DEANS FOR IMPACT

THE SCIENCE OF LEARNING

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About
THE SCIENCE OF LEARNING

The purpose of *The Science of Learning* is to summarize the existing research from cognitive science related to how students learn, and connect this research to its practical implications for teaching and learning. This document is intended to serve as a resource to teacher-educators, new teachers, and anyone in the education profession who is interested in our best scientific understanding of how learning takes place.

This document identifies six key questions about learning that should be relevant to nearly every educator. Deans for Impact believes that, as part of their preparation, every teacher-candidate should grapple with — and be able to answer — the questions in *The Science of Learning*. Their answers should be informed and guided by the existing scientific consensus around basic cognitive principles. And all educators, including new teachers, should be able to connect these principles to their practical implications for the classroom (or wherever teaching and learning take place).

The Science of Learning was developed by member deans of Deans for Impact in close collaboration with Dan Willingham, a cognitive scientist at the University of Virginia, and Paul Bruno, a former middle-school science teacher. We are greatly indebted to the reviewers who provided thoughtful feedback and comments on early drafts, including cognitive scientists, teacher-educators, practicing teachers, and many others.

The Science of Learning does not encompass everything that new teachers should know or be able to do, but we believe it is part of an important — and evidence-based — core of what educators should know about learning. Because our scientific understanding is ever evolving, we expect to periodically revise *The Science of Learning* to reflect new insights into cognition and learning. We hope that teachers, teacher-educators, and others will conduct additional research and gather evidence related to the translation of these scientific principles to practice.

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About
DEANS FOR IMPACT

Founded in 2015, Deans for Impact is a national nonprofit organization representing leaders in educator preparation who are committed to transforming educator preparation and elevating the teaching profession. The organization is guided by four key principles:

- Data-informed improvement;
- Common outcome measures;
- Empirical validation of effectiveness; and
- Transparency and accountability for results.

More information on the organization and its members can be found on the Deans for Impact website.

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DEANS FOR IMPACT

1 HOW DO STUDENTS UNDERSTAND NEW IDEAS?

COGNITIVE PRINCIPLES

PRACTICAL IMPLICATIONS FOR THE CLASSROOM

Students learn new ideas by reference to ideas they already know.[1]

- A well-sequenced curriculum is important to ensure that students have the prior knowledge they need to master new ideas.[2]
- Teachers use analogies because they map a new idea onto one that students already know. But analogies are effective only if teachers elaborate on them, and direct student attention to the crucial similarities between existing knowledge and what is to be learned.[3]

To learn, students must transfer information from working memory (where it is consciously processed) to long-term memory (where it can be stored and later retrieved). Students have limited working memory capacities that can be overwhelmed by tasks that are cognitively too demanding. Understanding new ideas can be impeded if students are confronted with too much information at once.[4]

- Teachers can use "worked examples" as one method of reducing students' cognitive burdens.[5] A worked example is a step-by-step demonstration of how to perform a task or solve a problem. This guidance – or "scaffolding" – can be gradually removed in subsequent problems so that students are required to complete more problem steps independently.
- Teachers often use multiple modalities to convey an idea; for example, they will speak while showing a graphic. If teachers take care to ensure that the two types of information complement one another – such as showing an animation while describing it aloud – learning is enhanced. But if the two sources of information are split – such as speaking aloud with different text displayed visually – attention is divided and learning is impaired.[6]
- Making content explicit through carefully paced explanation, modeling, and examples can help ensure that students are not overwhelmed.[7] *(Note: "explanation" does not mean teachers must do all the talking.)*

Cognitive development does not progress through a fixed sequence of age-related stages. The mastery of new concepts happens in fits and starts.[8]

- Content should not be kept from students because it is "developmentally inappropriate." The term implies there is a biologically inevitable course of development, and that this course is predictable by age. To answer the question "is the student ready?" it's best to consider "has the student mastered the prerequisites?"[9]

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[1] Bransford, Brown, & Cocking, 2000
[2] Agodini, Harris, Atkins-Burnett, Heaviside, Novak, & Murphy, 2009; TeachingWorks
[3] Richland, Zur, & Holyoak, 2007
[4] Sweller, 1988
[5] Pashler, Bain, Bottge, Graesser, Koedinger, & McDaniel, 2007; Kirschner, Sweller, & Clark, 2006; Atkinson, Derry, Renkl, & Wortham, 2000; Sweller, 2006
[6] Chandler & Sweller, 1992; Moreno & Mayer, 1999; Moreno, 2006
[7] Kirschner, Sweller, & Clark, 2006; TeachingWorks
[8] Flynn, O'Malley, & Wood, 2004; Siegler, 1995
[9] Willingham, 2008

