

NOTES

CHAPTER ONE: MOTIVATION

11 Ochsner Clinic in New Orleans The facility is now known as the Ochsner Medical Center.

12 *Archives of Neurology* Richard L. Strub, “Frontal Lobe Syndrome in a Patient with Bilateral Globus Pallidus Lesions,” *Archives of Neurology* 46, no. 9 (1989): 1024–27.

13 “to get up in the morning” Michel Habib, “Athymhormia and Disorders of Motivation in Basal Ganglia Disease,” *The Journal of Neuropsychiatry and Clinical Neurosciences* 16, no. 4 (2004): 509–24.

14 movement and emotion emerge This is how Mauricio Delgado, a neurologist at Rutgers, describes the striatum: “The striatum is the input unit of a larger structure, the basal ganglia. I say the input unit because it receives connections from different brain areas which subserve distinct brain functions—putting the striatum in a prime position to influence behavior. The basal ganglia and in turn the striatum are very important in facets of behavior related to motor (deficits in this structure is common in Parkinson’s patients), cognitive and motivation. One line of thinking regarding the striatum and its role in motivation and more specifically reward processing is that it is involved

in learning about rewards and using that information to make decisions that help guide behavior, updating the brain along the way whether a reward is better or worse than prior expectations.”

14 regulating our moods Oury Monchi et al., “Functional Role of the Basal Ganglia in the Planning and Execution of Actions,” *Annals of Neurology* 59, no.2 (2006): 257–64; Edmund T. Rolls, “Neurophysiology and Cognitive Functions of the Striatum,” *Revue Neurologique* 150 (1994): 648–60; Patricia S. Goldman-Rakic, “Regional, Cellular, and Subcellular Variations in the Distribution of D₁ and D₅ Dopamine Receptors in Primate Brain,” *The Journal of Neuroscience* 15, no. 12 (1995): 7821–36; Bradley Voytek and Robert T. Knight, “Prefrontal Cortex and Basal Ganglia Contributions to Working Memory,” *Proceedings of the National Academy of Sciences of the United States of America* 107, no. 42 (2010): 18167–72.

14 motivation had disappeared For my understanding of how brain injuries influence behavior, I am indebted to Julien Bogousslavsky and Jeffrey L. Cummings, *Behavior and Mood Disorders in Focal Brain Lesions* (Cambridge: Cambridge University Press, 2000).

14 striatal injuries Parkinson’s frequently involves injuries to the substantia nigra, a region that communicates with the striatum. R. K. B. Pearce et al., “Dopamine Uptake Sites and Dopamine Receptors in Parkinson’s Disease and Schizophrenia,” *European Neurology* 30, supplement 1 (1990): 9–14; Philip Seeman et al., “Low Density of Dopamine D4 Receptors in Parkinson’s, Schizophrenia, and Control Brain Striatum,” *Synapse* 14, no. 4 (1993): 247–53; Philip Seeman et al., “Human Brain D₁ and D₂ Dopamine Receptors in Schizophrenia, Alzheimer’s, Parkinson’s, and Huntington’s Diseases,” *Neuropsychopharmacology* 1, no. 1 (1987): 5–15.

16 see a computer screen Mauricio R. Delgado et al., “Tracking the Hemodynamic Responses to Reward and Punishment in the Striatum,” *Journal of Neurophysiology* 84, no. 6 (2000): 3072–77.

16 expectation and excitement In some versions of this experiment, participants were rewarded for guessing right and penalized for guessing wrong with small financial winnings. In response to a fact-checking email, Delgado provided further context for the experiments: “The goal of that initial study was to investigate the human reward circuit. That is, we know from animal research that certain brain regions were important for processing information about reward. We knew less about how that translated to the human brain and how it translated to more common human rewards such as money, which had implications to behavioral addictions such as pathological gambling. Thus, with the guessing game, our initial goal was to compare what happened in the brain when participants received a monetary reward (for a correct guess)

and a monetary punishment or loss (for an incorrect guess). The pattern we observe is very characteristic of a reward response. We see activity in the striatum (both dorsal and ventral parts). The response is an initial increase at the beginning of the trial when the question mark appears and they make a guess. We reasoned that it reflected anticipation of a potential reward. Other work using this task (see Delgado et al. 2004, Leotti and Delgado 2011) support that as does the work by Brian Knutson (2001). They don't know yet if their guess is correct and lead to a reward or incorrect and lead to a loss. So the increase is common for both types of trials. Once the outcome is revealed, we see an interesting pattern where the striatum differentiates between a positive and negative outcome—a gain or a loss. It is increased for a gain and decreased response for a loss. One interpretation of this finding was that the striatum was coding for the value of an outcome. A more global interpretation that takes into account all the neural inputs and outputs of this structure is that it takes in information about the outcome/reward, it matches up with the expectations (e.g., was the outcome better or worse than expected—if you guessed high was the card high, or did you make the wrong guess) and allows for the system to update and inform the next decision (e.g., maybe try low next time).”

17 computer guessed for them In response to a fact-checking email, Delgado expanded his comments: “There were three experiments related to this. . . . [In] the first one (Tricomi et al. 2004), they were told that they would see two circles. Upon seeing the yellow circle for example they would guess as before whether the correct answer was button 1 or 2 and were told that a correct response would yield a monetary reward. If they saw a blue circle they were told to press a button (motor control) but that the button had nothing to do with the reward, it was random. In truth, the reward was random in both cases, but if the subjects believed that their button press mattered, as in the yellow circle condition, then they engaged the striatum response much more than if it was a non-contingent reward. This experiment showed that if participants felt they were in control that the reward response was more prominent. The second experiment took this back to the card guessing game (Delgado et al. 2005) and this time added a cue, like a circle, before each trial that predicted if the card would be high or low. Participants had to learn via trial and error what the cue predicted. This experiment showed that the signal in the striatum was related to learning about the reward, rather than just purely processing the reward value. . . . In [the] third experiment (Leotti and Delgado 2005) we presented subjects with let's say two cues—a square and a circle. When they saw the square, they knew they would be faced with a 50/50 choice (a guess of sorts) and if they chose correctly, they would get a reward (no losses in this experiment, either a reward or no reward). In this condition, they felt in ‘control.’ Much like my participant who felt they could ‘beat the game.’ The

other condition was the no-choice condition. Here, they saw a circle and were faced with the same choice. Except this time the computer picked for them. And if the computer was right they got a reward. So in both conditions one could get a reward (or no reward). But the key difference was that participants either had a choice or the computer chose. Interestingly, people preferred the choice condition, even though such condition required more effort (the actual choice) and led to the same amount of rewards. We also saw that the striatum activity was present to the square (compared to the circle). That is, when participants found out they had a choice, we saw activity in this reward area of the brain, suggesting that the mere opportunity for exerting one's choice may be rewarding in and of itself."

18 believed they were in control For more on Delgado's work, I recommend Elizabeth M. Tricomi, Mauricio R. Delgado, and Julie A. Fiez, "Modulation of Caudate Activity by Action Contingency," *Neuron* 41, no. 2 (2004): 281–92; Mauricio R. Delgado, M. Meredith Gillis, and Elizabeth A. Phelps, "Regulating the Expectation of Reward via Cognitive Strategies," *Nature Neuroscience* 11, no. 8 (2008): 880–81; Laura N. Martin and Mauricio R. Delgado, "The Influence of Emotion Regulation on Decision-Making Under Risk," *Journal of Cognitive Neuroscience* 23, no. 9 (2011): 2569–81; Lauren A. Leotti and Mauricio R. Delgado, "The Value of Exercising Control over Monetary Gains and Losses," *Psychological Science* 25, no. 2 (2014): 596–604; Lauren A. Leotti and Mauricio R. Delgado, "The Inherent Reward of Choice," *Psychological Science* 22 (2011): 1310–18.

18 reported to a boss "Self-Employment in the United States," *Monthly Labor Review*, U.S. Bureau of Labor Statistics, September 2010, <http://www.bls.gov/opub/mlr/2010/09/art2full.pdf>.

18 otherwise transitory positions A 2006 study by the Government Accountability Office found that 31 percent of workers were in temporary positions.

18 allocate their energy Michelle Conlin et al., "The Disposable Worker," *Bloomberg Businessweek*, January 7, 2010.

19 "The need for control" Lauren A. Leotti, Sheena S. Iyengar, and Kevin N. Ochsner, "Born to Choose: The Origins and Value of the Need for Control," *Trends in Cognitive Sciences* 14, no. 10 (2010): 457–63.

19 setbacks faster Diana I. Cordova and Mark R. Lepper, "Intrinsic Motivation and the Process of Learning: Beneficial Effects of Contextualization, Personalization, and Choice," *Journal of Educational Psychology* 88, no. 4 (1996): 715; Judith Rodin and Ellen J. Langer, "Long-Term Effects of a Control-Relevant Intervention with the Institutionalized Aged," *Journal of Personality and Social Psychology* 35, no. 12 (1977): 897; Rebecca A. Henry and Janet A. Sniezek, "Situational Factors Affecting Judgments of Future Performance," *Organiza-*

tional Behavior and Human Decision Processes 54, no. 1 (1993): 104–32; Romin W. Tafarodi, Alan B. Milne, and Alyson J. Smith. “The Confidence of Choice: Evidence for an Augmentation Effect on Self-Perceived Performance,” *Personality and Social Psychology Bulletin* 25, no. 11 (1999): 1405–16; Jack W. Brehm, “Postdecision Changes in the Desirability of Alternatives,” *The Journal of Abnormal and Social Psychology* 52, no. 3 (1956): 384; Leon Festinger, *A Theory of Cognitive Dissonance*, vol. 2 (Stanford, Calif.: Stanford University Press, 1962); Daryl J. Bem, “An Experimental Analysis of Self-Persuasion,” *Journal of Experimental Social Psychology* 1, no. 3 (1965): 199–218; Louisa C. Egan, Laurie R. Santos, and Paul Bloom, “The Origins of Cognitive Dissonance: Evidence from Children and Monkeys,” *Psychological Science* 18, no. 11 (2007): 978–83.

19 longer than their peers E. J. Langer and J. Rodin, “The Effects of Choice and Enhanced Personal Responsibility for the Aged: A Field Experiment in an Institutional Setting,” *Journal of Personality and Social Psychology* 34, no. 2 (1976): 191–98.

19 food into their mouths Margaret W. Sullivan and Michael Lewis, “Contextual Determinants of Anger and Other Negative Expressions in Young Infants,” *Developmental Psychology* 39, no. 4 (2003): 693.

19 freedom to choose Leotti and Delgado, “Inherent Reward of Choice.”

