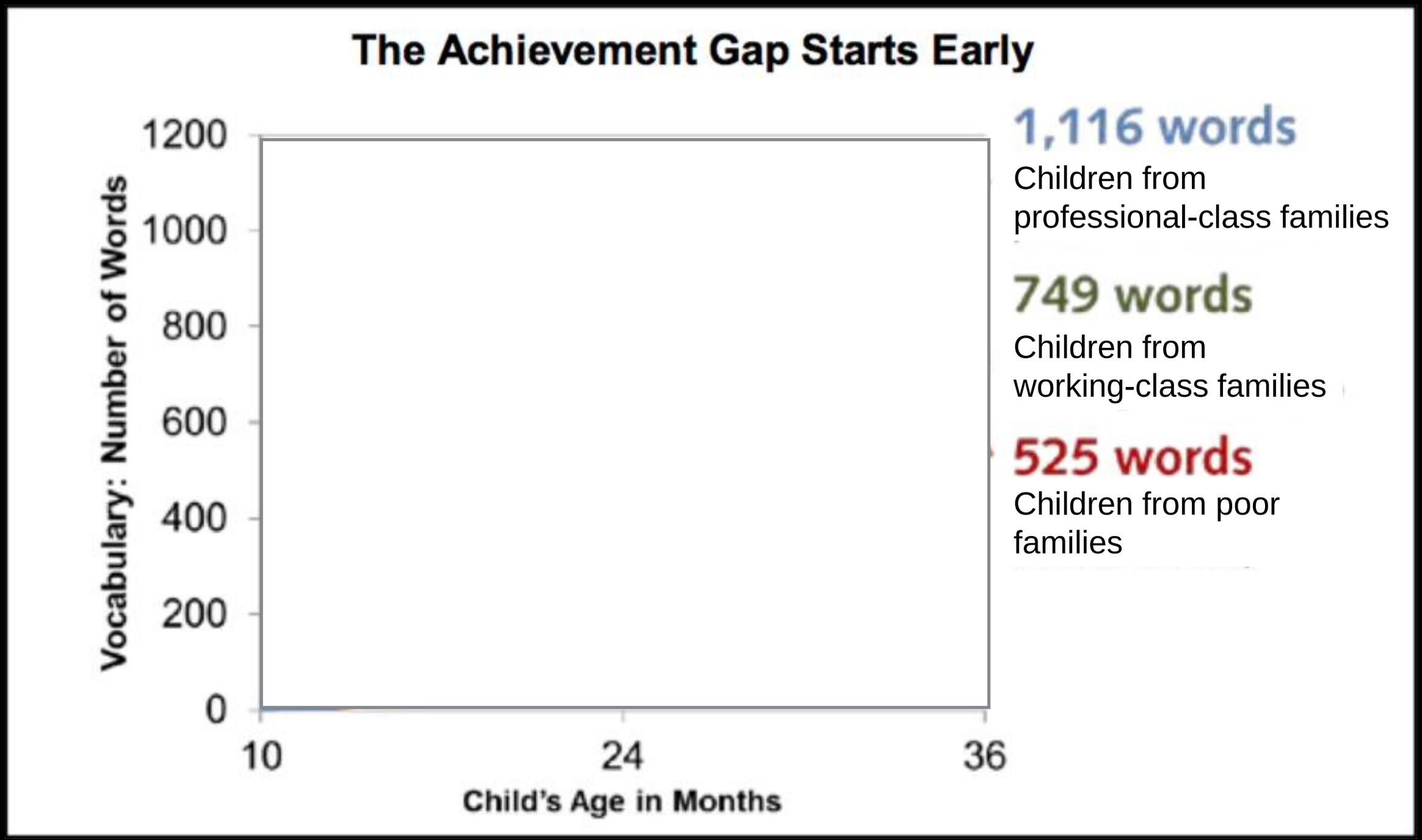
[a]Department of Health Services, School of Public Health, University of California, Los Angeles, California; [b]Department of Research, LENA Foundation, Boulder, Colorado; [c]Outcomes Research, Children's Hospital and Regional Medical Center, Seattle, Washington

KEY WORDS
language development, reading, television

Rozhovory mezi dospělým a dítětem významně ovlivňují zdravý jazykový vývoj. Rodiče by měli být povzbuzováni, aby svým dětem neposkytovali čtením či vyprávěním příběhů pouhý jazykový vklad, ale aby své děti zapojovali do oboustranných rozhovorů.

RESULTS: In fully adjusted regressions, the effects of adult word count were significant when included alone but were partially mediated by adult-child conversations. Television viewing when included alone was significant and negative but was fully mediated by the inclusion of adult-child conversations. Adult-child conversations were significant when included alone and retained both significance and magnitude when adult word count and television exposure were included.

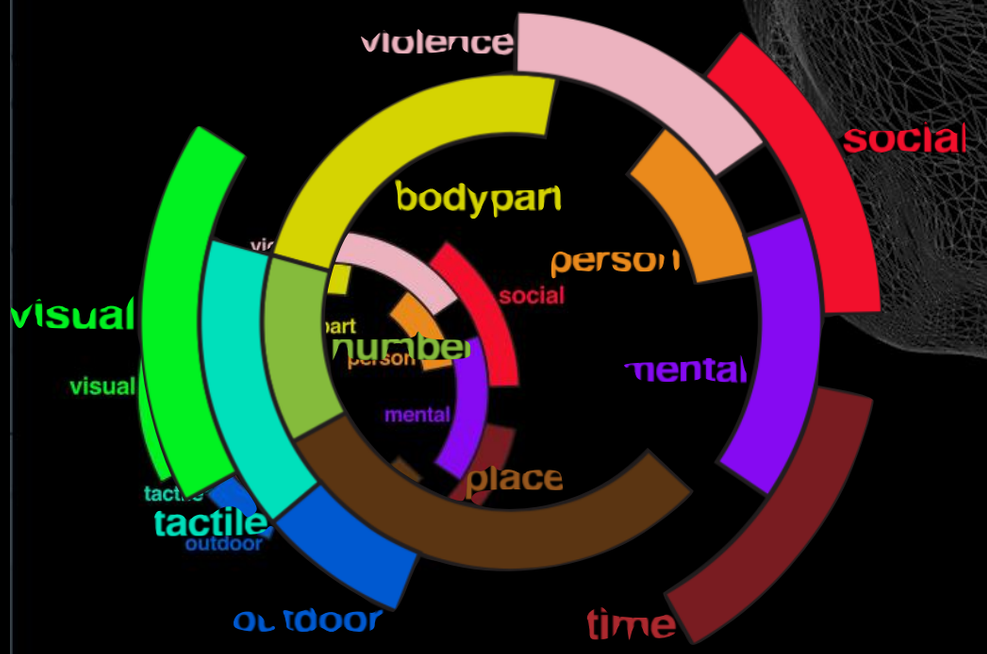
CONCLUSIONS: Television exposure is not independently associated with child language development when adult-child conversations are controlled. Adult-child conversations are robustly associated with healthy language development. Parents should be encouraged not merely to provide language input to their children through reading or storytelling, but also to engage their children in two-sided conversations. *Pediatrics* 2009;124:342–349



Source: *Meaningful Differences in the Everyday Experience of Young American Children*. Betty Hart and Todd R. Risley. Brookes Publishing, 1995 (4th printing, January 2003)

voxel selectivity

colors show approximate semantic selectivity



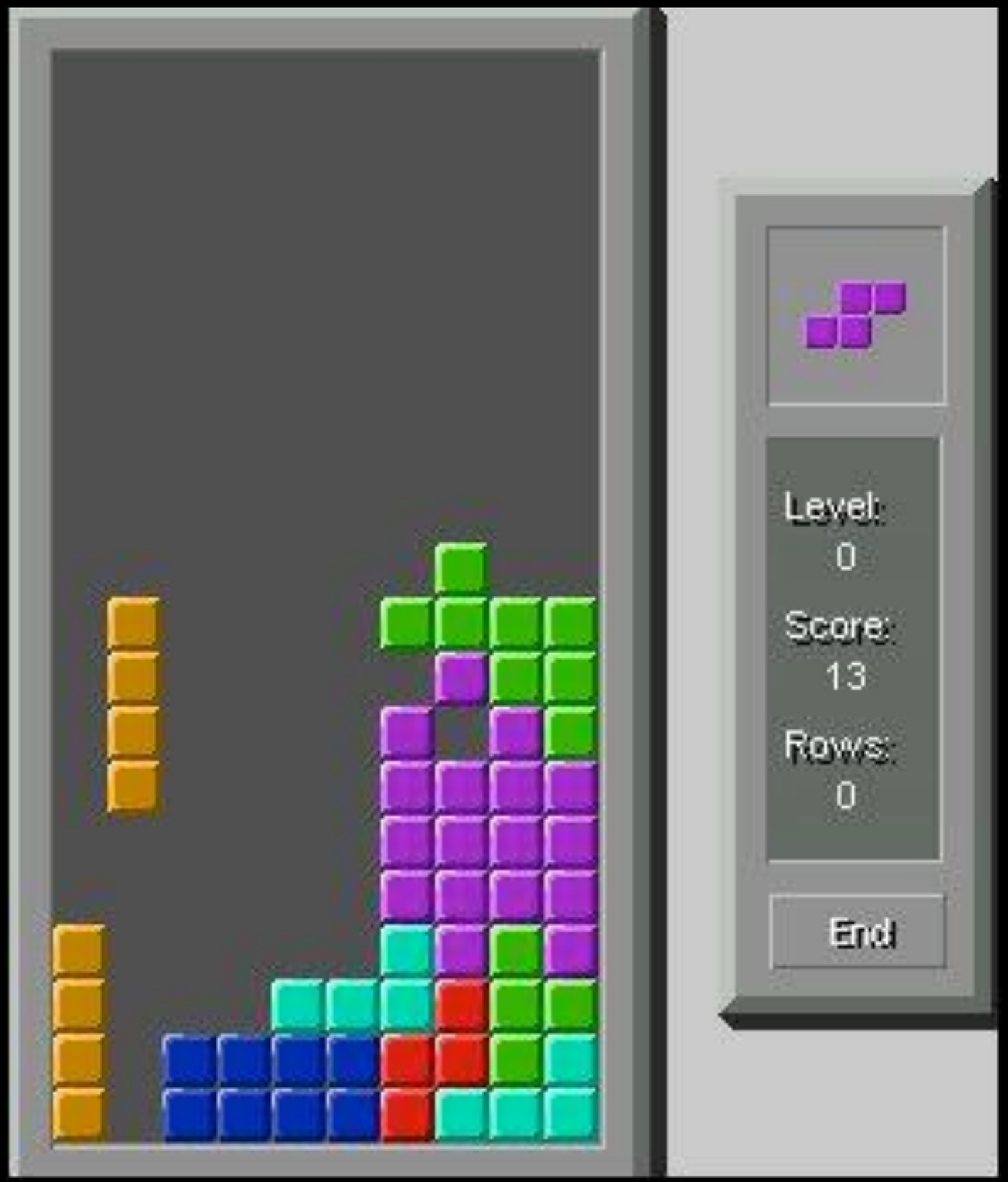
Namáhavé, motivované, opakované, zkoušené metodou pokusu a omylu, experimentální interakce s okolím.

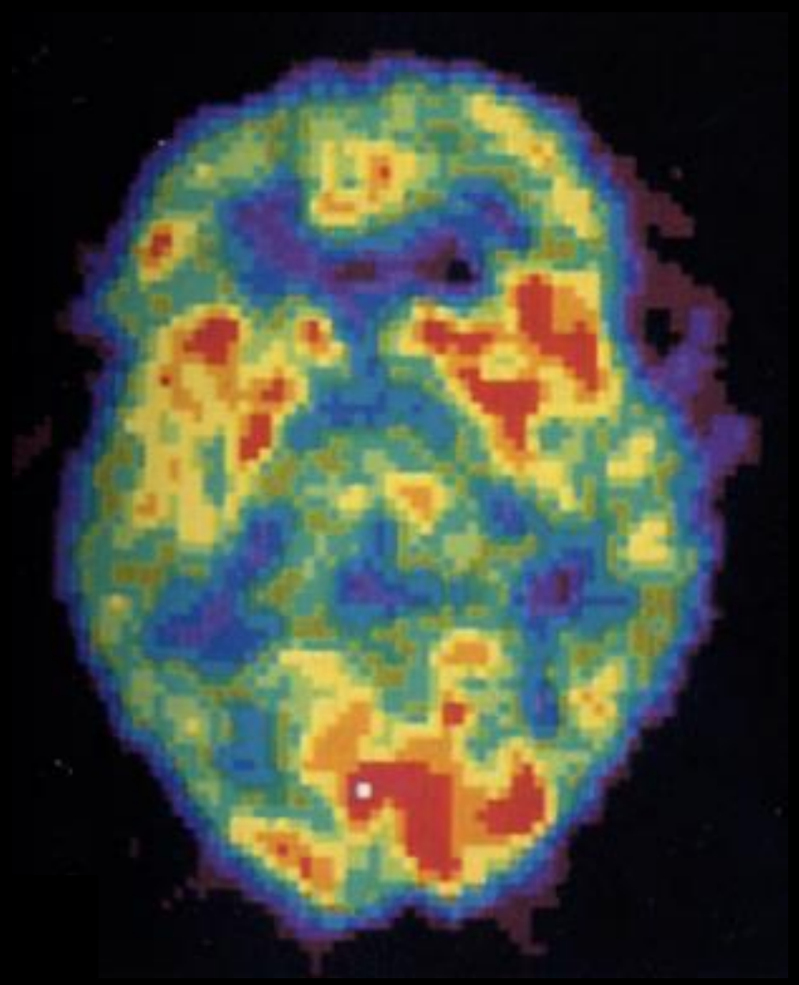

Alamy

Podívejte se kolem sebe, zjistěte, co je potřeba udělat, a udělejte to.

Podívejte se ~~kolem sebe, zjistěte, co je potřeba udělat~~ , a udělejte to.

Výkonnost


Level:
0
Score:
13
Rows:
0
End



Haier, R.J., Siegel, B.V., MacLachlan, A., Soderling, E., Lottenberg, S., Buchsbaum, M.S. (1991). Regional glucose metabolic changes

