PAYING ATTENTION OR FATALLY DISTRACTED? CONCENTRATION, MEMORY, AND MULTI-TASKING IN A MULTI-MEDIA WORLD

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I. INTRODUCTION

Success in law school requires intense and sustained cognitive effort. Students must master both the abstract and the concrete. Students must read and process more than 1,000 pages of material for each course, five courses per semester. From that material, they begin with the concrete by extracting a variety of details from each page, including each piece of language parsed from any enacted law involved, as well as the procedure, facts, legal issue, decision, and reasoning of each case. But working with the details is just the beginning.

From this material, students must also master multiple levels of abstraction. They must determine which details are analytically relevant and which are not. They must understand how the details fit together and why they are analytically significant. They must create an analytical framework that establishes and defines the required analysis and any alternative analyses. They must understand the policies furthered by each analysis and critique the relative success at achieving those policies.

All of this, though, is just foundational. Students must then apply the foundational information to evaluate a legal problem. They must sort through the facts of the legal problem to determine what legal questions are presented. They must understand which facts are legally relevant to those questions and which facts

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are not. They must apply the required analysis for each legal question. To do this, they must structure the analysis and then evaluate each point within each of the relevant tests. When evaluating each point, they must define the point, relying on prior interpretations, and determine if the facts from the legal problem are a good fit or not. In the end, they must answer the question asked of them; whether it is to predict how a court most likely would rule, to achieve a particular remedy, to achieve certain success, to limit damages, to negotiate a settlement, or any of a number of other options.

Throughout these analytical steps, students will be engaged in sophisticated reasoning. Students will engage in deductive reasoning when they extract rules, tests, and policies from judicial opinions resolving individual disputes. They will engage in inductive reasoning when they apply general statements, whether the general language of enacted law or the rules or tests extracted from cases, to facts. They will engage in reasoning by analogy when they evaluate the similarities and differences between the legally relevant facts of a case and the facts of their legal problem. They will draw reasonable inferences and critique unreasonable inferences. They will identify inaccuracies and logical fallacies, and they will work with vagueness, indefiniteness, possibilities, conditions, and probabilities. Students will be engaged in every level of knowledge, from the simplest, memorization, to the most complex, reasoning.

And there's more: The description thus far only identifies the essential cognitive tasks for the law school classroom and the final exam. Even more cognitive effort is involved with clinics, externships and internships, trial practice, negotiations, and other similar law school settings.

To successfully engage in the cognitive heavy-lifting that is required for law school, students must be able to pay attention and to concentrate. Law professors often bemoan that students are not engaged in the classroom discussion when they surf the web, answer e-mail, and play FreeCell instead of marveling at the intricacies of joinder, justiciability, or executory interests. Some law professors respond that this situation is no different from the doodling and mind-wandering of the pre-laptop era. Both are right, and both are wrong. They are right in stating that wandering minds existed before laptops, and they are right that students whose minds are wandering are not engaged in the classroom discussion. However, they are wrong in thinking that this does not present a problem in learning, or that the problem will be solved simply by banning laptops.

In this Article, I will discuss the role of attention in learning, what limits attention, and how to improve the ability to pay attention and concentrate.

II. ATTENTION AND LEARNING

What is attention and how is it achieved? Generally, attention is the ability to attend to desired or necessary stimuli and to exclude unwanted or unnecessary stimuli.[1] While this may seem simple enough, it is not. Learning involves multiple cognitive processes, including absorbing, processing, remembering, and retrieving information.[2] Attention is needed in each of those processes. Let me illustrate.

Learning begins by absorbing new information through our senses. Whether consciously or subliminally, new information is absorbed through sight, hearing, touch, smell, or taste. These senses are bombarded with stimuli, but we must attend, or pay attention, to those that are relevant to the task at hand.[3] For example, a runner who is attending to breathing and cadence may not notice traffic; a runner who is attending to traffic may not notice the squirrels romping up and down trees with nuts in cheek; and a runner who is attending to the squirrels may not hear the motor of a vehicle or see the pothole in time to avoid it.

Attention also requires ignoring stimuli that are not relevant to the task at hand.[4] For example, a student wanting to read in the library must ignore the conversation at a neighboring table, the dog barking outside the window, and the person walking by.

The stimuli attended to are then processed. Some stimuli are processed without our having to attend to them, such as automatic or highly practiced tasks. Automatic tasks are those tasks that do not require conscious control, such as walking, chewing,

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1. Christopher D. Wickens & Jason S. McCarley, *Applied Attention Theory* 2 (Taylor & Francis Group 2008).

2. David G. Meyers, *Psychology* chs. 5, 9 (9th ed., W. H. Freeman & Co. 2009).

3. Addie Johnson & Robert W. Proctor, *Attention: Theory and Practice* 71–73 (Sage Publishers 2004); Daniel Kahneman, *Attention and Effort* 112–113 (Prentice-Hall 1973); Sophie Forster & Nilli Lavie, *Failures to Ignore Entirely Irrelevant Distractors: The Role of Load*, 14 J. Experimental Psychol.: Applied 73, 73–74 (2008).

4. *Id.*

breathing, and the like.[5] Highly practiced tasks are tasks that originally required attention, but with practice became more automatic.[6] For example, consider the difference between the beginning student of piano and the pianist in a cocktail lounge. When learning to play the piano, the student must pay attention to the notes on the page, the placement of the fingers, the location of the keys, the use of the pedals, and much more. However, after much practice, the lounge pianist can do all of these things automatically while carrying on a conversation or singing into a microphone.

Highly practiced tasks are only automatic within the scope of what was highly practiced.[7] For example, the pianist who was highly practiced at playing new age jazz suitable for a cocktail lounge would have to pay attention when playing Tchaikovsky's First Concerto in B-flat Minor. In addition, highly practiced tasks can require attention when new circumstances occur.[8] For example, typing may be a highly practiced task, but the typist must attend to the task to correct a mistake or to use parts of the keyboard that are not often used. Similarly, driving may be a highly practiced task that a driver can do automatically, but the driver must pay attention when road conditions change such as when there is road construction, ice, or an accident.

Tasks that are not automatic tasks or highly practiced tasks require attention.[9] The learner must not only consciously attend to the task to be done, but must also exercise cognitive control of any interruptions and distractions from that task.[10] Only those

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5. Johnson & Proctor, *supra* n. 3, at 175–177; Gordon D. Logan, *Toward an Instance Theory of Automatization*, 95 Psychol. Rev. 492, 492, (1988) ("[W]e perform routine activities quickly and effortlessly, with little thought and conscious awareness—in short, automatically.").

6. Johnson & Proctor, *supra* n. 3, at 175; Logan, *supra* n. 5, at 492–519.

7. *See e.g.* Richard M. Shiffrin & Walter Schneider, *Controlled and Automatic Information Processing: II. Perception, Learning, Automatic Attending and a General Theory*, 84 Psychol. Rev. 127, 131–133 (1977) (practice with one response to a task improved speed and recall on that task but when an element of the task was changed, performance was poor and slow, and recall was limited); *see also* Logan, *supra* n. 5, at 501–508 (automaticity is specific to the stimuli experienced during training).

8. Shiffrin & Schneider, *supra* n. 7, at 133 (change of an element of an automatic, rehearsed task required controlled attention).

9. Johnson &. Proctor, *supra* n. 3, at 322–323; Shiffrin & Schneider, *supra* n. 7, at 127, 131–133.

10. Cognitive control is needed to stay on task, that is, to monitor and regulate performance related to goal-directed behavior. Johnson & Proctor, *supra* n. 3, at 200 ("[M]emory processes may be required to actively inhibit irrelevant information."); David

tasks attended to will be remembered,[11] so if interruptions and distractions are not controlled, the right things may not be remembered. This is because of the limits of working memory[12] or the limits of attention when using working memory,[13] depending on the study or the theorist.

What is working memory? Working memory is a cognitive function that processes information over brief periods of time.[14] Working memory is essential to learning,[15] including inputting information, and it is highly correlated to reasoning ability[16] and intelligence.[17]

The information processed in working memory is that which has been attended to and which has not been forgotten.[18] Conventional wisdom has been that working memory can only hold seven bits of information, plus or minus two.[19] However, subse-

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P. McCabe et al., *The Relationship between Working Memory Capacity and Executive Function: Evidence for a Common Executive Attention Construct*, 24 Neuropsychology 222, 222 (2010); *see infra* nn. 55–76 and accompanying text (discussing how distractions capture our attention and interfere with memory and reasoning).

11. *Id.* at 153.

12. *E.g.* Nelson Cowan, *The Magical Number 4 in Short-Term Memory: A Reconsideration of Mental Storage Capacity*, 24 Behavioral & Brain Scis. 87, 87–113 (2000) (including an extensive review of empirical literature).

13. *E.g.* Michael J. Kane & Randall W. Engle, *Working-Memory Capacity, Proactive Interference, and Divided Attention: Limits on Long-Term Memory Retrieval*, 26 J. Experimental Psychol.: Learning, Memory, & Cognition 336, 336–358 (2000).

14. David E. J. Linden, *The Working Memory Networks of the Human Brain*, 13 Neuroscientist 257, 257 (2007).

15. Johnson & Proctor, *supra* n. 3, at 198.

16. Patrick C. Kyllonen, *g: Knowledge, Speed, Strategies, or Working-Memory Capacity? A Systems Perspective*, in *The General Factor of Intelligence: How General Is It?* 415, 432–436 (Robert J. Sternberg & Elena L. Grigorenko, eds., Lawrence Erlbaum Assocs., Inc. 2002) (g is the symbol for fluid intelligence, which concerns reasoning abilities); Andrew R. A. Conway et al., *A Latent Variable Analysis of Working Memory Capacity, Short-Term Memory Capacity, Processing Speed, and General Fluid Intelligence*, 30 Intelligence 163, 177–178 (2002); Randall W. Engle et al., *Working Memory, Short-Term Memory, and General Fluid Intelligence: A Latent-Variable Approach*, 128 J. Experimental Psychol.: Gen. 309, 309–328 (1999).

17. *See e.g.* Chris R. Brewin & A. Beaton, *Thought Suppression, Intelligence, and Working Memory Capacity*, 40 Behaviour Research & Therapy 923, 928 (2002).

18. To illustrate this principle, we can only remember dreams if they are recalled immediately after waking because while we are sleeping, only working memory is available, and because we cannot attend to the information in it while we are sleeping, the information is constantly being replaced by new incoming information until we wake up and can attend to the information in working memory. Jie Zhang, *Memory Process and the Function of Sleep*, 6 J. Theoretics 1, 5 (2004) (available at www.journaloftheoretics.com/Articles/6-6/Zhang.pdf); *see also* William A. Johnston & Veronica J. Dark, *Selective Attention*, 37 Annual Rev. Psychol. 43, 45 (1986) (using the "cocktail-party problem" to illustrate how attention can be selective).

19. George A. Miller, *The Magical Number Seven, Plus or Minus Two: Some Limits on*

quent studies indicate it may be significantly less than that, perhaps three to five, depending on the type and complexity of information and the degree of chunking, or recoding, of the information.[20] In addition, the larger the chunk, the fewer chunks that working memory can handle. When the chunks are large, working memory may have a capacity of only two chunks.[21]

Chunking involves associating pieces of information, so that the chunk becomes one of the bits in working memory, rather than each piece being an individual bit in working memory.[22] People chunk information all the time in their daily lives, often without giving it a second thought. For example, seven- and ten-digit phone numbers and nine-digit Social Security numbers are chunked into units of two, three, and four; and sixteen-digit credit card numbers are chunked into units of four. Without chunking in some manner, too many bits exist for working memory to handle, meaning some of the information will be forgotten, disappearing into the thought-osphere, that place of limbo for unclaimed thoughts, and will not be available for processing.

Consequently, chunking is important to working memory for inputting, processing, and remembering information. In an early experiment, people were asked to remember these letters: fbicbsibmirs.[23] The letters could not be remembered without chunking because working memory could not handle this many individual bits of information. However, if people chunked the letters into fbi, cbs, ibm, and irs, they had sufficient capacity in working memory to recall the letters sequentially and accurately.[24] In this manner, chunking allows more information into working memory where it will be held until it is processed into long-term memory.

Our Capacity for Processing Information, 63 Psychol. Rev. 81, 90–93, 96 (1956).

20. *See* Cowan, *supra* n. 12, at 94–107, 114; Marilyn L. Turner & Randall W. Engle, *Is Working Memory Capacity Task Dependent?* 28 J. Memory & Lang. 127, 147 (1989) (recall of words decreased by approximately one-third when the task became more difficult).

21. Fernand Gobet & Gary Clarkson, *Chunks in Expert Memory: Evidence for the Magical Number Four . . . Or Is It Two?* 12 Memory 732, 744, 746 (2004). The more expert the learner, the larger the chunk. Fernand Gobet & Andrew J. Waters, *The Role Constraints in Expert Memory*, 29 J. Experimental Psychol.: Learning, Memory, & Cognition 1082, 1082–1092 (2003). Very large chunks may require mental imagery. Andrew J. Waters & Fernand Gobet, *Mental Imagery and Chunks: Empirical and Computational Findings*, 36 Memory & Cognition 505, 505–515 (2008).