19 Psychological Science in 2011 Ibid.

20 autonomy and self-determination Erika A. Patall, Harris Cooper, and Jorgianne Civey Robinson, “The Effects of Choice on Intrinsic Motivation and Related Outcomes: A Meta-Analysis of Research Findings,” *Psychological Bulletin* 134, no. 2 (2008): 270; Deborah J. Stipek and John R. Weisz, “Perceived Personal Control and Academic Achievement,” *Review of Educational Research* 51, no. 1 (1981): 101–37; Steven W. Abrahams, “Goal-Setting and Intrinsic Motivation: The Effects of Choice and Performance Frame-of-Reference” (PhD diss., Columbia University, 1989); Teresa M. Amabile and Judith Gitomer, “Children’s Artistic Creativity Effects of Choice in Task Materials,” *Personality and Social Psychology Bulletin* 10, no. 2 (1984): 209–15; D’Arcy A. Becker, “The Effects of Choice on Auditors’ Intrinsic Motivation and Performance,” *Behavioral Research in Accounting* 9 (1997); Dan Stuart Cohen, “The Effects of Task Choice, Monetary, and Verbal Reward on Intrinsic Motivation: A Closer Look at Deci’s Cognitive Evaluation Theory” (PhD diss., Ohio State University, 1974); Diana I. Cordova and Mark R. Lepper, “Intrinsic Motivation and the Process of Learning: Beneficial Effects of Contextualization, Personalization, and Choice,” *Journal of Educational Psychology* 88, no. 4 (1996): 715; Hsiao d’Ailly, “The Role of Choice in Children’s Learning: A Distinctive Cultural and Gender Difference in Efficacy, Interest, and Effort,” *Canadian Journal of Behavioural Science* 36, no. 1 (2004): 17; Edward L. Deci, *The Psychology of Self-*

Determination (New York: Free Press, 1980); J. B. Detweiler, R. J. Mendoza, and M. R. Lepper, "Perceived Versus Actual Choice: High Perceived Choice Enhances Children's Task Engagement," 8th Annual Meeting of the American Psychological Society, San Francisco, 1996; John J. M. Dwyer, "Effect of Perceived Choice of Music on Exercise Intrinsic Motivation," *Health Values: The Journal of Health Behavior, Education and Promotion* 19, no. 2 (1995): 18–26; Gregory G. Feehan and Michael E. Enzle, "Subjective Control over Rewards: Effects of Perceived Choice of Reward Schedule on Intrinsic Motivation and Behavior Maintenance," *Perceptual and Motor Skills* 72, no. 3 (1991): 995–1006; Terri Flowerday, Gregory Schraw, and Joseph Stevens, "The Role of Choice and Interest in Reader Engagement," *The Journal of Experimental Education* 72, no. 2 (2004): 93–114; Claus A. Hallschmidt, "Intrinsic Motivation: The Effects of Task Choice, Reward Magnitude and Reward Choice" (PhD diss., University of Alberta, 1977); Sheena S. Iyengar and Mark R. Lepper, "Rethinking the Value of Choice: A Cultural Perspective on Intrinsic Motivation," *Journal of Personality and Social Psychology* 76, no. 3 (1999): 349; Keven A. Prusak et al., "The Effects of Choice on the Motivation of Adolescent Girls in Physical Education," *Journal of Teaching in Physical Education* 23, no. 1 (2004): 19–29; Johnmarshall Reeve, Glen Nix, and Diane Hamm, "Testing Models of the Experience of Self-Determination in Intrinsic Motivation and the Conundrum of Choice," *Journal of Educational Psychology* 95, no. 2 (2003): 375; Romina W. Tafarodi, Alan B. Milne, and Alyson J. Smith, "The Confidence of Choice: Evidence for an Augmentation Effect on Self-Perceived Performance," *Personality and Social Psychology Bulletin* 25, no. 11 (1999): 1405–16; Miron Zuckerman et al., "On the Importance of Self-Determination for Intrinsically-Motivated Behavior," *Personality and Social Psychology Bulletin* 4, no. 3 (1978): 443–46.

22 on a new life In response to a fact-checking email, Colonel Robert Gruny, commanding officer, Recruit Training Regiment, MCRD San Diego, wrote: "From the moment the recruits first step off of the bus onto the yellow footprints they are exposed to a degree of collective shock and stress that is designed to emphasize teamwork [and] obedience to orders and to reinforce the fact that they are entering into a new phase of their life in which selfless dedication to each other is coveted far more than individual achievement. In addition to the medical processing and haircuts reference above night one includes being checked for contraband, the very practical tasks of administrative processing and clothing issue, and making an initial call home to inform their parents or other designated individual that they have arrived safely at the Recruit Depot."

22 "their whole life" In response to a fact-checking email, Colonel Gruny wrote regarding Krulak's reforms: "The series of reforms were centered on the

institution of values based training into recruit training and the introduction of the Crucible. While self-motivation and leadership were certainly enhanced by these reforms they also focused on teamwork, followership, and core values development (honor, courage, and commitment). Gen. Krulak sought to embed a training philosophy that resulted in our Marines making the right kind of values based decisions, in combat or in peacetime.”

23 best course of action For my understanding of USMC boot camp, I am indebted to General Krulak and Major Neil A. Ruggiero, director of public affairs at MCRD San Diego/Western Recruiting Region. Additionally, I am indebted to Thomas E. Ricks and his book *Making the Corps* (New York: Scribner, 2007). I have also drawn upon Vincent Martino, Jason A. Santamaria, and Eric K. Clemons, *The Marine Corps Way: Using Maneuver Warfare to Lead a Winning Organization* (New York: McGraw-Hill, 2005); James Woulfe, *Into the Crucible: Making Marines for the 21st Century* (Novato, Calif.: Presidio Press, 2009); Jon R. Katzenbach, *Peak Performance: Aligning the Hearts and Minds of Your Employees* (Boston: Harvard Business Press, 2000); Megan M. Thompson and Donald R. McCreary, *Enhancing Mental Readiness in Military Personnel* (Toronto: Defense Research and Development, 2006); Ross R. Vickers Jr. and Terry L. Conway, “Changes in Perceived Locus of Control During Basic Training” (1984); Raymond W. Novaco et al., *Psychological and Organizational Factors Related to Attrition and Performance in Marine Corps Recruit Training*, no. AR-001 (Seattle: Washington University Department of Psychology, 1979); Thomas M. Cook, Raymond W. Novaco, and Irwin G. Sarason, “Military Recruit Training as an Environmental Context Affecting Expectancies for Control of Reinforcement,” *Cognitive Therapy and Research* 6, no. 4 (1982): 409–27.

23 since the 1950s Julian B. Rotter, “Generalized Expectancies for Internal Versus External Control of Reinforcement,” *Psychological Monographs: General and Applied* 80, no. 1 (1966): 1; Timothy A. Judge et al., “Are Measures of Self-Esteem, Neuroticism, Locus of Control, and Generalized Self-Efficacy Indicators of a Common Core Construct?” *Journal of Personality and Social Psychology* 83, no. 3 (2002): 693; Herbert M. Lefcourt, *Locus of Control: Current Trends in Theory and Research* (Hillsdale, N.J.: L. Erlbaum, 1982); Cassandra Bolyard Whyte, “High-Risk College Freshmen and Locus of Control,” *Humanist Educator* 16, no. 1 (1977): 2–5; Angela Roddenberry and Kimberly Renk, “Locus of Control and Self-Efficacy: Potential Mediators of Stress, Illness, and Utilization of Health Services in College Students,” *Child Psychiatry and Human Development* 41, no. 4 (2010): 353–70; Victor A. Benassi, Paul D. Sweeney, and Charles L. Dufour, “Is There a Relation Between Locus of Control Orientation and Depression?” *Journal of Abnormal Psychology* 97, no. 3 (1988): 357.

23 “Internal locus of control” Alexandra Stocks, Kurt A. April, and Nandani Lynton, “Locus of Control and Subjective Well-Being: A Cross-Cultural Study,” *Problems and Perspectives in Management* 10, no. 1 (2012): 17–25.

24 difficult puzzles Claudia M. Mueller and Carol S. Dweck, “Praise for Intelligence Can Undermine Children’s Motivation and Performance,” *Journal of Personality and Social Psychology* 75, no 1 (1998): 33.

25 that study, told me The specific experiment conducted by Professor Dweck described in this chapter was focused on her implicit theory of intelligence rather than locus of control. In an interview, she drew comparisons between that work and its implications for understanding locus of control.

25 “in control of themselves” For more on Professor Dweck’s fascinating research, I recommend Carol S. Dweck and Ellen L. Leggett, “A Social-Cognitive Approach to Motivation and Personality,” *Psychological Review* 95, no. 2 (1988): 256; Carol S. Dweck, “Motivational Processes Affecting Learning,” *American Psychologist* 41, no 10 (1986): 1040; Carol S. Dweck, Chi-yue Chiu, and Ying-yi Hong, “Implicit Theories and Their Role in Judgments and Reactions: A Word from Two Perspectives,” *Psychological Inquiry* 6, no. 4 (1995): 267–85; Carol Dweck, *Mindset: The New Psychology of Success* (New York: Random House, 2006).

26 ketchup bottles In response to a fact-checking email, Colonel Jim Gruny, commanding officer, Recruit Training Regiment, MCRD San Diego, wrote that “this sounds like a scenario that may have been accurate at the time the Marine describing it experienced recruit training. Recruits no longer clean mess halls. That said, this scenario does accurately illustrate the methods used by our drill instructors and the lessons they seek to impart on our recruits.”

27 obstacle courses In response to a fact-checking email, a spokesman for the USMC stressed that recruits are under supervision during the entirety of the Crucible, and that the area where the Crucible takes place is USMC property. In California, the Crucible takes place within Camp Pendleton; in Parris Island, South Carolina, it is an area around an old airstrip. Colonel Jim Gruny, commanding officer, Recruit Training Regiment, MCRD San Diego, wrote that “General Krulak pioneered the use of values-based training and a crucible to cement it among recruits. Krulak said his original intent for the Crucible as a culminating event was threefold. First, it would be the drill instructor’s last opportunity to give a ‘go or no go’ to the individual recruit. Second, it would ‘emphasize and reinforce all the core values training that was ongoing throughout recruit training’ . . . Last, it would ‘bring the recruit from an emphasis on self-discipline to where we want them to be in combat, which is selflessness.’ . . . Failure to complete the Crucible may require a recruit to be recycled to another Company with which he can undergo the Crucible

again. He will only be dropped from the Marine Corps if he repeatedly fails to complete the Crucible or if he suffers an injury that prevents further military service.” Colonel Christopher Nash, commanding officer, Weapons and Field Training Battalion, wrote: “The Crucible is a 54-hour endurance event that marks the transformation from civilian to U.S. Marine. Recruits, over a three day period, will travel approximately 68 km on foot, eat no more than three MREs for the duration of the event and operate with less than four hours of sleep a night. The focus of the Crucible is core values and teamwork. Recruits must overcome 24 stations/obstacles, participate in three core values discussions and two night endurance events during the three days. No event can be completed alone. The Crucible culminates with a 16 km ‘Reaper’ hike in which an emblem ceremony occurs. During this event recruits earn the title Marine.”