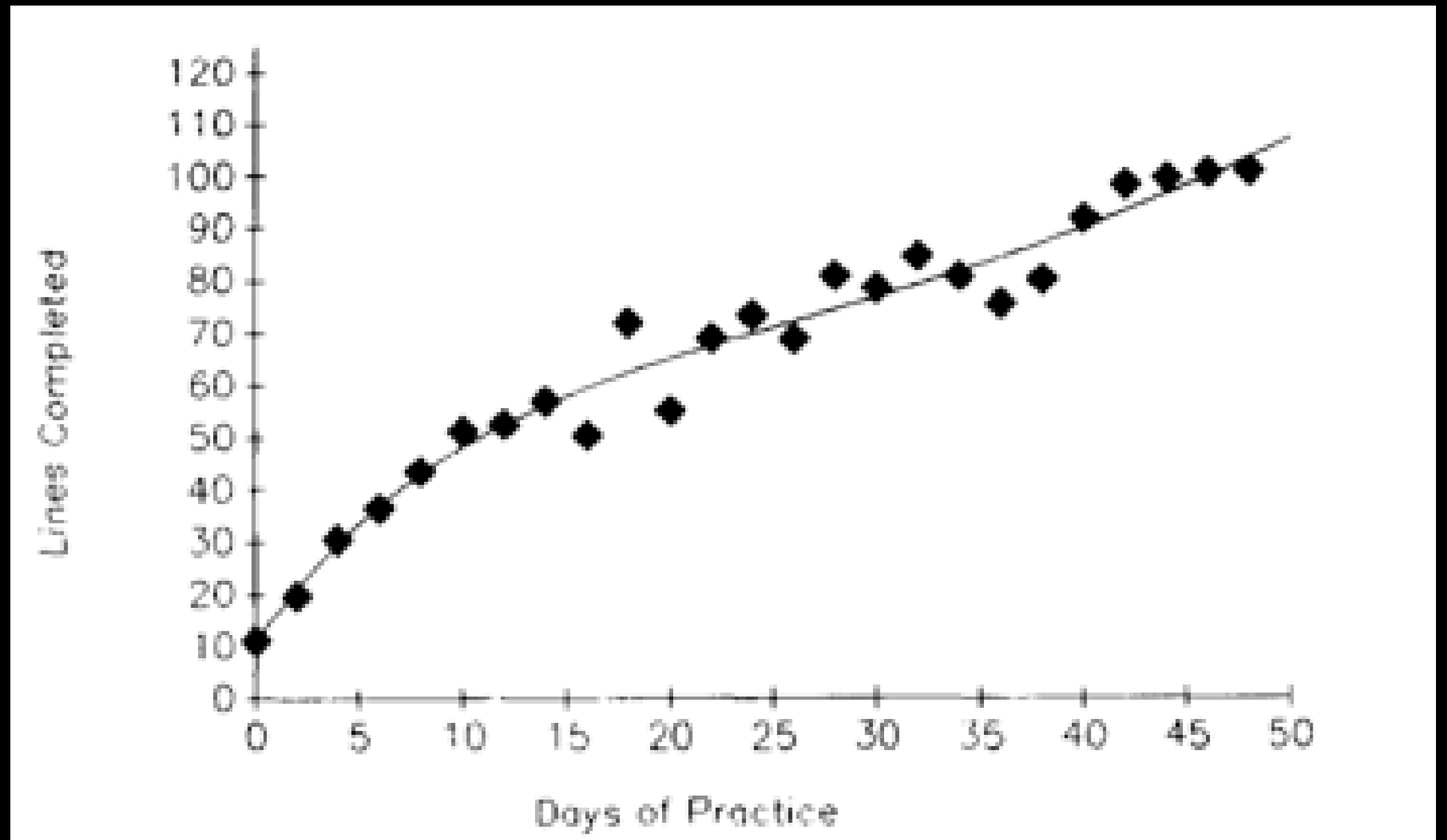
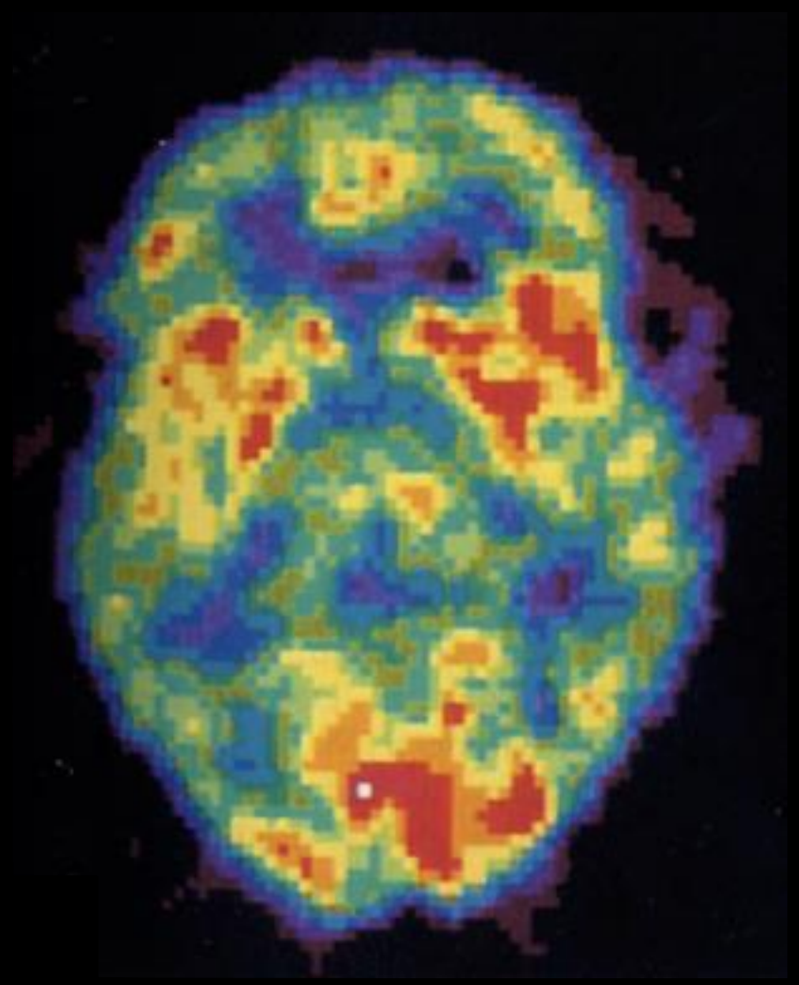
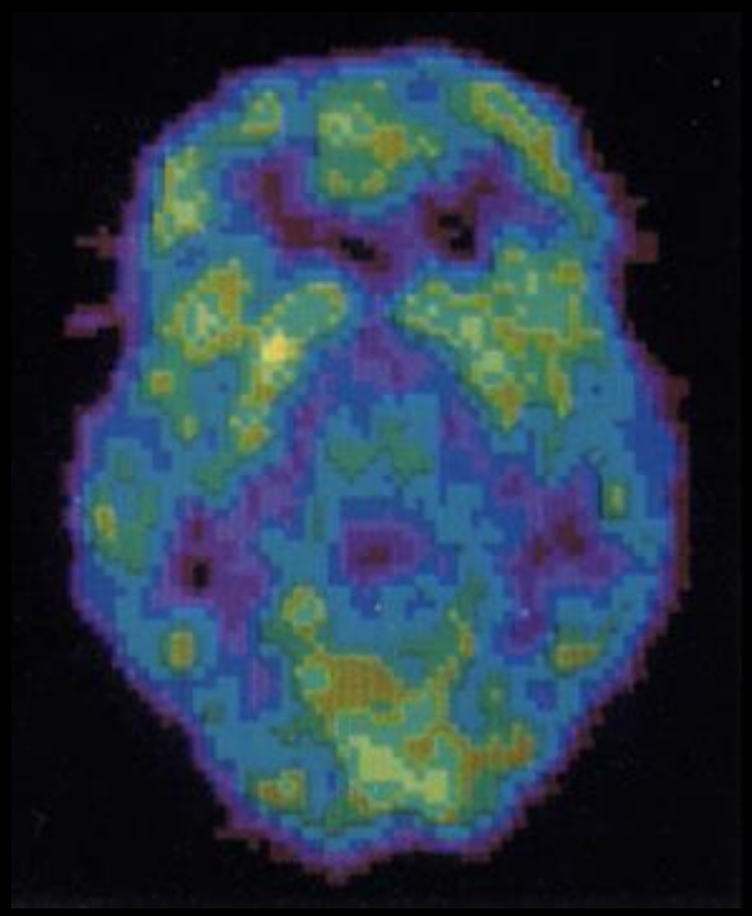


Fig. 2. Tetris learning curve. Plots average score (lines completed) at each practice session. Some later sessions included fewer subjects.

Haier, R.J., Siegel, B.V., MacLachlan, A., Soderling, E., Lottenberg, S., Buchsbaum, M.S. (1991). Regional glucose metabolic changes
after learning a complex visuospatial/motor task: a positron emission tomographic study. *Brain Research, 570*, P 134-143.



Haier, R.J., Siegel, B.V., MacLachlan, A., Soderling, E., Lottenberg, S., Buchsbaum, M.S. (1991). Regional glucose metabolic changes



Haier, R.J., Siegel, B.V., MacLachlan, A., Soderling, E., Lottenberg, S., Buchsbaum, M.S. (1991). Regional glucose metabolic changes

Porovnávání vzorů

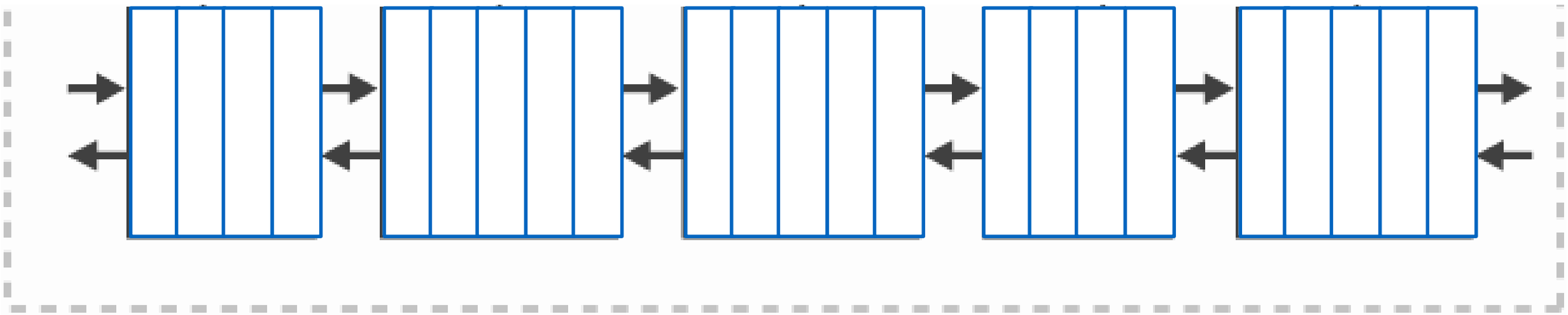
Motorické reakce

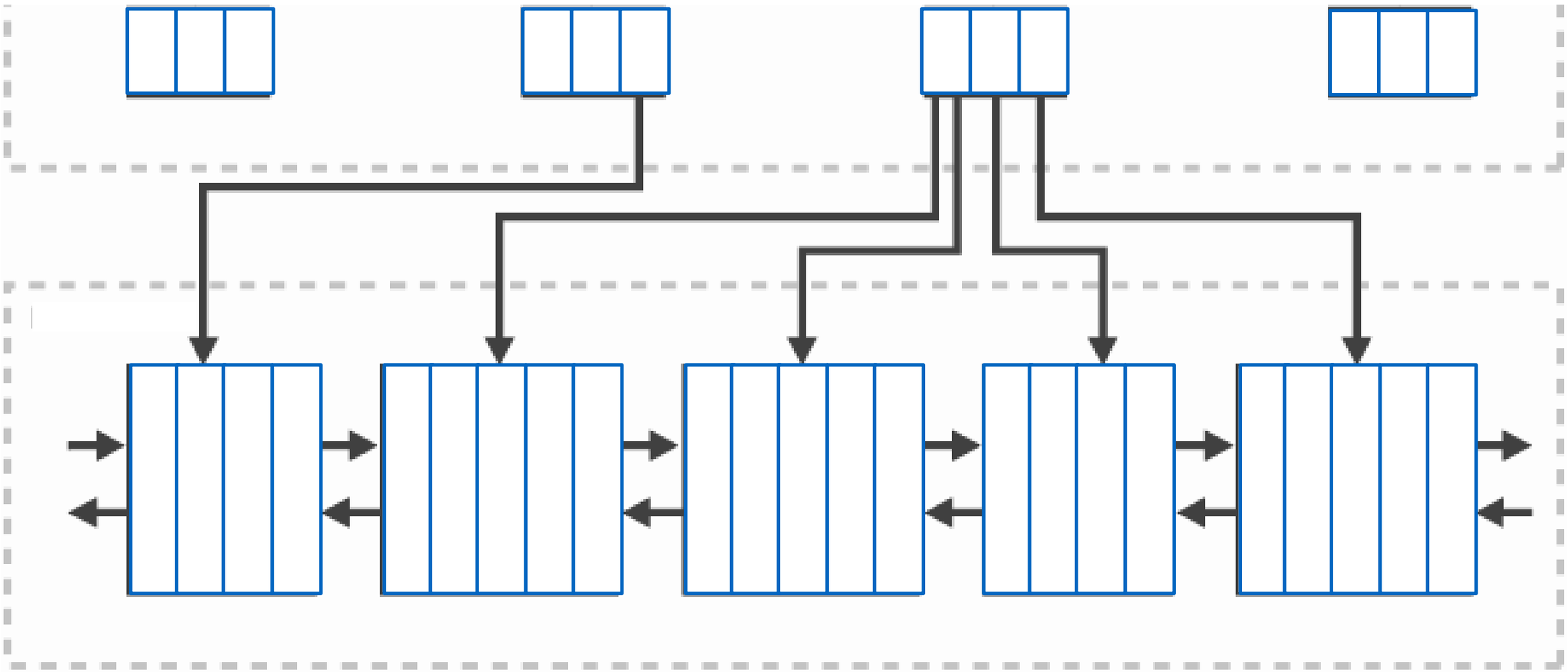
Smyslovo-motorické párování

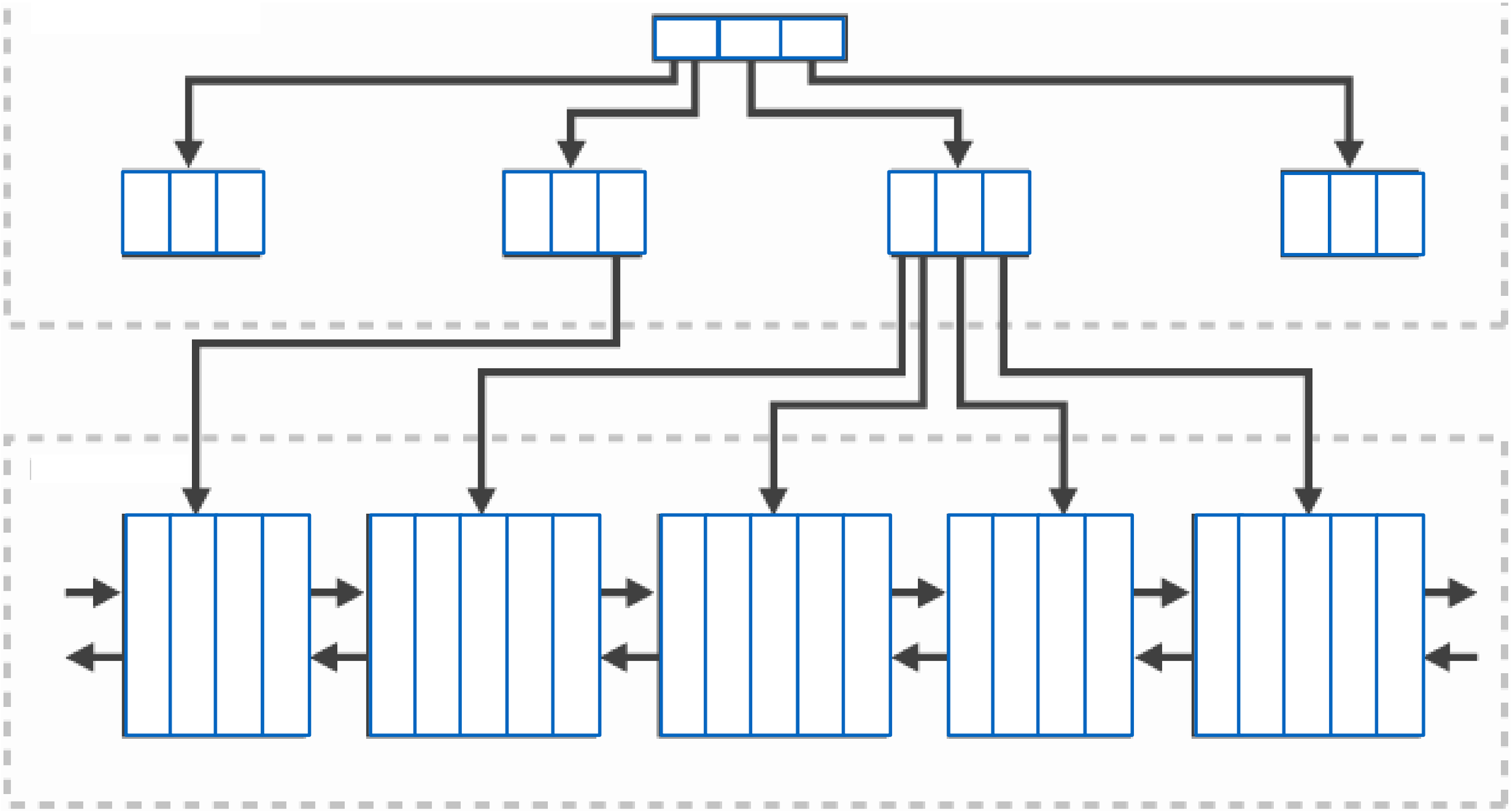
Automatičnost

How to Win at Tetris

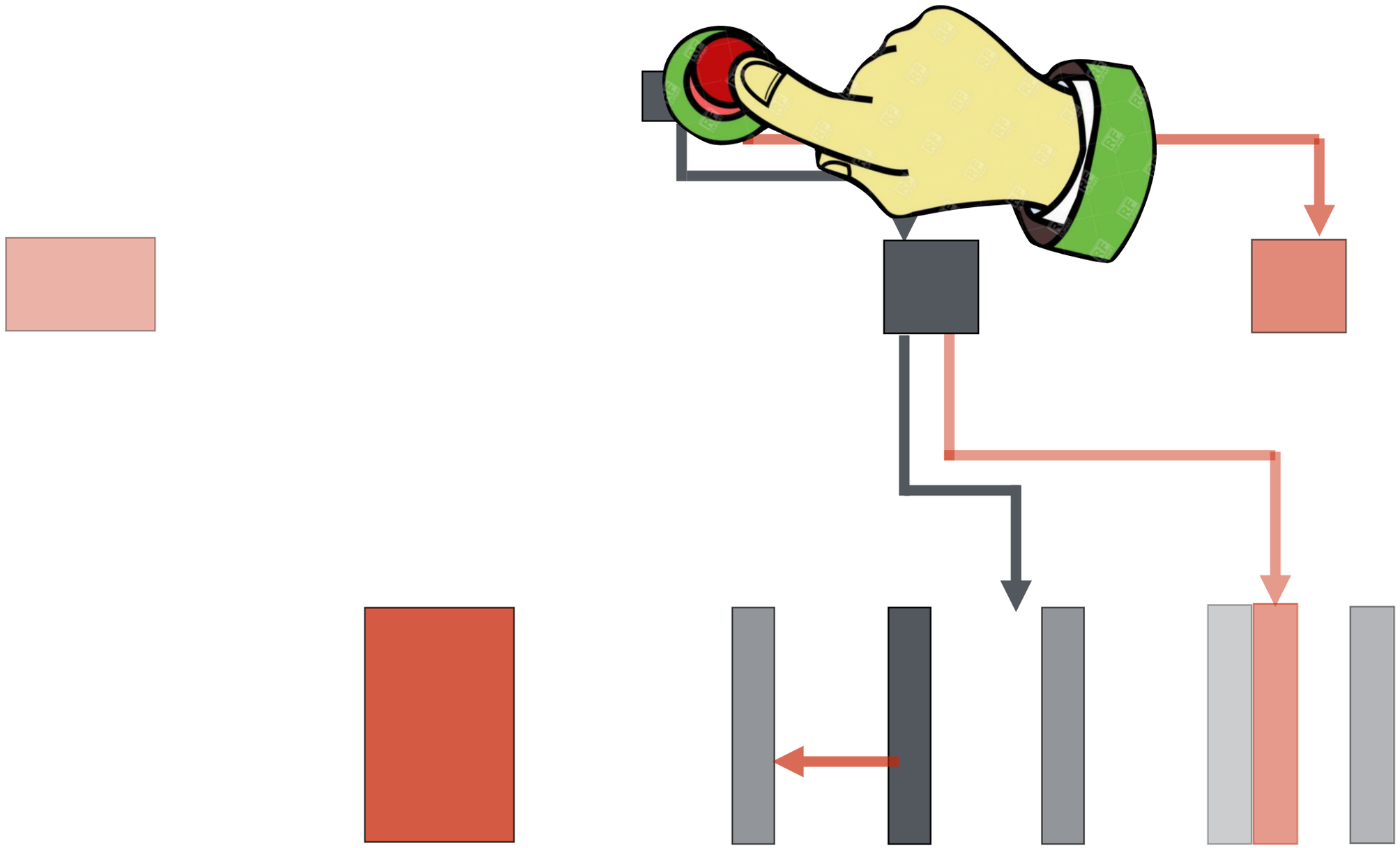
1. Learn all the shapes
2. Figure out how to move the shapes
3. Learn the patterns: "*What to do when…*"
4. Figure out how to match the shapes (stimuli) with the best movements (behaviors)
5. Master all the best stimulus – response patterns
6. Go to the pub and win bets