22. Cowan, *supra* n. 12, at 89–90; Miller, *supra* n. 19, at 93–95.

23. Cowan, *supra* n. 12, at 90.

24. *Id.*

In addition to needing attention to absorb the right bits of information into working memory, attention is needed to hold a bit of information in working memory so that it can be processed and retained in long-term memory.[25] Holding information in working memory requires rehearsal in which the person thinks of the bit of information repeatedly until it becomes sufficiently automatic to not require attention.[26] This rehearsal is needed to avoid losing bits of information from working memory because a bit remains in working memory only for a very short period of time, say two seconds.[27] This time limitation also means that processing must occur quickly, because the longer the time taken for processing, the more opportunity for bits of information to be forgotten.[28]

Next, attention is needed to process the information into long-term memory.[29] This processing tends to be either verbal (words) or visuospatial (pictures or diagrams),[30] whichever method of processing a learner habitually prefers.[31]

Regardless of processing method, information stored in long-term memory generally must be chunked to facilitate retrieval.

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25. Alan D. Baddeley, *The Episodic Buffer: A New Component of Working Memory?*, 4 Trends in Cognitive Sci. 417, 419 (2000) (items in working memory decay quickly unless revived by rehearsal).

26. Cowan, *supra* n. 12, at 93.

27. *Id.*; Zhijian Chen & Nelson Cowan, *Chunk Limits and Length Limits in Immediate Recall: A Reconciliation*, 31 J. Experimental Psychol.: Learning, Memory, & Cognition 1235, 1246 (2005) (citing Alan D. Baddeley et al., *Word Length and the Structure of Short-Term Memory*, 14 J. Verbal Learning & Verbal Behavior 575 (1975)).

28. Nelson Cowan & Angela M. AuBuchon, *Short-Term Memory Loss over Time without Retroactive Stimulus Interference*, 15 Psychonomic Bull. & Rev. 230, 234 (2008); John N. Towse et al., *Working Memory Period: The Endurance of Mental Representations*, 58 Q.J. Experimental Psychol. 547, 549, 567–568 (2005); Nash Unsworth et al., *Complex Working Memory Span Tasks and Higher-Order Cognition: A Latent-Variable Analysis of the Relationship between Processing and Storage*, 17 Memory 635, 648 (2009).

29. Attention is needed to encode and store information into long-term memory, such as through repetition and chunking, for it to be available for future retrieval. Meyers, *supra* n. 2, at 347–360; Cowan, *supra* n. 12, at 93 (coding and rehearsal needed for long-term memory).

30. *E.g.* Alison M. Bacon et al., *Reasoning Strategies: The Role of Working Memory and Verbal-Spatial Ability*, 20 Eur. J. Cognitive Psychol. 1065, 1065–1066, 1078 (2008); Marilyn Ford, *Two Modes of Mental Representation and Problem Solution in Syllogistic Reasoning*, 54 Cognition 1, 69 (1994); Priti Shah & Akira Miyake, *The Separability of Working Memory Resources for Spatial Thinking and Language Processing: An Individual Differences Approach*, 125 J. Experimental Psychol.: Gen. 4, 4–6, 20–23 (1996).

31. Verbal and visual/spatial information are coded by different structures in the brain. Randall W. Engle & Michael J. Kane, *Executive Attention, Working Memory Capacity, and a Two-Factor Theory of Cognitive Control*, 44 Psychol. Learning & Motivation 145, 170 (2004).

That chunking is easiest when new information can be associated with information already in long-term memory.[32] For example, law students who are taking Civil Procedure are often confused about the difference between improper venue and dismissal. I ask if they have ever been to a concert and the answer has, so far, always been yes. If the concert producers do not sell as many tickets as they thought, they might move the concert from a 10,000 seat stadium to a 2,500 seat theater. That is a change in venue, and the concert will go on in the new venue. However, the concert producers might also cancel the performance. That would be analogous to a dismissal. If the concert takes place later, it is analogous to a dismissal without prejudice where the lawsuit can be refiled. However, if no concert will ever take place, it is analogous to a dismissal with prejudice: it is done, finito, caput. With this example, students always understand how these concepts differ simply by connecting the concepts with something they already know.

With the addition of new information, new chunks will form, old chunks will reform to account for the new information, or new structures will form involving multiple chunks.[33] However, when new information cannot associate with any information already in long-term memory, entirely new structures must be created, beginning in working memory.[34] This requires greater attention than associating new information with information already existing in long-term memory.[35] It is also susceptible to more mistakes because of the greater need for attention and because of the lack of expertise in chunking the new material.[36]

As a child, I always envisioned my memory as nearly infinite rows of blackboards with a small gnome, sort of a cross between Dopey and Doc in appearance, scurrying to inscribe each new

32. Cowan, *supra* n. 12, at 92.

33. *Id.*

34. *Id.*

35. For example, in a study involving chess players, superior players could recall random positions of chess pieces after viewing them for sixty seconds at the same level of accuracy as their recall of game positions viewed for about two seconds. Fernand Gobet & Herbert A. Simon, *Five Seconds or Sixty? Presentation Time in Expert Memory*, 24 Cognitive Sci. 651, 659 fig. 2 (2000). The game positions could associate with information they already knew where the random positions could not.

36. Superior players could recall game positions with 100 percent accuracy after viewing them for ten seconds, but when the positions were random, they could recall the positions of the chess pieces with only about 34 percent accuracy. *Id.* Even when the players viewed the random positions for 60 seconds, accuracy only reached 70 percent. *Id.*

piece of information onto the blackboard concerning that topic. Once preserved, I could recall information by retrieving the relevant blackboard, skimming for the relevant subtopic, and updating with the newly inputted information that had not yet been organized by subtopic. Little did I know that my mind's eye was envisioning the nearly unlimited storage available in long-term memory and the organization of expert memory.

Expert memory is not only well-chunked, either verbally or visuospatially, but the chunks are well associated in a hierarchy that allows attention to shift from higher to lower levels within this hierarchy.[37] Expertise comes from practice that develops domain-specific knowledge.[38] That knowledge is organized by chunks and then the chunks are chunked into templates.[39] Capacity in long-term memory appears to be limitless,[40] but the retrieval of that information is not.[41] Information in long-term memory is retrieved into working memory, which is limited. Just as working memory had limits when holding information going into long-term memory, it has the same limits for holding information retrieved from long-term memory.[42]

Without knowing any of this cognitive research, those studying law already account for these limitations. Consider the process of outlining for law school courses. Outlines organized by case will not be useful because students will not be able to retrieve the information they need in the form that they need it to solve a legal problem, whether in an exam or some other context. Instead, students need to organize the information on a topic so that they know the test and what each part of the test means.

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37. K. Anders Ericsson & Walter Kintsch, *Long Term Working Memory*, 102 Psychol. Rev. 211, 215–222 (1995) (Figure 4, at page 221, nicely illustrates hierarchical organization); Cowan, *supra* n. 12, at 93–94; *see also* Fernand Gobet, *Chunk Hierarchies and Retrieval Structures: Comments on Saariluoma and Laine*, 42 Scandinavian J. Psychol. 149, 149–155 (2001).

38. Gobet & Clarkson, *supra* n. 21, at 732.

39. Cowan, *supra* n. 12, at 92; Fernand Gobet & Herbert A. Simon, *Templates in Chess Memory: A Mechanism for Recalling Several Boards*, 31 Cognitive Psychol. 1, 31 (1996) (templates are also called schemas, frames, or prototypes).

40. Meyers, *supra* n. 2, at 361 ("Our capacity for storing information permanently in long-term memory is essentially unlimited."); Cowan, *supra* n. 12, at 91 (The focus of attention required for inputting and retrieving information is restricted but other mental faculties are not limited except perhaps by time or inference.).

41. Johnson & Proctor, *supra* n. 3, at 216 ("Retrieval of items from long-term memory. . . seems to be subject to the central bottleneck."); Cowan, *supra* n. 12, at 92 (Information retrieved from long-term memory is subject to the capacity limit of the focus of attention.).

42. *Id.*

Information remembered in this format will be useful when retrieved. In this process of outlining, students are learning how to appropriately chunk their information.

In addition, students are also learning how to establish helpful hierarchies that will enhance their recall of information. Consider the analysis of judicial powers in Constitutional Law. Assume the student needed to analyze standing to answer a question on a Constitutional Law exam. If information was stored with appropriate chunking and hierarchies, the student could go to the mental chunk for judicial powers and then to the chunk for justiciability (or case or controversy) to retrieve the one chunk of information needed, standing. Like a blossoming flower, that chunk would open up into two more chunks, the constitutional requirements and the prudential requirements. Then *constitutional requirements* would blossom into three chunks, injury-in-fact, causation, and redressability; and injury-in-fact would blossom into two more, concrete and particularized and actual or imminent, and each of those points would blossom into definitions derived directly from statements in the authorities or indirectly from the facts of the authorities.

Mentally maneuvering up and down the levels of hierarchy requires attention, retrieving the right chunk requires attention, and opening up the chunks and their sub-chunks requires attention.[43] In fact, every aspect of learning, beginning with the inputting of information, requires attention. However, attention is also challenged in every aspect of learning. This next section will discuss the challenges to paying attention.

III. THE LIMITS OF ATTENTION

Dogs are a wonderful illustration of attention and the limits of attention. Dogs run the gamut from total concentration to total distraction. Total concentration occurs with my dog if I am eating. My dog's entire being is focused on my food and the possibility

43. Retrieval from memory requires significant attentional resources. Moshe Naveh-Benjamin & Jonathan Guez, *Effects of Divided Attention on Encoding and Retrieval Processes: Assessment of Attentional Costs and a Componential Analysis*, 26 J. Experimental Psychol.: Learning, Memory & Cognition 1461, 1477 (2000) (attentional resources required to retrieve information was equal to (experiment 1) or greater than (experiment 2) that required encoding).

that he may get some of it. Nothing breaks his concentration, no matter how long he has to wait, no matter what the interruption.

However, if we go for a walk in the forest, then his concentration is not so intense, and he is more likely to be distracted. We can be walking along a path when zip!, he detours off for a new smell. Then he rejoins me when zip!, he detours off to see what was moving in the grass. He rejoins me again, and the process continues until the fun ends.

Even with his occasional distractions, my dog still exhibits some modicum of concentration. Not so much with the dog down the hill. With her, nothing registers for more than a quick second. Everything, and I do mean everything, is a distraction from the task at hand. Actually, she is so distracted all the time that I am not sure there ever could be a task at hand.

These dogs help illustrate well how attention comes in different packages, one controlled and one driven by the latest stimulus, which is also called dual attention.[44] Controlled attention, or top-down attention, involves conscious awareness[45] and requires significant cognitive effort[46] to maintain focus without interruption or interference. The ability to control attention against competing demands is a major predictor of how well a person will perform on complex working memory tasks.[47]

The stimulus-driven attention[48] or bottom-up attention[49] is more instinctual or automatic. This attention is grabbed by novel or sudden changes in our environment.[50] Humans' evolutionary survival depended on noticing the flash of bright light, the thudding noise, the movement in the trees, the rush of water, or the unusual smell. Novel or sudden changes could indicate an intruder, a food source, or a danger.

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44. Lisa Feldman Barrett et al., *Individual Differences in Working Memory Capacity and Dual-Process Theories of the Mind*, 130 Psychol. Bull. 553, 553 (2004).

45. Elizabeth A. Styles, *The Psychology of Attention* 185 (2d ed., Psychol. Press 2006).

46. Johnson & Proctor, *supra* n. 2, at 221.

47. Barrett et al., *supra* n. 44, at 553; Randall W. Engle, *Working Memory Capacity as Executive Attention*, 11 Current Directions in Psychol. Science 19, 19–23 (2002); Michael J. Kane et al., *A Controlled-Attention View of Working-Memory Capacity*, 130 J. Experimental Psychol.: Gen. 169, 170–171, 178–181 (2001).

48. Torkel Klingberg, *The Overflowing Brain: Information Overload and the Limits of Working Memory* 21 (Oxford U. Press 2009).

49. Winifred Gallagher, *RAPT: Attention and the Focused Life* 16 (Penguin Press 2009).

50. Howard E. Egeth & Steven Yantis, *Visual Attention: Control, Representation, and Time Course*, 48 Annual Rev. Psychol. 269, 274–275 (1997).

Despite the changed circumstances, modern brains react the same way to novel or sudden changes as the brains of the Cro-Magnon of 40,000 years ago.[51] Now, however, they represent interruptions or distractions that interfere with our memory and reasoning processes. According to a number of studies, individual differences in working memory are due to differing capacities for attentional control.[52] What determines successful performance on reasoning and other higher-order cognitive tasks is the ability to control attention to avoid distractions, not just the ability to hold and quickly retrieve the information.[53]

Attentional control, then, is an essential skill for a person to successfully engage in the higher-order cognitive tasks required of legal analysis and reasoning. A person must be able to shut out distractions, including other cognitive work, when attending to cognitively complex tasks. In our multi-media world, the ability to control attention becomes seriously undermined. This occurs for a variety of reasons, including the lack of control over stimulus-driven distractions, mental load, and conditions of stress, anxiety, and fatigue; all of which undermine the ability to concentrate or to pay attention.[54] Let me discuss each of these situations.

A. Distractions

We are regularly barraged with visual and auditory cues from a variety of sources, including e-mail, twitter, mobile phones, telephones, text messages, Skype, YouTube, Facebook, and more. They bounce, they flash, they ding, and more. And each is a distraction, one compelling to the Cro-Magnon mind, but not for the task at hand.

Consider what happens when you just want to type a document. You open the file and begin working when a pop-up message says you have a program update. You can attend to it now, and then restart your computer, or you can have the pop-up message return over and over and over again until you give up in frustration, save what you were doing, update the program, and res-

51. Klingberg, *supra* n. 48, at 10–11.

52. Kane et al., *supra* n. 47, at 170.

53. Engle, *supra* n. 47, at 20; Stephen Tuholski et al., *Individual Differences in Working Memory Capacity and Enumeration*, 29 Memory & Cognition 484, 491 (2001).