30 during basic training Joey E. Klinger, “Analysis of the Perceptions of Training Effectiveness of the Crucible at Marine Corps Recruit Depot, San Diego” (PhD diss., Naval Postgraduate School, 1999); S. P. Dynan, *Updating Tradition: Necessary Changes to Marine Corps Recruit Training* (Quantico, Va.: Marine Corps Command and Staff College, 2006); M. C. Cameron, *Crucible Marine on Point: Today’s Entry-Level Infantry Marine* (Quantico, Va.: Marine Corps Command and Staff College, 2006); Michael D. Becker, “‘We Make Marines’: Organizational Socialization and the Effects of ‘The Crucible’ on the Values Orientation of Recruits During US Marine Corps Training” (PhD diss., Indiana University of Pennsylvania, 2013); Benjamin Eiseman, “Into the Crucible: Making Marines for the 21st Century,” *Military Review* 80, no. 1 (2000): 94; Terry Terriff, “Warriors and Innovators: Military Change and Organizational Culture in the US Marine Corps,” *Defense Studies* 6, no. 2 (2006): 215–47; Antonio B. Smith, *United States Marine Corps’ Entry-Level Training for Enlisted Infantrymen: The Marginalization of Basic Warriors* (Quantico, Va.: Marine Corps Command and Staff College, 2001); William Berris, *Why General Krulak Is the Marine Corps’ Greatest Strategic Leader* (Carlisle Barracks, Penn.: U.S. Army War College, 2011); Terry Terriff, “Of Romans and Dragons: Preparing the US Marine Corps for Future Warfare,” *Contemporary Security Policy* 28, no. 1 (2007): 143–62; Marie B. Caulfield, *Adaptation to First Term Enlistment Among Women in the Marine Corps* (Boston: Veterans Administration Medical Center, 2000); Craig M. Kilhenny, “An Organizational Analysis of Marine Corps Recruit Depot, San Diego” (PhD diss., Naval Postgraduate School, 2003); Larry Smith, *The Few and the Proud: Marine Corps Drill Instructors in Their Own Words* (New York: W. W. Norton, 2007); Thomas M. Cook, Raymond W. Novaco, and Irwin G. Sarason, “Military Recruit Training as an Environmental Context Affecting Expectancies for Control of Reinforcement,” *Cognitive Therapy and Research* 6, no. 4 (1982): 409–27; Ross R. Vickers Jr.

and Terry L. Conway, *The Marine Corps Basic Training Experience: Psychosocial Predictors of Performance, Health, and Attrition* (San Diego: Naval Health Research Center, 1983); Ross R. Vickers Jr. and Terry L. Conway, "Changes in Perceived Locus of Control During Basic Training" (paper presented at the Annual Meeting of the American Psychological Association: Toronto, Canada, August 24–28 (1984); Thomas M. Cook, Raymond W. Novaco, and Irwin G. Sarason, *Generalized Expectancies, Life Experiences, and Adaptation to Marine Corps Recruit Training* (Seattle: Washington University: Department of Psychology, 1980); R. R. Vickers Jr. et al., *The Marine Corps Training Experience: Correlates of Platoon Attrition Rate Differences* (San Diego: Naval Health Research Center, 1983).

31 force upon them Rosalie A. Kane et al., "Everyday Matters in the Lives of Nursing Home Residents: Wish for and Perception of Choice and Control," *Journal of the American Geriatrics Society* 45, no. 9 (1997): 1086–93; Rosalie A. Kane et al., "Quality of Life Measures for Nursing Home Residents," *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences* 58, no. 3 (2003): 240–48; James R. Reinardy and Rosalie A. Kane, "Anatomy of a Choice: Deciding on Assisted Living or Nursing Home Care in Oregon," *Journal of Applied Gerontology* 22, no. 1 (2003): 152–74; Robert L. Kane and Rosalie A. Kane, "What Older People Want from Long-Term Care, and How They Can Get It," *Health Affairs* 20, no. 6 (2001): 114–27; William J. McAuley and Rosemary Blieszner, "Selection of Long-Term Care Arrangements by Older Community Residents," *The Gerontologist* 25, no. 2 (1985): 188–93; Bart J. Collopy, "Autonomy in Long Term Care: Some Crucial Distinctions," *The Gerontologist* 28, supplement (1988): 10–17; Elizabeth H. Bradley et al., "Expanding the Andersen Model: The Role of Psychosocial Factors in Long-Term Care Use," *Health Services Research* 37, no. 5 (2002): 1221–42; Virginia G. Kasser and Richard M. Ryan, "The Relation of Psychological Needs for Autonomy and Relatedness to Vitality, Well-Being, and Mortality in a Nursing Home: Effects of Control and Predictability on the Physical and Psychological Well-Being of the Institutionalized Aged," *Journal of Applied Social Psychology* 29, no. 5 (1999): 935–54; James F. Fries, "The Compression of Morbidity," *The Milbank Memorial Fund Quarterly: Health and Society* 83, no. 4 (2005): 801–23; Richard Schulz, "Effects of Control and Predictability on the Physical and Psychological Well-Being of the Institutionalized Aged," *Journal of Personality and Social Psychology* 33, no. 5 (1976): 563.

35 They didn't feel anything In response to a fact-checking email, Habib expanded upon his comments and said that rather than categorize the patients as not understanding feelings, it might be more accurate to say "it is a matter of expression of feelings, more than feeling itself. They can recall what they felt before, and there is no evidence they cannot feel it anymore. Instead, it

seems that since they have no more manifestations of seeking satisfaction, they look like they had no feeling. This is also an intriguing observation, since it suggests that the intensity of feelings is dependent upon the individual's capacity of seeking satisfaction or reward."

CHAPTER TWO: TEAMS

39 school's websites explained Alex Roberts, "What a Real Study Group Looks Like," Yale School of Management, *MBA Blog*, August 31, 2010, <http://som.yale.edu/what-real-study-group-looks>.

40 "didn't gel." In an email sent in response to fact-checking questions, Julia Rozovsky wrote: "There were a few members of my study group that I developed close friendships with, however I was much closer to my case study team."

41 first in the nation "Yale SOM Team Wins National Net Impact Case Competition," Yale School of Management, November 10, 2011, <http://som.yale.edu/news/news/yale-som-team-wins-national-net-impact-case-competition>.

41 were at Yale In an email sent in response to fact-checking questions, Julia Rozovsky wrote: "We chose to enter the competition each time. Each competition was a separate team/entry/packet/process. I just happened to work with the same team fairly consistently."

42 spent their time In an email sent in response to fact-checking questions, a Google spokeswoman wrote that "People Analytics' overarching theme is that we study the key drivers of Health, Happiness and Productivity of Googlers in a scientific and rigorous way. . . . No one part of Google controls or oversees hiring or promo, but rather it is shared with Googlers themselves, with managers, etc." For more on Google's approach to human resources, please see Thomas H. Davenport, Jeanne Harris, and Jeremy Shapiro, "Competing on Talent Analytics," *Harvard Business Review* 88, no. 10 (2010): 52–58; John Sullivan, "How Google Became the #3 Most Valuable Firm by Using People Analytics to Reinvent HR," *ERE Media*, February 25, 2013, <http://www.ere-media.com/ere/how-google-became-the-3-most-valuable-firm-by-using-people-analytics-to-reinvent-hr/>; David A. Garvin, "How Google Sold Its Engineers on Management," *Harvard Business Review* 91, no. 12 (2013): 74–82; Adam Bryant, "Google's Quest to Build a Better Boss," *The New York Times*, March 12, 2011; Laszlo Bock, *Work Rules! Insights from Inside Google That Will Transform the Way You Live and Lead* (New York: Twelve, 2015).

42 America's top workplaces In 2007, 2008, 2012, 2013, and 2014, Google was ranked number one by *Fortune*.

43 one of the effort's researchers In an email sent in response to fact-checking questions, Julia Rozovsky wrote: "I worked on several other efforts prior to joining the Project Aristotle team. Here's a quick bio that I use internally: 'Julia Rozovsky joined Google's People Analytics team in August 2012. During her time at Google, Julia has advised teams on workforce planning and design strategies, analyzed the impact of workplace flexibility programs, and conducted research on empowering leaders. She is currently the [project manager] of Project Aristotle, which aims to improve team effectiveness at Google. Prior to Google, Julia collaborated with Harvard Business School academics on competitive strategy and organizational behavior research focusing specifically on game theory, ethics and financial controls, and organizational structure. Earlier in her career, Julia was a strategy consultant with a boutique marketing analytics firm. Julia holds an MBA from the Yale School of Management, and a BA in mathematics and economics from Tufts University.'"

44 made a team effective In comments sent in response to fact-checking questions, a Google spokeswoman wrote: "The first thing we had to start with was the definition of a team, and we arrived at groups of people collaborating closely on projects and working toward a common goal. Then, since we knew a hierarchical team definition would be too limiting in our environment where people collaborate across reporting lines, we had to figure out how to systematically identify intact teams and their accurate membership so we could study them. In the end, we had to do it manually, by asking senior leaders to identify teams in their orgs and ask the teams' leads to confirm the members."

45 "appropriate behavior" David Lyle Light Shields et al., "Leadership, Cohesion, and Team Norms Regarding Cheating and Aggression," *Sociology of Sport Journal* 12 (1995): 324–36.

45 deference to the team For more on norms, please see Muzafer Sherif, *The Psychology of Social Norms* (London: Octagon Books, 1965); Jay Jackson, "Structural Characteristics of Norms," *Current Studies in Social Psychology* 301 (1965): 309; P. Wesley Schultz et al., "The Constructive, Destructive, and Reconstructive Power of Social Norms," *Psychological Science* 18, no. 5 (2007): 429–34; Robert B. Cialdini, "Descriptive Social Norms as Underappreciated Sources of Social Control," *Psychometrika* 72, no. 2 (2007): 263–68; Keithia L. Wilson et al., "Social Rules for Managing Attempted Interpersonal Domination in the Workplace: Influence of Status and Gender," *Sex Roles* 44, nos. 3–4 (2001): 129–54; Daniel C. Feldman, "The Development and Enforcement of Group Norms," *Academy of Management Review* 9, no. 1 (1984): 47–53; Deborah J. Terry, Michael A. Hogg, and Katherine M. White, "The Theory of Planned Behaviour: Self-Identity, Social Identity and Group Norms," *The British Journal of Social Psychology* 38 (1999): 225; Jolanda Jetten, Russell Spears, and Antony S. R. Manstead, "Strength of Identification and Intergroup Dif-

ferentiation: The Influence of Group Norms,” *European Journal of Social Psychology* 27, no. 5 (1997): 603–9; Mark G. Ehrhart and Stefanie E. Naumann, “Organizational Citizenship Behavior in Work Groups: A Group Norms Approach,” *Journal of Applied Psychology* 89, no. 6 (2004): 960; Daniel C. Feldman, “The Development and Enforcement of Group Norms,” *Academy of Management Review* 9, no. 1 (1984): 47–53; Jennifer A. Chatman and Francis J. Flynn, “The Influence of Demographic Heterogeneity on the Emergence and Consequences of Cooperative Norms in Work Teams,” *Academy of Management Journal* 44, no. 5 (2001): 956–74.

46 discouraged by our teammates Sigal G. Barsade, “The Ripple Effect: Emotional Contagion and Its Influence on Group Behavior,” *Administrative Science Quarterly* 47, no. 4 (2002): 644–75; Vanessa Urch Druskat and Steven B. Wolff, “Building the Emotional Intelligence of Groups,” *Harvard Business Review* 79, no. 3 (2001): 80–91; Vanessa Urch Druskat and Steven B. Wolff, “Group Emotional Intelligence and Its Influence on Group Effectiveness,” in *The Emotionally Intelligent Workplace: How to Select for, Measure, and Improve Emotional Intelligence in Individuals, Groups and Organizations*, ed. Cary Cherniss and Daniel Goleman (San Francisco: Jossey-Bass, 2001), 132–55; Daniel Goleman, Richard Boyatzis, and Annie McKee, “The Emotional Reality of Teams,” *Journal of Organizational Excellence* 21, no. 2 (2002): 55–65; William A. Kahn, “Psychological Conditions of Personal Engagement and Disengagement at Work,” *Academy of Management Journal* 33, no. 4 (1990): 692–724; Tom Postmes, Russell Spears, and Sezgin Cihangir, “Quality of Decision Making and Group Norms,” *Journal of Personality and Social Psychology* 80, no. 6 (2001): 918; Chris Argyris, “The Incompleteness of Social-Psychological Theory: Examples from Small Group, Cognitive Consistency, and Attribution Research,” *American Psychologist* 24, no. 10 (1969): 893; James R. Larson and Caryn Christensen, “Groups as Problem-Solving Units: Toward a New Meaning of Social Cognition,” *British Journal of Social Psychology* 32, no. 1 (1993): 5–30; P. Wesley Schultz et al., “The Constructive, Destructive, and Reconstructive Power of Social Norms,” *Psychological Science* 18, no. 5 (2007): 429–34.