2 HOW DO STUDENTS LEARN AND RETAIN NEW INFORMATION?

COGNITIVE PRINCIPLES

PRACTICAL IMPLICATIONS FOR THE CLASSROOM

Information is often withdrawn from memory just as it went in. We usually want students to remember what information means and why it is important, so they should think about meaning when they encounter to-be-remembered material.[10]

- Teachers can assign students tasks that require explanation (e.g., answering questions about how or why something happened) or that require students to meaningfully organize material. These tasks focus students' attention on the meaning of course content.[11]
- Teachers can help students learn to impose meaning on hard-to-remember content. Stories and mnemonics are particularly effective at helping students do this.[12]

Practice is essential to learning new facts, but not all practice is equivalent. [13]

- Teachers can space practice over time, with content being reviewed across weeks or months, to help students remember that content over the long-term.[14]
- Teachers can explain to students that trying to remember something makes memory more long-lasting than other forms of studying. Teachers can use low- or no-stakes quizzes in class to do this, and students can use self-tests.[15]
- Teachers can interleave (i.e., alternate) practice of different types of content. For example, if students are learning four mathematical operations, it's more effective to interleave practice of different problem types, rather than practice just one type of problem, then another type of problem, and so on.[16]

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[10] Morris, Bransford, & Franks, 1977

[11] McDaniel, Hines, Waddill, & Einstein, 1994; Rosenshine, Meister, & Chapman, 1996; Graesser & Olde, 2003; TeachingWorks

[12] Peters & Levin, 1986

[13] Ericsson, Krampe, & Tesch-Römer, 1993

[14] Cepeda, Pashler, Vul, Wixted, & Rohrer, 2006; Pashler, Bain, Bottge, Graesser, Koedinger, & McDaniel, 2007

[15] Agarwal, Bain, & Chamberlain, 2012; Pashler, Bain, Bottge, Graesser, Koedinger, & McDaniel, 2007

[16] Pashler, Bain, Bottge, Graesser, Koedinger, & McDaniel, 2007; Rohrer, Dedrick, & Stershic, 2015

3 HOW DO STUDENTS SOLVE PROBLEMS?

COGNITIVE PRINCIPLES

PRACTICAL IMPLICATIONS FOR THE CLASSROOM

Each subject area has some set of facts that, if committed to long-term memory, aids problem-solving by freeing working memory resources and illuminating contexts in which existing knowledge and skills can be applied. The size and content of this set varies by subject matter.[17]

- Teachers will need to teach different sets of facts at different ages. For example, the most obvious (and most thoroughly studied) sets of facts are math facts and letter-sound pairings in early elementary grades. For math, memory is much more reliable than calculation. Math facts (e.g., 8 x 6 = ?) are embedded in other topics (e.g., long division). A child who stops to calculate may make an error or lose track of the larger problem.[18] The advantages of learning to read by phonics are well established.[19]

Effective feedback is often essential to acquiring new knowledge and skills.[20]

- Good feedback is:
  - Specific and clear;
  - Focused on the task rather than the student; and
  - Explanatory and focused on improvement rather than merely verifying performance.[21]

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[17] Glaser & Chi, 1988; TeachingWorks

[18] National Mathematics Advisory Panel, 2008

[19] National Reading Panel, 2000; EU High Level Group of Experts on Literacy, 2012

[20] Ericsson, Krampe, & Tesch-Römer, 1993

[21] Ericsson, Krampe, & Tesch-Römer, 1993; Shute, 2008; TeachingWorks; Butler & Winne, 1995; Hattie & Timperley, 2007

4 HOW DOES LEARNING TRANSFER TO NEW SITUATIONS IN OR OUTSIDE OF THE CLASSROOM?

COGNITIVE PRINCIPLES

PRACTICAL IMPLICATIONS FOR THE CLASSROOM

The transfer of knowledge or skills to a novel problem requires both knowledge of the problem's context and a deep understanding of the problem's underlying structure.[22]