54. *Infra* nn. 55–167 and accompanying text.

tart your computer. You open the document again and resume working when another pop-up says you have a Skype contact. You do not have time to talk, so you close Skype. Okay, now back to the document. Another pop-up says you have new e-mail messages. You ignore it but it keeps popping up every few minutes and obscuring part of your document. After the fourth or fifth reminder, you give up and check your mail. Then, back to the document. Now an icon is bouncing up and down at the bottom of the screen. Better check it out. You need to run your anti-virus program through all your documents. You get that going and then it is back to the document. Knock, knock. Someone is at the door. And so it goes until hours later, the letter finally is done. To paraphrase a childhood rhyme:

> Around, and around,
> and around it goes.
> Where it ends,
> only a scientist knows.

What the scientists know is that each novel and sudden change, whether a motion, a noise, or a flash, affects our brain in three ways.[55] First, these rapid visual and auditory changes capture our attention. Television provides a great example of how this occurs. When my oldest nephew was a young child, he had little interest in television except when a commercial came on. Then he would be mesmerized while someone hawked plastic wrap, soda, or detergent. The minute the commercial ended, he would go back to piling blocks, coloring, or whatever else had engaged him before the interruption.

The television medium controls our automatic processes through cuts, edits, movement, flashes of light, and sound.[56] By increasing the pacing in a message, viewers will allocate more

55. Francisco Barcelo et al., *Task Switching and Novelty Processing Activate a Common Neural Network for Cognitive Control*, 18 J. Cognitive Neuroscience 1734, 1734 (2006); Luis Carretié et al., *Danger Is Worse When It Moves: Neural and Behavioral Indices of Enhanced Attentional Capture by Dynamic Threatening Stimuli*, 47 Neuropsychologia 364, 364–369 (2009).

56. Annie Lang et al., *The Effects of Edits on Arousal, Attention, and Memory for Television Messages: When an Edit Is an Edit Can an Edit Be Too Much?* 44 J. Broad. & Elec. Media 94, 105 (2000) (increasing the number of edits in a television message increases viewers' attention); Annie Lang et al., *The Effects of Production Pacing and Arousing Content on the Information Processing of Television Messages*, 43 J. Broad. & Elec. Media 451, 452 (1999) [hereinafter Lang et al., *Effects of Production Pacing*].

cognitive resources to the message and the message will increase viewers' sense of arousal.[57] Commercials are designed for maximum scene shifting, visually and auditorily, to maintain viewer attention. A thirty-second commercial may contain sixty shifts,[58] many of which are not noticeable to the viewer because of their short duration. To illustrate, if you close your eyes while a commercial is on, you will notice flashes of light, similar to a strobe light, that you did not notice when watching the commercial. In addition, viewers have long complained that commercials are louder than the program they interrupt.[59]

Now some programming follows suit. News programming may grab attention by appealing to primal fears: as the saying goes, if it bleeds, it leads. As reported by the non-profit Center for Media and Public Affairs, the reporting of violent crimes on the evening news increased by 240 percent over a five-year period during which violent crimes had decreased nationally.[60] Entertainment programming may use short cuts and fast shifts to hold your attention.[61] My husband, an actor and director, commented the other night that a scene in the movie[62] we were watching had forty-seven cuts (that he could see) in thirty seconds. I had not noticed, because my eyes were too glued to the screen.

Second, these rapid visual and auditory changes interfere with memory and reasoning. With each beep, flash, pop-up, and bouncing icon, our attention can be captured to attend to the novel and abrupt stimuli, rather than to the cognitive task interrupted. Each distraction interferes with memory. Since working memory capacity (or our attention to working memory) is limited,[63] then a distraction must necessarily bump one of the bits

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57. Lang et al., *Effects of Production Pacing*, *supra* n. 56, at 453–454, 469.

58. *E.g.* Byron Reeves et al., *Attention to Television: Intrastimulus Effects of Movement and Scene Changes on Alpha Variation over Time*, 27 Intl. J. Neuroscience 241, 241–255 (1985).

59. Devin Powell, *Effort to Shush Loud TV Commercials*, LiveScience, http://livescience.com/culture/090918-loud-commercials.html (posted Sept.18, 2009, 9:35 a.m. EDT).

60. Ctr. for Media and Pub. Affairs, *Network News in the Nineties: The Top Topics and Trends of the Decade*, 11 Media Monitor 1, 2–3 (July/Aug. 1997) (available at http://www.cmpa.com/files/media_monitor/97julaug.pdf).

61. *E.g.* James E. Cutting et al., *Attention and the Evolution of Hollywood Film*, 21 Psychol. Sci. 1, 1–7 (Mar. 2010) (available at http://pss.sagepub.com/content/early/2010/02/04/0956797610361679).

62. *Quantum of Solace* (MGM 2008) (motion picture).

63. *Supra* nn. 19–21 and accompanying text (discussing the limitations of working

already in working memory. That bit is then lost from working memory, lost from further review of the information that will move it into long-term memory, and lost from retrieval and future use in the other contexts.[64]

In addition, each beep, flash, pop-up, and bouncing icon puts our brains in survival mode so that it interferes with any complex cognition. As one doctor put it,

> when you are confronted with the sixth decision after the fifth interruption in the midst of a search for the ninth missing piece of information on the day that the third deal has collapsed and the twelfth impossible request has blipped unbidden across your computer screen, your brain begins to panic, reacting just as if that sixth decision were a bloodthirsty, man-eating tiger.[65]

When the brain shifts to survival mode, the frontal lobes lose their sophistication, intelligence dims, and the brain is unable to think clearly.[66]

Third, those rapid and visual auditory changes overstimulate our brains in a way that may even be addictive.[67] In studies using fMRI, the part of the brain that lights up is the addiction cen-

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memory).

64. Memory involves three essential processes: encoding sensory input, a process that involves working memory; storing information, a process that involves moving information from working memory to long-term memory; and retrieving information from long-term memory, a process that involves moving information from long-term memory to working memory. Richard A. Griggs, *Psychology: A Concise Introduction* ch. 5 (2d ed., Worth Publishers 2008); Meyers, *supra* n. 2. Therefore, when incoming information is not retained in working memory because of its limited capacity, *supra* nn. 19–22, that information is not available for any of the subsequent processes required for memory.

65. Edward M. Hallowell, *Overloaded Circuits: Why Smart People Underperform*, Harv. Bus. Rev. 55, 58 (Jan. 2005).

66. *Id.* at 58–59.

67. *E.g.* Chien Chou, *A Review of the Research on Internet Addiction*, 17 Educ. Psychol. Rev. 363, 363–388 (2005); Jee Hyun Ha et al., *Characteristics of Excessive Cellular Phone Use in Korean Adolescents*, 11 CyberPsychology & Behavior 783, 783–784 (2008); Robert Kubey & Mihaly Csikszentmihalyi, *Television Addiction is No Mere Metaphor*, 14 Scientific Am. Special Ed., at 48–55 (Jan. 2004); Martha Shaw & Donald W. Black, *Internet Addiction: Definition, Assessment, Epidemiology and Clinical Management*, 22 CNS Drugs 353, 353–365 (2008). A recent study of student iPhone users at Stanford University revealed that 33 percent worry about becoming addicted to their iPhones and 41 percent said that losing it would be a tragedy. Pete Carey, *Stanford Student Survey Finds iPhone Users Hooked and Happy*, The Mercury News, http://www.mercurynews.com/topstories/ci_14470072 (posted Feb. 28, 2010 12:12 p.m. PST; updated Mar. 2, 2010 2:37 a.m. PST).

ter.[68] This addictive effect is recognized in popular culture as well, where Blackberry phones are called Crackberrys because of their addictive properties;[69] a wiki discusses how to defeat a Facebook addiction;[70] and numerous fora, all online, offer services for internet addiction.[71]

Even if not addicting, the overstimulation is certainly acculturating. Most children are exposed to this overstimulation from a very early age. One study reported that 82 percent of children are online by seventh grade[72] and what they enjoy are all the stimulatory bells and whistles: the games, movies, e-mail, IM, Google, and social networking sites.[73] The exposure to this stimulation begins young: children between the ages of six months and six years of age spend as much time before a media screen as they do playing outside.[74] By the time children reach the ages of ten to seventeen, they are spending a whopping 7.5 hours per day using electronic media.[75] Over time, this sustained overstimulation can even result in a temporary condition, attention deficit trait, similar in its effects to attention deficit disorder.[76]

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68. *E.g.* Chih-Hung Ko et al., *Brain Activities Associated with Gaming Urge of Online Gaming Addiction*, 43 J. Psych. Research 739, 740–746 (2009).

69. Ryan Reynolds, *Breaking Free from Blackberry Addiction*, Evansville Courier & Press (Jan. 16, 2009) (available at http://www.courierpress.com/news/2009/jan/16/breaking-the-connection/); *CrackBerry.com: The #1 Site for Blackberry Users and Abusers*, http://crackberry.com (accessed Feb. 1, 2010).

70. WikiHow, *How to Defeat a Facebook Addiction*, http://www.wikihow.com/Defeat-a-Facebook-Addiction (accessed Apr. 15, 2010). For additional examples, see Elizabeth Cohen, *Five Clues That You Are Addicted to Facebook*, http://www.cnn.com/2009/HEALTH/04/23/ep.facebook.addict/index.html (accessed Feb. 1, 2010); Katie Hafner, *To Deal with Obsession, Some Defriend Facebook*, N.Y. Times A16 (Dec. 21, 2009) (available at www.nytimes.com/2009/12/21/technology/internet/21facebook.htm).

71. *E.g.* Ctr. for Online & Internet Addiction, *netaddiction.com*, http://www.netaddiction.com (accessed Apr. 15, 2010); Ctr. for Internet and Tech. Addiction, *Virtual Addiction*, http://www.virtual-addiction.com (accessed Apr. 15, 2010).

72. Amanda Lenhart et al., *Teens and Technology: Youth Are Leading the Transition to a Fully Wired and Mobile Nation*, v, 2 (Pew Internet & Am. Life Project 2005) (available at http://www.pewinternet.org/~/media//Files/Reports/2005/PIP_Teens_Tech_July2005web.pdf).

73. Victoria J. Rideout et al., *Generation M^2: Media in the Lives of 8- to 18-Year-Olds* 2 (Kaiser Family Found. Jan. 2010) (available at http://www.kff.org/entmedia/upload/8010.pdf) [hereinafter Rideout et al., *Generation M^2*].

74. Victoria J. Rideout et al., *Zero to Six: Electronic Media in the Lives of Infants, Toddlers and Preschoolers* 4 (Kaiser Family Found. 2003) (available at http://www.kff.org/entmedia/upload/Zero-to-Six-Electronic-Media-in-the-Lives-of-Infants-Toddlers-and-Preschoolers-PDF.pdf).

75. *See* Rideout et al., *Generation M^2*, *supra* n. 73, at 74.

76. Hallowell, *supra* n. 65, at 56–57. Just like those with ADD, persons with this trait get frustrated and irritated easily, feel impatient and restless, are easily distracted, and

These are just the distractions associated with automatic, and cognitively primitive, reactions to stimuli. Plenty of additional distractions occur by our own making, especially as we attempt to multi-task.

B. Multi-Tasking

Multi-tasking is not a myth. People do it everyday, all the time. What is a myth is that multi-tasking is the most effective way to get more things done faster. Au contraire. The mania about the merits of multi-tasking reminds me of the game of Curses.[77] In this game, players have two responsibilities: to draw a card that asks them to perform a task and to conduct themselves according to the curse cards other players have bestowed on them. While playing with our neighbors, my husband had to play with seven curses: he had to stand up any time someone clapped, he had to sign as he spoke, he had to keep his hands in fists so that his fingers did not show, he had to speak like a pirate, he had to speak like Scooby-Doo, and he had to bow when someone said his name. When he tried to do the task on the task card that he drew, he was constantly interrupted by other players who clapped and called his name, all while he spoke like Scooby-Doo as a pirate and signed with his fists. How he managed to do it all, I have no idea. All that multi-tasking was truly a curse. Maybe that was the point the inventors of the game wanted to make.

So why is multi-tasking ineffective? It begins with attention. Attention is a finite resource.[78] A person may be able to walk and chew gum at the same time, two automatic or highly practiced tasks that require little cognitive effort or attention, but what about walking and talking or walking and texting? Not so much. Cell phone users walking across a square on the campus of Western Washington University largely failed to notice a clown on a unicycle.[79] The clown was brightly dressed in purple and yellow

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thrive on speed. Edward M. Hallowell, *CrazyBusy: Overstretched, Overbooked, and About to Snap! Strategies for Handling Your Fast-Paced Life* 9 (Ballantine Bks. 2007). Unlike those with ADD, this trait is not genetic in origin, but a result of our "attention deficit world." *Id.* at 2.

77. *Curses!* by Worldwise Imports, Inc. (board game).

78. Styles, *supra* n. 45, at 158.

79. Ira E. Hyman, Jr. et al., *Did You See the Unicycling Clown? Inattentional Blindness While Walking and Talking on a Cell Phone*, Applied Cognitive Psychol. 1, 7 (2009)

(with a hefty dash of polka dots), and wore huge floppy shoes, a big red nose, and an odd little hat. Plus, he was moving and in a novel and unexpected way. Not the sort of thing a person would normally miss. However, only 25 percent of cell phone users even noticed.[80]

On a busy street in London, a directory assistance firm and a nonprofit organization padded the telephone polls to protect texters who kept walking into them.[81] A woman talking on her cell phone walked right into a truck parked in a driveway.[82] Northwest Airlines pilots missed the Minneapolis airport while on their computers.[83] An engineer of a Southern California commuter train was texting when he ran a red light and slammed into a freight train, killing 25 people and injuring more than 130 others; he never hit the brakes.[84] A New York teen fell into an open manhole while walking and texting.[85] An Oregon man who was texting at a wedding walked smack into the bride, notwithstanding her white dress and eight-foot train.[86]

In response to injuries suffered from walking-while-texting, an application is now available for iPhone that will use the phone's camera to provide a view in front of the camera, allowing the user to see "through" the cell phone while texting and know where he or she is going.[87] Will accommodations like this help?