46 put her on guard In an email sent in response to fact-checking questions, Julia Rozovsky wrote: “This is how the study group felt from time to time. Not consistently.”

46 equally successful group In comments sent in response to fact-checking questions, a Google spokeswoman wrote: “We wanted to test many group norms that we thought might be important. But at the testing phase we didn’t know that the *how* was going to be more important than the *who*. When we started running the statistical models, it became clear that not only were the norms more important in our models but that 5 themes stood out from the rest.”

47 Boston hospitals Amy C. Edmondson, “Learning from Mistakes Is Easier Said than Done: Group and Organizational Influences on the Detection and Correction of Human Error,” *The Journal of Applied Behavioral Science* 32, no. 1 (1996): 5–28; Druskat and Wolff, “Group Emotional Intelligence,” 132–55; David W. Bates et al., “Incidence of Adverse Drug Events and Potential Adverse Drug Events: Implications for Prevention,” *Journal of the American Medical Association* 274, no. 1 (1995): 29–34; Lucian L. Leape et al., “Systems Analysis of Adverse Drug Events,” *Journal of the American Medical Association* 274, no. 1 (1995): 35–43.

47 “slip through the cracks” In an email sent in response to fact-checking questions, Edmondson wrote: “It’s not MY insight that mistakes occur because of system complexity (and its challenging combination with patient heterogeneity). . . . I am merely the messenger bringing that perspective to certain audiences. But yes, the opportunities for slipping through are ever-present, so the challenge is building awareness and teamwork that catch and correct and prevent the slips.”

49 teammates behaved In an email sent in response to fact-checking questions, Edmondson wrote: “My goal was to figure out whether the interpersonal climate that I’d found to differ in this setting would differ in other organizations, especially in terms of differing between groups within the same organization. Later I called this psychological safety (or team psychological safety). I also wanted to discover whether, if it did differ, whether that difference would be associated with differences in learning behavior (and in performance).” For more on Edmondson’s work, please see Amy C. Edmondson, “Psychological Safety and Learning Behavior in Work Teams,” *Administrative Science Quarterly* 44, no. 2 (1999): 350–83; Ingrid M. Nembhard and Amy C. Edmondson, “Making It Safe: The Effects of Leader Inclusiveness and Professional Status on Psychological Safety and Improvement Efforts in Health Care Teams,” *Journal of Organizational Behavior* 27, no. 7 (2006): 941–66; Amy C. Edmondson, Roderick M. Kramer, and Karen S. Cook, “Psychological Safety, Trust, and Learning in Organizations: A Group-Level Lens,” *Trust and Distrust in Organizations: Dilemmas and Approaches* 10 (2004): 239–72; Amy C. Edmondson, *Managing the Risk of Learning: Psychological Safety in Work Teams* (Boston: Division of Research, Harvard Business School, 2002); Amy C. Edmondson, Richard M. Bohmer, and Gary P. Pisano, “Disrupted Routines: Team Learning and New Technology Implementation in Hospitals,” *Administrative Science Quarterly* 46, no. 4 (2001): 685–716; Anita L. Tucker and Amy C. Edmondson, “Why Hospitals Don’t Learn from Failures,” *California Management Review* 45, no. 2 (2003): 55–72; Amy C. Edmondson, “The Competitive Imperative of Learning,” *Harvard Business Review* 86, nos. 7–8 (2008): 60; Amy C. Edmondson, “A Safe Harbor: Social Psychological Conditions Enabling Bound-

ary Spanning in Work Teams,” *Research on Managing Groups and Teams* 2 (1999): 179–99; Amy C. Edmondson and Kathryn S. Roloff, “Overcoming Barriers to Collaboration: Psychological Safety and Learning in Diverse Teams,” *Team Effectiveness in Complex Organizations: Cross-Disciplinary Perspectives and Approaches* 34 (2009): 183–208.

50 1999 paper Amy C. Edmondson, “Psychological Safety and Learning Behavior in Work Teams,” *Administrative Science Quarterly* 44, no. 2 (1999): 350–83.

50 her Google colleagues In an email responding to fact-checking questions, a Google spokeswoman wrote: “We found Edmondson’s papers on psych safety very useful when trying to figure out how to cluster norms that we saw popping up as important into meta-themes. When we reviewed the papers about psych safety, we noticed that norms like allowing others to fail without repercussions, respecting divergent opinions, feeling as if others aren’t trying to undermine you are all part of psychological safety. This became one of our five key themes, along with dependability, structure/clarity, job meaning, and impact.”

51 would never stop For my understanding of the early days of *Saturday Night Live*, I am indebted to those writers and cast members who were willing to speak with me, as well as Tom Shales and James Andrew Miller, *Live from New York: An Uncensored History of “Saturday Night Live”* (Boston: Back Bay Books, 2008); Ellin Stein, *That’s Not Funny, That’s Sick: The National Lampoon and the Comedy Insurgents Who Captured the Mainstream* (New York: Norton, 2013); Marianne Partridge, ed., “*Rolling Stone*” Visits “*Saturday Night Live*” (Garden City, N.Y.: Dolphin Books, 1979); Doug Hill and Jeff Weingrad, *Saturday Night: A Backstage History of “Saturday Night Live”* (San Francisco: Untreed Reads, 2011).

53 “never be heard from again” In an email sent in response to a fact-checking question, Schiller wrote: “It was an intense experience for me since I had never lived in New York or worked on a comedy-variety show. A lot of us were new to Manhattan and as such, hung out a lot together not only because New York at that time was sort of dangerous and scary, but also we didn’t know that many people and we were formulating the show. We were in our midtwenties and early thirties. Yes, we’d eat at restaurants and go to bars together even when out of the studio. We moved en masse, trying to make each other laugh.”

54 “among the show’s cast” Malcolm Gladwell, “Group Think: What Does *Saturday Night Live* Have in Common with German Philosophy?” *The New Yorker*, December 2, 2002.

54 team intensely bonds Donelson Forsyth, *Group Dynamics* (Boston: Cengage Learning, 2009).

54 **“It was a stalag”** Alison Castle, *“Saturday Night Live”: The Book* (Reprint, Cologne: Taschen, America, 2015).

55 **“someone else was failing”** In an email sent in response to a fact-checking question, Beatts wrote: “My Holocaust joke, which was certainly said in jest because there is no other way to say a joke, had nothing whatsoever to do with the show’s writers. The exact wording was ‘Imagine if Hitler hadn’t killed six million Jews, how hard it would be to find an apartment in New York.’ It was a joke about the difficulty of finding apartments in New York, riffing off New York’s large Jewish population and general ethnic feeling, a la ‘You don’t have to be Jewish to love Levy’s rye bread. But it wouldn’t hurt.’ Zero to do with the writers. Marilyn Miller took offense at the mere mention of Hitler and the Holocaust, which to her could not be a subject for comedy. . . . [Regarding] competition among the writers, not that it didn’t exist, because it did, but . . . everyone always had a chance to come back swinging the following week. Also the other writers and everyone in general, despite the competition for airtime, Lorne’s approval, audience appreciation, etc., were always very supportive of other people’s efforts and sympathetic to each other’s failures. No one went around rubbing their hands in glee and going haha, your sketch was cut and mine wasn’t, so there! It was more an attitude of ‘Better luck next time.’ I think everyone felt part of a family, maybe a dysfunctional family, but a close-knit family all the same. I would say that there is more backstabbing and jealousy and rivalry and competition and cliqueishness on the average middle school playground than there ever was at *SNL* during the time I was there.”

55 **“stuff for other people”** In an email sent in response to fact-checking questions, Alan Zweibel wrote: “I wasn’t angry because of anything to do with that character or the process in which it was written. She and I weren’t speaking for reasons that I really can’t recall. But after about three shows where I didn’t write with her (and for her) we both realized that our work was suffering—that we were better as a team than we were individually—so we buried the hatchet and began collaborating again.”

56 **“it could be brutal”** In an email sent in response to a fact-checking question, Schiller wrote: “I would say that some, not all, comedy writers and stand-up comedians have some sadness or anger in their life that helped fuel their comedy. They are fast with quips, and the stand-ups were used to hecklers and had to be prepared with a quick comeback. So just as much as they can say something sharply funny, they can also jab you with a quick, hostile (but also funny) remark. . . . The atmosphere at *SNL*, although we all liked each other, could become highly competitive based on the fact that there were 10 writers and only so many sketches could go on the show, so we all did our best to write the winning sketch or make (in my case) the best short film.”

58 58 percent The correct answers to the quiz are upset, decisive, skeptical, and cautious. These images come from Simon Baron-Cohen et al., “Another Advanced Test of Theory of Mind: Evidence from Very High Functioning Adults with Autism or Asperger Syndrome,” *Journal of Child Psychology and Psychiatry* 38, no. 7 (1997): 813–22. And Simon Baron-Cohen et al., “The ‘Reading the Mind in the Eyes’ Test Revised Version: A Study with Normal Adults, and Adults with Asperger Syndrome or High-Functioning Autism,” *Journal of Child Psychology and Psychiatry* 42, no. 2 (2001): 241–51.

58 Science in 2010 Anita Williams Woolley et al., “Evidence for a Collective Intelligence Factor in the Performance of Human Groups,” *Science* 330, no. 6004 (2010): 686–88.

60 “individuals in it” Anita Woolley and Thomas Malone, “What Makes a Team Smarter? More Women,” *Harvard Business Review* 89, no. 6 (2011): 32–33; Julia B. Bear and Anita Williams Woolley, “The Role of Gender in Team Collaboration and Performance,” *Interdisciplinary Science Reviews* 36, no. 2 (2011): 146–53; David Engel et al., “Reading the Mind in the Eyes or Reading Between the Lines? Theory of Mind Predicts Collective Intelligence Equally Well Online and Face-to-Face,” *PloS One* 9, no. 12 (2014); Anita Williams Woolley and Nada Hashmi, “Cultivating Collective Intelligence in Online Groups,” in *Handbook of Human Computation*, ed. Pietro Michelucci (New York: Springer, 2013), 703–14; Heather M. Caruso and Anita Williams Woolley, “Harnessing the Power of Emergent Interdependence to Promote Diverse Team Collaboration,” *Research on Managing Groups and Teams: Diversity and Groups* 11 (2008): 245–66; Greg Miller, “Social Savvy Boosts the Collective Intelligence of Groups,” *Science* 330, no. 6000 (2010): 22; Anita Williams Woolley et al., “Using Brain-Based Measures to Compose Teams: How Individual Capabilities and Team Collaboration Strategies Jointly Shape Performance,” *Social Neuroscience* 2, no. 2 (2007): 96–105; Peter Gwynne, “Group Intelligence, Teamwork, and Productivity,” *Research Technology Management* 55, no. 2 (2012): 7.