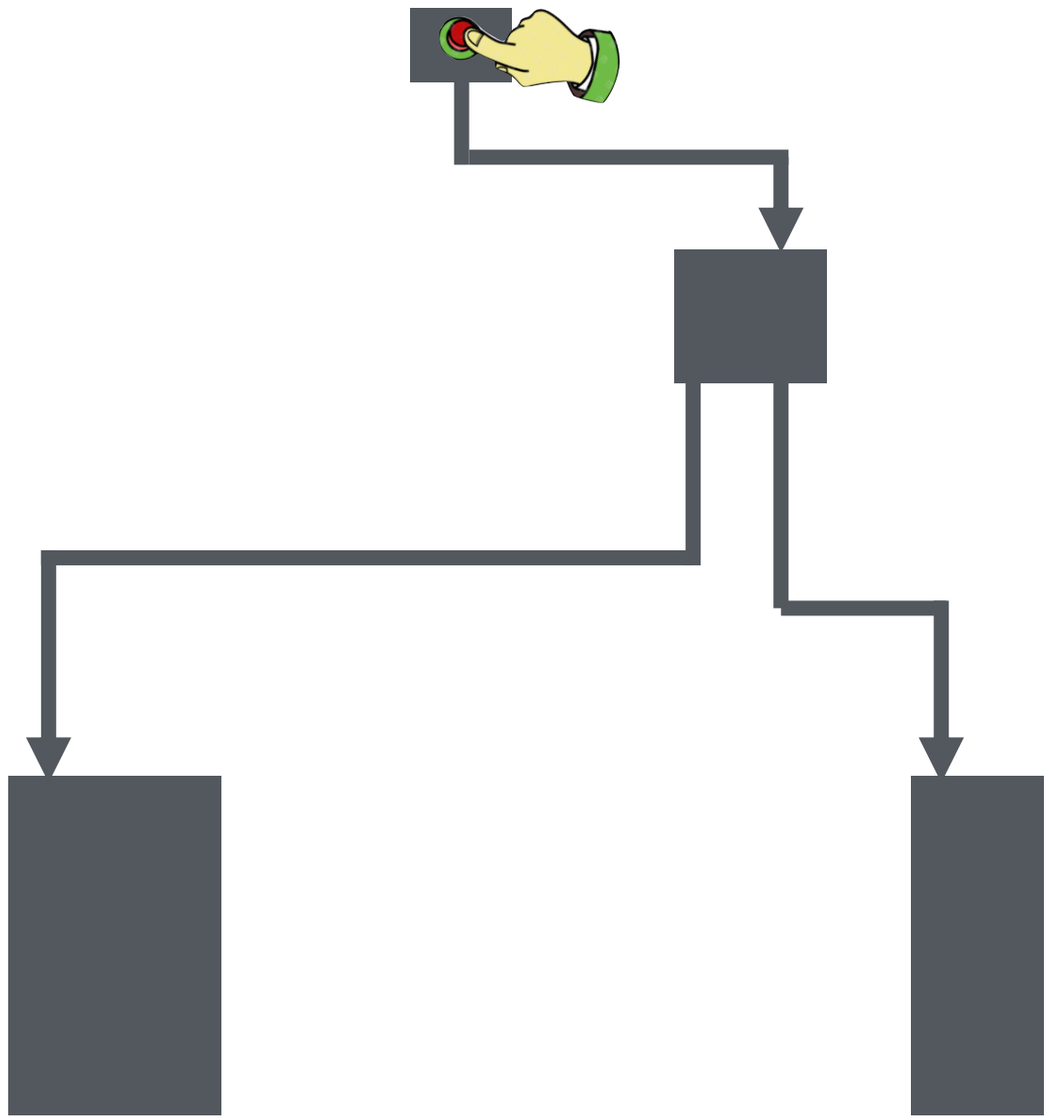




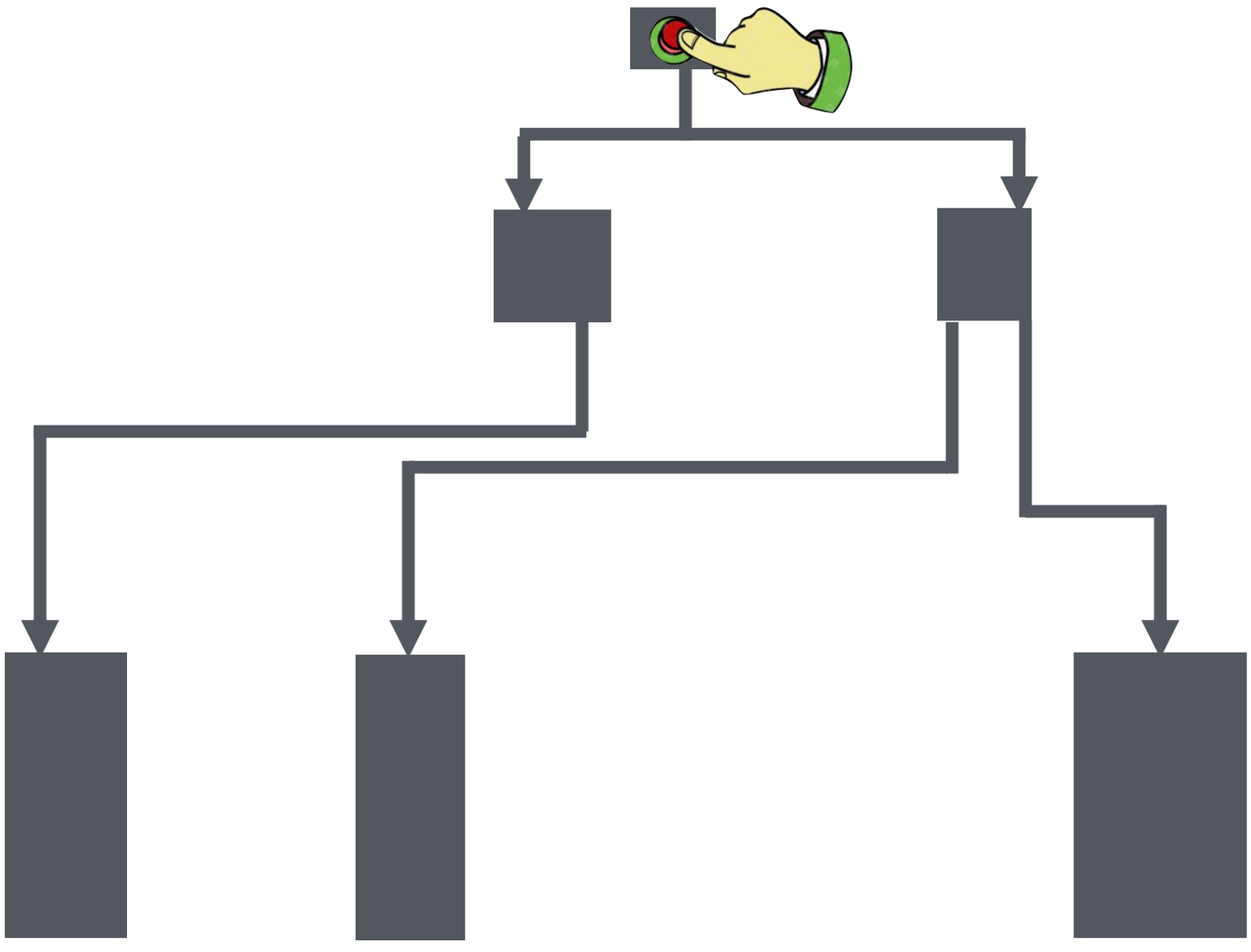
“Walk”



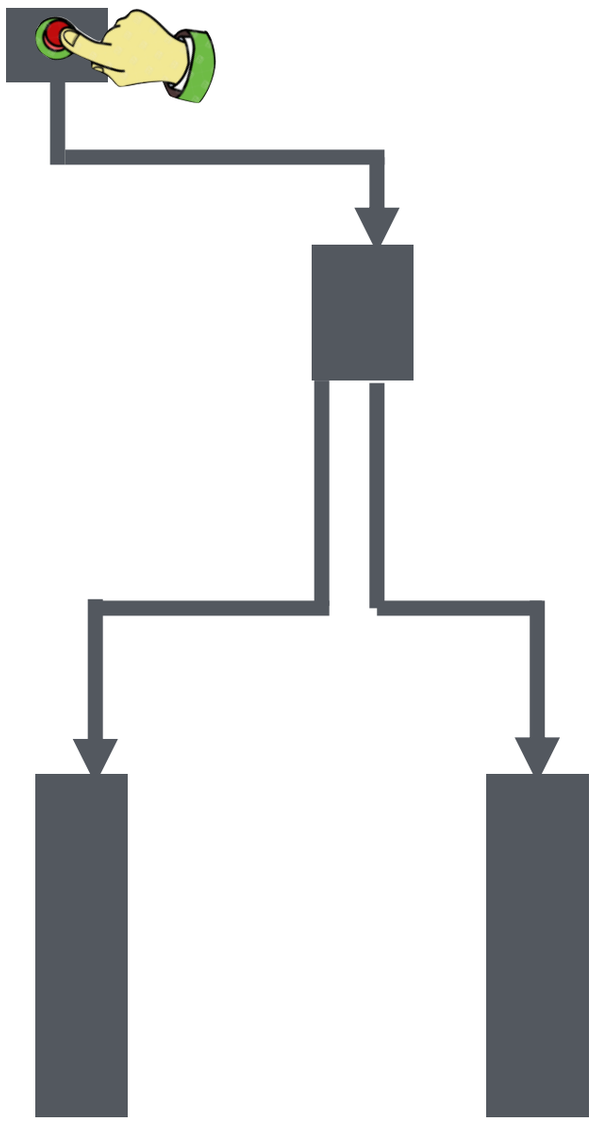
“Catch the ball”



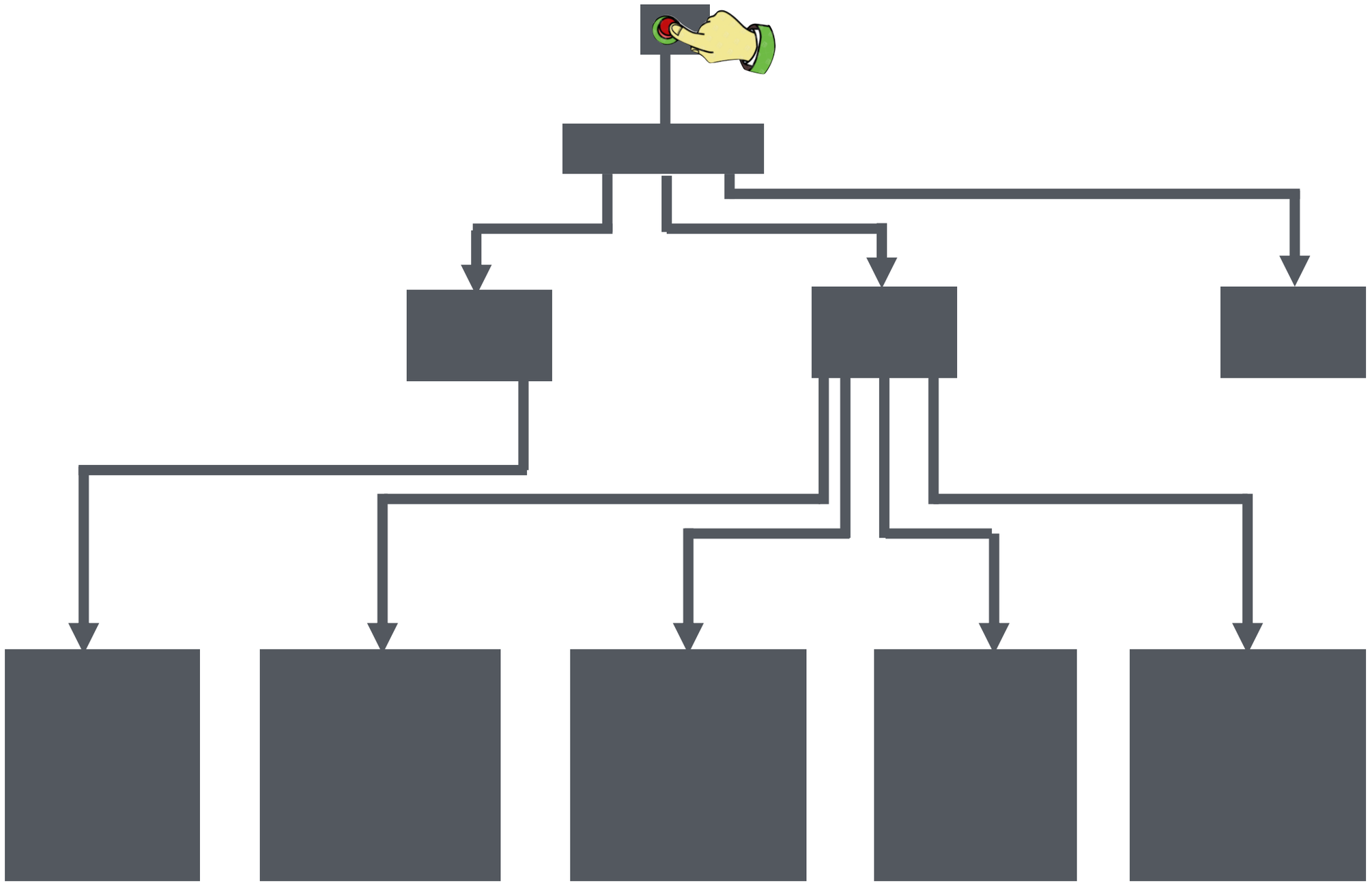
“Clear the Airway”



“Sell the Shares”



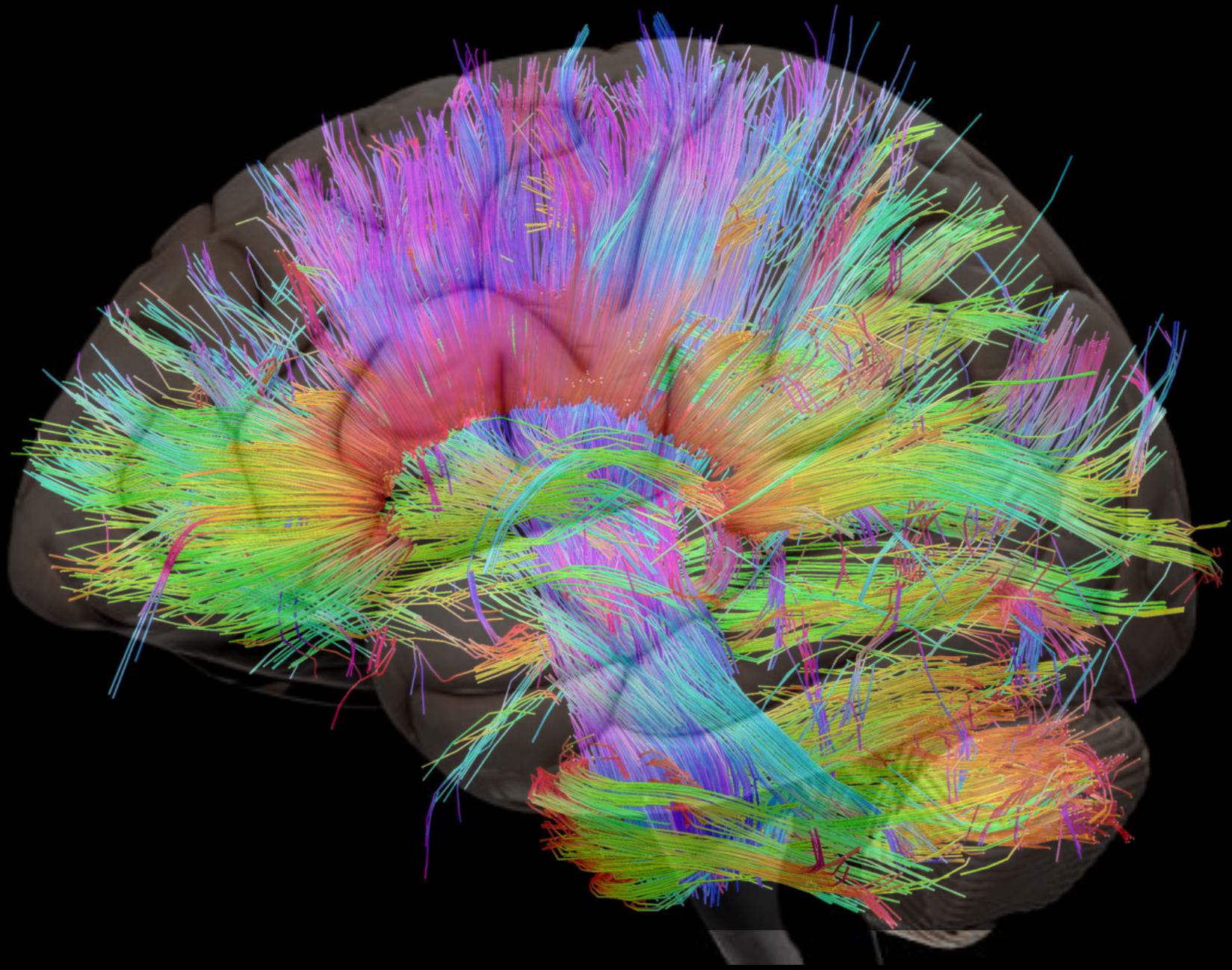
“Skate the Routine”