(available at http://www3.interscience.wiley.com/cgi-bin/fulltext/122623627/PDFSTART).

80. *Id.* at 6–7.

81. Hilary Hylton, *Texting and Walking: Dangerous Mix*, Time (Mar. 21, 2008) (available at www.time.com/time/business/article/0,8599,1724522,00.html); *London Street Has Record Cell Phone Texting Injuries*, www.youtube.com/watch?v=807vebt-mmQ (accessed Feb. 3, 2010) (videotape).

82. Matt Richtel, *Driven to Distraction: Forget Gum. Walking and Using Phone Is Risky*, N.Y. Times A1 (Jan. 17, 2010) (available at http://www.nytimes.com/2010/01/17/technology/17distracted.htm).

83. Micheline Maynard & Matthew L. Wald, *Off-Course Pilots Cite Computer Distraction*, N.Y. Times (Oct. 27, 2009) (available at http://www.nytimes.com/2009/10/27/us/27plane.html).

84. Wash. Post, *Engineer in Deadly LA Train Crash Was Texting*, http://voices.washingtonpost.com/washingtonpostinvestigations/2008/09/conductor_in_deadly_la_train_c.html (posted Sept. 18, 2008, 5:40 p.m. EDT).

85. Christina Boyle, *A Staten Island Teenager Fell into a Manhole While Texting*, N.Y. Daily News, http://www.nydailynews.com/news/2009/07/11/2009-07-11_shes_texting_but_then_she_just_drops_in.html (posted July 10, 2009, 10:45 p.m. EDT).

86. Jeanna Bryner, LiveScience.com, *The Perils of Text Messaging While Walking*, http://www.livescience.com/blogs/2008/07/25/the-perils-of-text-messaging-while-walking/ (July 25, 2008).

87. Victor Agreda, Jr., The Unofficial Apple Weblog, *Walk and Talk Feature Added to Agile Messenger for iPhone* (Nov. 12, 2009) (available at http://www.tuaw.com/2009/11/12/walk-and-talk-feature-added-to-agile-messenger-for-iphone).

No. If people cannot see a clown or a truck or even a large city,[88] a peephole through their texting device will not make much difference. In each of the examples, the actors were blind to their surroundings because their attentional resources[89] were devoted to another task.[90] A porthole in their texting device will not change this.

Instead, a person must attend to that which needs attending. If cell phone use requires all of a person's attentional resources, then that is the only task to which the person can attend at the time. While a person may have enough attentional resources to do more than one automatic or highly practiced task at a time, resources become stretched when doing tasks that require more cognitive effort. For example, assume that you are driving, a highly practiced task, and engaging in light conversation with your passengers, a cognitive task requiring some, but not much, attention. When you encounter a roadblock, an accident, or some other hazard, what is the first thing you say? "Everyone be quiet." That is because driving has now shifted from a highly practiced task to a cognitive task that requires all of your attention.

If people only have resources for one cognitive task at a time, how do they multi-task? If multi-tasking means doing two or more things simultaneously, things that are competing for the same cognitive resources, they don't.[91] Instead, the brain divides its attention between the tasks and attention is shifted back and forth between them. This is bad news not only for the quality of performance but also for the time within which the performance occurs. A simple example helps to illustrate this.

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88. The Minneapolis-St. Paul metropolitan area is the fifteenth largest in the United States with a population of over 3.2 million people. U.S. Census Bureau, Population Estimates, *Estimates of Population Change for Micropolitan Statistical Areas and Rankings: July 1, 2008 to July 1, 2009*, http://www.census.gov/popest/metro/CBSA-est2009-pop-chg.html (released Mar. 2010).

89. Styles, *supra* n. 45, at 158.

90. This phenomenon is termed inattentional blindness. Daryl Fougnie & René Marois, *Executive Working Memory Load Induces Inattentional Blindness*, 14 Psychonomic Bull. & Rev. 142, 142 (2007); Daniel J. Simons & Christopher F. Chabris, *Gorillas in Our Midst: Sustained Inattentional Blindness for Dynamic Events*, 28 Perception 1059, 1069–1070 (1999). To experience inattentional blindness, try this video awareness test: *Test Your Awareness: Do the Test*, http://www.youtube.com/watch?v=Ahg6qcgoay4.

91. *E.g.* Yuhong Jiang et al., *Functional Magnetic Resonance Imaging Provides New Constraints on Theories of the Psychological Refractory Period*, 15 Psychol. Sci. 390, 390–396 (2004).

Assume that you are having a phone conversation, when a third person begins talking to you. You have a range of choices. At the two extremes, you can attend fully (100 percent) to the phone conversation and ignore (0 percent) the person talking to you, or you can attend fully (100 percent) to the person talking to you and ignore (0 percent) the phone conversation. In between, you can reduce your attention to one of the conversations to attend to the other one. In the latter situation, you will miss some of each conversation, so the quality of your performance will suffer. In addition, you need to have information repeated, which takes more time.

What happens cognitively when people try to do more than one task at a time? Attention is divided between the two tasks. While the theories vary as to why this occurs,[92] studies fairly universally agree that attention shifts back and forth between the two tasks. The shifts occur very rapidly. Each shift takes time, generally about 20 percent longer.[93] The time involved varies considerably depending on the tasks involved, but a good rule of thumb is the time will be longer when the work gets more complex,[94] when the work moves from familiar to unfamiliar,[95] when the tasks must be done quickly,[96] and when the tasks compete for the same cognitive resource, such as talking and reading.[97]

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92. One theory is that the tasks are sharing a finite capacity, and so must share that capacity between the tasks in some graded fashion. *E.g.* Kahneman, *supra* n. 3, at 7–11; Christopher D. Wickens, *Processing Resources in Attention*, in *Varieties of Attention* 63, 63–101 (Raja Parasuraman & D. R. Davies eds., Academic Press 1984). A second theory suggests that a bottleneck exists. *E.g.* Harold Pashler, *Processing Stages in Overlapping Tasks: Evidence for a Central Bottleneck*, 10 J. Experimental Psychol.: Human Perception & Performance 358 (1984). A third theory is that crosstalk exists when the outcome of the processing of one task conflicts with the processing of a second task (i.e., the processing streams are not kept separate). *E.g.* David Navon & Jeff Miller, *Role of Outcome Conflict in Dual-Task Interference*, 13 J. Experimental Psychol.: Human Perception & Performance 435 (1987).

93. *E.g.* Catherine M. Arrington & Gordon D. Logan, *The Cost of a Voluntary Task Switch*, 15 Psychol. Sci. 610, 612 (2004) (tasks took about 20 percent longer to perform when alternating between two concurrent tasks compared to doing one task at a time).

94. Michael J. Emerson & Akira Miyake, *The Role of Inner Speech in Task Switching: A Dual-Task Investigation*, 48 J. Memory & Language 148, 159–160 (2003) (task cost increased 150 percent with complexity); Joshua S. Rubinstein et al., *Executive Control of Cognitive Processes in Task Switching*, 27 J. Experimental Psychol.: Human Perception & Performance 763, 787 (2001) (tripled switching cost [time] from simplest task to most complex).

95. *See* Joshua S. Rubinstein et al., *Executive Control of Cognitive Processes in Task Switching*, 27 Experimental Psychol.: Human Perception & Performance 763, 783 (2001).

96. Arrington & Logan, *supra* n. 93, at 612.

97. Alan Baddeley et al., *Working Memory and the Control of Action: Evidence from*

In addition, the shifts consume more time because performance can be slowed after a switch.[98] This effect is called a restart cost.[99] According to one study, the restart costs are higher when individuals are interrupted from more demanding tasks, like reading.[100] This means that shifting from an easier task to a more difficult task may be more difficult, i.e., it may involve more shift costs, than shifting to an easier task.[101]

Because of the time it takes to perform these cognitive shifts, trying to do more than one task at a time takes longer than doing each task sequentially.[102] This may seem counter-intuitive to die-hard multi-taskers; after all, they are busy, busy, busy. However, most of that busyness is wasted cognitive energy. In fact, the less time available to perform the tasks, the greater the time it takes to do the switch.[103]

That is not to say that multi-taskers cannot improve their performance time-wise. The switch time can be reduced by cuing and by practice. With cuing, people are told what to look for, which can reduce switch time by about one-third or more.[104] Self-cuing through inner speech can also reduce switch time but not nearly as much as explicit cuing.[105] With practice, tasks can become more automatic,[106] so the time it takes to switch tasks is

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Task Switching, 130 J. Experimental Psychol.: Gen. 641, 652–656 (2001); Emerson & Miyake, *supra* n. 94, at 153 (doing task while talking increased switch cost up to 62 percent); Torkel Klingberg, *Limitations in Information Processing in the Human Brain: Neuroimaging of Dual Task Performance and Working Memory Tasks*, 126 Progress in Brain Research 95, 95–100 (2000).

98. Florian Waszak et al., *Task-Switching and Long-Term Priming: Role of Episodic Stimulus—Task Bindings in Task-Shift Costs*, 46 Cognitive Psychol. 361, 400 (2003); Glenn Wylie & Alan Allport, *Task Switching and the Measurement of "Switch Costs,"* 63 Psychol. Research 212, 225 (2000).

99. Waszak et al., *supra* n. 98, at 400.

100. *Id.*

101. *Id.* at 402 (shift to dominant task (reading) had higher shift cost than shifting to non-dominant task (picture-naming)). The results on this point are mixed, however, so it may depend on the nature of the tasks involved. *Id.* (listing studies where similar shift costs were found and other studies where no additional shift costs were found).

102. Rubinstein et al., *supra* n. 95, at 783.

103. Arrington & Logan, *supra* n. 93, at 612 (voluntary switch cost was one-third greater when significantly less time was available to perform the task).

104. Rubinstein et al., *supra* n. 95, at 780.

105. Emerson & Miyake, *supra* n. 94, at 156 (when did not have to rely so much on self-cuing through inner speech, task switching costs went down by one-third for an indirect cue and 58 percent for a direct cue).

106. Harold Pashler et al., *Attention and Performance*, 52 Annual Rev. Psychol. 629, 641 (2001).

shortened, but not eliminated.[107] However, the decreased switch time occurs only when practice is extensive.[108] In addition, regardless of the process used to get faster, the process of shifting still occurs,[109] with each shift slowing performance and increasing the risk of error.[110]

The risk of error increases with each shift, so the more switches, the more that accuracy decreases.[111] Accuracy can be reduced by 20 to 40 percent,[112] with the greatest interference occurring when a person is doing intellectually demanding work,[113] such as struggling with problem-solving and reasoning tasks.[114]

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107. Nachshon Meiran, *Modeling Cognitive Control in Task-Switching*, 63 Psychol. Research 234, 235 (2000) (preparation reduces switching costs, but does not eliminate them); Stephen Monsell et al., *Reconfiguration of Task-Set: Is It Easier to Switch to the Weaker Task?* 63 Psychol. Research 250, 253 (2000) (reviewing studies supporting that preparation reduces switching costs). While general agreement exists about this conclusion, different theories exist to explain the phenomena. One theory is that residual task costs remain because a person can only plan ahead for one of the two stages of executive processing. William J. Gehring et al., *The Mind's Eye, Looking Inward? In Search of Executive Control in Internal Attention Shifting*, 40 Psychophysiology 572, 580–581 (2003) (most time is involved in the top-down process involving cognitive control); Monsell et al., *supra* n. 107, at 254; Pashler et al., *supra* n. 106, at 642, 646 (residual task costs exist even when a person has a long time to prepare for the shift); Rubinstein et al., *supra* n. 95. An alternative theory is that the residual task costs are due to interference. Monsell et al., *supra* n. 107, at 262.

108. Eric Ruthruff et al., *Vanishing Dual-Task Interference after Practice: Has the Bottleneck Been Eliminated or Is It Merely Latent?* 29 J. Experimental Psychol.: Human Perception & Performance 280, 280 (2003) (citing several studies); *cf.* Eric H. Schumacher et al., *Virtually Perfect Time Sharing in Dual-Task Performance: Uncorking the Central Cognitive Bottleneck*, 12 Psychol. Sci. 101, 102 (2001) (modest practice eliminates costs of shift but affected by personal preference for daring versus conservative task scheduling).

109. Harold Pashler, *Dissociations and Dependencies between Speed and Accuracy: Evidence for a Two-Component Theory of Divided Attention in Simple Tasks*, 21 Cognitive Psychol. 469, 508 (1989).

110. *Supra* nn. 98–103 and accompanying text; *infra* nn. 111–117 and accompanying text.

111. Nash Unsworth & Randall W. Engle, *Speed and Accuracy of Accessing Information in Working Memory: An Individual Differences Investigation of Focus Switching*, 34 J. Experimental Psychol.: Learning, Memory, & Cognition 616, 628 (2008).

112. Pashler et al., *supra* n. 106, at 508 (20 percent); Rubinstein et al., *supra* n. 95, at 776 (approximately 20 to 40 percent).

113. *See e.g.* Mary Czerwinski et al., Paper Presentation, *A Diary Study of Task Switching and Interruptions* (*ACM Conf. on Human Factors in Computing Systems*, Vienna, Austria, April 28, 2004) (http://research.microsoft.com/en-us/um/people/horvitz/taskdiary.htm. (describing diary methodology).