61 University of Cambridge Baron-Cohen et al., “‘Reading the Mind in the Eyes’ Test Revised Version,” 241–51.

63 “more initials he sees” In an email sent in response to fact-checking questions, Alan Zweibel wrote: “[Michaels] had said that he likes when there’s a lot of initials at the top of the page because it meant that it had a variety of input and sensibilities. I believe that the show has lasted 40 years because Lorne is a genius when it comes to recognizing talent, rolling with the changing times, and encouraging everyone (while developing their individual voices) to work with each other so the total is greater than the sum of its parts.”

63 “the pain!” In the script that made it to air, O’Donoghue says, “I know I can! I know I can! I know I can! I know I can! Heart attack! Heart attack! Heart attack! Heart attack! Oh, my God, the pain! Oh, my God, the pain! Oh, my God, the pain!” It is worth noting that the original concept for depressing children stories originated with O’Donoghue, not Garrett.

CHAPTER THREE: FOCUS

72 **bound for Paris** For my understanding of the details of Air France Flight 447, I am indebted to numerous experts, including William Langewiesche, Steve Casner, Christopher Wickens, and Mica Endsley. I also drew heavily on a number of publications: William Langewiesche, “The Human Factor,” *Vanity Fair*, October 2014; Nicola Clark, “Report Cites Cockpit Confusion in Air France Crash,” *The New York Times*, July 6, 2012; Nicola Clark, “Experts Say Pilots Need More Air Crisis Training,” *The New York Times*, November 21, 2011; Kim Willsher, “Transcripts Detail the Final Moments of Flight from Rio,” *Los Angeles Times*, October 16, 2011; Nick Ross and Neil Tweedie, “Air France Flight 447: ‘Damn It, We’re Going to Crash,’” *The Daily Telegraph*, May 1, 2012; “Air France Flight 447: When All Else Fails, You Still Have to Fly the Airplane,” *Aviation Safety*, March 1, 2011; “Concerns over Recovering AF447 Recorders,” *Aviation Week*, June 3, 2009; Flight Crew Operating Manual, *Airbus 330—Systems—Maintenance System*; Tim Vasquez, “Air France Flight 447: A Detailed Meteorological Analysis,” Weather Graphics, June 3, 2009, <http://www.weathergraphics.com/tim/af447/>; Cooperative Institute for Meteorological Satellite Studies, “Air France Flight #447: Did Weather Play a Role in the Accident?” *CIMSS Satellite Blog*, June 1, 2009, <http://cimss.ssec.wisc.edu/goes/blog/archives/2601>; Richard Woods and Matthew Campbell, “Air France 447: The Computer Crash,” *The Times*, June 7, 2009; “AF 447 May Have Come Apart Before Crash,” Associated Press, June 3, 2009; Wil S. Hylton, “What Happened to Air France Flight 447?” *The New York Times Magazine*, May 4, 2011; “Accident Description F-GZC,” Flight Safety Foundation, Web; “List of Passengers Aboard Lost Air France Flight,” Associated Press, June 4, 2009; “Air France Jet ‘Did Not Break Up in Mid-Air,’ Air France Crash: First Official Airbus A330 Report Due by Air Investigations and Analysis Office,” *Sky News*, July 2, 2009; Matthew Wald, “Clues Point to Speed Issues in Air France Crash,” *The New York Times*, June 7, 2009; Air France, “AF 447 RIO-PARIS-CDG, Pitot Probes,” October 22, 2011, <http://corporate.airfrance.com/en/press/af-447-rio-paris-cdg/pitot-probes/>; Edward Cody, “Airbus Recommends Airlines Replace Speed Sensors,” *The Washington Post*, July 31, 2009; Jeff Wise, “What Really Happened Aboard Air France 447,” *Popular Mechanics*, December 6, 2011; David Kaminski-Morrow, “AF447 Stalled but Crew

Maintained Nose-Up Attitude,” *Flight International*, May 27, 2011; David Talbot, “Flight 447’s Fatal Attitude Problem,” *Technology Review*, May 27, 2011; Glenn Pew, “Air France 447—How Did This Happen?” *AVweb*, May 27, 2011; Bethany Whitfield, “Air France 447 Stalled at High Altitude, Official BEA Report Confirms,” *Flying*, May 27, 2011; Peter Garrison, “Air France 447: Was It a Deep Stall?” *Flying*, June 1, 2011; Gerald Traufetter, “Death in the Atlantic: The Last Four Minutes of Air France Flight 447,” *Spiegel Online*, February 25, 2010; Nic Ross and Jeff Wise, “How Plane Crash Forensics Lead to Safer Aviation,” *Popular Mechanics*, December 18, 2009; *Interim Report on the Accident on 1 June 2009 to the Airbus A330-203 Registered F-GZCP Operated by Air France Flight AF 447 Rio de Janeiro–Paris* (Paris: Bureau d’Enquêtes et d’Analyses pour la sécurité de l’aviation civile [BEA], 2012); *Interim Report No. 3 on the Accident on 1 June 2009 to the Airbus A330-203 registered F-GZCP Operated by Air France Flight AF 447 Rio de Janeiro–Paris* (Paris: BEA, 2011); *Final Report on the Accident on 1st June 2009 to the Airbus A330-203 Registered F-GZCP Operated by Air France Flight AF 447 Rio de Janeiro–Paris* (Paris: BEA, 2012); “Appendix 1 to *Final Report on the Accident on 1st June 2009 to the Airbus A330-203 Registered F-GZCP Operated by Air France Flight AF 447 Rio de Janeiro–Paris*” (Paris: BEA, July 2012); *Lost: The Mystery of Flight 447*, BBC One, June 2010; “Crash of Flight 447,” *Nova*, 2010, produced by Nacressa Swan; “Air France 447, One Year Out,” *Nova*, 2010, produced by Peter Tyson.

72 flying them home Air France has argued that it is inappropriate to blame pilot error as the primary cause for the crash of Flight 447. (This perspective is disputed by numerous aviation experts.) Air France was presented with a complete list of questions regarding details discussed in this chapter. The airline declined to comment on issues that fell outside of those topics discussed in the official report regarding Air France Flight 447 published by the Bureau d’Enquêtes et d’Analyses pour la sécurité de l’aviation civile, or BEA, which is the French authority responsible for investigating aviation accidents. In a statement, a spokesman for Air France wrote: “It is essential to remember that the BEA investigation report, the only official and public investigation to date, discusses and develops many of the subjects mentioned [in this chapter]. This report is available on the BEA website in English. We can only direct the journalist to this report to supplement our answers.”

72 rotated responsibilities In response to questions, a spokesman for Air France noted that automation on long-haul aircraft preceded the A330 by twenty years, and that at one time “the crew included a flight engineer, who was responsible for monitoring all aircraft systems during the flight. On modern aircraft, the flight engineer has disappeared, but the requirement of monitoring aircraft systems remains. This is carried out by the pilots. Finally, now

as in the past, beyond a certain flight time the crew is reinforced by one or more additional pilots to enable each pilot to take a rest period.”

72 crashed after takeoff Isabel Wilkerson, “Crash Survivor’s Psychic Pain May Be the Hardest to Heal,” *The New York Times*, August 22, 1987; Mike Householder, “Survivor of 1987 Mich. Plane Crash Breaks Silence,” Associated Press, May 15, 2013.

73 One hundred and one people Ninety-nine people were killed instantly in this crash. Two later died from complications.

73 into the Everglades Ken Kaye, “Flight 401 1972 Jumbo Jet Crash Was Worst Aviation Disaster in State History,” *Sun Sentinel*, December 29, 1992.

73 other human errors Aviation Safety Network, NTSB records.

74 ascended by three thousand feet In response to questions, a spokesman for Air France wrote: “It has not been shown by the BEA that the action to pitch up is the result of the pilot’s actions faced with the rolling of the aircraft, but rather the loss of altitude read, the vertical speed on descent of 600 ft per minute, the noise, the pitch that had diminished during the seconds before etc.”

75 said Bonin In response to questions, a spokesman for Air France wrote: “What is written is true, but does not throw light comprehensively on this phase because of the lack of some essential elements, such as the fact that the STALL alarm went off twice at the beginning of the incident which may have led the pilots to doubt its validity when it went off repeatedly. The BEA report stated that audio alarms are not ‘unmissable’ and that on the contrary they are often the first to be ignored.”

75 watching the kids Zheng Wang and John M. Tchernev, “The ‘Myth’ of Media Multitasking: Reciprocal Dynamics of Media Multitasking, Personal Needs, and Gratifications,” *Journal of Communication* 62, no. 3 (2012): 493–513; Daniel T. Willingham, *Cognition: The Thinking Animal*, 3rd ed. (Upper Saddle River, N.J.: Pearson, 2007).

76 by automation Juergan Kiefer et al., “Cognitive Heuristics in Multitasking Performance,” Center of Human-Machine Systems, Technische Universität Berlin, 2014, http://www.prometei.de/fileadmin/prometei.de/publikationen/Kiefer_eurocogsci2007.pdf.

76 automaticity and focus Barnaby Marsh et al., “Cognitive Heuristics: Reasoning the Fast and Frugal Way,” in *The Nature of Reasoning*, eds. J. P. Leighton and R. J. Sternberg (New York: Cambridge University Press, 2004); “Human Performance,” Aerostudents, <http://aerostudents.com/files/humanMachineSystems/humanPerformance.pdf>.

76 misstep can be tragic For more on this topic, I particularly recommend Martin Sarter, Ben Givens, and John P. Bruno, “The Cognitive Neuroscience

of Sustained Attention: Where Top-Down Meets Bottom-Up,” *Brain Research Reviews* 35, no. 2 (2001): 146–60; Michael I. Posner and Steven E. Petersen, “The Attention System of the Human Brain,” *Annual Review of Neuroscience* 13, no. 1 (1990): 25–42; Eric I. Knudsen, “Fundamental Components of Attention,” *Annual Review of Neuroscience* 30 (2007): 57–78; Steven E. Petersen and Michael I. Posner, “The Attention System of the Human Brain: 20 Years After,” *Annual Review of Neuroscience* 35 (2012): 73; Raja Parasuraman, Robert Molloy, and Indramani L. Singh, “Performance Consequences of Automation-Induced ‘Complacency,’” *The International Journal of Aviation Psychology* 3, no. 1 (1993): 1–23; Raymond S. Nickerson et al., *Handbook of Applied Cognition*, ed. Francis T. Durso (Hoboken, N.J.: Wiley, 2007); Christopher D. Wickens, “Attention in Aviation,” University of Illinois at Urbana-Champaign Institute of Aviation, Research Gate, February 1987, http://www.researchgate.net/publication/4683852_Attention_in_aviation; Christopher D. Wickens, “The Psychology of Aviation Surprise: An 8 Year Update Regarding the Noticing of Black Swans,” *Proceedings of the 15th International Symposium on Aviation Psychology*, 2009.

76 critical than ever before Ludwig Reinhold Geissler, “The Measurement of Attention,” *The American Journal of Psychology* (1909): 473–529; William A. Johnston and Steven P. Heinz, “Flexibility and Capacity Demands of Attention,” *Journal of Experimental Psychology: General* 107, no. 4 (1978): 420; Robin A. Barr, “How Do We Focus Our Attention?” *The American Journal of Psychology* (1981): 591–603.