- Teachers can ensure that students have sufficient background knowledge to appreciate the context of a problem.[23]

We understand new ideas via examples, but it's often hard to see the unifying underlying concepts in different examples.[24]

- Teachers can have students compare problems with different surface structures that share the same underlying structure. For example, a student may learn to calculate the area of a rectangle via an example of word problem using a table top. This student may not immediately recognize this knowledge is relevant in a word problem that asks a student to calculate the area of a soccer field. By comparing the problems, this practice helps students perceive and remember the underlying structure.[25]
- For multi-step procedures, teachers can encourage students to identify and label the substeps required for solving a problem. This practice makes students more likely to recognize the underlying structure of the problem and to apply the problem-solving steps to other problems.[26]
- Teachers can alternate concrete examples (e.g., word problems) and abstract representations (e.g., mathematical formulas) to help students recognize the underlying structure of problems. [27]

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[22] Bransford, Brown, & Cocking, 2000; Pellegrino & Hilton, 2012

[23] Pellegrino & Hilton, 2012; Day & Goldstone, 2012

[24] Richland, Zur, & Holyoak, 2007; Ainsworth, Bibby, & Wood, 2002

[25] Richland, Zur, & Holyoak, 2007; Gentner, et al., 2015

[26] Catrambone, 1996; Catrambone, 1998

[27] Goldstone & Son, 2005; Botge, Rueda, Serlin, Hung, & Kwon, 2007

5 WHAT MOTIVATES STUDENTS TO LEARN?

COGNITIVE PRINCIPLES	PRACTICAL IMPLICATIONS FOR THE CLASSROOM
Beliefs about intelligence are important predictors of student behavior in school. [28]	• Teachers should know that students are more motivated if they believe that intelligence and ability can be improved through hard work.[29] • Teachers can contribute to students' beliefs about their ability to improve their intelligence by praising productive student effort and strategies (and other processes under student control) rather than their ability.[30] • Teachers can prompt students to feel more in control of their learning by encouraging them to set learning goals (i.e., goals for improvement) rather than performance goals (i.e., goals for competence or approval).[31]
Self-determined motivation (a consequence of values or pure interest) leads to better long-term outcomes than controlled motivation (a consequence of reward/punishment or perceptions of self-worth).[32]	• Teachers control a number of factors related to reward or praise that influence student motivation, such as: ▪ whether a task is one the student is already motivated to perform; ▪ whether a reward offered for a task is verbal or tangible; ▪ whether a reward offered for a task is expected or unexpected; ▪ whether praise is offered for effort, completion, or quality of performance; and ▪ whether praise or a reward occurs immediately or after a delay.[33]
The ability to monitor their own thinking can help students identify what they do and do not know, but people are often unable to accurately judge their own learning and understanding.[34]	• Teachers can engage students in tasks that will allow them to reliably monitor their own learning (e.g., testing, self-testing, and explanation).[35] If not encouraged to use these tasks as a guide, students are likely to make judgments about their own knowledge based on how familiar their situation feels and whether they have partial – or related – information. These cues can be misleading.[36]
Students will be more motivated and successful in academic environments when they believe that they belong and are accepted in those environments.[37]	• Teachers can reassure students that doubts about belonging are common and will diminish over time.[38] • Teachers can encourage students to see critical feedback as a sign of others' beliefs that they are able to meet high standards.[39]

[28] Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013
[29] Burnette, O'Boyle, VanEpps, Pollack, & Finkel, 2013; Yeager, Johnson, Spitzer, Trzesniewski, Powers, & Dweck, 2014
[30] Mueller & Dweck, 1998; Blackwell, Trzesniewski, & Dweck, 2007; Kamins & Dweck, 1999
[31] Elliott & Dweck, 1988; Smiley & Dweck, 1994
[32] Davis, Winsler, & Middleton, 2006
[33] Deci, Koestner, & Ryan, 1999; Levitt, List, & Neckermann, 2012
[34] Koriat, 1993
[35] Pashler, Bain, Bottge, Graesser, Koedinger, & McDaniel, 2007; Karpicke, Butler, & Roediger, 2009
[36] Koriat & Levy-Sadot, 2001
[37] Yeager, Walton, & Cohen, Addressing achievement gaps with psychological interventions, 2013
[38] Walton & Cohen, 2011; Yeager, Walton, & Cohen, Addressing achievement gaps with psychological interventions, 2013
[39] Yeager, et al., 2014; Cohen, Steele, & Ross, 1999