114. Unsworth & Engle, *supra* n. 111, at 628, 629. Task-switching affects low-ability individuals more than high-ability individuals. A low-ability individual has lower fluid intelligence (gF) and reduced working memory capacity; a high-ability individual has higher fluid intelligence and greater working memory capacity. *Id.* at 618–629. Fluid intelligence concerns the ability to do nonverbal problem-solving and reasoning tasks that are independent of general knowledge. Klingberg, *supra* n. 48, at 148.

Real world examples abound. When driving while talking or listening on a cell phone, the risk of accidents increases by about 30 percent, driving while dialing nearly triples the risk, and texting while driving a truck increases the risk of an accident a whopping 23-fold.[115] When reading while also instant messaging, expect the reading to take 50 percent longer to complete[116] and comprehension to take a dive.[117]

Multi-tasking not only takes more time and adversely affects accuracy, but it can also adversely affect memory.[118] Based on the discussion about working memory, this makes sense: bits are being booted from working memory with each switch. In one study, dual-tasking reduced recall by 25 percent.[119] To make matters worse, the recall was 54 percent slower than with single-tasking.[120]

So far, multi-tasking is slower, less accurate, and less likely to be remembered than doing one task at a time. Not so great. But, like the refrain of late-night televisions ads, there is more. Multi-taskers are more susceptible to distraction,[121] especially when the tasks come from the same broad content domain.[122] Multi-tasking tends to overload the brain and overloaded brains are more subject to distraction. Then, if stress and fatigue are added to the mix, the effects of multi-tasking only become "worser and worser." The next sections will explain why.

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115. Data released in a July 2009 press release from the Virginia Tech Transportation Institute is available at http://www.vtti.vt.edu/PDF/7-22-09-VTTI-Press_Release_Cell_phones_and_Driver_Distraction.pdf. (accessed Apr. 15, 2010). Additional data is reported in the United States Department of Transportation report issued by the National Highway Traffic Safety Administration, *The Impact of Driver Inattention on Near-Crash/Crash Risk: An Analysis Using the 100-Car Naturalistic Driving Study Data*, can be found at http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/NRD/Multimedia/PDFs/Crash%20Avoidance/Driver%20Distraction/810594.pdf (accessed April 15, 2010).

116. Mary Czerwinski et al., Paper Presentation, *Instant Messaging and Interruption: Influence of Task Type on Performance* (OZCHI: Annual Conf. of the Australian Computer-Human Interaction Spec. Interest Group, Sydney, Austrl., Dec. 4–8, 2000) (http://research.microsoft.com/en-us/um/people/marycz/ozchi2000.pdf); Annie Beth Fox et al., *Distractions, Distractions: Does Instant Messaging Affect College Students' Performance on a Concurrent Reading Comprehension Task?* 12 CyberPsychology & Behavior 51 (2009).

117. Fox et al., *supra* n. 116, at 52.

118. Doug Rohrer & Harold E. Pashler, *Concurrent Task Effects on Memory Retrieval*, 10 Psychonomic Bull. & Rev. 96, 99 (2003).

119. *Id.*

120. *Id.* at 100.

121. Barrett et al., *supra* n. 44, at 554.

122. Baddeley, *supra* n. 97, at 655.

C. Stress and Anxiety

Not only is our attention stretched by distractions and multitasking, but it is also adversely affected by stress and anxiety. While everyone suffers from stress and anxiety to differing degrees in different contexts, law schools are particularly significant breeding grounds for both.[123] While lower levels of stress and anxiety can help concentration and speed,[124] as stress and anxiety levels increase, the ability to do sophisticated reasoning,[125] like that required for legal analysis, becomes significantly impaired.[126] How does this occur?

Significant levels of stress and anxiety affect the entire learning process from perception to memory. First, significant levels of stress and anxiety affect what a person perceives. The world is filled with stimuli that compete for attention with each of our senses.[127] Out of necessity, we filter through the stimuli to select what we need for the task at hand. Significant stress and anxiety alter that filtering process: the top-down process that controls

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123. *See e.g.* G. Andrew H. Benjamin et al., *The Role of Legal Education in Producing Psychological Distress Among Law Students and Lawyers*, 1986 Am. Bar Found. Research J. 225, 246 (1986) (before law school, law students experience stress and anxiety at levels similar to the general population; during law school, symptom levels are elevated significantly above the general population); Matthew M. Dammeyer & Narina Nunez, *Anxiety and Depression Among Law Students: Current Knowledge and Future Directions*, 23 Law & Human Behavior 55, 63 (1999) (law students report higher levels of anxiety than comparison groups, including medical students); Ann L. Iijima, *Lessons Learned: Legal Education and Law Student Dysfunction*, 48 J. Legal Educ. 524, 526 (1998) (empirical and anecdotal reports indicate that law schools contribute directly or indirectly to law students' dysfunction); Lawrence Silver, Student Author, *Anxiety and the First Semester of Law School*, 1968 Wis. L. Rev. 1201, 1201–1210 (attributing high anxiety in law school to high expectations, the subject matter and method of study, and the importance of first-semester grades).

124. Rob Booth & Dinkar Sharma, *Stress Reduces Attention to Irrelevant Information: Evidence from the Stroop Task*, 33 Motivation & Emotion 412, 416–417 (2009) (playing loud white noise reduced Stroop interference); Klingberg, *supra* n. 48, at 22.

125. Examples of sophisticated, high-level cognitive processes include problem-solving, abstraction, inference, decision-making, analysis, and synthesis. Yingxu Wang et al., *A Layered Reference Model of the Brain (LRMB)*, 36 IEEE Transactions on Systems, Man, and Cybernetics Part C: Applications and Reviews 124, 129 (2006). Most models of cognitive hierarchy are derivative of Bloom's Taxonomy. *See* Comm. of College & U. Examiners, *Taxonomy of Educational Objectives: The Classification of Educational Goals, Handbook I: Cognitive Domain* (Benjamin S. Bloom ed., David McKay Company, Inc. 1956).

126. *See e.g.* Anne Richards et al., *Test-Anxiety, Inferential Reasoning and Working Memory Load*, 13 Anxiety, Stress, & Coping 87, 102 (2000) (study participants with high test anxiety performed more slowly and less accurately on an inferential reasoning task).

127. Marian R. Weierich et al., *Theories and Measurement of Visual Attentional Processing in Anxiety*, 22 Cognition & Emotion 985, 988 (2008).

which stimuli we attend to gets hijacked or overwhelmed by a stimulus-driven, bottom-up process.[128] This changes the priorities of selecting stimuli from goal-oriented selection—selecting the stimuli necessary to accomplish a task—to threat-oriented selection—selecting the stimuli needed to achieve a safe environment. In this way, the perceptual process is skewed to the negative and the fear-inducing.[129]

Second, significant stress and anxiety affects working memory. Cues signaling danger are more likely to capture the attention of those suffering from significant stress and anxiety, and stress and anxiety sufferers are more likely to interpret stimuli to be threatening.[130] The loss of attentional control affects working memory in a number of ways. During task-shifting, the probability increases that the brain will divert processing resources from stimuli relevant to the task at hand to irrelevant stimuli.[131] This is exacerbated when cognitive load is high[132] and when processing new tasks.[133] To compensate for the impaired processing efficiency, anxious individuals may compensate with additional effort[134] to avoid the impairments to memory that would otherwise re-

128. Michael W. Eysenck et al., *Anxiety and Cognitive Performance: Attentional Control Theory*, 7 Emotion 336, 338 (2007).

129. *See e.g.* Peter J. Lang et al., *Fear and Anxiety: Animal Models and Human Cognitive Psychophysiology*, 61 J. Affective Disorders 137, 148–154 (2000) (The fear response in humans is similar to the fight or flight response in animals in close proximity to predators.). "Fear is viewed as a biologically adaptive physiological and behavioral response to the actual or anticipated occurrence of an explicit threatening stimulus." Sonia J. Bishop, *Neurocognitive Mechanisms of Anxiety: An Integrative Account*, 11 Trends in Cognitive Sci. 307, 307 (2007).

130. *See e.g.*, Yair Bar-Haim et al, *Threat-Related Attentional Bias in Anxious and Nonanxious Individuals: A Meta-analytic Study*, 133 Psychol. Bull. 1, 15–18 (2007) (high trait anxiety may be a result of, among other things, a person's "tendency to automatically evaluate benign or slightly threatening stimuli as high threat" and "tendency to consciously evaluate alert signals as highly threatening even when [all else] may indicate the contrary"); Colin MacLeod et al., *Selective Attention and Emotional Vulnerability: Assessing the Causal Basis of Their Association through the Experimental Manipulation of Attentional Bias*, 111 J. Abnormal Psychol. 107, 119–120 (2002) (anxious individuals tend to focus on negative information).

131. Eysenck et al., *supra* n. 128, at 339, 346–347.

132. *See e.g.* N. Y. L. Oei et al., *Psychosocial Stress Impairs Working Memory at High Loads: An Association with Cortisol Levels and Memory Retrieval*, 9 Stress: The Intl. J. on the Biology of Stress 133, 139 (2006) (stress impaired working memory at high working memory loads).

133. Daniela Schoofs et al., *Psychosocial Stress Induces Working Memory Impairments in an n-Back Paradigm*, 33 Psychoneuroendocrinology 643, 650 (2008).

134. Eysenck et al., *supra* n. 128, at 340.

sult.[135] That additional compensatory effort generally requires more time.[136]

Third, significant stress and anxiety affect high-level cognition, such as reasoning. High-level cognition relies on all of the processes just discussed, so if those processes are skewed, the ultimate output will be skewed as well. However, significant stress and anxiety affect high-level cognition independent of those processes. Anxiety generally impairs performance of complex and attentionally demanding tasks.[137] In one study, those who were highly anxious made substantially more errors in analogical reasoning than those who were not anxious, especially when they tried to perform more quickly.[138]

Unfortunately, the study of law is inherently stressful and anxiety producing, for reasons ranging from the institutional design of law schools[139] to the high-level cognitive work. In addition, interruptions while performing those high-level cognitive tasks produce stress, and a perception of higher workload, even after only twenty minutes of interrupted work.[140] To the extent that some of the stress and anxiety can be controlled or limited, the deleterious effects that significant stress and anxiety have on learning can also be controlled or limited.

D. Fatigue and Lack of Sleep

A common reaction to the lack of time to complete a task is to insert more working hours into the day by forgoing sleep. This

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135. *Id*. at 347.

136. *See e.g.* Nazanin Derakshan & Michael W. Eysenck, *Working Memory Capacity in High Trait-Anxious and Repressor Groups*, 12 Cognition & Emotion 697, 710–711 (1998) (finding a disproportionately greater slowing of reasoning speed among the highly anxious).

137. Nazanin Derakshan & Michael W. Eysenck, *Anxiety, Processing Efficiency, and Cognitive Performance: New Developments from Attentional Control Theory*, 14 European Psychologist 168, 168 (2009).

138. Marjorie Roth Leon & William Revelle, *Effects of Anxiety on Analogical Reasoning: A Test of Three Theoretical Models*, 49 J. Personality & Soc. Psychol. 1302, 1312–1313 (1985).

139. *See e.g.* M. H. Sam Jacobson, *The Curse of Tradition in the Law School Classroom: What Casebook Professors Can Learn from Those Professors Who Teach Legal Writing*, 61 Mercer L. Rev. 899 (2010).

140. Gloria Mark et al., *The Cost of Interrupted Work: More Speed and Stress*, in *CHI '08: Proceeding of the Twenty-Sixth Annual SIGCHI Conference on Human Factors* in *Computing Systems* 107, 110 (2008) (available at http://www.ics.uci.edu/~gmark/chi08-mark.pdf).

reaction is penny wise and pound foolish. Sleep is critical to attention and learning.

First, sleep is essential to nourish the parts of the brain needed to learn. If ignorance is bliss, the best way to become blissfully ignorant is to go without sleep. One study found that if a person gets fewer hours of sleep than normal, she actually loses IQ points, and those lost IQ points are accumulated with successive nights of lost sleep.[141] Have any extra IQ points to spare? Didn't think so.

Studies of sleep deprivation confirm that lack of sleep will result in more problems with working memory,[142] including needing more time to accomplish tasks,[143] more effort to do them,[144] and more effort to remember,[145] all while making more errors.[146] The results are similar whether the sleep deprivation was total,[147] such as when a person stays up all night to finish a project or cram for an exam; chronic partial,[148] such as when a person rou-

141. *Sleep Deprivation: Effects on Brain Function and Health*, http://www.learninginfo.org/sleep-deprivation.htm (accessed Apr. 16, 2010) (citing research by Stanley Coren, psychologist at University of British Columbia).

142. *E.g.* Michael W. L. Chee et al., *Functional Imaging of Working Memory Following Normal Sleep and after 24 and 35 h of Sleep Deprivation: Correlations of Fronto-Parietal Activation with Performance*, 31 NeuroImage 419, 425–426 (2006).

143. *E.g.* Melynda Casement et al., *The Contribution of Sleep to Improvements in Working Memory Scanning Speed: A Study of Prolonged Sleep Restriction*, 72 Biological Psychol. 208, 211 (2006) (working memory speed was 58 percent faster for those who had eight hours of sleep); Herbert Heuer et al., *Total Sleep Deprivation Increases the Costs of Shifting between Simple Cognitive Tasks*, 117 Acta Psychologica 29, 59–61 (2004).

144. *See e.g.* Michael W. L. Chee et al., *Lapsing During Sleep Deprivation Is Associated with Distributed Changes in Brain Activation*, J. Neuroscience 5519, 5525–5527 (2008) (effort is spent on staying awake and that negatively affects attention); Mindy Engle-Friedman et al., *The Effect of Sleep Loss on Next Day Effort*, 12 J. Sleep Research 113, 117 (2003) (finding that sleep loss resulted in some participants in the study selecting less difficult tasks to perform).