76 panicked attention G. R. Dirkin, “Cognitive Tunneling: Use of Visual Information Under Stress,” *Perceptual and Motor Skills* 56, no. 1 (1983): 191–98; David C. Foyle, Susan R. Dowell, and Becky L. Hooey, “Cognitive Tunneling in Head-Up Display (HUD) Superimposed Symbology: Effects of Information Location” (2001); Adrien Mack and Irvin Rock, *Inattentional Blindness* (Cambridge, Mass.: MIT Press, 2000); Steven B. Most, Brian J. Scholl, Daniel J. Simons, and Erin R. Clifford, “What You See Is What You Get: Sustained Inattentional Blindness and the Capture of Awareness,” *Psychological Review* 112, no. 1 (2005): 217–42; Daniel J. Simons, “Attentional Capture and Inattentional Blindness,” *Trends in Cognitive Sciences* 4, no. 4 (2000): 147–55; Gustav Kuhn and Benjamin W. Tatler, “Misdirected by the Gap: The Relationship Between Inattentional Blindness and Attentional Misdirection,” *Consciousness and Cognition* 20, no. 2 (2011): 432–36; William J. Horrey and Christopher D. Wickens, “Examining the Impact of Cell Phone Conversations on Driving Using Meta-Analytic Techniques,” *Human Factors: The Journal of the Human Factors and Ergonomics Society* 48, no. 1 (2006): 196–205.

77 red light ahead G. D. Logan, “An Instance Theory of Attention and Memory,” *Psychological Review* 109 (2002): 376–400; D. L. Strayer and F. A. Drews,

“Attention,” *Handbook of Applied Cognition*, ed. Francis T. Durso (Hoboken, N.J.: Wiley, 2007); A. D. Baddeley, “Selective Attention and Performance in Dangerous Environments,” *British Journal of Psychology* 63 (1972): 537–46; E. Goldstein, *Cognitive Psychology: Connecting Mind, Research and Everyday Experience* (Independence, Ky.: Cengage Learning, 2014).

77 of common sense In response to a fact-checking email, Strayer expanded his comments: “With automated systems, we may not focus or concentrate attention on the task—we even mind wander in boring or repetitive settings. It takes effort to concentrate attention and this can lead to high levels of mental workload and we see a ‘vigilance decrement’ where attention lapses (and we make errors and miss critical events). This is often the case with monitoring tasks (keep an eye on the autonomous system) and when things go awry we may not notice or react on autopilot (even if this is not the correct action—we refer to this as slips where autopilot took over).”

78 gauges and controls Airbus, *Airbus A330 Aircraft Recovery Manual Airbus*, 2005, http://www.airbus.com/fileadmin/media_gallery/files/tech_data/ARM/ARM_A330_20091101.pdf.

80 throughout the flight The automatic warning system of this A330 was programmed so that the stall warning would cease when the plane’s stall was most severe. In some situations, when the pitch attitude was too high and the airflow into the pitot tubes too low, the computer assumed the data it was gathering was erroneous. So it sounded no alarms. Thus, a perverse situation arose for Flight 447 after the pitot tubes thawed: At times, when Bonin did something to make the stall worse, the alarm stopped. The computers worked as programmed, but the result was information that might have been confusing to the pilots.

81 “reactive thinking” Koji Jimura, Maria S. Chushak, and Todd S. Braver, “Impulsivity and Self-Control During Intertemporal Decision Making Linked to the Neural Dynamics of Reward Value Representation,” *The Journal of Neuroscience* 33, no. 1 (2013): 344–57; Ayeley P. Tchangani, “Modeling for Reactive Control and Decision Making in Uncertain Environment,” in *Control and Learning in Robotic Systems*, ed. John X. Liu (New York: Nova Science Publishers, 2005), 21–58; Adam R. Aron, “From Reactive to Proactive and Selective Control: Developing a Richer Model for Stopping Inappropriate Responses,” *Biological Psychiatry* 69, no. 12 (2011): 55–68; Veit Stuphorn and Erik Emeric, “Proactive and Reactive Control by the Medial Frontal Cortex,” *Frontiers in Neuroengineering* 5 (2012): 9; Todd S. Braver et al., “Flexible Neural Mechanisms of Cognitive Control Within Human Prefrontal Cortex,” *Proceedings of the National Academy of Sciences* 106, no. 18 (2009): 7351–56; Todd S. Braver,

“The Variable Nature of Cognitive Control: A Dual Mechanisms Framework.” *Trends in Cognitive Sciences* 16, no. 2 (2012): 106–13; Yosuke Morishima, Jiro Okuda, and Katsuyuki Sakai, “Reactive Mechanism of Cognitive Control System,” *Cerebral Cortex* 20, no. 11 (2010) 2675–83; Lin Zhiang and Kathleen Carley, “Proactive or Reactive: An Analysis of the Effect of Agent Style on Organizational Decision Making Performance,” *Intelligent Systems in Accounting, Finance and Management* 2, no. 4 (1993): 271–87.

81 the psychologist, in 2009 Joel M. Cooper et al., “Shifting Eyes and Thinking Hard Keep Us in Our Lanes,” *Human Factors and Ergonomics Society Annual Meeting Proceedings* 53, no. 23 (2009): 1753–56. For more on this topic, please see Frank A. Drews and David L. Strayer, “Chapter 11: Cellular Phones and Driver Distraction,” in *Driver Distraction: Theory, Effects, and Mitigation*, ed. Michael A. Regan, John D. Lee, and Kristie L. Young (Boca Raton, Fla.: CRC Press, 2008): 169–90; Frank A. Drews, Monisha Pasupathi, and David L. Strayer, “Passenger and Cell Phone Conversations in Simulated Driving,” *Journal of Experimental Psychology: Applied* 14, no. 4 (2008): 392; Joel M. Cooper, Nathan Medeiros-Ward, and David L. Strayer, “The Impact of Eye Movements and Cognitive Workload on Lateral Position Variability in Driving,” *Human Factors: The Journal of the Human Factors and Ergonomics Society* 55, no. 5 (2013): 1001–14; David B. Kaber et al., “Driver Performance Effects of Simultaneous Visual and Cognitive Distraction and Adaptation Behavior,” *Transportation Research Part F: Traffic Psychology and Behaviour* 15, no. 5 (2012): 491–501; I. J. Faulks et al., “Update on the Road Safety Benefits of Intelligent Vehicle Technologies—Research in 2008–2009,” 2010 Australasian Road Safety Research, Policing and Education Conference, August 31–September 3, 2010, Canberra, Australia.

82 announcement of any kind In a fact-checking conversation, Stephen Casner, a research psychologist at NASA, said that if a plane was falling at ten thousand-plus feet per minute, the g-force would be pretty close to 1, and as a result, it would be unlikely the passengers would have noticed that anything was amiss. However, he added, “Actually, *no one* knows what that feels like. Everyone who has felt what it’s like to lose 10,000 feet a minute dies pretty soon after feeling it.”

83 ten thousand feet per minute In response to questions, a spokesman for Air France wrote: “A fundamental aspect is that the STALL alarm stopped when the speed fell below 60 kts, leading the pilots to think they were out of the stall. Especially that every time they pushed on the stick to try and get out of the stall situation, the STALL alarm started to work again, leading them to cancel their pitching action! Also, during the last phase, vertical speed indications were unstable, adding doubt and confusion in the pilots’ minds.”

85 Dayton, near where she lived In an email sent in reply to a fact-checking inquiry, Crandall wrote: “In 1986, I began working with Dr. Gary Klein at his company Klein Associates Inc. The work you mention with firefighters and military commanders had already begun when I joined the company. It continued for many years, expanding well beyond firefighting and military command and control, and was carried out by Gary and the Klein Associates research team (who were an amazing bunch of very smart talented quirky people). I had both research and management positions at Klein Associates, and I was involved in some of those studies, not in others. As owner and Chief Scientist, Gary led our efforts to describe how (some) people are able to ‘keep their heads in chaotic environments’ and particularly how (some) people are able to make effective decisions under conditions of stress, risk, and time pressure. . . . It is correct that in the interviews we conduct, when asked about decision making and how a person knew to do X in a particular situation, they often respond with, ‘experience’ or ‘gut feel’ or ‘intuition’ or ‘I just knew.’ . . . These accounts of an intuitive basis for decision making became a cornerstone of our research efforts. . . . The studies we did in the NICU confirmed what we were finding in other work domains—highly experienced, highly skilled personnel become very good at paying attention to what’s most important (the critical cues) in a given situation, and not getting distracted by less important information. . . . Over time and repeated experience with similar situations, they learn what matters and what doesn’t. They learn to size up a situation very quickly and accurately. They see connections across various cues (clusters; packages; linkages) that form a meaningful pattern. Some people refer to this as a gestalt, and others as ‘mental models’ or schemas.” For more details, please see Beth Crandall and Karen Getchell-Reiter, “Critical Decision Method: A Technique for Eliciting Concrete Assessment Indicators from the Intuition of NICU Nurses,” *Advances in Nursing Science* 16, no. 1 (1993): 42–51; B. Crandall and R. Calderwood, “Clinical Assessment Skills of Experienced Neonatal Intensive Care Nurses,” *Contract* 1 (1989): R43; B. Crandall and V. Gamblian, “Guide to Early Sepsis Assessment in the NICU,” *Instruction Manual Prepared for the Ohio Department of Development Under the Ohio SBIR Bridge Grant Program* (Fairborn, Ohio: Klein Associates, 1991).

87 “a whole picture” In an email sent in reply to a fact-checking inquiry, Crandall wrote: “The other nurse was a preceptee—in training to provide nursing care in a NICU. Darlene was her preceptor—helping her learn and providing oversight and guidance as she learns how to care for premature babies. So, the baby WAS Darlene’s responsibility in the sense that she was supervising/precepting the nurse caring for the baby. You are correct, she noticed that the baby didn’t look ‘good.’ Here is the incident account that we wrote up based on our interview notes: ‘When this incident took place, I was

teaching, serving as a preceptor for a new nurse. We had been working together for quite awhile and she was nearing the end of her orientation, so she was really doing primary care and I was in more of a supervisory position. Anyway, we were nearing the end of a shift and I walked by this particular isolette and the baby really caught my eye. The baby's color was off and its skin was mottled. Its belly looked slightly rounded. I looked at the chart and it indicated the baby's temp was unstable. I also noticed that the baby had had a heel stick for lab work several minutes ago and the stick was still bleeding. When I asked my orientee how she thought the baby was doing, she said that he seemed kind of sleepy to her. I went and got the Doctor immediately and told him we were "in big trouble" with this baby. I said the baby's temp was unstable, that its color was funny, it seemed lethargic and it was bleeding from a heel stick. He reacted right away, put the baby on antibiotics and ordered cultures done. I was upset with the orientee that she had missed these cues, or that she had noticed them but not put them together. When we talked about it later I asked about the baby's temp dropping over four readings. She had noticed it, but had responded by increasing the heat in the isolette. She had responded to the 'surface' problem, instead of trying to figure out what might be causing the problem."