How to Win at LIFE

1. Learn the relevant stimuli in the environment
2. Figure out how to do things
3. Learn the patterns: *“What to do when…”*
4. Figure out how to match stimuli with the best behaviors
5. Master all the best stimulus – behavior patterns
6. Prosper

Kognitivní sítě

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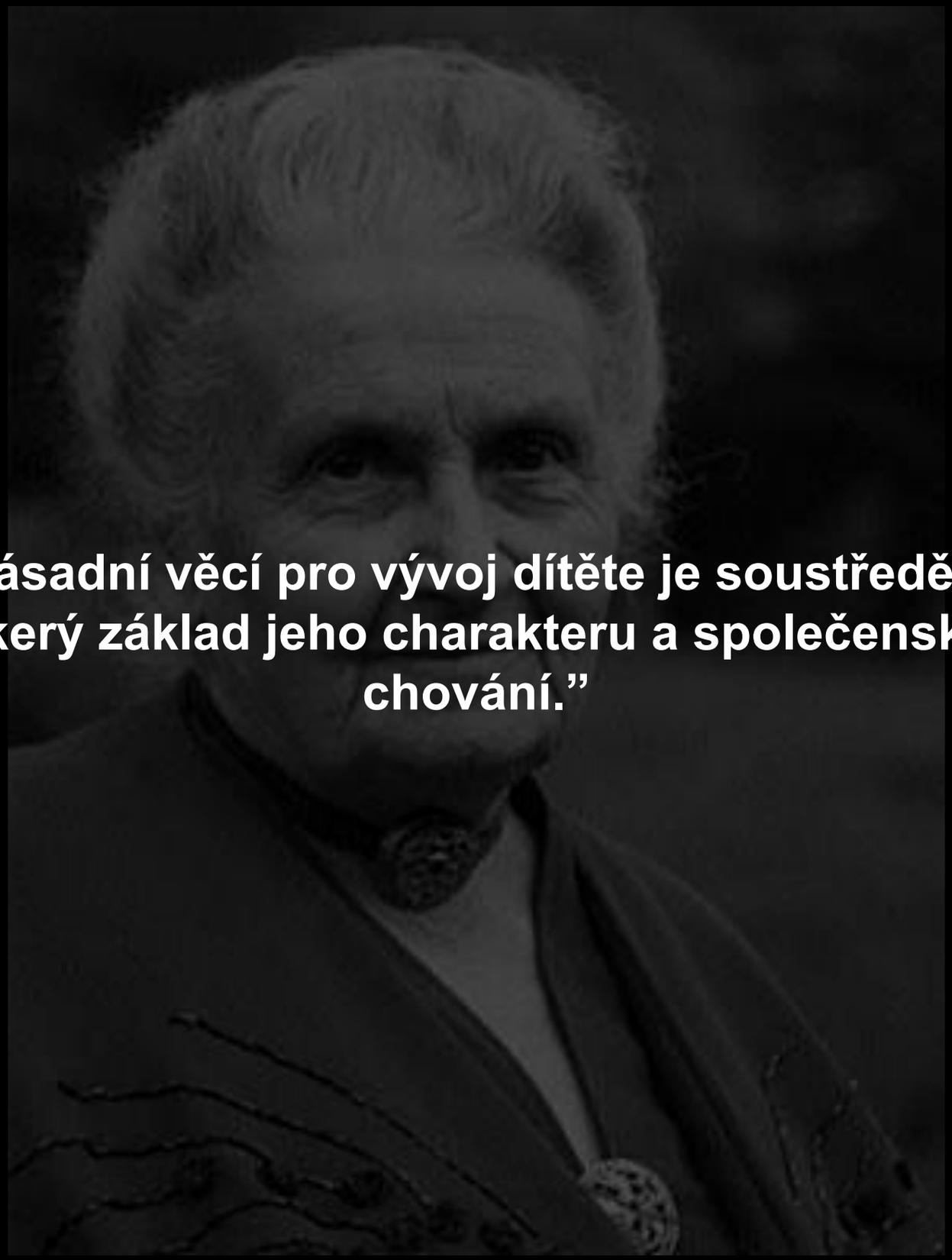
Namáhavé, motivované, opakované, zkoušené metodou pokusu a omylu, experimentální interakce s okolím.

Myšlení

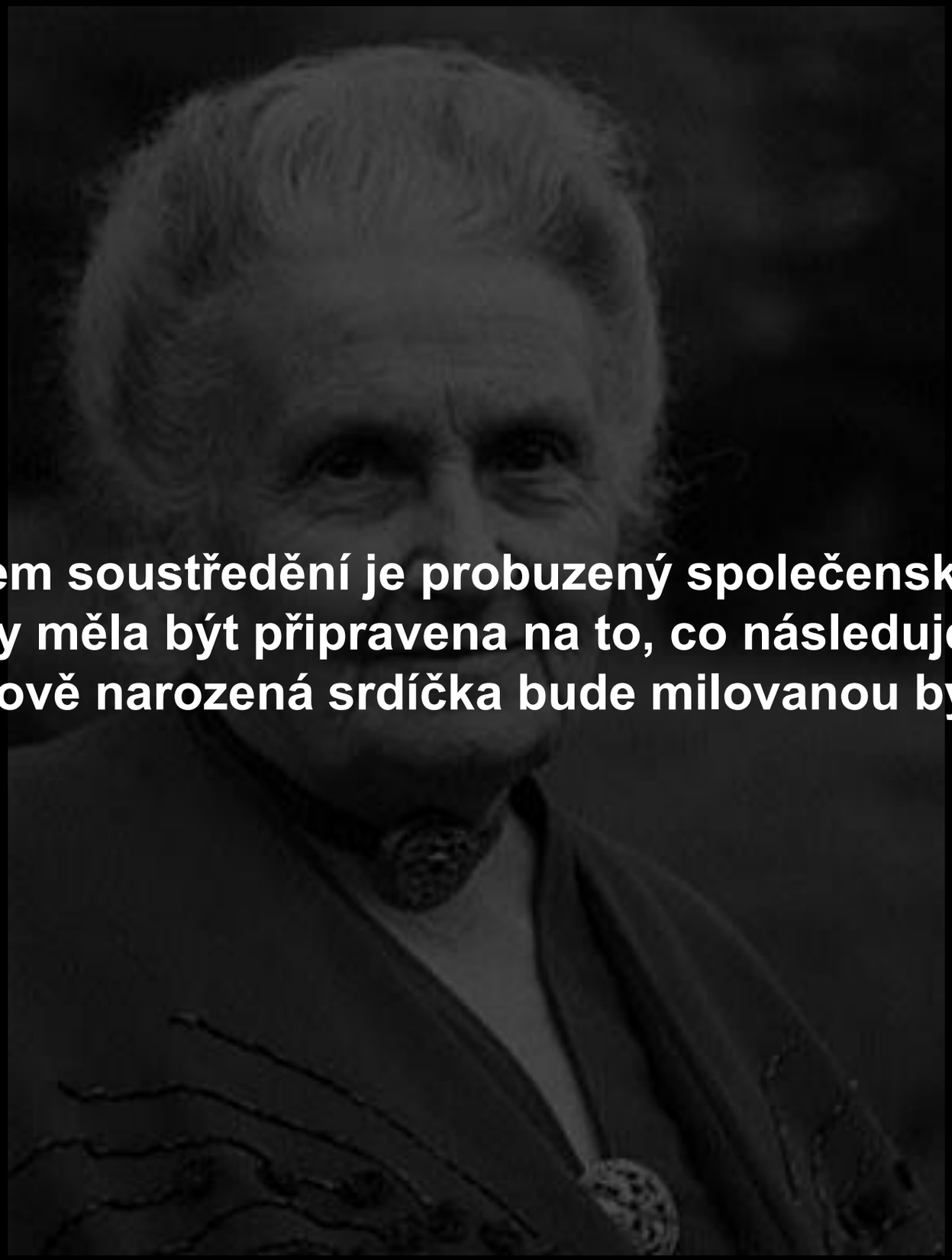
Předolebeční síť
Užívá se při namáhavých kognitivních úkolech, kde se k řízení jednání musí používat pravidla a informace

Soustředění

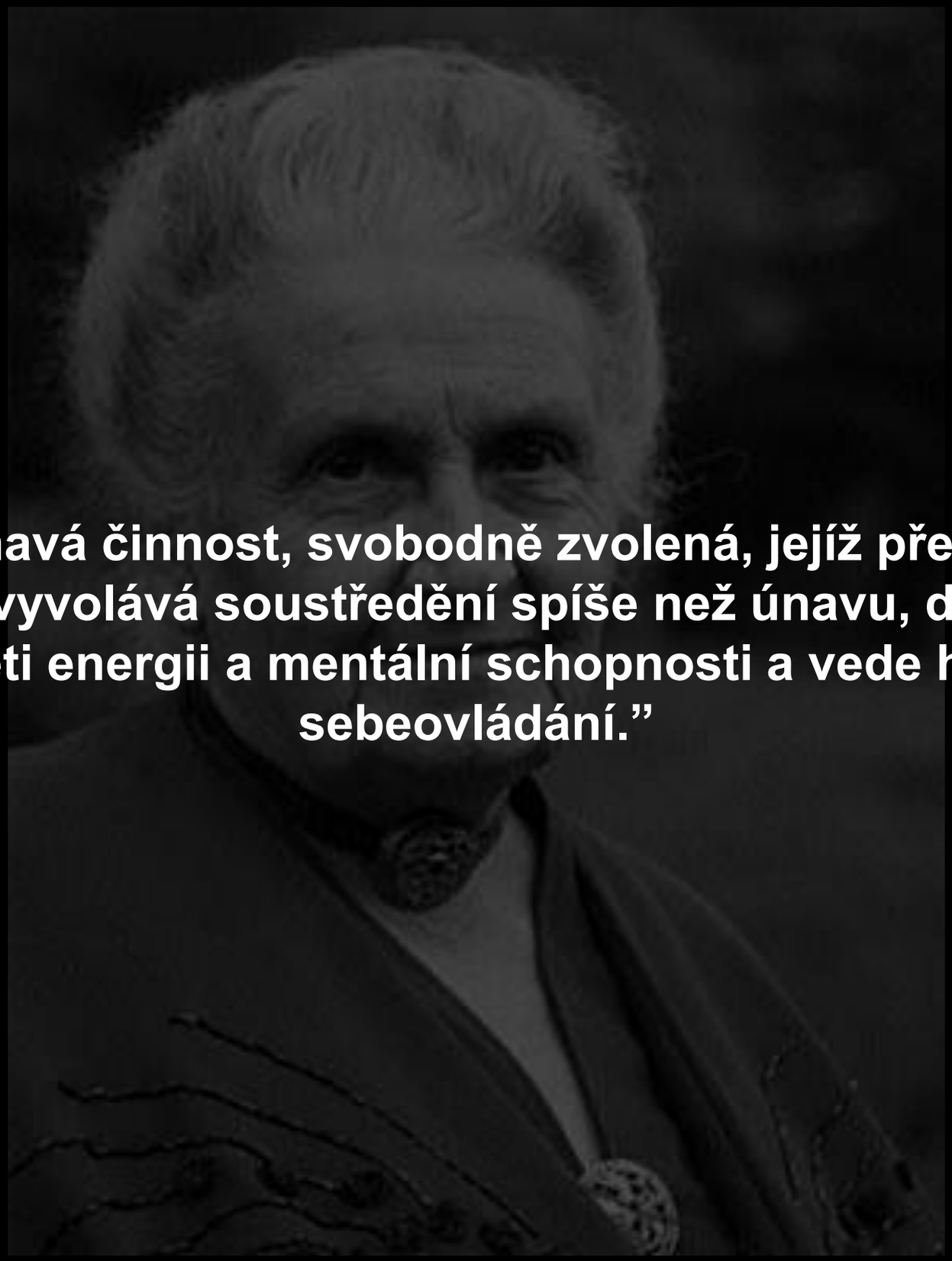
“Soustředění je klíčem, jenž dítěti otvírá poklady v něm ukryté.”



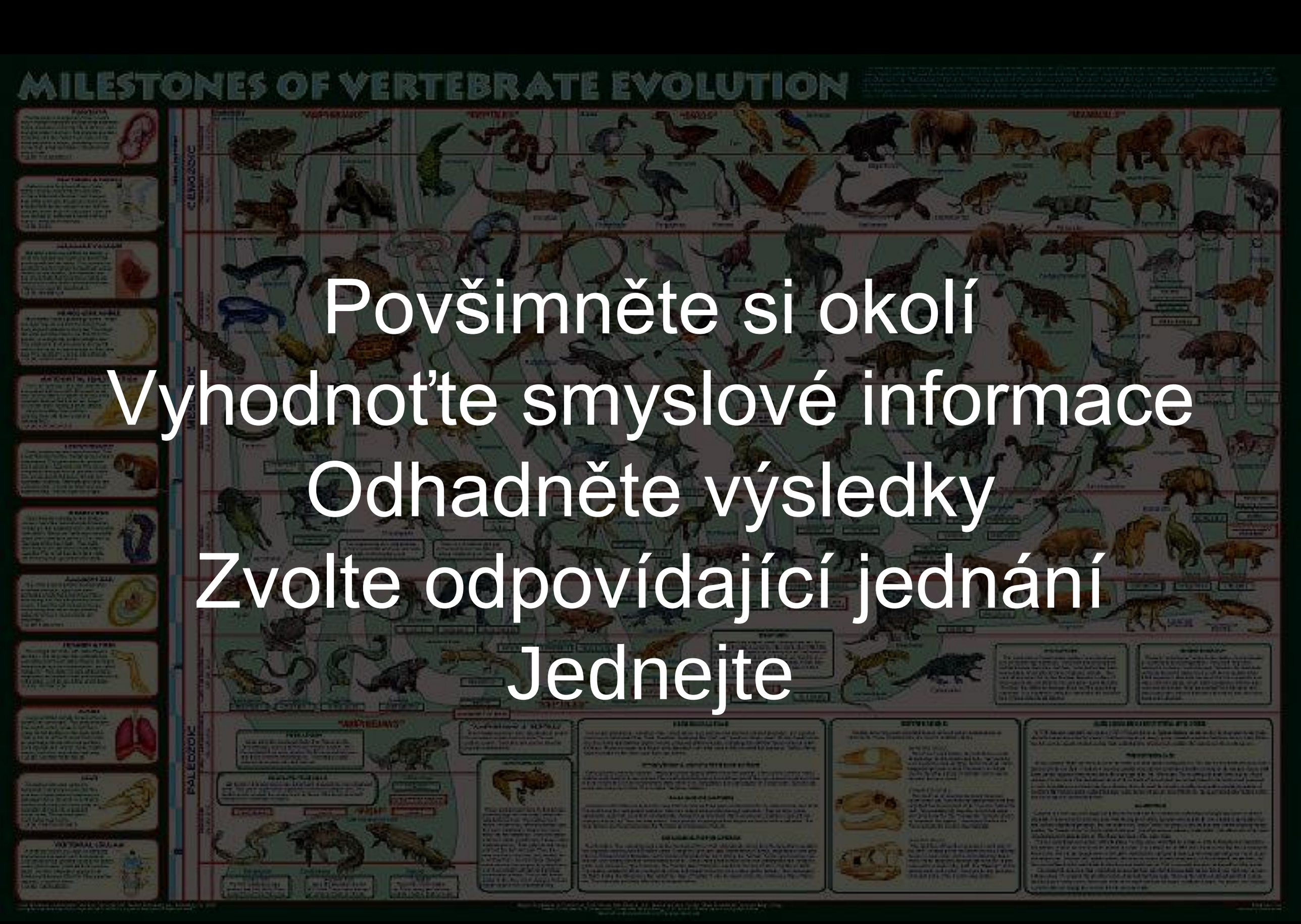
“První zásadní věcí pro vývoj dítěte je soustředění. Tvoří veškerý základ jeho charakteru a společenského chování.”