145. *See e.g.* Michael W. L. Chee et al., *Sleep Deprivation and Its Effects on Object-Selective Attention*, 49 NeuroImage 1903, 1908–1909 (2010) (sleep deprivation resulted in poorer recognition memory and slower response times).

146. *See e.g.* Wei-Chieh Choo et al., *Dissociation of Cortical Regions Modulated by Both Working Memory Load and Sleep Deprivation and by Sleep Deprivation Alone*, 25 NeuroImage 579, 584–586 (2005) (sleep deprivation resulted in slower response times and reduced accuracy).

147. *See e.g.* Jens P. Nilsson et al., *Less Effective Executive Functioning after One Night's Sleep Deprivation*, 14 J. Sleep Research 1, 3–5 (2005) (study participants showed less effective executive functioning after one night's sleep deprivation).

148. *See e.g.* Patricia Tassi et al., *EEG Spectral Power and Cognitive Performance During Sleep Inertia: The Effect of Normal Sleep Duration and Partial Sleep Deprivation*, 87 Physiology & Behavior 177, 178–183 (2006) (subjects permitted to sleep only two hours showed poorer speed and accuracy in performing tasks upon waking than subjects who slept eight hours); Hans P. A. Van Dongen et al., *The Cumulative Cost of Additional Wake-*

tinely cuts sleep short by a couple of hours; or interrupted,[149] such as when a person's sleep is disrupted by noises, even if she's not aware of the disruption. Cognitive deficits of approximately 30 percent are often reported.[150] In fact, performance while sleep deprived typically approximates the performance of someone who is legally intoxicated.[151] One big difference, though: people know about the impairments of intoxication, but most are probably clueless about the impairments from lack of sleep.

That sleep is needed to learn is nothing new. Sleep is needed before learning so that information can be properly encoded into long-term memory.[152] In one study, subjects who were deprived of sleep before a learning session remembered 40 percent less.[153] New technology allows us to see why. Functional MRI scans show a significant difference in the activation of the hippocampus, an area of the brain important to memory formation, for those who had had a full complement of sleep compared to those who were sleep-deprived.[154] The brain activity patterns revealed in the scans reflect a marked deficit in the neural ability to encode new memories in those subjects deprived of a night's sleep.[155]

Second, sleep is needed after learning as well. Functional MRI scans show neural and other changes in the brain after

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fulness: Dose-Response Effects on Neurobehavioral Functions and Sleep Physiology from Chronic Sleep Restriction and Total Sleep Deprivation, 26 Sleep 117, 118–125 (2003) (sleep limited to four and six hours per night for up to seven nights negatively affected working memory and cognitive performance).

149. Michael H. Bonnet & Donna L. Arand, *Clinical Effects of Sleep Fragmentation Versus Sleep Deprivation*, 7 Sleep Med. Rev. 297, 300 (2003).

150. *E.g.* Harvey Babkoff et al., *Effect of the Diurnal Rhythm and 24 h of Sleep Deprivation on Dichotic Temporal Order Judgment*, 14 J. Sleep Research 7, 12 (2005).

151. *See e.g.* Paul Maruff et al., *Fatigue-Related Impairment in the Speed, Accuracy and Variability of Psychomotor Performance: Comparison with Blood Alcohol Levels*, 14 J. Sleep Research 21, 26–27 (2005) (twenty-four hours of sustained wakefulness equivalent to .08 BAC); A. M. Williamson & Anne-Marie Feyer, *Moderate Sleep Deprivation Produces Impairments in Cognitive and Motor Performance Equivalent to Legally Prescribed Levels of Alcohol Intoxication*, 57 Occupational & Environmental Medicine 649, 653–654 (2000) (seventeen to eighteen hours without sleep equivalent to .05 BAC; longer hours without sleep equivalent to .10 BAC).

152. Encoding strategies are highly linked to intelligence. *See generally* Rhodri Cusack et al., *Encoding Strategy and Not Visual Working Memory Capacity Correlates with Intelligence*, 16 Psychonomic Bull. & Rev. 641 (2009).

153. Matthew Walker & Robert Stickgold, *Sleep, Memory and Plasticity*, 10 Annual Rev. Psychol. 139, 143–144 (2006).

154. Seung-Schik Yoo et al., *A Deficit in the Ability to Form New Human Memories without Sleep*, 10 Nature Neuroscience 385, 385–391 (2007).

155. *Id.* at 386–389.

sleep.[156] These changes reflect a process of consolidating and reorganizing memories to facilitate more efficient access to the information and improved recall.[157] The additional processing makes the memories less susceptible to interference.[158] For example, correct recall after twelve hours for subjects who had had sleep was reduced from 94 percent with no interference to 76 percent with interference, but correct recall for subjects without sleep was reduced from 82 percent with no interference to 32 percent with interference.[159]

In addition to strengthening individual memories, sleep helps to build relational associations between the memories by integrating them into the templates or schema that will facilitate their recall.[160] Functional MRI scans indicate that the brain "plays back" daytime learning during REM sleep.[161] In addition, the more the playback, the greater the extent of the learning as measured by next-day improvement.[162]

Not only is sleep needed to improve learning, it is also needed to see beyond the explicit knowledge learned, so that one can gain insight.[163] This is when the magic happens. All the neural connections come out to play,[164] creating depth of understanding that would not otherwise exist.

The bottom line is this: performing well requires sleep. For students, sleep correlates highly with grades.[165] Students receiving the highest grades had more sleep.[166] In addition, people who

156. Matthew P. Walker, *Cognitive Consequences of Sleep and Sleep Loss*, 9 Sleep Med. Supp. I S29, S31–S33 (2008).

157. *E.g.* Ullrich Wagner & Jan Born, *Memory Consolidation during Sleep: Interactive Effects of Sleep Stages and HPA Regulation*, 11 Stress 28, 28–38 (2008).

158. Jeffrey M. Ellenbogen et al., *Interfering with Theories of Sleep and Memory: Sleep, Declarative Memory, and Associative Interference*, 16 Current Biology 1290, 1291 (2006).

159. *Id.*

160. Jeffrey M. Ellenbogen et al., *Human Relational Memory Requires Time and Sleep*, 104 Proceedings Natl. Acad. Science 7723, 7723–7728 (2007).

161. Pierre Maquet et al., *Experience-Dependent Changes in Cerebral Activation during Human REM Sleep*, 3 Nature Neuroscience 831, 832–834 (2000).

162. Philippe Peigneux et al., *Learned Material Content and Acquisition Level Modulate Cerebral Reactivation during Posttraining Rapid-Eye-Movements Sleep*, 20 NeuroImage 125, 125–133 (2003).

163. *E.g.* Ullrich Wagner et al., *Sleep Inspires Insight*, 427 Nature 352, 352–355 (2004).

164. *E.g.* James M. Krueger et al., *Sleep as a Fundamental Property of Neuronal Assemblies*, 9 Nat. Revs.: Neuroscience 910, 910–919 (2008).

165. *E.g.* Howard Taras & William Potts-Datema, *Sleep and Student Performance at School*, 75 J. Sch. Health 248, 248–254 (2005) (reviewing research on the association between sleep and school performance).

166. Pamela V. Thacher, *University Students and "The All Nighter": Correlates and*

have adequate sleep are better able to cope with stress, to maintain a positive attitude, and to maintain quality in interpersonal relationships.[167]

IV. IMPROVING ATTENTION

As the preceding discussion suggests, attention will improve when distractions are managed, either by eliminating them or minimizing their adverse effects, when tasks can be divided into manageable pieces and analytical thinking preserved, when stress is controlled, and when sleep is adequate.

A. Manage Distractions

Not every distraction is equally distracting. Therefore, we cannot manage distractions effectively without knowing what makes a distraction so distracting that it will interfere with the attention and concentration required to perform well. Whether a distraction will adversely affect attention and concentration depends on the type of distraction, the person being distracted, and the task being interrupted.

First, distractions that adversely affect attention and concentration vary by type of interruption. When the distraction is auditory, it will be more interruptive than other modes of interruptions, such as visual interruptions.[168] This is especially the case when reading,[169] perhaps because the stimuli are competing for

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Patterns of Students' Engagement in a Single Night of Total Sleep Deprivation, 6 Behavioral Sleep Med. 16, 24 (2008) (students engaging in all-nighters had lower GPAs); Amy R. Wolfson & Mary A. Carskadon, *Sleep Schedules and Daytime Functioning in Adolescents*, 69 Child Dev. 875, 884 (1998) (students with grades of C or below obtained twenty-five minutes less sleep per night and went to bed forty minutes later than students with grades of A or B).

167. William D. S. Killgore et al., *Sleep Deprivation Reduces Perceived Emotional Intelligence and Constructive Thinking Skills*, 9 Sleep Med. 517, 523 (2008).

168. Christopher D. Wickens et al., *Auditory Preemption Versus Multiple Resources: Who Wins in Interruption Management?* in *Proceedings of the Human Factors and Ergonomics Society 49th Annual Meeting—2005*, at 463, 464 (2005); Simon Banbury et al., *Using Auditory Streaming to Reduce Disruption to Serial Memory by Extraneous Auditory Warnings*, 9 J. Experimental Psychol.: Applied 12, 19, 21 (2003).

169. James W. Aldridge, *Levels of Processing in Speech Perception*, 4 J. Experimental Psychol.: Human Perception & Performance 164–177 (1978) (series of experiments establishing that speech interferes with concurrent verbal memory); Quintus R. Jett & Jennifer M. George, *Work Interrupted: A Closer Look at the Role of Interruptions in Organizational Life*, 28 Acad. Mgt. Rev. 494, 500 (2003).

the same cognitive resources.[170] Distractions will also be more interruptive when they are more frequent,[171] and more complex.[172] In addition, distractions will be interruptive even when relatively short in length.[173]

Second, distractions that adversely affect attention and concentration vary by person. Personal variations are a result of personality differences, modality preferences, and motivation. People will be more adversely affected by distractions[174] if they are weak stimulus screeners,[175] are Type A personalities,[176] or have a need for personal structure.[177] However, individuals who are strong stimulus screeners,[178] are more patient and easygoing Type B personalities,[179] or have an openness to actions,[180] will be less adversely affected. In addition to personality, the modality of the distraction will affect how adversely affected someone is, depending on personal preferences. For example, certain noises might be distracting to some people but not others,[181] and certain

170. *See* Tony Gillie & Donald Broadbent, *What Makes Interruptions Disruptive? A Study of Length, Similarity, and Complexity*, 50 Psychol. Research 243, 247–249 (1989).

171. Fred R. H. Zijlstra et al., *Temporal Factors in Mental Work: Effects of Interrupted Activities*, 72 J. Occ. & Organizational Psychol. 163, 173 (1999).

172. *Id.* at 171, 173; Gillie & Broadbent, *supra* n. 170, at 249; Helen M. Hodgetts & Dylan M. Jones, *Reminders, Alerts and Pop-ups: The Cost of Computer-Initiated Interruptions*, in *Human Computer Interaction: Interaction Design and Usability* 818, 822 (Julie A. Jacko ed., Springer-Verlag 2007).

173. Gillie & Broadbent, *supra* n. 170, at 249; Hodgetts & Jones, *supra* n. 172, at 820–821.

174. In addition to the adverse effects that distractions have on attention and cognition, *supra* sec. III(A), additional adverse affects include stress and anxiety, feelings of being overloaded or overworked, and fatigue. *See e.g.* Andrew M. Carton & John R. Aiello, *Control and Anticipation of Social Interruptions: Reduced Stress and Improved Task Performance*, 39 J. Applied Social Psychol. 169, 178 (2009) (study participants who could prevent interruptions reported significantly less stress than those who could not); Gloria Mark et al., *The Cost of Interrupted Work: More Speed and Stress*, in *Proceedings of the Twenty-Sixth Annual SIGCHI Conference on Human Factors in Computing*, at 107–110 (2008) (after only twenty minutes of interrupted performance, study participants reported significantly higher stress, frustration, workload, effort, and pressure) (available at http://portal.acm.org/citation.cfm?id=1357072).

175. Greg R. Oldham et al., *Physical Environments and Employee Reactions: Effects of Stimulus-Screening Skills and Job Complexity*, 34 Acad. Mgt. J. 920, 936 (1991).

176. Sandra L. Kirmeyer, *Coping with Competing Demands: Interruption and the Type A Pattern*, 73 J. Applied Psychol. 621, 622–628 (1988).

177. Mark et al., *supra* n. 174, at 109.

178. Oldham et al., *supra* n. 175, at 936.

179. Kirmeyer, *supra* n. 176, at 622.

180. Mark et al., *supra* n. 174, at 109.

181. *See e.g.* Oldham et al., *supra* n. 175, at 929–938.

types of music might be distracting compared to others.[182] Finally, the adverse effects of distractions will vary by personal motivation.[183] For example, a person who lacks motivation to perform a task may be more open to distraction than someone who is motivated to accomplish a goal.[184]

Third, distractions that adversely affect attention and concentration vary by the task interrupted. When the tasks are simple, distractions may even be welcome.[185] However, when distractions interrupt tasks that are complex or new, the effects of the distractions are more significant and adverse,[186] primarily because a person must rely more heavily on working memory in performing these tasks.[187]

Regardless of the reason for the distraction, distractions are costly. Recovering from an interruption takes fifteen to twenty-five minutes, even longer when the interrupted tasks require significant concentration.[188] If distractions in the workplace account for 1.5 to 2 hours of an eight-hour day's work,[189] that percentage could be much higher in a less structured work environment, like law school. Ouch.