6 WHAT ARE COMMON MISCONCEPTIONS ABOUT HOW STUDENTS THINK AND LEARN?

COGNITIVE PRINCIPLES

- **Students do not have different "learning styles."[40]**
- **Humans do not use only 10% of their brains.[41]**
- **People are not preferentially "right-brained" or "left-brained" in the use of their brains.[42]**
- **Novices and experts cannot think in all the same ways.[43]**
- **Cognitive development does not progress via a fixed progression of age-related stages.[44]**

PRACTICAL IMPLICATIONS FOR THE CLASSROOM

- Teachers should be able to recognize common misconceptions of cognitive science that relate to teaching and learning.

[40] Pashler, McDaniel, Rohrer, & Bjork, 2008
[41] Boyd, 2008
[42] Nielson, Zielinski, Ferguson, Lainhart, & Anderson, 2013
[43] Glaser & Chi, 1988
[44] Willingham, 2008

Works Cited

Agarwal, P. K., Bain, P. M., & Chamberlain, R. W. (2012). The value of applied research: Retrieval practice improves classroom learning and recommendations from a teacher, a principal, and a scientist. *Educational Psychology Review*, 24(3), 437-448.

Agodini, R., Harris, B., Atkins-Burnett, S., Heaviside, S., Novak, T., & Murphy, R. (2009). *Achievement Effects of Four Early Elementary School Math Curricula: Findings from First Graders in 39 Schools.* NCEE 2009-4052. National Center for Education Evaluation and Regional Assistance.

Ainsworth, S., Bibby, P., & Wood, D. (2002). Examining the Effects of Different Multiple Representational Systems in Learning Primary Mathematics. *The Journal of the Learning Sciences*, 11(1), 25-61.

Atkinson, R. K., Derry, S. J., Renkl, A., & Wortham, D. (2000). Learning from Examples: Instructional Principles from the Worked Examples Research. *Review of Educational Research*, 70(2), 181-214.

Blackwell, L. S., Trzesniewski, K. H., & Dweck, C. S. (2007). Implicit theories of intelligence predict achievement across an adolescent transition: A longitudinal study and an intervention. *Child Development*, 78(1), 246-263.

Bottge, B. A., Rueda, E., Serlin, R. C., Hung, Y.-H., & Kwon, J. M. (2007). Shrinking Achievement Differences With Anchored Math Problems. *The Journal of Special Education*, 41(1), 31-49.

Boyd, R. (2008, February 7). *Do People Only Use 10 Percent of Their Brains?* Retrieved March 7, 2015, from Scientific American: http://www.scientificamerican.com/article/do-people-only-use-10-percent-of-their-brains/

Bransford, J. D., Brown, A. L., & Cocking, R. R. (2000). *How People Learn: Brain, Mind, Experience, and School.* Washington, DC: National Academy Press.

Burnette, J. L., O'Boyle, E. H., VanEpps, E. M., Pollack, J. M., & Finkel, E. J. (2013). Mind-sets matter: A meta-analytics review of implicit theories and self-regulation. *Psychological Bulletin*, 139(3), 655-701.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245-281.

Cameron, J., Banko, K. M., & Pierce, W. D. (2001). Pervasive negative effects of rewards on intrinsic motivation: The myth continues. *The Behavior Analyst*, 24(1), 1-44.

Catrambone, R. (1996). Generalizing solution procedures learned from examples. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 22(4), 1020-1031.

Catrambone, R. (1998). The subgoal learning model: Creating better examples so that students can solve novel problems. *Journal of Experimental Psychology: General*, 127(4), 355-376.

Cepeda, N. J., Pashler, H., Vul, E., Wixted, J. T., & Rohrer, D. (2006). Distributed Practice in Verbal Recall Tasks: A Review and Qualitative Synthesis. *Psychological Bulletin*, 132(3), 354-380.

Chandler, P., & Sweller, J. (1992). The Split-Attention Effect as a Factor in the Design of Instruction. *British Journal of Educational Psychology*, 62(2), 233-246.

Cohen, G., Steele, C., & Ross, L. (1999). The Mentor's Dilemma: Providing Critical Feedback Across the Racial Divide. *Personality and Social Psychology Bulletin*, 25(10), 1302-1318.