88 "creating mental models" Thomas D. LaToza, Gina Venolia, and Robert DeLine, "Maintaining Mental Models: A Study of Developer Work Habits," *Proceedings of the 28th International Conference on Software Engineering* (New York: ACM, 2006); Philip Nicholas Johnson-Laird, "Mental Models and Cognitive Change," *Journal of Cognitive Psychology* 25, no. 2 (2013): 131–38; Philip Nicholas Johnson-Laird, *How We Reason* (Oxford: Oxford University Press, 2006); Philip Nicholas Johnson-Laird, *Mental Models*, Cognitive Science Series, no. 6 (Cambridge, Mass.: Harvard University Press, 1983); Earl K. Miller and Jonathan D. Cohen, "An Integrative Theory of Prefrontal Cortex Function," *Annual Review of Neuroscience* 24, no. 1 (2001): 167–202; J. D. Serman and D. V. Ford, "Expert Knowledge Elicitation to Improve Mental and Formal Models," *Systems Approach to Learning and Education into the 21st Century*, vol. 1, 15th International System Dynamics Conference, August 19–22, 1997, Istanbul, Turkey; Pierre Barrouillet, Nelly Grosset, and Jean-François Lecas, "Conditional Reasoning by Mental Models: Chronometric and Developmental Evidence," *Cognition* 75, no. 3 (2000): 237–66; R. M. J. Byrne, *The Rational Imagination: How People Create Alternatives to Reality* (Cambridge, Mass.: MIT Press, 2005); P. C. Cheng and K. J. Holyoak, "Pragmatic Reasoning Schemas," in *Reasoning: Studies of Human Inference and Its Foundations*, eds. J. E. Adler and L. J. Rips (Cambridge: Cambridge University Press, 2008), 827–42; David P. O'Brien, "Human Reasoning Includes a Mental Logic," *Behavioral and Brain Sciences* 32, no. 1 (2009): 96–97; Niki Verschueren, Walter

Schaeken, and Gery d'Ydewalle, "Everyday Conditional Reasoning: A Working Memory–Dependent Tradeoff Between Counterexample and Likelihood Use," *Memory and Cognition* 33, no. 1 (2005): 107–19.

88 the child's bassinets In response to a fact-checking email, Crandall wrote: "The key to this story (for me anyway) is that experts see meaningful patterns that novices miss altogether. As an experienced NICU nurse, Darlene has seen hundreds of babies. She is not reflecting on all of them . . . they have merged into a sense of what is typical for a premie baby at X weeks. She has also seen many babies with sepsis (it happens a lot in NICUs, for a variety of reasons unrelated to quality of care). The combination of cues (bloody bandaid, falling temp, distended belly, sleepiness/lethargy) brought with it the recognition 'this baby is in trouble' and 'probably septic.' At least, that's what she told us in the interview. . . . I agree that people often create narratives to help explain what's going on around them, and help them make sense—particularly when they are having trouble figuring something out. In this incident, Darlene was not having trouble figuring out what was going on—she recognized immediately what was going on. . . . I think of Darlene's story as being about expertise, and the difference between how experts and novices view and understand a given situation. . . . Storytelling takes time, and stories are linear (this happened, then this, and then that). When experienced people describe events such as this one, what happens is very fast: They 'read' the situation, they understand what's going on, and they know what to do."

90 "It's even harder now" In response to a fact-checking email, Casner expanded his comments: "I wouldn't say that pilots are 'passive' but that they find it exceedingly difficult to maintain their attention on an automated system that works so reliably well. Humans are not good at sitting and staring. . . . Humans have limited attentional resources (e.g., how our kids do stuff behind our backs and get away with it). So we have to keep our attention pointed in the direction that we think is most important at all times. If a cockpit computer in front of me has worked impeccably for 100 hours in a row, it's hard to envision that as being the most important thing to think about. For example, my kid could be getting away with some insane stuff at that very moment. In our study of mind wandering among pilots [*Thoughts in Flight: Automation Use and Pilots' Task-Related and Task-Unrelated Thought*], we found that the pilot flying was thinking 'task-unrelated thoughts' about 30% of the time. The other pilot, the monitoring pilot, was mind wandering about 50% of the time. Why wouldn't they? If you don't give me something important or pressing to think about, I'll come up with something myself."

90 people build mental models Sinan Aral, Erik Brynjolfsson, and Marshall Van Alstyne, "Information, Technology, and Information Worker Productivity," *Information Systems Research* 23, no. 3 (2012): 849–67; Sinan Aral and

Marshall Van Alstyne, “The Diversity-Bandwidth Trade-Off,” *American Journal of Sociology* 117, no. 1 (2011): 90–171; Nathaniel Bulkley and Marshall W. Van Alstyne, “Why Information Should Influence Productivity” (2004); Nathaniel Bulkley and Marshall W. Van Alstyne, “An Empirical Analysis of Strategies and Efficiencies in Social Networks,” Boston U. School of Management research paper no. 2010-29, MIT Sloan research paper no. 4682-08, February 1, 2006, <http://ssrn.com/abstract=887406>; Neil Gandall, Charles King, and Marshall Van Alstyne, “The Social Network Within a Management Recruiting Firm: Network Structure and Output,” *Review of Network Economics* 8, no. 4 (2009): 302–24.

90 leveraged existing skills In response to a fact-checking email, Van Alstyne expanded upon his comments: “One of the original hypotheses attributed the gains of the smaller project load to the efficacy associated with economies of specialization. Doing a singular, focused activity can make you very good at that activity. The idea goes all the way back to Adam Smith and the efficiency associated with focused tasks at a pin factory. Generalization, or pursuing diverse work in our context, meant spreading projects across finance, education, and commercial IT. These are very different industries. Running projects across them requires different knowledge and it also means tapping different social networks. Specialization, in these consulting projects, meant focusing on, say, just the finance projects. Knowledge could be deepened within this focal area and the social network could be adapted to finance contacts alone. At least this is one theory as to why specialization might be better. Obviously, specialization can restrict the number of possible projects—there might not be a new finance project when there does happen to be one, or several, in education or IT. But perhaps if you wait, you’ll get another finance project.”

91 deemed a success In response to a fact-checking email, Van Alstyne identified other reasons why joining small numbers of projects, and a project at its start, had benefits: “The first is multitasking. Initially, taking on new projects strictly increases output, in this case revenues generated by these consultants. Revenue growth can continue even past the point where the productivity on a given project starts to fall. Consider a project as a collection of tasks (assessing client needs, generating target candidates, selecting candidates, vetting resumes, presenting options to clients, closing the deal . . .). As a person takes on new work, its tasks displace some tasks of the existing work. So an existing project can take longer when a person takes on a new project, drawing out the period over which he/she gets paid. Total throughput, however, can still rise for awhile as a person takes on new projects. The stream of revenues brought in by a person juggling 6 projects tends to be higher than the stream of revenues brought in by a person juggling 4 even though each of

the 6 projects takes longer than it would have taken if it were only in a group of 4. At some point, however, this relationship trends completely downward. New projects take too long *and* revenues decline. Taking on another project strictly decreases productivity. As one consultant put it, ‘There are too many balls in the air and then too many get dropped.’ It takes too long to complete tasks, some tasks are not completed at all, and the flow of revenues dribbles out over a really long period. So there is an optimal number of projects to take on and this is below 12. The second consideration, as you suggest, is access to rich information. This exhibits a similar invert-U pattern. We were able to judge how much novel information each person received by tracking their actual email communication. We measured this both in a sense of ‘variance,’ i.e., how *unusual* was a fact relative to other received facts, and also in terms of ‘volume,’ i.e., how *many* new facts a person received. . . . Initially, greater access to more novel information strictly increased productivity. Superstars did receive about 25% more novel information than their typical peer and this access to novelty helped predict their success. Eventually, however, those outlying people who received the absolute highest novelty—about twice that of the superstars—were less productive than the superstars. Either excess information was too weird, off-topic, and not actionable or excess information was too much to process. A massive volume of novelty introduces the white-collar worker’s equivalent of the ‘Where’s Waldo’ problem: You can’t find the important information in all the noise. Both of these factors were statistically significant predictors of the superstars.”

93 bright morning sky Richard De Crespigny, *QF32* (Sydney: Pan Macmillan Australia, 2012); *Aviation Safety Investigation Report 089: In-Flight Uncontained Engine Failure Airbus A380–842, VH-OQA* (Canberra: Australian Transport Safety Bureau, Department of Transport and Regional Services, 2013); Jordan Chong, “Repaired Qantas A380 Arrives in Sydney,” *The Sydney Morning Herald*, April 22, 2012; Tim Robinson, “Qantas QF32 Flight from the Cockpit,” *The Royal Aeronautical Society*, December 8, 2010; “Qantas Airbus A380 Inflight Engine Failure,” Australian Transport Safety Bureau, December 8, 2010; “Aviation Occurrence Investigation AO-2010–089 Interim-Factual,” Australian Transport Safety Bureau, May 18, 2011; “In-Flight Uncontained Engine Failure—Overhead Batam Island, Indonesia, November 4, 2010, VH-OQA, Airbus A380–842,” Australian Transport Safety Bureau, investigation no. AO-2010–089, Sydney.

95 de Crespigny later told me I am indebted to Captain de Crespigny for his time as well as his book, *QF32*. In an interview, de Crespigny emphasized that he is speaking for himself, and not for Qantas, in recalling and describing these events.

99 “models they can use” In response to a fact-checking email, Burian expanded upon her comments and said that her comments should be read in the light of “shifting focus from what was wrong/malfunctioning/not available to what was working/functioning/available was a turning point. I spoke of how this happened for him in this specific situation but generalized to how this shift in mindset has been found to be quite helpful to pilots, particularly when faced with multiple failure conditions. . . . Modern aircraft are highly technically advanced and their system designs are tightly coupled and fairly opaque. This can make it quite difficult for pilots to understand the whys and wherefores of some malfunctions and how multiple malfunctions might be associated with each other. Instead of trying to sort through a myriad of malfunctions and think about how they are connected and the implications they have, shifting focus to an aircraft’s capabilities simplifies the cognitive demands and can facilitate deciding how to do what is needing to be done. . . . Once a critical event has occurred, really good pilots do several things—they try to determine what is most critical to be dealt with first (narrowing of attention) but also pull back from time to time (broadening of attention) to do two things: 1) make sure they are not missing cues/information that might contradict or alter their understanding of their situation and 2) track the overall situation as part of their assessment of the most critical things to be attending to. For example, consider a catastrophic emergency (requiring an emergency landing/ditching) that occurs at cruise altitude. The crew will have some time to deal with the condition, but at some point, their attention should shift from dealing directly with the malfunction/condition to preparing for and executing a ditching/landing. Good pilots are constantly assessing the actions being taken, their efficacy, and needed actions relative to the overall status of the aircraft and phase of flight. Of course, good pilots also fully enlist the help of others in doing all this (i.e., good CRM). Good pilots also do a lot of ‘what if’ exercises before any event occurs, mentally running through a variety of scenarios to think about what they might do, how the situation might unfold, circumstances that would alter the way(s) in which they would respond, etc. General aviation pilots are taught to do something similar during flight when they say to themselves at various points along their route ‘If I were to lose my (only) engine right now (i.e., engine dies), where would I land?’”

99 “land the plane” In response to a fact-checking email, de Crespigny expanded upon his comments: “Dave used [an onboard computer] program to check the landing distance. His first pass resulted in NO SOLUTION because there were too many failures for the program to come up with a landing solution. Dave then simplified the entries for the failures. The LDPA program [the landing distance performance application] then displayed a landing distance

margin of just 100 metres. Whilst Dave and the others were calculating the performance (that turned out to be incorrect anyways because of errors in the LDPA program and more extensive aircraft (brakes) damage than what was reported), I kept a broad situation awareness of the entire operation: aircraft, fuel, critical paths, pilot duties, cabin crew, passengers, air traffic control, emergency services. . . . Simplifying the A380 (with 4,000 parts) down to a Cessna (the flying version of the 1938 Ariel Red Hunter motorcycle) kept things very simple for me, removing the complexity, making each system simple to understand from a mechanical (not mechatronic perspective), simplifying my mental model of the aircraft's systems, freeing up mind-space to manage the entire event. It [is] vital in an emergency that there is a structured hierarchy of responsibility and authority. It's even more important that pilots understand the roles, tasks, and teamwork required in an autonomous team of just two pilots (more in our case on board QF32), isolated from help but in charge of 469 lives."