Based on this information, managing distractions requires a two-pronged approach: limiting the number and type of distrac-

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182. *E.g.* Greg R. Oldham et al., *Listen While You Work? Quasi-Experimental Relations between Personal-Stereo Headset Use and Employee Work Responses*, 80 J. Applied Psychol. 547, 547–562 (1995).

183. Jett & George, *supra* n. 169, at 501.

184. *E.g.* Erik M. Altmann & J. Gregory Trafton, *Memory for Goals: An Activation-Based Model*, 26 Cognitive Sci. 39, 39–67 (2002).

185. *See e.g.* Zijlstra et al., *supra* n. 171, at 181 (when performing routine, simple tasks, study participants found interruptions to be a welcome break); Oldham et al., *supra* n. 182, at 561.

186. *See e.g.* Cheri Speier et al., *The Influence of Task Interruption on Individual Decision Making: An Information Overload Perspective*, 30 Dec. Scis. 337, 338–353 (1999).

187. Gillie & Broadbent, *supra* n. 170, at 249; *supra* nn. 14–28 and accompanying text (discussing working memory).

188. Gloria Mark et al., *CHI '05: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* 321, 324, 326 (2005) (on average, study participants took twenty-five minutes, twenty-six seconds to return to original task after interruption); Tom DeMarco & Timothy Lister, *Peopleware: Productive Projects and Teams* 69–70, 72 (2d ed., Dorset House 1999) (at least fifteen minutes to recover from telephone call); Thomas Jackson et al., *The Cost of Email Interruption*, 5 J. Sys. & Info. Tech. 81, 85 (2001) (average recovery time of sixty-four seconds from e-mail; frequent checking of email creates many interruptions: employees reacted to 85 percent of e-mails within two minutes of getting them).

189. Rini van Solingen et al., *Interrupts: Just a Minute Never Is*, IEEE Software 97, 99 (Sept./Oct. 1998) (reporting study results similar to other studies' results).

tions and limiting the impact of those distractions that are unavoidable or necessary.

Limiting the number and type of distractions. To limit the number and type of distractions, people must first know how they are being distracted and what distractions are particularly disruptive to them. Often people lack insight into how often they are being interrupted and how significant those interruptions are to them. Keeping a diary for a few days might provide valuable insight for developing an individualized plan.[190]

Even without an individualized plan, everyone will benefit by controlling the distractions created by technology in today's multimedia, 24/7-access world. The most common distractions are technological distractions including e-mail, telephone calls, and instant communications, such as instant-messaging, texting, and Skyping. These are also the most easily controlled distractions, because people can control if and when they respond to them. However, the reality differs from the possible.

For e-mail, workplace studies indicate that people handle e-mails as they arrive, attending to 70 percent of them in less than six seconds from the time of arrival.[191] On average, each e-mail involves two minutes, one minute to handle it and one minute of recovery time.[192] The number of e-mails someone receives will vary widely; for example, nearly half of workers in one survey received 50 or more e-mail messages per workday,[193] but my average is about 100 per day throughout the school year. The math is not encouraging. However, the time involved in handling e-mails can be cut dramatically by reading them less often. If each e-mail distraction involves one minute of recovery time, then checking e-mail once instead of each time an e-mail arrived would cut the time spent on e-mail in half. Even checking e-mail a few times a day, rather than with each e-mail, would save considerable time. The time can also be cut significantly by deleting and not reading unimportant messages.

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190. *See e.g.* Czerwinski et al., *supra* n. 116, at 2–3 (describing diary methodology).

191. Jackson et al., *supra* n. 188, at 85 (70 percent of e-mails reacted to within six seconds of arriving and 85 percent within two minutes of arriving).

192. *Id.* (average recovery time from reacting to an e-mail is sixty-four seconds); Thomas Jackson et al., *Reducing the Effect of Email Interruptions on Employees*, 23 Intl. J. Info. Mgt. 55, 61 (2003) (average of 60 seconds spent per e-mail).

193. *See* Jonathan B. Spira, *The High Cost of Interruptions*, KMWorld 1, 32 (Sept. 2005) (45 percent of study respondents received fifty or more e-mail messages per day).

In addition, eliminate any auditory or visual announcements of new e-mails. This eliminates two distractions, the dings and pop-ups, as well as the temptation to attend to individual e-mails.

For telephone calls, studies indicate that each call interrupts for the time of the call, plus at least fifteen minutes to recover.[194] The more complex the task that is interrupted, the more recovery time it takes to resume the task. In private practice, I learned quickly that a five-minute telephone call from a client was easily a thirty-minute interruption because of the time it took me to resume my prior task; I adjusted my billing practices to account for that. For telephone calls and other instant communications, the same strategies used to manage e-mail disruptions work here: turn off the prompts, whether auditory or visual, and attend to these communications after completing a task or when it is otherwise convenient.

In addition to managing the distractions of technology, most people[195] will benefit by controlling the distractions created by noise, the most disruptive stimuli. Irrelevant sounds in the environment disrupt concurrent mental activities.[196] A good way to avoid distraction from environmental noise is to mask the distracting noises with a more uniform noise.[197] Headsets provide a simple way to mask distracting environmental noises. In one experiment, employees listening to music while working increased their productivity substantially, not only because the music masked distracting environmental noises but also because it induced a relaxed state.[198]

Limiting the impact of unavoidable distractions. While many distractions can be avoided or managed, some distractions are unavoidable. When distractions occur, the goal is to make them as harmless as possible. The harmful impact of those distractions can be limited by improving the time it takes to recover from them. Simply resuming the prior task does not reflect the total

194. *E.g.* DeMarco & Lister, *supra* n. 188, at 62.

195. *E.g.* Wolfgang Ellermeier & Karin Zimmer, *Individual Differences in Susceptibility to the "Irrelevant Speech Effect,"* 102 J. Acoustical Soc. Am. 2191 (1997) (85 percent of study participants were disrupted by irrelevant sound).

196. Banbury et al., *supra* n. 168, at 13.

197. Wolfgang Ellermeier & Jürgen Hellbrück, *Is Level Irrelevant in "Irrelevant Speech"? Effects of Loudness, Signal-to-Noise Ratio, and Binaural Unmasking*, 24 J. Experimental Psychol.: Human Perception & Performance 1406, 1412–1413 (1998).

198. Oldham et al., *supra* n. 182, at 560.

time it takes to recover from an interruption, especially for complex work. Let me illustrate.

I have always imagined my complex cognitive activity to resemble the spinning plates entertainer who was on the Ed Sullivan show when I was a child. This man would spin a plate on the end of a stick and keep the plate spinning after placing the stick on his chin, then another stick on his forehead, nose, arms, hands, feet, and so on, until he had about twenty plates spinning around.[199] For me, each of my ideas is a spinning plate, and when I am interrupted, all of my plates crash to the floor. Resuming means starting the process over, one plate at a time, until all the plates are spinning again.[200] That assumes that all the plates (ideas) are available because the broken ones would be lost (forgotten).

In the real world, as opposed to my cognitive imagination, recovery will improve if the timing of the interruptions is controlled and if memory of the interrupted task is improved before attending to the interruption.

First, recovery from a distraction is easier when the distraction occurs at the beginning or the end of a task.[201] At the beginning of a task, the work has not yet begun. For a completed task, the task is more likely to be in long-term memory and, therefore, more easily reinstated by retrieval cues.[202] However, if the interruption occurs in the middle of the task, the recovery costs are much more significant.[203]

Second, recovery from a distraction is easier when the interrupted task is processed in a way that minimizes forgetting. The

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199. Now that my cognitive abilities are more fully developed, my sophisticated cognitive work better resembles these Chinese acrobats on *Peking Acrobats: Plate Spinning Opening*, http://www.youtube.com/watch?v=W6jk8Cu5sZg (video).

200. *Eric Brenn "Plate Spinning" on The Ed Sullivan Show*, http://www.youtube.com/watch?v=Zhoos1oY404 (Feb. 16, 1969) (video).

201. *E.g.* Christopher A. Monk et al., *Recovering from Interruptions: Implications for Driver Distraction Research*, 46 Human Factors 650, 650–662 (2004) (least costly interruptions were those that occurred between tasks or during a repetitive operation such as scrolling); Ericsson & Kintsch, *supra* n. 37, at 212.

202. Mark B. Edwards & Scott D. Gronlund, *Task Interruption and Its Effects on Memory*, 6 Memory 665, 682 (1998) (after interruptions, superior memory for completed tasks compared to unfinished tasks).

203. *See e.g.* Monk et al. *supra* n. 201, at 650–656 (the most costly interruptions were those in the middle of the task); Karin Zimmer et al., *The Role of Task Interference and Exposure Duration in Judging Noise Annoyance*, 311 J. Sound & Vibration 1039, 1044 (2008) (noise interruptions more significant when in middle of task).

greater that the interrupted task is encoded in memory or associated with information already in memory, the better it will be remembered and the faster it can be retrieved from memory when it is resumed.

One way to better remember information is to improve the way in which it is stored (encoded) into memory so that it will be easy to recall (retrieve) after an interruption. Information is stored in long-term memory by connecting new information to information that is already learned and by creating clumps of related information within a hierarchical structure, such as a template or a schema.[204] While important for creating and retrieving from memory, this system alone will not help resume an interrupted task quickly because of interference from other memories, dubbed mental clutter.[205] Instead, we want to direct attention to the interrupted task.[206] We can do that by encoding goals.[207]

Goals are a cognitive "to do" list.[208] An ultimate goal may consist of many subgoals and each subgoal may consist of further divisions and subdivisions, each of which needs to be completed to achieve the ultimate goal.[209] Each goal is encoded and then cued to retrieve the task.[210] This goal-activation process significantly increases the proportion of interrupted tasks resumed[211] and reduces the time lost in resuming them.[212]

To understand how the encoding and cuing process works with interruptions, envision an interruption as two events, an

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204. Cowan, *supra* n. 12, at 92–94; *see also* David E. Rumelhart, *Schemata: The Building Blocks of Cognition*, in *Theoretical Issues in Reading Comprehension: Perspectives from Cognitive Psychology, Linguistics, Artificial Intelligence, and Education*, at 33–58 (Rand J. Spiro et al. eds., Lawrence Erlbaum Assocs. Publishers 1980).

205. Altmann & Trafton, *supra* n. 184, at 45.

206. *Id.*

207. *Id.* at 44–49.

208. Styles, *supra* n. 45, at 236 (referred to as a "goal list"). A goal is "a mental representation of an intention to accomplish a task, achieve some specific state of the world, or take some mental or physical action . . . ." Altmann & Trafton, *supra* n. 184, at 39.

209. *Id.* at 41.

210. *Id.* at 61.

211. Rahul M. Dodhia & Robert K. Dismukes, *Interruptions Create Prospective Memory Tasks*, 23 Applied Cognitive Psychol. 73, 83 (2009).

212. *Id.* at 79–80, 84 (reminder cues dramatically increased performance, reducing lag after interruption from 8 to 12 seconds to 2.5 seconds); Richard L. Marsh et al., *Activation of Completed, Uncompleted, and Partially Completed Intentions*, 24 J. Experimental Psychol.: Learning, Memory & Cognition 350, 359 (1998) (self-initiated cuing heightens goal activation so that goals come to mind more quickly).

alert and the interruption itself.[213] For example, an e-mail interruption involves an alert, such as a sound or pop-up, that the e-mail has arrived, followed by the interruption of attending to the e-mail. Similarly, for telephone calls, the alert is the sound or vibration of the telephone ringing, followed by the interruption itself in taking the call.[214]

To lower the cost of an interruption, you use the time between the alert and the onset of the interruption, called the interruption lag, to prepare for the interruption by prospectively encoding cues that will help to retrieve the suspended task later.[215] To illustrate, assume you are reading a judicial opinion that concerns claim preclusion. As you read, you want to prospectively cue what you are reading by talking your way through the material, for example, by asking whether the opinion provides a test, whether it directly defines each (or any) part of the test, and whether it indirectly defines each (or any) part of the test by inference from its facts. If you were interrupted while you were encoding this information, you could prospectively cue your goal of defining claim preclusion or your sub-goal of defining privity after the interruption alert but before the interruption itself. Then, you would use that cue to resume the interrupted task. Voila! You have created your own version of instant replay.

B. Divide and Conquer

Remember the example of the spinning plates? One way to keep all of the plates from dropping to the floor when interrupted is not to have so many plates in the air. Remember how multi-tasking is slower and less accurate? One way to work faster, to be more accurate, and to remember more is to do one task at a time. Accomplishing this requires deconstructing each task into its component parts so you can do one part at a time, and then preserving your thinking so the ideas (plates) are not spinning in air and cannot fall from memory.

Deconstructing tasks. Dividing tasks into their component parts avoids the pitfalls of multi-tasking by allowing individuals to do one cognitive task at a time. Tasks can be divided at a ma-

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213. Altmann & Trafton, *supra* n. 184, at 65.

214. *Id.*

215. *Id.* at 65–66; Hodgetts & Jones, *supra* n. 172, at 823, 825 (participants resumed tasks more quickly by prospectively encoding during the interruption lag).

cro-level, which helps to avoid cognitive overload that leads to stress and additional interruptions. Tasks can also be divided at the micro-level, so that each cognitive task is separately identified and performed.

At the macro-level, we can avoid the pitfalls of multi-tasking by deconstructing larger tasks into smaller tasks. Consider, for example, the writing of a legal memorandum. If the ultimate task were attempted, chances are high that the writer would feel extremely stressed. The reason is that the task is too big, resulting in a cognitive load that is not manageable.[216] When a task is too big to be manageable, attention will wander to things that are easier to do,[217] like checking to see whose car just pulled up (distraction), answering e-mails (more distractions), or talking on the phone (even more distractions).