"Výsledkem soustředění je probuzený společenský smysl a učitelka by měla být připravena na to, co následuje: pro tato malá nově narozená srdíčka bude milovanou bytostí."



“Zajímavá činnost, svobodně zvolená, jejíž předností je, že vyvolává soustředění spíše než únavu, dodává dítěti energii a mentální schopnosti a vede ho k sebeovládání.”

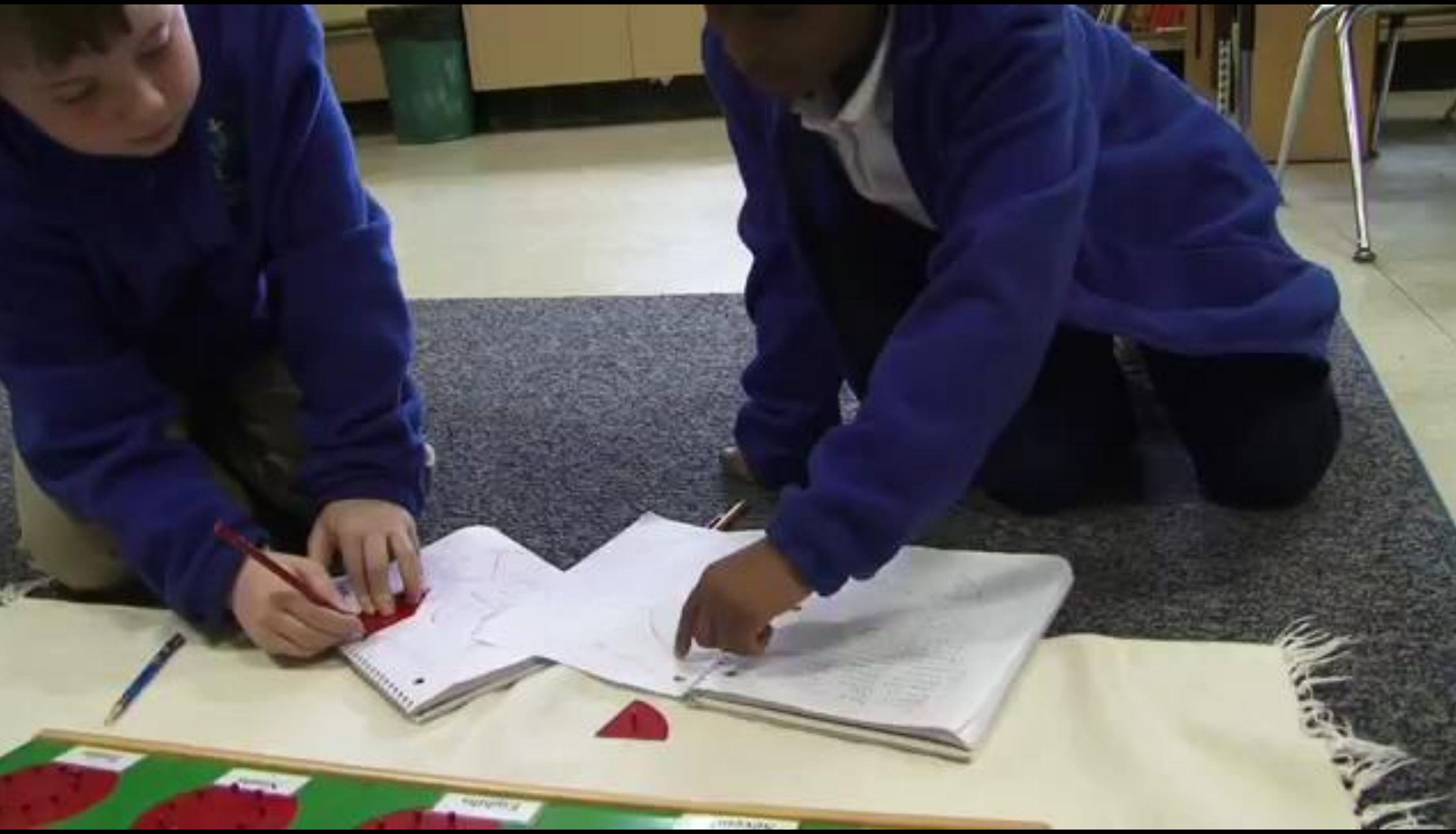


Povšimněte si okolí
Vyhodnoťte smyslové informace
Odhadněte výsledky
Zvolte odpovídající jednání
Jednejte

Vytváření smyslovo-motorických vazeb

Vytváření automatičnosti

Vytváření předvídavého, smyslovo-motorického modelu světa



Povšimněte si okolí

~~Vyhodnoťte smyslové informace~~

~~Odhadněte výsledky~~

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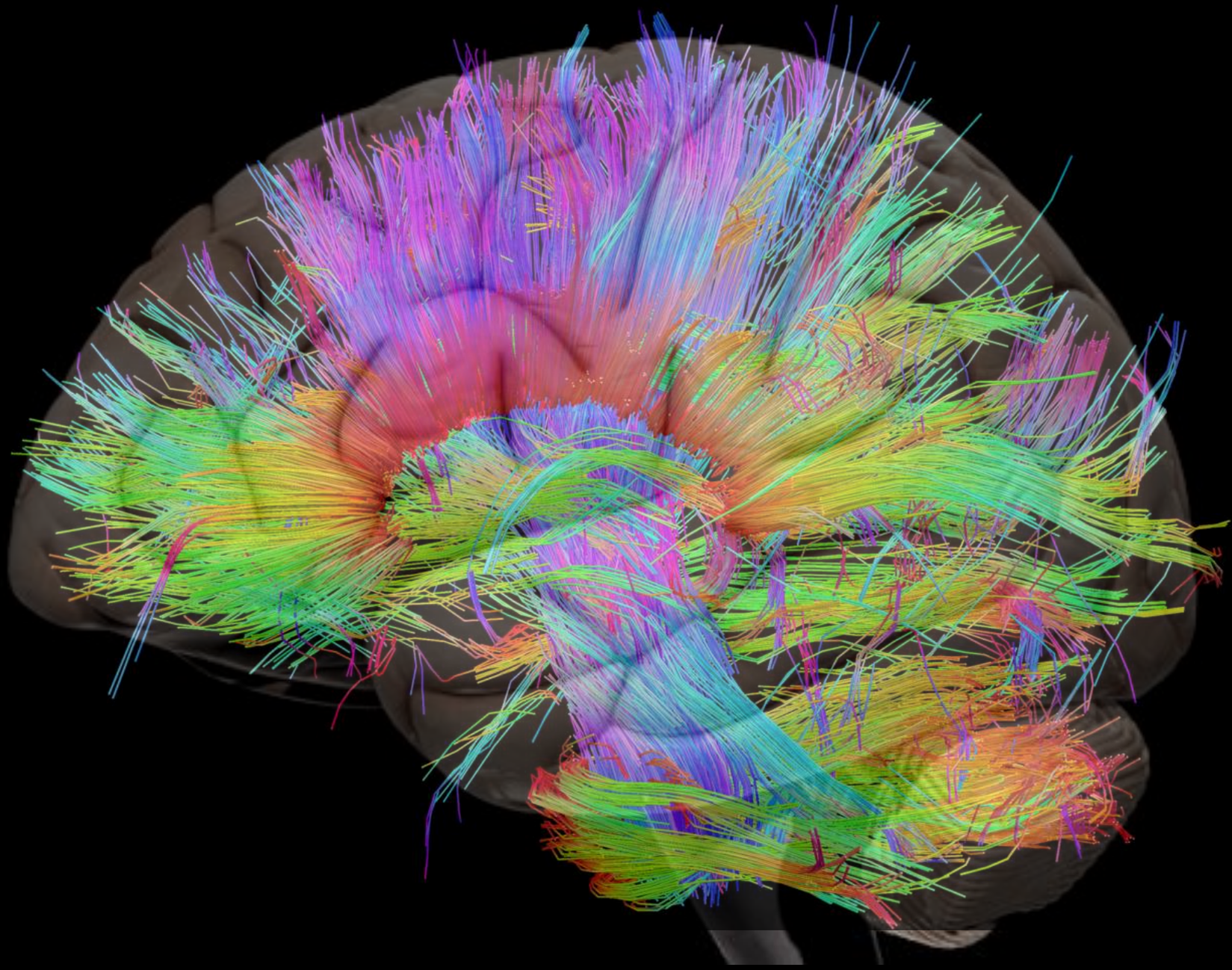

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Development of the Default Mode and Central Executive Networks across early adolescence: A longitudinal study

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IQ bylo významným a pozitivním způsobem dáno do souvislosti se …. síťovou integrací ve věku 10 let a mezi-síťovou segregací u obou věkových kategoriích.

Early adolescence

and other CEN nodes, as well as increasing DMN segregation. IQ was significantly positively related to CEN integration at age 10, and between-network segregation at both ages. These findings highlight early adolescence as a period of significant maturation for the brain's functional architecture and demonstrate the utility of longitudinal designs to investigate neural network development.

1. Introduction

Early adolescence is a period of substantial neural development, triggered in part by biological changes related to the onset of puberty as well as significant changes in youths' social sphere. Work in animals and neuroimaging studies in humans suggest that pubertal development corresponds with significant changes in the brains' structural and functional organization (e.g., Blakemore et al., 2010; Sato et al., 2008). This neural maturation is accompanied by developments in the social and cognitive domains. Adolescents experience a "social reorientation" (Nelson et al., 2005) whereby they become increasingly sensitive to social cues and peer relationships. Indeed, the emphasis on social learning and preparation for adult roles during adolescence occurs in cultures around the world (Schlegel and Barry, 1991; Schlegel, 1995). Youth also make important strides in executive functioning, including inhibitory control, planning for the future, metacognition, and hypothesizing about others' mental states (e.g., Dumontheil et al., 2010; Weil et al., 2013; Williams et al., 1999).

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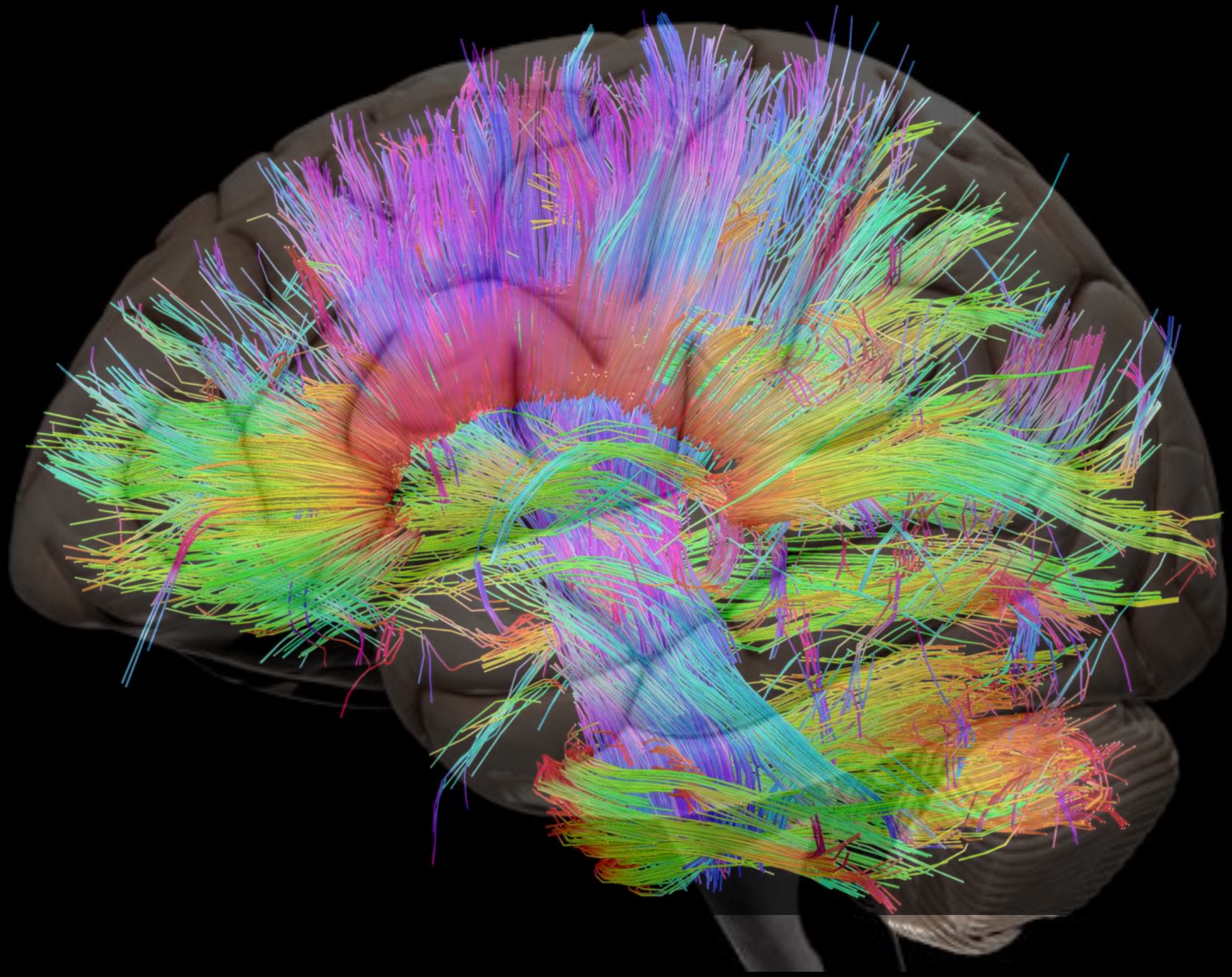
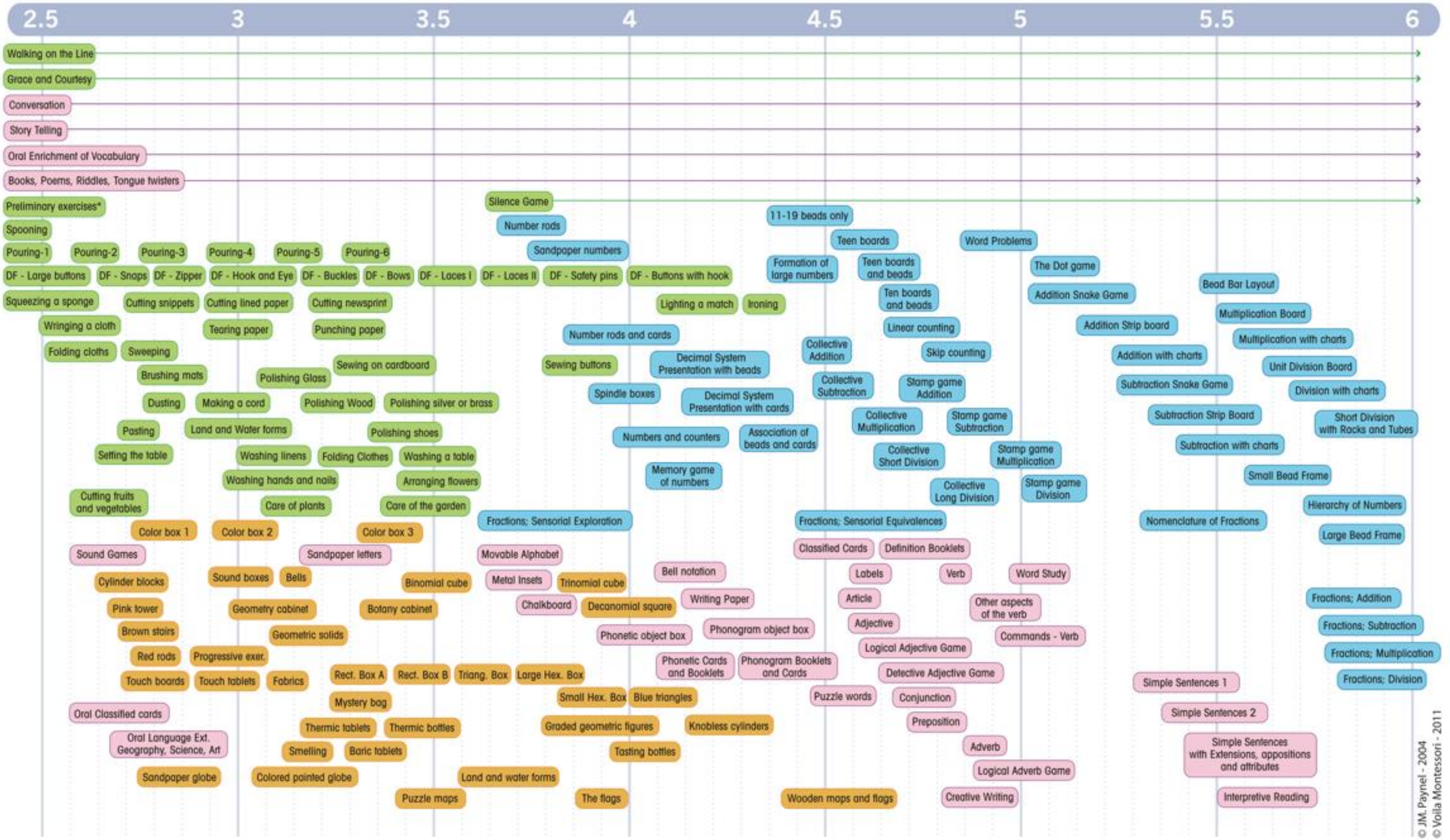
http://dx.doi.org/10.1016/j.dcn.2014.08.002

Schopnost vytvářet smyslovo-motorické vazby.