Davis, K. D., Winsler, A., & Middleton, M. (2006). Students' perceptions of rewards for academic performance by parents and teachers: Relations with achievement and motivation in college. *Journal of Genetic Psychology*, 167(2), 211-220.

Day, S. B., & Goldstone, R. L. (2012). The import of knowledge export: Connecting findings and theories of transfer of learning. *Educational Psychologist*, 47(3), 153-176.

Deci, E. L., Koestner, R., & Ryan, R. M. (1999). A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation. *Psychological Bulletin*, 125(6), 627-668.

Elliott, E. S., & Dweck, C. S. (1988). Goals: An approach to motivation and achievement. *Journal of Personality and Social Psychology*, 54(1), 5-12.

Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The Role of Deliberate Practice in the Acquisition of Expert Performance. *Psychological Review*, 100(3), 363-406.

EU High Level Group of Experts on Literacy. (2012). *Final Report.* Luxembourg: Publications Office of the European Union.

Flynn, E., O'Malley, C., & Wood, D. (2004). A longitudinal, microgenetic study of the emergence of false belief understanding and inhibition skills. *Developmental Science*, 7(1), 103-115.

Gentner, D., Levine, S. C., Dhillon, S., Ping, R., Bradley, C., Poltermann, A., et al. (2015). Rapid learning in a children's museum via analogical comparison [in press]. *Cognitive Science.*

Glaser, R., & Chi, M. T. (1988). Overview. *In The Nature of Expertise* (pp. xv-xxvii). Hillsdale: Erlbaum.

Goldstone, R. L., & Son, J. Y. (2005). The Transfer of Scientific Principles using Concrete and Idealized Simulations. *Journal of the Learning Sciences*, 14(1), 69-110.

Graesser, A. C., & Olde, B. A. (2003). How does one know whether a person understands a device? The quality of the questions the person asks when the device breaks down. *Journal of Educational Psychology*, 95(3), 524-536.

Hattie, J., & Timperley, H. (2007). The Power of Feedback. *Review of Educational Research*, 77(1), 81-112.

Kamins, M. L., & Dweck, C. S. (1999). Person versus process praise and criticism: implications for contingent self-worth and coping. *Developmental Psychology*, 35(3), 835-847.

Karpicke, J. D., Butler, A. C., & Roediger, H. L. (2009). Metacognitive strategies in student learning: Do students practise retrieval when they study on their own? *Memory*, 17(4), 471-479.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). Why Minimal Guidance During Instruction Does Not Work. *Educational Psychologist*, 41(2), 75-86.

Koriat, A. (1993). How do we know that we know? The accessibility model of the feeling of knowing. *Psychological Review*, 100(4), 609-639.

Koriat, A., & Levy-Sadot, R. (2001). The combined contributions of the cue-familiarity and accessibility heuristics to feelings of knowing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 27(1), 34-53.

Levitt, S. D., List, J. A., & Neckermann, S. S. (2012). *The Behavioralist Goes to School: Leveraging Behavioral Economics to Improve Educational Performance (NBER Working Paper, 18165).* National Bureau of Economic Research.

McDaniel, M. A., Hines, R. J., Waddill, P. J., & Einstein, G. O. (1994). What makes folk tales unique: Content familiarity, causal structure, scripts, or superstructures? *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 20(1), 169-184.

Moreno, R. (2006). Learning in High-Tech and Multimedia Environments. *Current Directions in Psychological Science*, 15(2), 63-67.

Moreno, R., & Mayer, R. E. (1999). Cognitive Principles of Multimedia Learning: The Role of Modality and Contiguity. *Journal of Educational Psychology*, 91(2), 358-368.

Morris, C. D., Bransford, J. D., & Franks, J. J. (1977). Levels of Processing Versus Transfer Appropriate Processing. *Journal of Verbal Learning and Verbal Behavior*, 16(5), 519-533.

Mueller, C. M., & Dweck, C. S. (1998). Praise for intelligence can undermine children's motivation and performance. *Journal of Personality and Social Psychology*, 75(1), 33-52.

National Mathematics Advisory Panel. (2008). *Foundations for Success: The Final Report of the National Mathematics Advisory Panel.* Washington, DC: U.S. Department of Education.