To move forward, the writer needs to divide the task into manageable chunks. Once the writer knows the analytical framework, the work can be separated into its individual points and then completed one point at a time. The rest of the memo can be put on hold until all the individual points are developed. Then, the writer can glue them together with thesis paragraphs, transitions, and thesis sentences.

At the micro-level, we can avoid the pitfalls of multi-tasking by deconstructing the cognitive tasks involved in legal analysis. This deconstruction may not always be easy, but the process is essential. Consider the simple and widely-used heuristic of IRAC: Issue, Rule, Application, and Conclusion. The heuristic may be simple, but the cognitive tasks involved are not. In fact, IRAC illustrates well the pitfalls of ambiguity and the multi-tasking that results from that.

Let's start with Issue. By the time law students learn IRAC, they have already learned how to brief a case. They should know that the judicial opinions they read involve an issue, which would appear in the Issue portion of the case brief, and that a test likely exists for that issue. For example, the issue might involve liability under a dog bite statute for which the test requires establish-

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216. Unsworth et al., *supra* n. 28, at 636.

217. *See e.g.* Jennifer C. McVay & Michael J. Kane, *Conducting the Train of Thought: Working Memory Capacity, Goal Neglect, and Mind Wandering in an Executive-Control Task*, 35 J. Experimental Psychol.: Learning, Memory & Cognition 196 (2009) (when working memory loses the capacity to attend to learning goals as a way of sorting through ongoing stimuli, the mind is more likely to wander).

ing an owner, a dog, a bite, lawful presence on the property, and damages. If liability under a dog bite statute is the issue, then IRAC would involve analyzing all five elements of the issue at once. This cognitive multi-tasking would create a mess because each of the elements for liability requires separate analysis.

Now consider Rule. Continuing with the example in the last paragraph, the test for liability would likely appear in the Rule portion of the case brief. If the Rule portion of the case brief had the same meaning as the Rule portion of IRAC, then again, someone would be analyzing five elements at once, rather than each separately. Instead, Rule in IRAC means something different: it refers to rules of interpretation of the point denoted as the Issue. However, these rules serve more than one analytical purpose, such as establishing policy, direct definitions derived from general statements, or indirect definitions derived from the facts of the case. By not separating the different analytical functions of the information, the writer is again multi-tasking.

Similar problems occur with the next part of IRAC, Application. This step also involves multiple cognitive tasks: identifying the relevant facts from the legal problem, analogizing those facts to the facts of the cases, and distinguishing them from the facts of the cases.

For some, the legal analysis represented by IRAC involves a process that happens intuitively and magically. For most, it does not. Instead, mastery of legal analysis occurs only after the process is deconstructed into its individual cognitive tasks, the elimination of detrimental multi-tasking, and the analytical purpose (goals) of each cognitive task are made apparent. Resulting in the facilitation of memory and recall after attention is interrupted.[218] Without deconstruction and practice, expect frustra-

218. I have deconstructed IRAC into RAFADC for a neutral analysis: Rule (the specific legal point to be analyzed), Authorities (that define the Rule either directly, through explanation, or indirectly, through their facts), Facts (from the legal problem), Analogies/Distinctions (comparing problem facts with case facts), and Conclusion (how a court will likely rule). For additional discussion of RAFADC, see M. H. Sam Jacobson, *Legal Analysis & Communication* 237–245 (Author House 2009) [hereinafter Jacobson, *Legal Analysis*]; M. H. Sam Jacobson, *Learning Styles and Lawyering: Using Learning Theory to Organize Thinking and Writing*, 2 J. ALWD 27, 66–68 (2004) [hereinafter Jacobson, *Learning Styles*]. For a persuasive analysis, I use CRAFADC: Conclusion (statement of your argument), Rule, Authorities, Analogies (to favorable authorities)/Distinctions (from unfavorable authorities), and Conclusion (how the court should rule). Jacobson, *Learning Styles*, *supra* n. 218, at 67–68.

tion;[219] which also impedes attention, and loss of motivation to recover the attention needed to learn effectively and thoroughly.

Preserving thoughts. In addition to deconstructing tasks, preserving analytical thinking for the tasks completed is important so that work done before an interruption is not lost. While encoding and cuing will aid recovery from an interruption, that process is insufficient for memorializing all the complexities of a sophisticated legal analysis or for recovering from longer interruptions. Memories decay over time,[220] and, in law, interruptions can be weeks or even months long.

Course outlining is a good example of a tool that preserves analytical thinking over time. For written documents involving legal research and analysis, like a legal memorandum or appellate brief, T-charts are a good tool.[221] Preserving thinking visually may also be effective. For example, studies of master chess players found that these players remembered games by preserving a picture of the chessboard and its pieces; this way they could preserve information about strategy, not just the pieces.[222]

C. Manage Stress

In addition to managing distractions and dividing tasks into manageable cognitive tasks, attention will improve by managing stress. The leading sources of stress in law school involve legal pedagogy and the workload.

Pedagogically, law school is stressful because students have little context for what they are doing in their casebook courses, either in the classroom or from their materials. The hallmark of the law school classroom is the quasi-Socratic dialogue. Many students become so stressed in this situation that they absorb nothing except the sound of their own internal voice chanting,

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219. *See* Sheldon Cohen, *Aftereffects of Stress on Human Performance and Social Behavior: A Review of Research and Theory*, 88 Psychol. Bull. 82, 84 (1980) (reviewing studies that found less tolerance for frustration when interrupted).

220. Cowan, *supra* n. 12, at 92; Cowan & AuBuchon, *supra* n. 28, at 230, 234. The question of whether the decay is due solely to the passage of time or to interference is an unresolved issue. Alan D. Baddeley, *Is Working Memory Still Working?* 7 Eur. Psychol. 85, 87 (2002).

221. Jacobson, *Legal Analysis*, *supra* n. 218, at 177–178, 225–228; M. H. Sam Jacobson, *Providing Academic Support without an Academic Support Program*, 3 Leg. Writing 241, 246–249 (1997).

222. Gobet & Simon, *supra* n. 39, at 1–40.

"please don't call on me, please don't call on me." In addition, neither the Socratic dialogue nor the casebook materials provides an overview. Instead, students must create the overview, or analytical framework, on their own.

This leads to the second source of stress in law school, the workload. The workload is unrelenting. Class preparation involves two to three hours for each class and most students have fifteen hours of class per week. Add research, papers, and outlining on to that and the weekly tally reaches sixty to seventy hours. The tally goes even higher if we consider optional study efforts such as study groups, library research workshops, chats with professors or student assistants, and exam preparation activities. It's no wonder that law students are always tired.

Since unchecked stress adversely affects attention and memory, not to mention health and relationships, managing stress is important. The stress involved with the quasi-Socratic classroom can be reduced through preparation, including collaborative discussions with others. An overview can be created from the course syllabus, the casebook's table of contents, supplemental materials, such as a hornbook or treatise, and from conversations with professors, so that the details covered in class and in the casebook make more sense. Topics can be divided up so as to avoid brain overload.

In addition, stress can be managed through good time management practices. Everyone has the same twenty-four hours of time. However, not everyone uses their time the same. One year, I had a student who was the single parent of three young children. She was an excellent student who was always prepared for her classes, kept current on outlines for every class, and received top grades on every assignment. At the same time, another student of equal ability but with no family responsibilities often complained that he did not have sufficient time to complete all of the readings for class and he had not yet started on his course outlines.

What accounts for the difference? Most likely the answer lies, in part, in how wisely each of these students was using his or her time. When I asked the single parent how she managed to get everything done, given all of the competing demands for her time, she told me that she was on a time budget. She allocated some time for everything she needed to do, including spending time with her children. She concentrated on making the best use of the time budgeted, so that she wouldn't have to borrow time from somewhere else in the budget; time that she probably would not be able to pay back. For her, time was like money: without a strict budget, it would disappear like coins through a hole in a pocket.

Developing a time budget requires determining what time is needed to do all that must be done, determining how time is actually used, eliminating time-wasters, setting priorities among the remaining tasks, and actively managing how time is allocated.[223] For example, eliminating two hours a day spent on distractions provides an extra day each week to accomplish something greater, whether that means completing coursework or having a social break with family or friends. If noise distracts, wear earplugs or mask the distracting noises with background music or white noise. If movement or sights distract, study in a quiet corner of the library with your back to the room, in a study room, in an empty classroom, or away from a window (better to know the law of negligence than the acorn-stashing habits of the local squirrels). If people distract, manage telephone calls by turning off your phone and retrieving messages later; limit when and how often you check for e-mail messages; and manage in-person interruptions by studying in a quiet corner of the library or by hanging a "do not disturb" sign on a chair, carrel, or door.

D. Get Sleep

Finally, attention will improve by getting sleep. Not only does the lack of sleep before or after learning impair cognitive functioning, but the effects of lack of sleep can be long-lasting. When sleep was chronically reduced over seven days, three days of recovery sleep (eight hours each night) did not restore subjects to their baseline performance before the sleep restriction.[224]

When a full night's sleep is not possible, a nap can work wonders,[225] even if it is just a ten-minute power nap.[226] In a recent

223. For more information about time management, including tools for evaluating time needs, for budgeting time, and for prioritizing, see Jacobson, *Legal Analysis*, *supra* n. 218, at 35, 37.

224. Gregory Belenky et al., *Patterns of Performance Degradation and Restoration During Sleep Restriction and Subsequent Recover: A Sleep Dose-Response Study*, 12 J. Sleep Research 1, 10 (2003) (brain adapts to chronic lack of sleep, making it more difficult to recover).

225. *E.g.* Sara C. Mednick et al., *The Restorative Effect of Naps on Perceptual Deteriora-*

study, participants who took a 90-minute nap in the middle of the afternoon did markedly better on subsequent learning exercises than those who had no nap.[227] While caffeine can provide a temporary boost,[228] a nap will do more: it will help to improve cognitive functioning. Maybe we did learn all we needed to know in kindergarten.

Whether managing distractions, minimizing stress, or maximizing sleep, the bottom line is that we must attend to attending. Minds have always wandered, but our attention has never been more challenged than in this multi-media, high-tech world. Media and technology must be our tools, not our masters. Without learning to attend to the things that matter, we will be fatally distracted by every beep, flash, and pop-up, and therefore, be unable to perform the sophisticated cognitive work required of the study and practice of law. If the study and practice of law require attention, then attention needs developing just like any other skill. Developing attention requires practice, self-reflection, and diligence. Developing attentional skills also requires listening. If professors find their students are not attending to the class material, but instead are engaged in computer games, e-mail, instant messaging, and other technological distractions, professors need to ask why. Then, professors need to listen to their self-analysis and their students. The *why* may be that students are so used to being distracted that they have not yet learned how to pay attention. If so, the professor has a teachable moment. The *why* might also be that the professor is teaching in a manner that does not engage the students. That too is a teachable moment. In the first instance, the *why* concerns all the attentional issues raised in this Article. In the second instance, the *why* concerns the age-old problem of mind-wandering, where the use of the laptop in class

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tion, 5 Nat. Neuroscience 677, 677–680 (2002).

226. *E.g.* Amber J. Tietzel & Leon C. Lack, *The Recuperative Value of Brief and Ultrabrief Naps on Alertness and Cognitive Performance*, 11 J. Sleep Research 213, 213–218 (2002).

227. Yasmin Anwar, *An Afternoon Nap Markedly Boosts the Brain's Learning Capacity*, Press Release (Feb. 22, 2010 (available at http://berkeley.edu/news/media/releases/2010/02/22_naps_boost_learning_capacity.shtml).

228. *E.g.* Nancy J. Wesensten et al., *Performance and Alertness Effects of Caffeine, Dextroamphetamine, and Modafinil During Sleep Deprivation*, 14 J. Sleep Research 255, 255–265 (2005) (caffeine and other stimulants provided a two- to four-hour boost but no clear benefit with executive functioning).

is no different from the doodling of pre-tech times.[229] Similarly, if students find themselves unable to attend to the material, they also need to ask why and then to listen to their self-analysis and the assessments of others. As mentioned for professors, the *why* could be boredom or it could be an acculturation, if not addiction, to distraction. The *why* also could be that students are avoiding the cognitive heavy lifting required of law school by diverting their attention to things that are fast and easy. While the solutions to each might be different, the problem is the same: the failure to attend to that which needs attending.

V. CONCLUSION

To summarize, hang on just a minute.—*I'm coming, I'm coming.*—The dog needed to go out. To summarize,—*Now where did I put those notes? I'll just check this pile. Not there. Maybe this one? Oh, the phone. Dental appointment tomorrow.*—Where was I? Oh yes, the summary. Well,—j*ust a sec, this e-mail is important. Yes, the appellate brief drafts are due in the morning; sorry, no extensions.*—Now, again: To summarize,—*Aqua, honey, no barking, okay?*—Our brains can only handle so much.—o*kay, need to edit that. Let me change this to*—our brains are easily distracted when—w*hat do you need? No, I mailed that last week.*—I'm back. Let me think. Oh, yes: To summarize,—*Leif, no treat. Let me type. No treat. I mean it. No. Well . . . okay.*—Shoot. I can't think! Okay, how about this: To summarize, I had a lot more to say but I cannot find the articles I was looking for, I have to prepare for my classes tomorrow, my students need answers to their questions concerning their assignment, my husband would like some attention, and of course, the dogs could use a belly-rub or two. I think I'll take a nap.

229. *See e.g.* Jackie Andrade, *What Does Doodling Do?* 24 Applied Cognitive Psychol. 100 (2010). Doodling aids concentration: study participants who doodled when listening to boring information recalled 29 percent more information than those who did not, perhaps because the doodling limited daydreaming. *Id.* at 102–104.