Namáhavé, motivované, opakované, zkoušené metodou pokusu a omylu, experimentální interakce s okolím.



*Preliminary exercises: Walking, Standing, Sitting down and getting up, Unrolling and rolling a mat or protector, Carrying a tray ,Carrying and looking at a book, Carrying a table, Carrying a chair, Carrying scissors, Carrying a pitcher, Carrying a bucket, Opening and closing a door, Opening and closing drawers, Opening and closing bottles or boxes, Washing hands at the sink… Pouring -1; grain, Pouring -2; water from pitcher to pitcher, Pouring -3; water from pitcher to glass, Pouring -4; water from pitcher to different glasses, Pouring -5; water from pitcher to marked glasses, Pouring -6; from teapot to cup and sauce.

Motor/Self-reg | Language | Math | Sensorial

Research Findings

THE EARLY YEARS

Evaluating Montessori Education

Angeline Lillard[1]* and Nicole Else-Quest[2]

An analysis of students' academic and social scores compares a Montessori school with other elementary school education programs.

Montessori education is a 100-year-old method of schooling that was first used with impoverished preschool children in Rome. The program continues to grow in popularity. Estimates indicate that more than 5000 schools in the United States—including 300 public schools and some high schools—use the Montessori program. Montessori education is characterized by multi-age classrooms, a special set of educational materials, student-chosen work in long time blocks, collaboration, the absence of grades and tests, and individual and small group instruction in both academic

tessori school we studied [located in Milwaukee, Wisconsin (*3*)], which served mainly urban minority children, was in its ninth year of operation and was recognized by the U.S. branch of the Association Montessori Internationale (AMI/USA) for its good implementation of Montessori principles (*4*).

Because it was not feasible to randomly assign children to experimental and control educational groups, we designed our study around the school lottery already in place. Both the experimental and the control group had entered the Montessori school lottery; those who were accepted were assigned to the experimental (Montessori) group, and those who were not accepted were assigned to the control (other education systems) group. This strategy addressed the concern that parents who seek to enroll their child in a Montessori school are different from parents who do not. It is crucial to control for this potential source of bias, because parents are the dominant influence on child outcomes (*5*).

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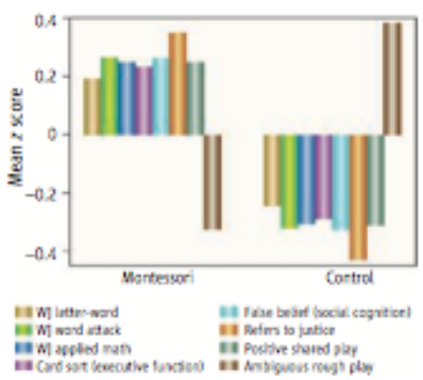
Recruitment

We contacted parents of children who had entered the Montessori school lottery in 1997 and 2003 and invited them to be in the study. All families were offered $100 for participation.

Because the lottery, which was conducted by the school district, was random, the Montessori and control groups should contain similar children. Ninety percent of parent income contributes more to child outcomes than does ethnicity (*6*). We were also concerned that requesting ethnicity data would reduce participation in this racially divided city.

Overall, 53 control and 59 Montessori students were studied (table S1). The 5-year-old group included 25 control and 30 Montessori children, and the 12-year-old group included 28 control and 29 Montessori children. Gender balance was imperfect, but gender did not contribute significantly to any of the differences reported here. Children at the Montessori school were drawn from all six classrooms at the primary level and all four at the upper elementary level. The control children were at non-Montessori schools: 27 public inner city schools (40 children) and 12 suburban public, private/voucher, or charter schools (13 children). Many of the public schools had enacted special programs, such as gifted and talented curricula, language immersion, arts, and discovery learning.

Children in both groups were tested for cognitive/academic and social/behavioral



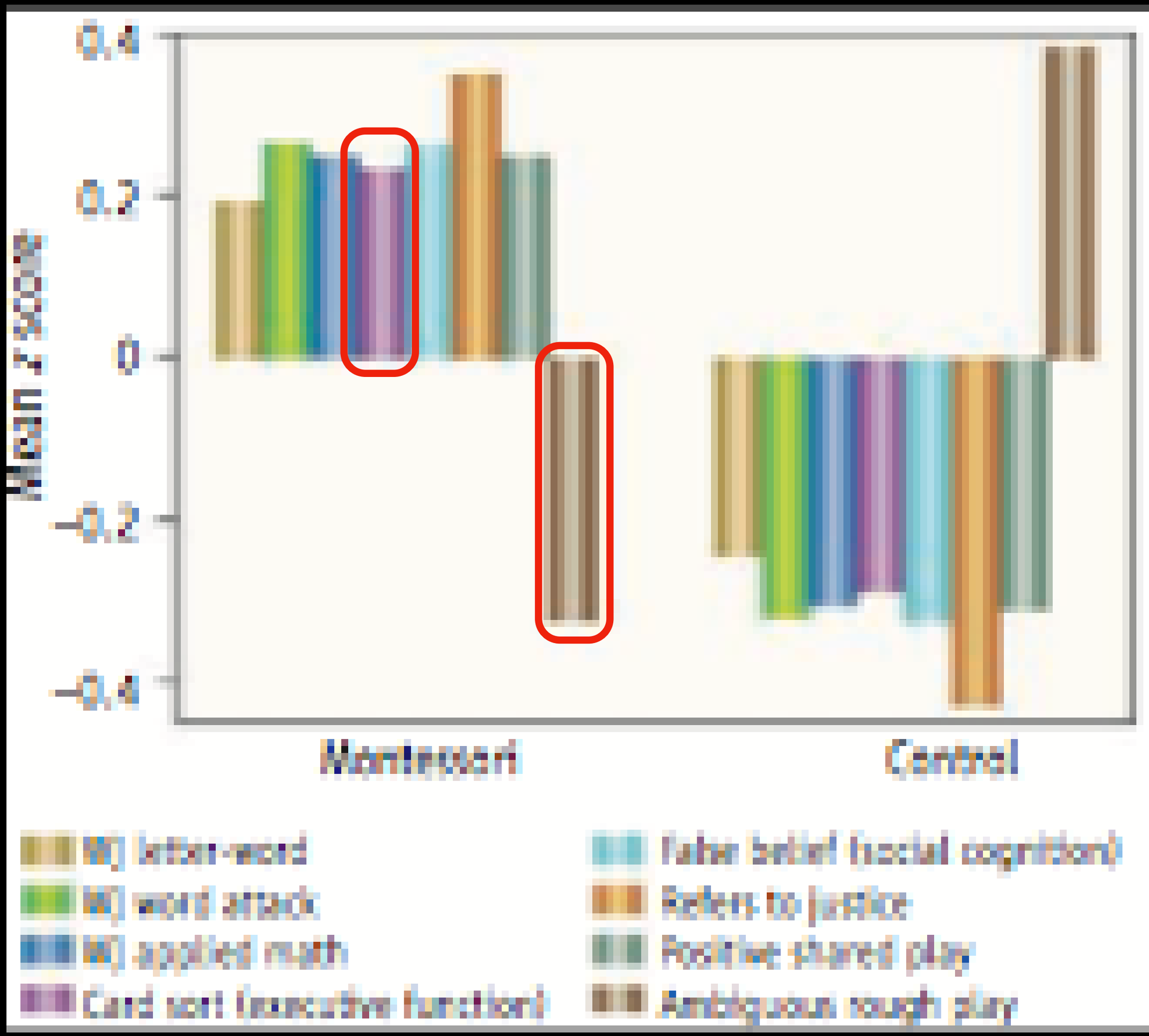
Results for 5-year-olds. Montessori students achieved higher scores [converted to average *z* scores (*18*)] for both academic and behavioral tests.

were administered from the Woodcock-Johnson (WJ III) Test Battery (*7*). Significant differences favoring Montessori 5-year-olds were found on three WJ tests measuring academic skills related to school readiness: Letter-Word Identification, Word Attack (phonological decoding ability), and Applied Problems (math skills) (see chart, left). No difference was expected or found on the Picture Vocabulary test (basic vocabulary) because vocabulary is highly related to family background variables (*8*). Two WJ tests of basic thinking skills—Spatial Reasoning and Concept Formation—also showed no difference.

Five-year-olds were also tested on executive function, thought to be important to success in school. On one such test, children were asked to sort cards by one rule, switch to a new rule, and (if they did well) then switch to a compound rule. Montessori children performed significantly better on this test. A test of children's ability to delay gratification (a treat) did not indicate statistically significant differences.

Social/Behavioral Measures. Children were given five stories about social problems, such as another child hoarding a swing, and were asked how they would solve each problem (*9*).