National Reading Panel. (2000). *Teaching Children to Read: Reports of the Subgroups.* National Institute of Child Health and Human Development.

Nielson, J. A., Zielinski, B. A., Ferguson, M. A., Lainhart, J. E., & Anderson, J. S. (2013). An Evaluation of the Left-Brain vs Right-Brain Hypothesis with Resting State Functional Connectivity Magnetic Resonance Imaging. *PLOS ONE*, 8(8).

Pashler, H., Bain, P. M., Bottge, B. A., Graesser, A., Koedinger, K., & McDaniel, M. (2007). *Organizing Instruction and Study to Improve Student Learning.* U.S. Department of Education. Washington DC: National Center for Education Research, Institute of Education Sciences.

Pashler, H., McDaniel, M., Rohrer, D., & Bjork, R. (2008). Learning Styles: Concepts and Evidence. *Psychological Science in the Public Interest*, 9(3), 105-119.

Pellegrino, J. W., & Hilton, M. L. (2012). *Education for Life and Work: Developing Transferable Knowledge and Skills in the 21st Century.* Washington, DC: National Academies Press.

Peters, E. E., & Levin, J. R. (1986). Effects of a mnemonic imagery strategy on good and poor readers' prose recall. *Reading Research Quarterly*, 21(2), 179-192.

Richland, L. E., Zur, O., & Holyoak, K. J. (2007). Cognitive Supports for Analogies in the Mathematics Classroom. *Science*, 316(5828), 1128-1129.

Rohrer, D., Dedrick, R. F., & Stershic, S. (2015). Interleaved practice improves mathematics learning. *Journal of Educational Psychology*, 107(3), 900-908.

Rosenshine, B., Meister, C., & Chapman, S. (1996). Teaching Students to Generate Questions: A Review of the Intervention Studies. *Review of Educational Research*, 66(2), 181-221.

Shute, V. J. (2008). Focus on Formative Feedback. *Review of Educational Research*, 78(1), 153-198.

Siegler, R. S. (1995). How does change occur: A microgenetic study of number conservation. *Cognitive Psychology*, 28(3), 225-273.

Smiley, P. A., & Dweck, C. S. (1994). Individual differences in achievement goals among young children. *Child Development*, 65(6), 1723-1743.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive Science*, 12(2), 257-285.

Sweller, J. (2006). The Worked Example Effect and Human Cognition. *Learning and Instruction*, 16(2), 165-169.

Sweller, J., van Merrienboer, J. J., & Paas, F. G. (1998). Cognitive Architecture and Instructional Design. *Educational Psychology Review*, 10(3), 251-296.

TeachingWorks. (n.d.). *High-Leverage Practices.* Retrieved March 7, 2015, from http://www.teachingworks.org/work-of-teaching/high-leverage-practices

Walton, G. M., & Cohen, G. L. (2011). A brief social-belonging intervention improves academic and health outcomes of minority students. *Science*, 331, 1447-1451.

Waterhouse, L. (2006). Multiple Intelligences, the Mozart Effect, and Emotional Intelligence: A Critical Review. *Educational Psychologist*, 41(4), 207-225.

Willingham, D. T. (2004). Reframing the Mind: Howard Gardner and the theory of multiple intelligences. *Education Next*, 4(3), 19-24.

Willingham, D. T. (2008, Summer). What is Developmentally Appropriate Practice? *American Educator*, pp. 34-39.

Willingham, D. T. (2009). *Why Don't Students Like School?* San Francisco, CA: Jossey-Bass.

Yeager, D. S., Johnson, R., Spitzer, B. J., Trzesniewski, K. H., Powers, J., & Dweck, C. S. (2014). The far-reaching effects of believing people can change: Implicit theories of personality shape stress, health, and achievement during adolescence. *Journal of Personality and Social Psychology*, 106(6), 867-884.

Yeager, D., Purdie-Vaughns, V., Garcia, J., Apfel, N., Brzustoski, P., Master, A., et al. (2014). Breaking the Cycle of Mistrust: Wise Interventions to Provide Critical Feedback Across the Racial Divide. *Journal of Experimental Psychology*, 143(2), 804-824.

Yeager, D., Walton, G., & Cohen, G. L. (2013, February). Addressing achievement gaps with psychological interventions. *Phi Delta Kappan*, 62-65.