"Randomized Controlled Trial"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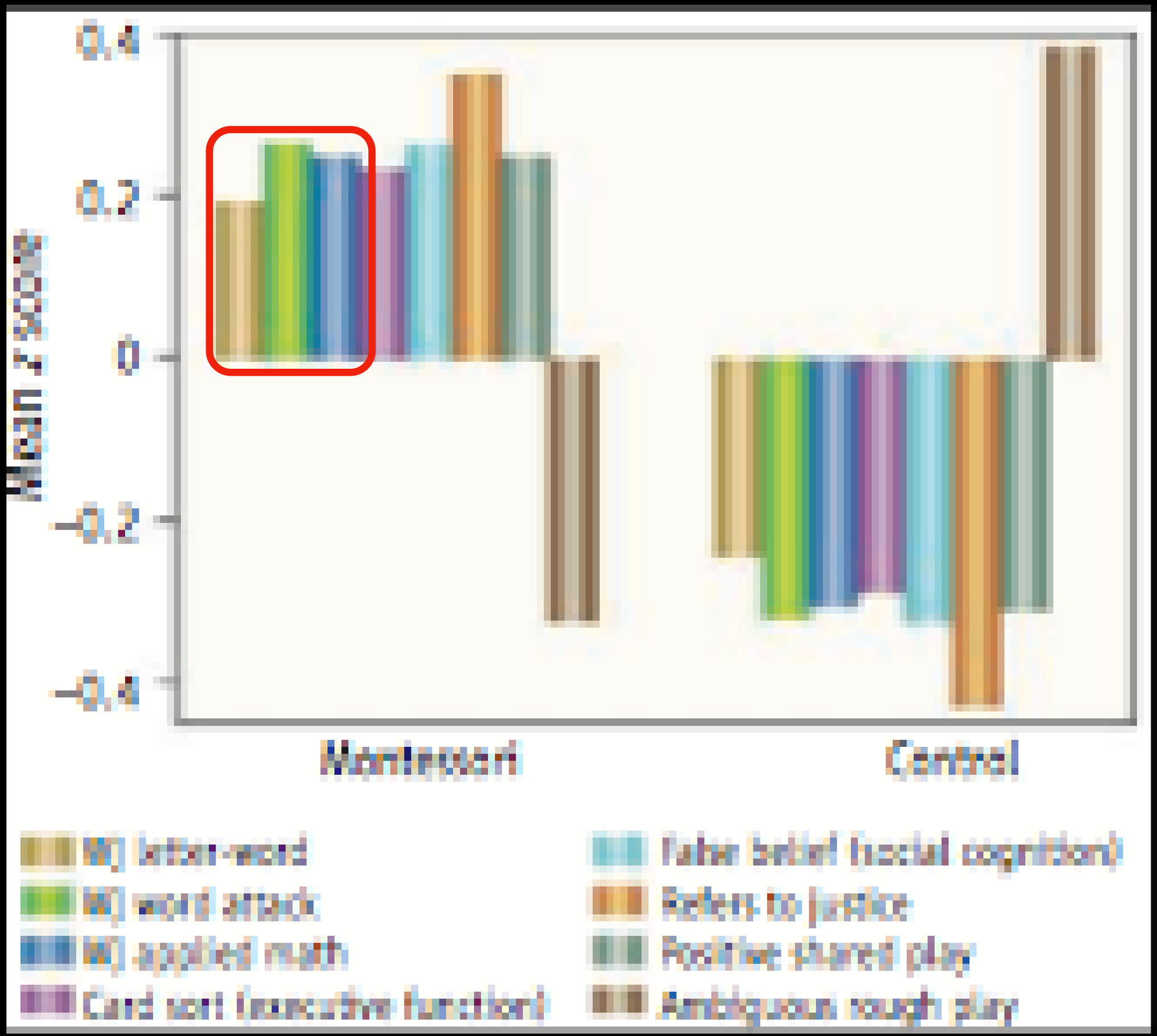
Neurotypical
Control
Letter-word
Word attack
Applied math
Card sort (executive function)
False belief (social cognition)
Refers to justice
Positive shared play
Ambiguous rough play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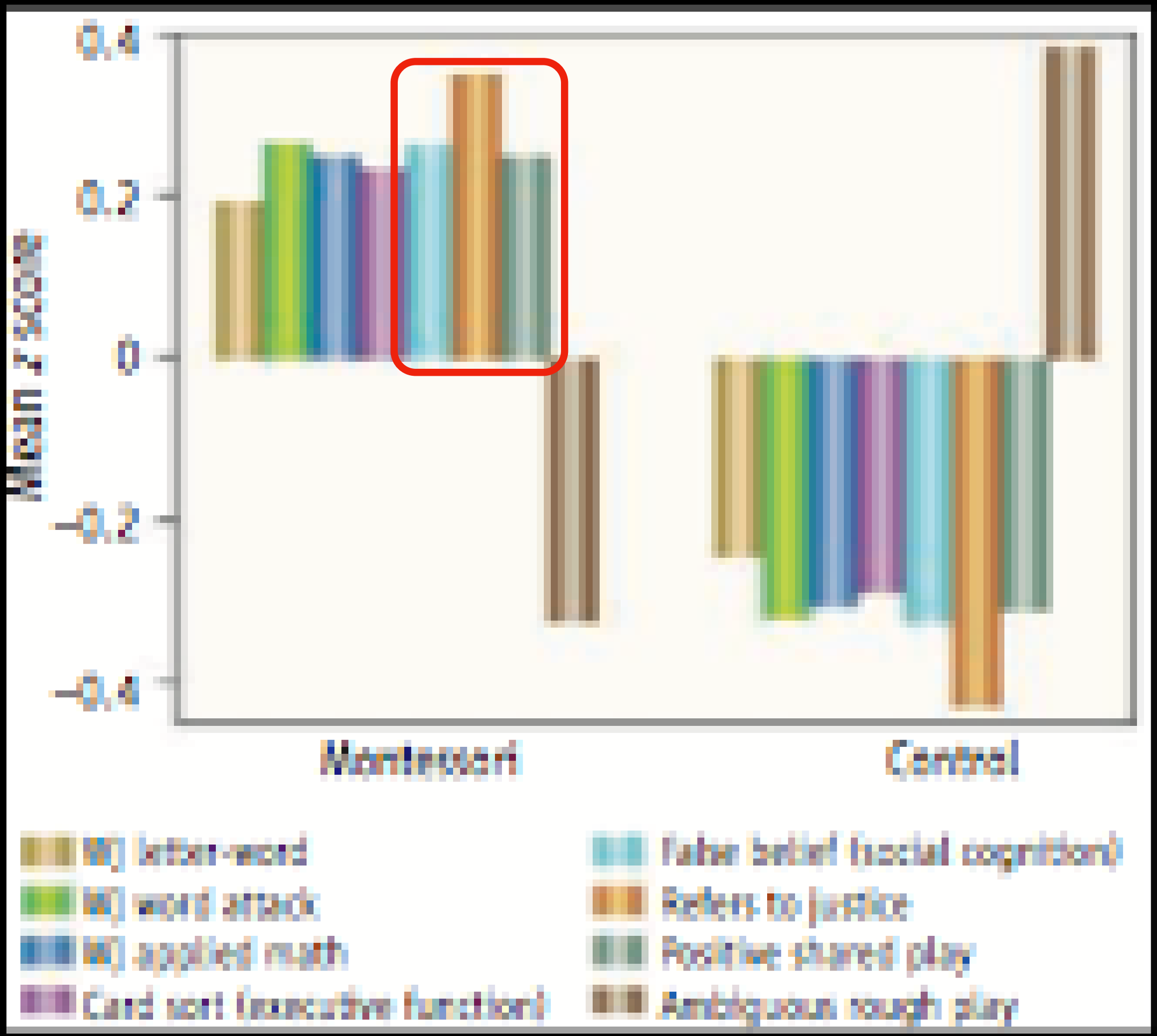
False belief (social cognition)
Refers to justice
Positive shared play
Ambiguous rough play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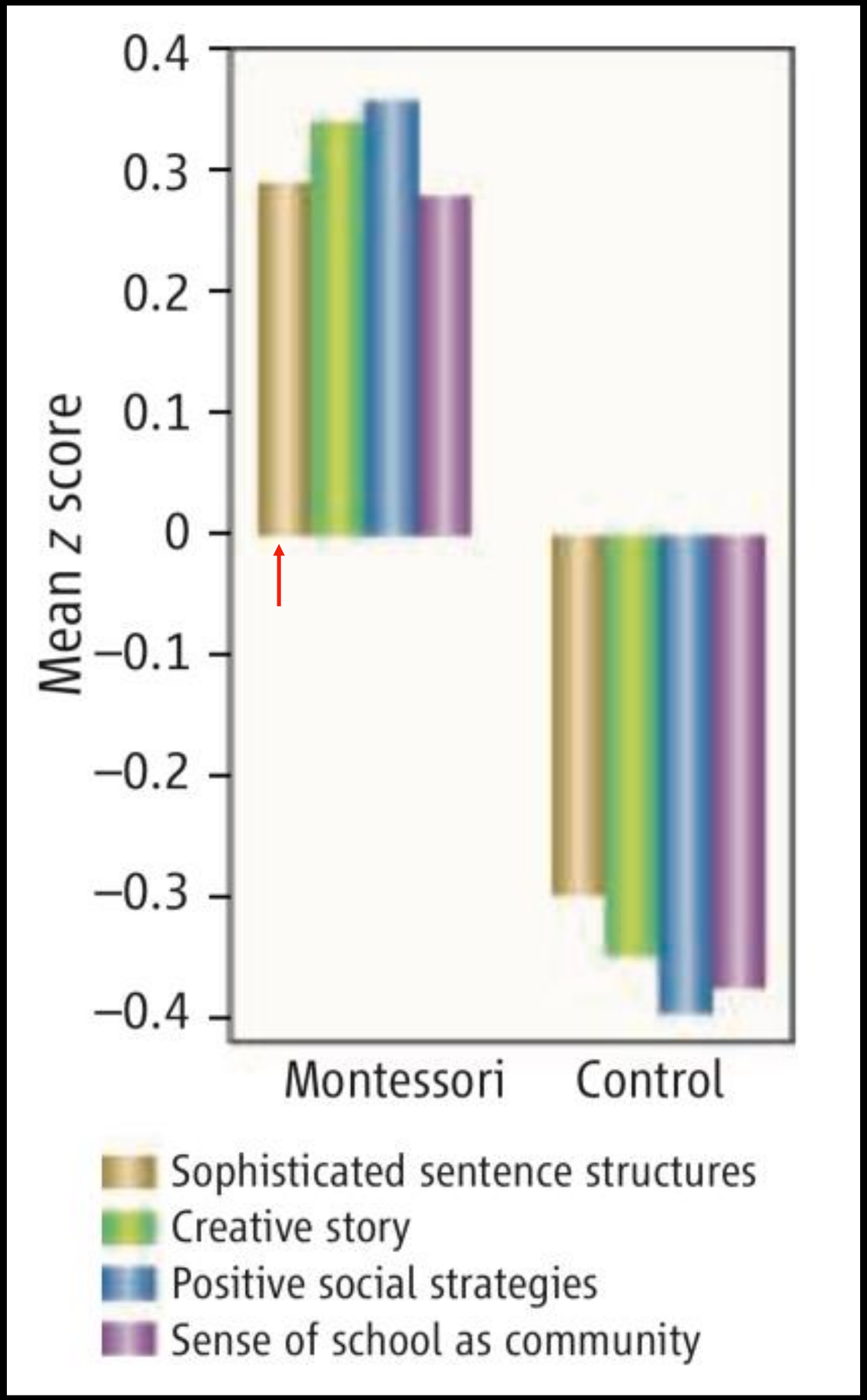
Card sort (executive function)
False belief (social cognition)
Refers to justice
Positive shared play
Ambiguous rough play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Mean z score
Montessori
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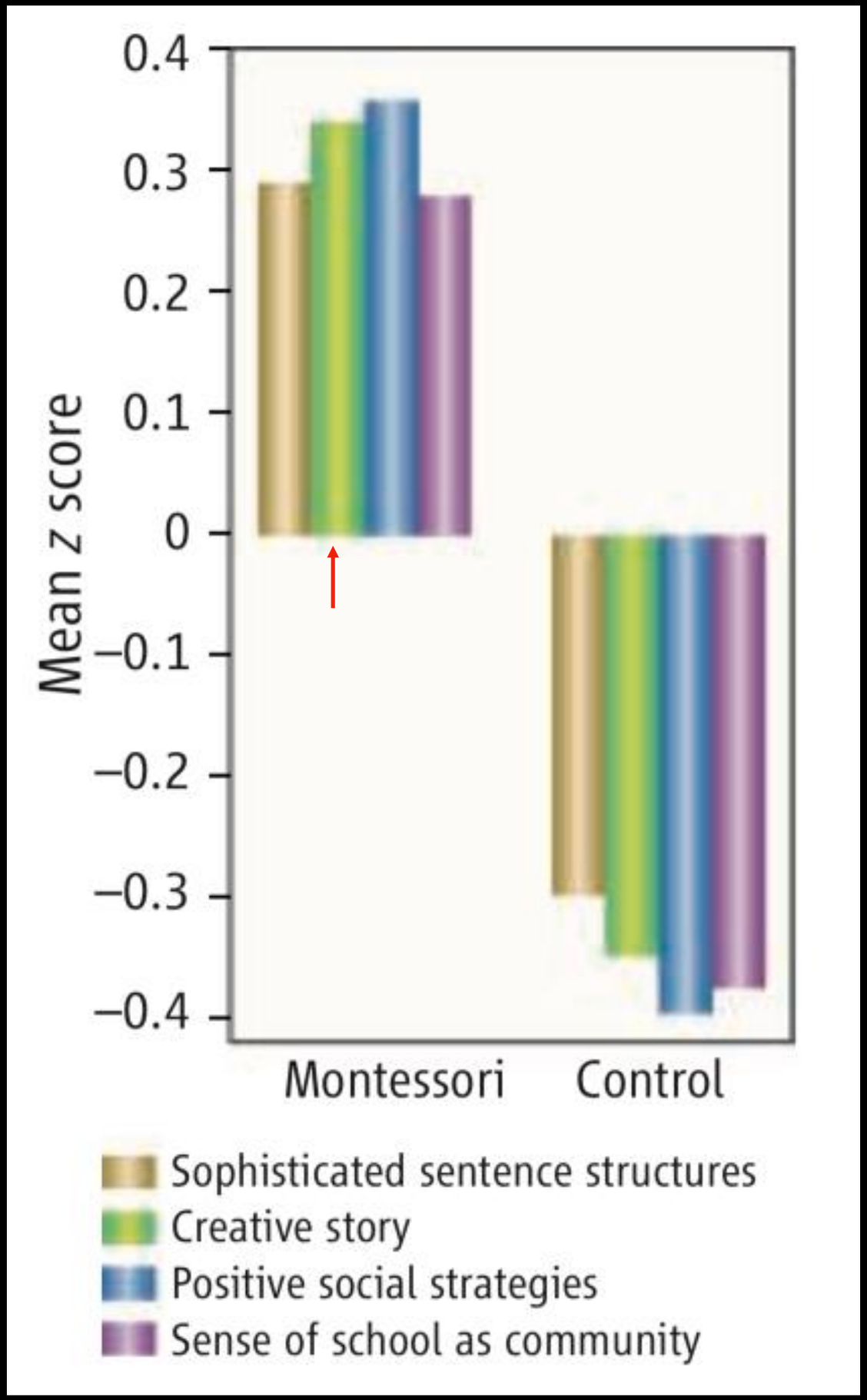
Sophisticated sentence structures
Creative story
Positive social strategies
Sense of school as community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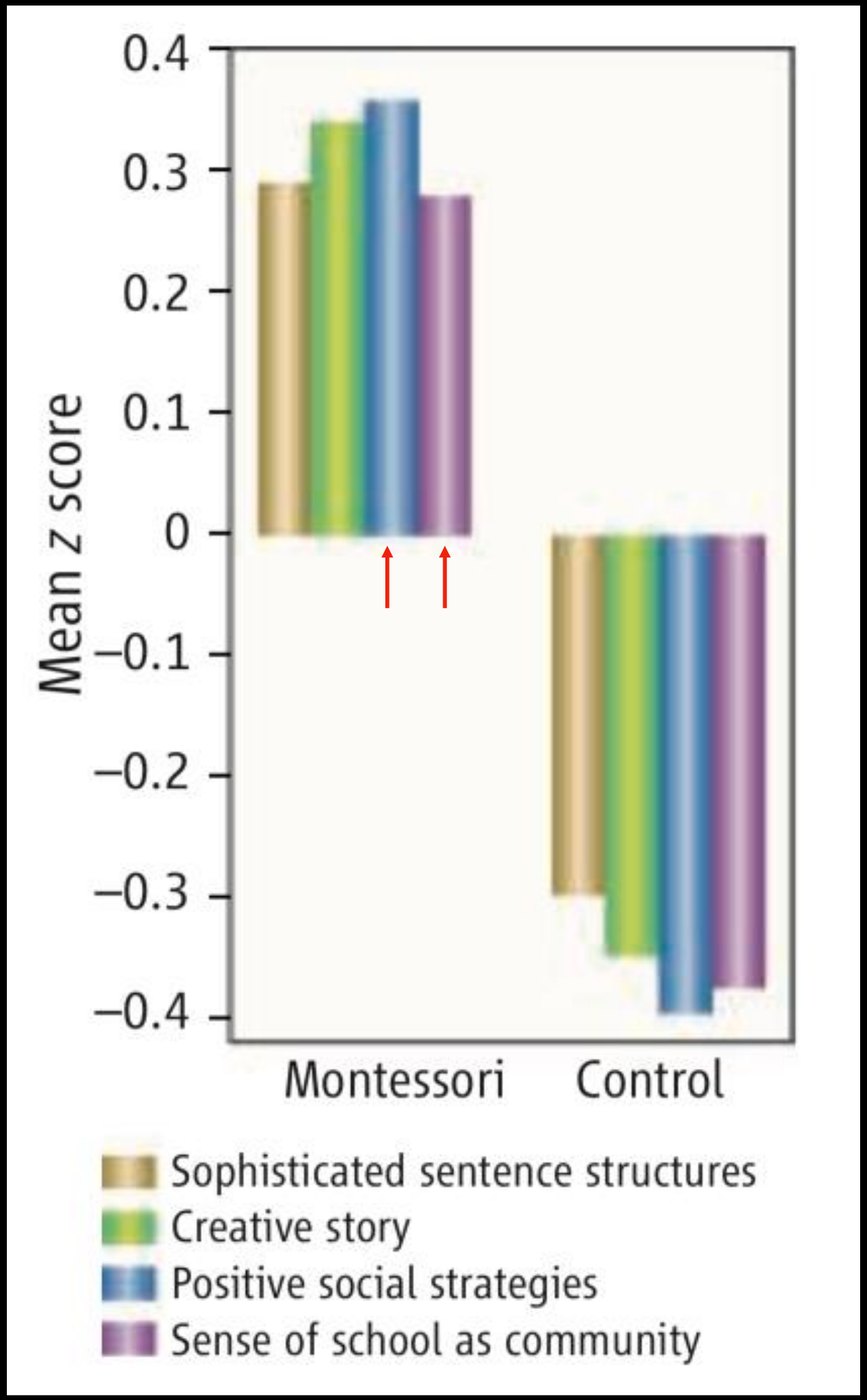
Creative story
Positive social strategies
Sense of school as community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Mean z score
Montessori
Control
Sophisticated sentence structures
Creative story
Positive social strategies
Sense of school as community

MIND

Students Prosper with Montessori Method

By David Biello on September 29, 2006

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Nearly 100 years ago, a physician opened a school in a poor section of Rome. In doing so, Maria Montessori went beyond being the first female doctor in Italy and became the pioneer of a new method of

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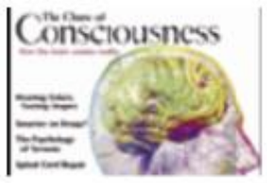

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frontiers in Psychology

ORIGINAL RESEARCH
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Montessori Preschool Elevates and Equalizes Child Outcomes: A Longitudinal Study

Angeline S. Lillard[1], Megan J. Heise[1], Eve M. Richey[1], Xin Tong[1], Alyssa Hart[1] and Paige M. Bray[2]*

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Quality preschool programs that develop the whole child through age-appropriate socioemotional and cognitive skill-building hold promise for significantly improving child outcomes. However, preschool programs tend to either be teacher-led and didactic, or else to lack academic content. One preschool model that involves both child-directed, freely chosen activity and academic content is Montessori. Here we report

"Randomized Controlled Trial"

understanding, and mastery orientation, and they also reported relatively more liking of scholastic tasks. They also scored higher on executive function when they were 4. In addition to elevating overall performance on these measures, Montessori preschool also equalized outcomes among subgroups that typically have unequal outcomes. First, the difference in academic achievement between lower income Montessori and higher income conventionally schooled children was smaller at each time point, and was not (statistically speaking) significantly different at the end of the study. Second, defying the typical finding that executive function predicts academic achievement, in Montessori classrooms children with lower executive function scored as well on academic achievement as those with higher executive function. This suggests that Montessori preschool has potential to elevate and equalize important outcomes, and a larger study of public Montessori preschools is warranted.

Keywords: early childhood education, preschool, Montessori, cognitive development, social development, theory of mind, mastery orientation, academic achievement

Reviewed by:
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INTRODUCTION

Optimizing preschool education is important from both economic and developmental standpoints (Heckman, 2006; Blair and Raver, 2016). The human brain undergoes marked development in the first 6 years, and the environment interacts with gene expression producing changes that appear to be permanent (Zhang and Meaney, 2010). Furthermore, neural development

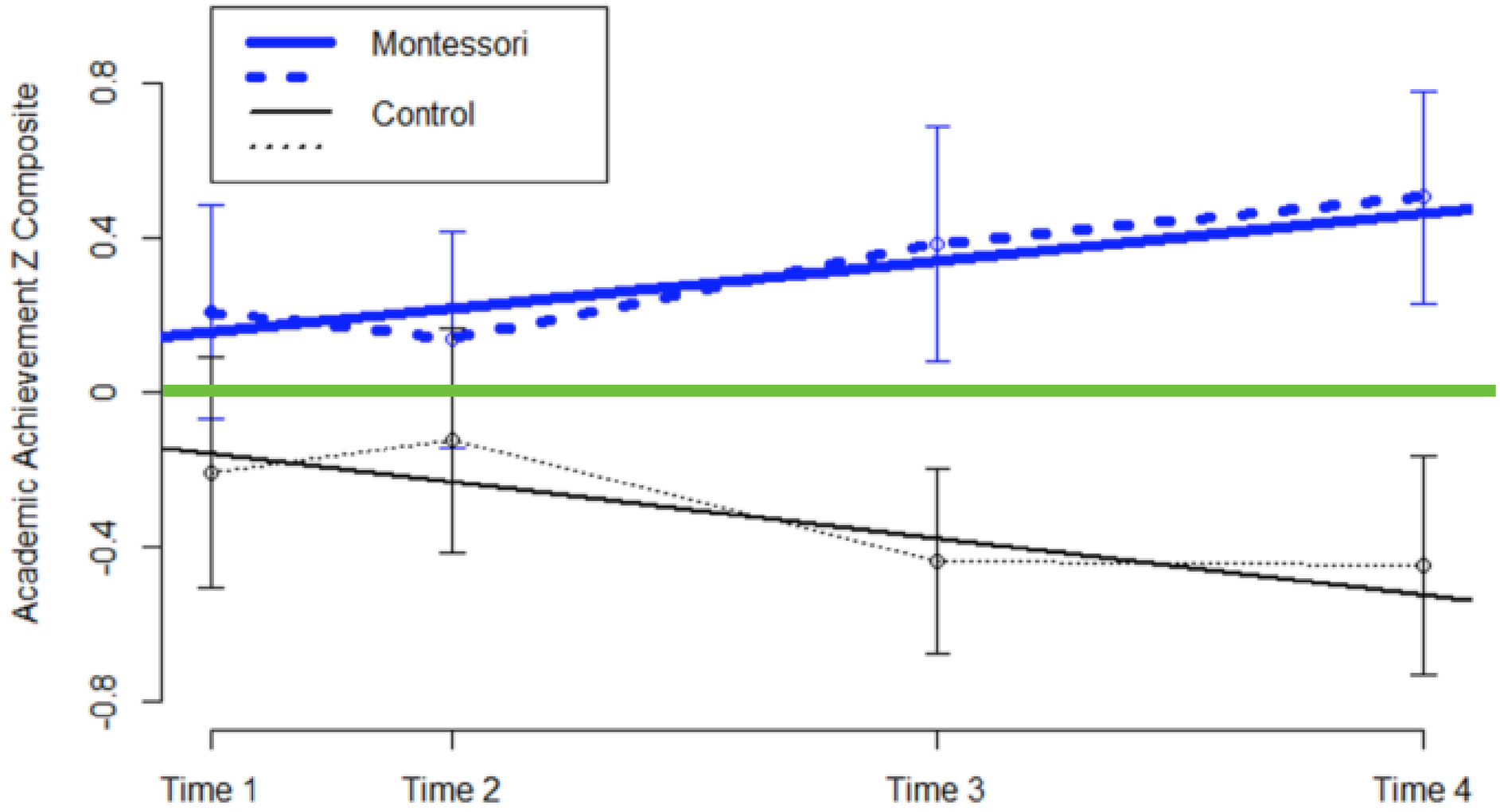

FIGURE 2 | Academic achievement across preschool by school type. The figure shows significantly greater growth in academic achievement across preschool for children enrolled in Montessori preschool (dashed blue lines, $n = 70$) than waitlisted controls (dotted black lines, $n = 71$). Groups were statistically equivalent at Time 1 (the non-significant difference at Time 1 is likely due the Time 1 tests occurring into mid-December, thus school programs could already have made a difference) and Time 2 (late in the spring of their 1st year in preschool) and significantly different by the end of their 2nd and 3rd years in preschool (Times 3 and 4). Dashed/dotted lines represent actual data and solid lines represent fitted linear growth curves. Standard error bars are shown.

STUDY: MONTESSORI EDUCATION ERASES INCOME ACHIEVEMENT GAP

November 01, 2017 • Jane Kelly, jak4g@virginia.edu

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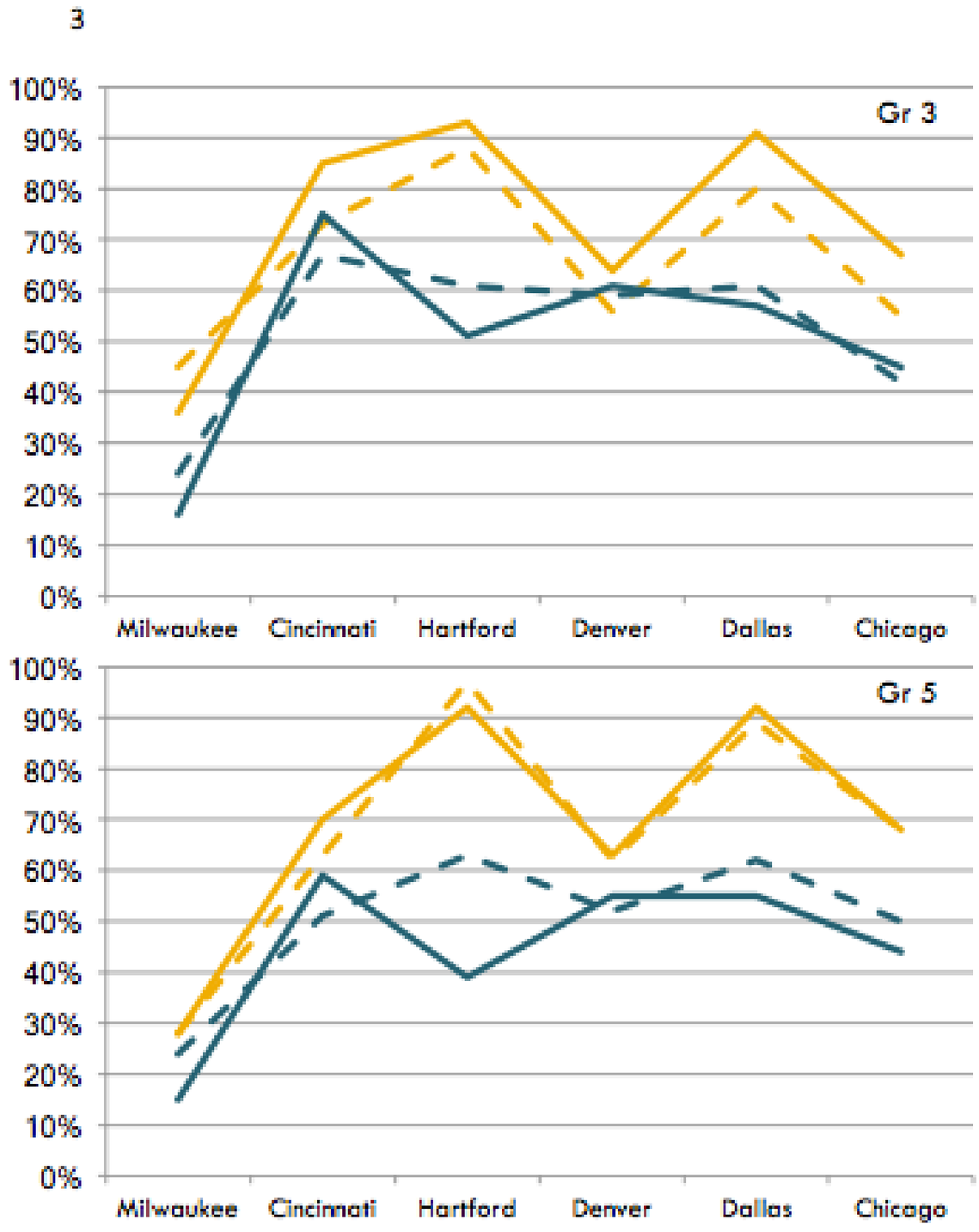
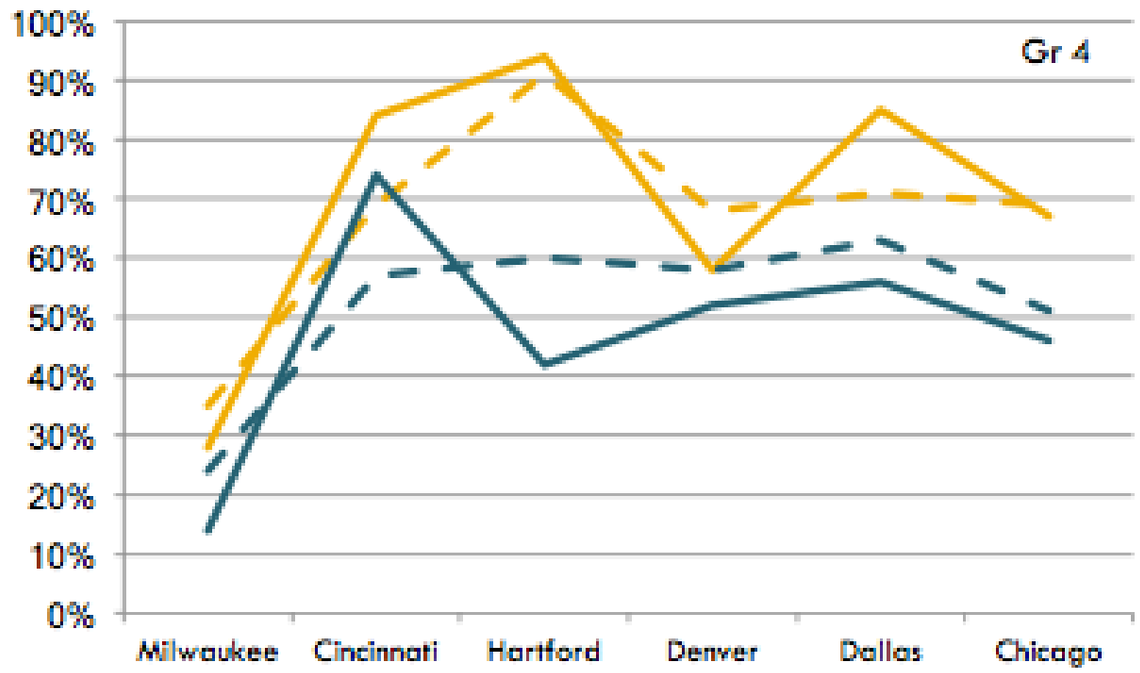
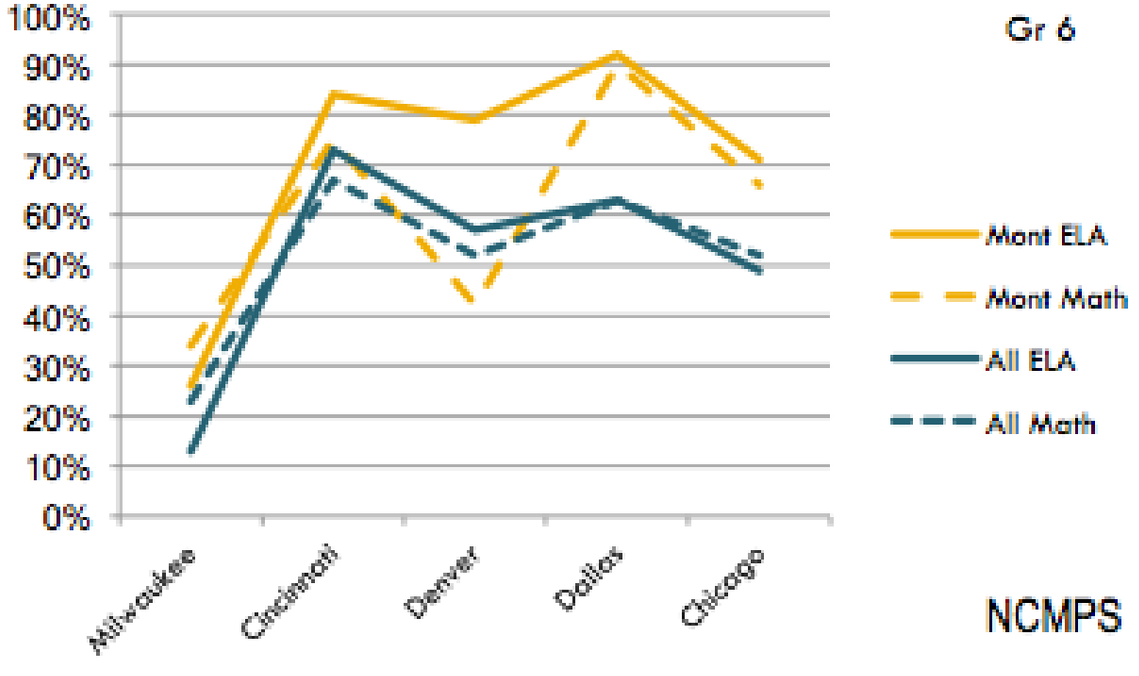
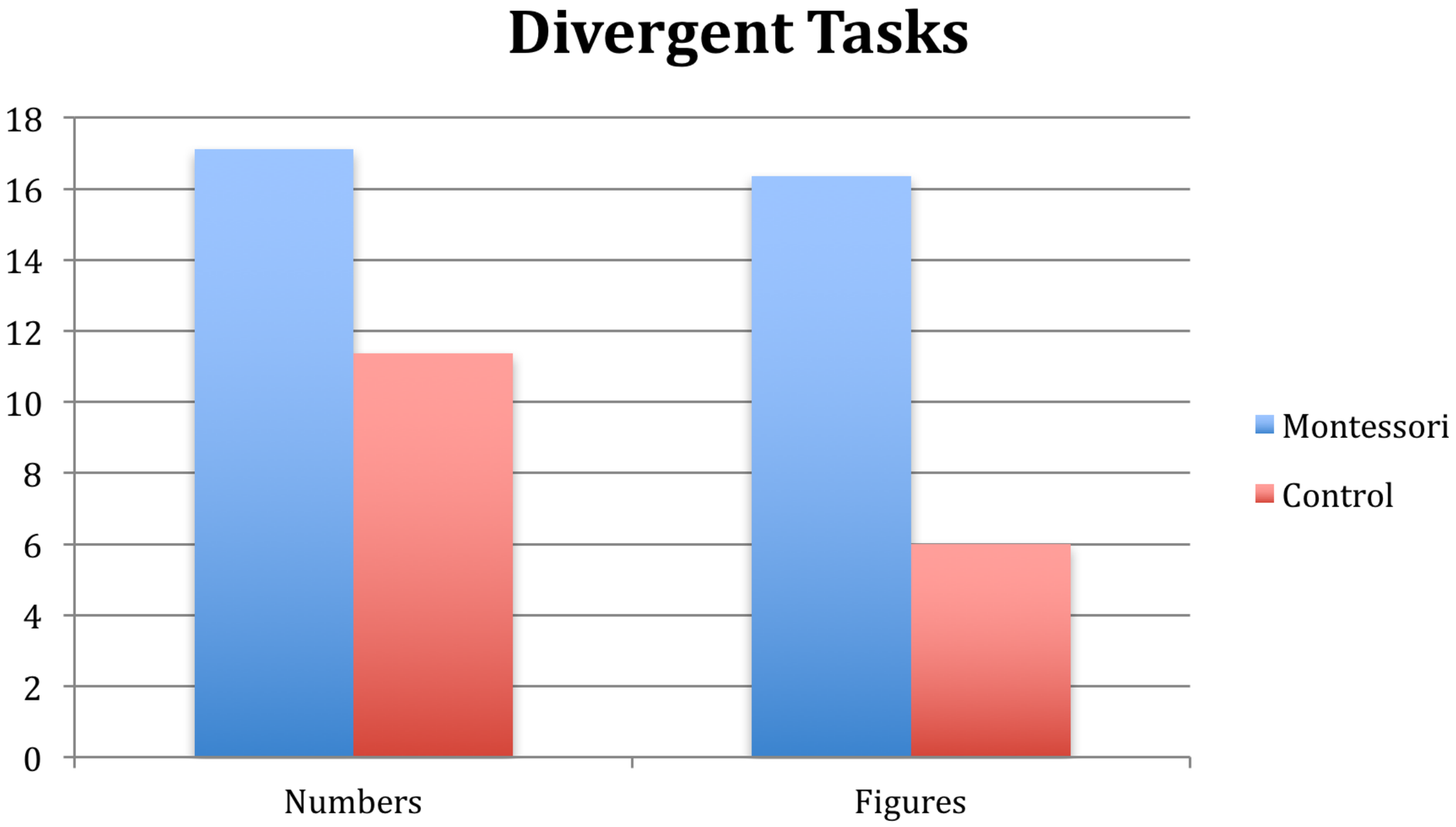






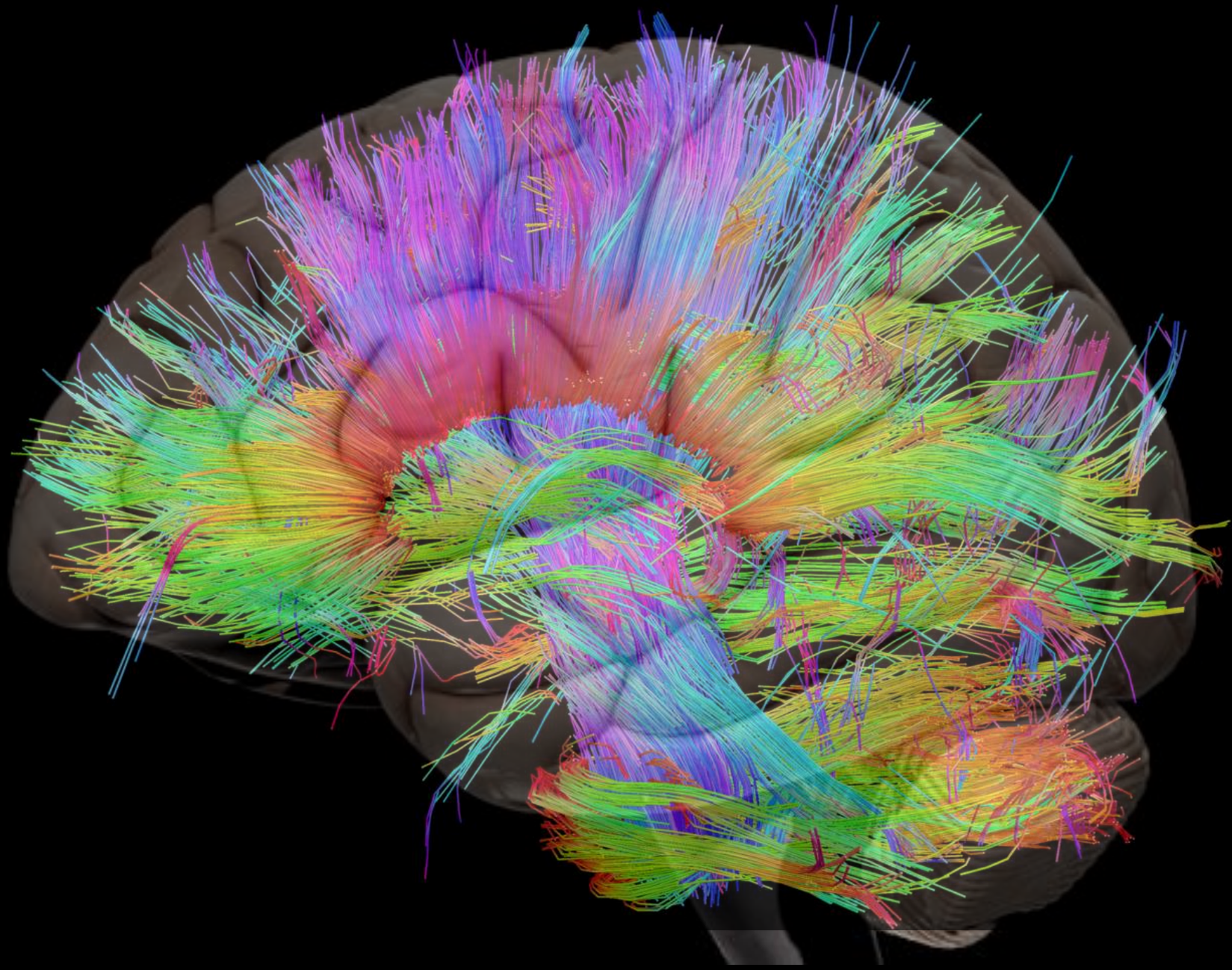
National Center for Montessori in the Public Sector

Results from OECD **creativity study** using the Evaluation of Creative Potential - Math



Katie Brown, K., Dosmann, Phillip (2017). Creativity in Montessori Adolescent Programs. Poster Presented at 2017 Annual conference of the American Montessori Society, San Diego.

Courtesy of National Center for Montessori in the Public Sector



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