101 fail every time In response to a fact-checking email, de Crespigny explained that it is impossible to get a simulator to re-create the conditions of QF32, because the problems with the plane were so extreme.

CHAPTER FOUR: GOAL SETTING

103 about to attack For my understanding of the events leading up to the Yom Kippur War, I am indebted to Professor Uri Bar-Joseph, who was kind enough to provide extensive written comments, as well as the following sources: Abraham Rabinovich, *The Yom Kippur War: The Epic Encounter That Transformed the Middle East* (New York: Schocken, 2007); Uri Bar-Joseph, *The Watchman Fell Asleep: The Surprise of Yom Kippur and Its Sources* (Albany: State University of New York Press, 2012); Uri Bar-Joseph, "Israel's 1973 Intelligence Failure," *Israel Affairs* 6, no. 1 (1999): 11–35; Uri Bar-Joseph and Arie W. Kruglanski, "Intelligence Failure and Need for Cognitive Closure: On the Psychology of the Yom Kippur Surprise," *Political Psychology* 24, no. 1 (2003): 75–99; Yosef Kuperwaser, *Lessons from Israel's Intelligence Reforms* (Washington, D.C.: Saban Center for Middle East Policy at the Brookings Institution, 2007); Uri Bar-Joseph and Jack S. Levy, "Conscious Action and Intelligence Failure," *Political Science Quarterly* 124, no. 3 (2009): 461–88; Uri Bar-Joseph and Rose McDermott, "Personal Functioning Under Stress Accountability and Social Support of Israeli Leaders in the Yom Kippur War," *Journal of Conflict Resolution* 52, no. 1 (2008): 144–70; Uri Bar-Joseph, "The Special Means of Collection: The Missing Link in the Surprise of the Yom Kippur War," *The Middle East Journal* 67, no. 4 (2013): 531–46; Yaakov Lapin, "Declassified Yom Kippur War Papers Reveal Failures," *The Jerusalem Post*, September 20,

2012; Hamid Hussain, "Opinion: The Fourth Round—A Critical Review of 1973 Arab-Israeli War," *Defence Journal*, November 2002, <http://www.defencejournal.com/2002/nov/4th-round.htm>; P. R. Kumaraswamy, *Revisiting the Yom Kippur War* (London: Frank Cass, 2000); Charles Liebman, "The Myth of Defeat: The Memory of the Yom Kippur War in Israeli Society," *Middle Eastern Studies* 29, no. 3 (1993): 411; Simon Dunstan, *The Yom Kippur War: The Arab-Israeli War of 1973* (Oxford: Osprey Publishing, 2007); Asaf Siniver, *The Yom Kippur War: Politics, Legacy, Diplomacy* (Oxford: Oxford University Press, 2013).

104 "sharp as possible" Bar-Joseph, *Watchman Fell Asleep*.

105 nothing more than words In an email, the historian Uri Bar-Joseph wrote that the concept was "a set of assumptions that were based on documented information that was passed to Israel by Ashraf Marwan, the son-in-law of late president Nasser and a close advisor to Sadat, who since late 1970 worked for the Mossad. The main assumptions were: (1) Egypt cannot occupy the Sinai without neutralizing the Israeli air-superiority. The way to do it is by attacking the bases of the [Israeli Air Force] at the beginning of the war. In order to do it, Egypt needs long-range attack aircraft which she won't have before 1975; (2) In order to deter Israel from attacking strategic targets in Egypt, Egypt needs Scud missiles that will be able to hit Tel Aviv. Scuds started arriving in Egypt in the summer of 1973 but were not expected to be operational before February 1974. (3) Syria will not go to war without Egypt. Zeira became an ardent believer in these assumptions and turned them into an orthodox conception, which he kept until war started."

106 within the next decade Bar-Joseph and Kruglanski, "Intelligence Failure and Need for Cognitive Closure," 75–99.

107 need for cognitive closure For more on cognitive closure, please see Steven L. Neuberg and Jason T. Newsom, "Personal Need for Structure: Individual Differences in the Desire for Simpler Structure," *Journal of Personality and Social Psychology* 65, no. 1 (1993): 113; Cynthia T. F. Klein and Donna M. Webster, "Individual Differences in Argument Scrutiny as Motivated by Need for Cognitive Closure," *Basic and Applied Social Psychology* 22, no. 2 (2000): 119–29; Carsten K. W. De Dreu, Sander L. Koole, and Frans L. Oldersma, "On the Seizing and Freezing of Negotiator Inferences: Need for Cognitive Closure Moderates the Use of Heuristics in Negotiation," *Personality and Social Psychology Bulletin* 25, no. 3 (1999): 348–62; A. Chirumbolo, A. Areni, and G. Senesales, "Need for Cognitive Closure and Politics: Voting, Political Attitudes and Attributional Style," *International Journal of Psychology* 39 (2004): 245–53; Arie W. Kruglanski, *The Psychology of Closed Mindedness* (New York: Psychology Press, 2013); Arie W. Kruglanski et al., "When Similarity Breeds Content: Need

for Closure and the Allure of Homogeneous and Self-Resembling Groups,” *Journal of Personality and Social Psychology* 83, no. 3 (2002): 648; Steven L. Neuberg and Jason T. Newsom, “Personal Need for Structure: Individual Differences in the Desire for Simpler Structure,” *Journal of Personality and Social Psychology* 65, no. 1 (1993): 113.

107 “confusion and ambiguity” Bar-Joseph, *Watchman Fell Asleep*; Donna M. Webster and Arie W. Kruglanski, “Individual Differences in Need for Cognitive Closure,” *Journal of Personality and Social Psychology* 67, no. 6 (1994): 1049.

108 “need for closure introduces a bias” Bar-Joseph and Kruglanski, “Intelligence Failure and Need for Cognitive Closure,” 75–99.

108 Donna Webster, wrote in 1996 Arie W. Kruglanski and Donna M. Webster, “Motivated Closing of the Mind: ‘Seizing’ and ‘Freezing,’” *Psychological Review* 103, no. 2 (1996): 263.

109 it has been selected *Ibid.*; De Dreu, Koole, and Oldersma, “On the Seizing and Freezing of Negotiator Inferences,” 348–62.

109 we’re making a mistake In an email responding to fact-checking questions, Arie Kruglanski wrote: “People under high need for closure have trouble appreciating others’ perspectives and points of view. People under high need for closure also prefer hierarchical, autocratic, decision making structures in groups because those provide better closure than horizontal or democratic structures that tend to be more chaotic. People under high need for closure are therefore intolerant of diversity, and of dissent in groups and aren’t very creative. Politically, conservatives tend to be higher on need for closure than liberals, but people with high need for closure tend to be more committed to things and values than people low on need for closure.”

110 “should not expect promotion” Bar-Joseph and Kruglanski, “Intelligence Failure and Need for Cognitive Closure,” 75–99.

110 “outside the organization” Uri Bar-Joseph, “Intelligence Failure and Success in the War of Yom Kippur,” unpublished paper.

113 “before war broke out” Abraham Rabinovich, “Three Years Too Late, Golda Meir Understood How War Could Have Been Avoided,” *The Times of Israel*, September 12, 2013.

115 Israelis were killed or wounded Zeev Schiff, *A History of the Israeli Army, 1874 to the Present* (New York: Macmillan, 1985).

115 “generation was nearly lost” Richard S. Lazarus, *Fifty Years of the Research and Theory of RS Lazarus: An Analysis of Historical and Perennial Issues* (New York: Psychology Press, 2013).

115 “Even a quarter century later” Kumaraswamy, *Revisiting the Yom Kippur War*.

115 **good at choosing goals** For my understanding of General Electric, I am indebted to Joseph L. Bower and Jay Dial, “Jack Welch: General Electric’s Revolutionary,” Harvard Business School case study no. 394-065, October 1993, revised April 1994; Francis Aguilar and Thomas W. Malnight, “General Electric Co: Preparing for the 1990s,” Harvard Business School case study no. 9-390, December 20, 1989; Francis J. Aguilar, R. Hamermesh, and Caroline Brainard, “General Electric: Reg Jones and Jack Welch,” Harvard Business School case study no. 9-391-144, June 29, 1991; Kirsten Lungberg, “General Electric and the National Broadcasting Company: A Clash of Cultures,” Harvard University John F. Kennedy School of Government case study, 1989; Nitin Nohria, Anthony J. Mayo, and Mark Benson, “General Electric’s 20th Century CEOs,” Harvard Business School case study, December 2005; Jack Welch and John A. Byrne, *Jack: Straight from the Gut* (New York: Warner, 2003); Larry Greiner, “Steve Kerr and His Years with Jack Welch at GE,” *Journal of Management Inquiry* 11, no. 4 (2002): 343–50; Stratford Sherman, “The Mind of Jack Welch,” *Fortune*, March 27, 1989; Marilyn Harris et al., “Can Jack Welch Reinvent GE?” *BusinessWeek*, June 30, 1986; Mark Potts, “GE Chief Hopes to Shape Agile Giant,” *Los Angeles Times*, June 1, 1988; Noel Tichy and Ram Charan, “Speed Simplicity and Self-Confidence: An Interview with Jack Welch,” *Harvard Business Review*, September 1989; Ronald Grover and Mark Landler, “NBC Is No Longer a Feather in GE’s Cap,” *BusinessWeek*, June 2, 1991; Harry Bernstein, “The Two Faces of GE’s ‘Welchism,’” *Los Angeles Times*, January 12, 1988; “Jack Welch Reinvents General Electric. Again,” *The Economist*, March 30, 1991; L. J. Dans, “They Call Him ‘Neutron,’” *Business Month*, March 1988; Richard Ellsworth and Michael Kraft, “Jack Welch at GE: 1981–1989,” Claremont Graduate School, Peter F. Drucker and Masatoshi Ito Graduate School of Management case study; Peter Petre, “Jack Welch: The Man Who Brought GE to Life,” *Fortune*, January 5, 1987; Peter Petre, “What Welch Has Wrought at GE,” *Fortune*, July 7, 1986; Stephen W. Quickel, “Welch on Welch,” *Financial World*, April 3, 1990; Monica Roman, “Big Changes Are Galvanizing General Electric,” *BusinessWeek*, December 18, 1989; Thomas Stewart, “GE Keeps Those Ideas Coming,” *Fortune*, August 12, 1991.

116 “became the work ‘contract’” Nitin Nohria, Anthony J. Mayo, and Mark Benson, “General Electric’s 20th Century CEOs,” *Harvard Business Review*, December 19, 2005, revised April 2011; John Cunningham Wood and Michael C. Wood, *Peter F. Drucker: Critical Evaluations in Business and Management*, vol. 1 (London: Routledge, 2005).

117 **best way to set goals** Gary P. Latham, Terence R. Mitchell, and Dennis L. Dossett, “Importance of Participative Goal Setting and Anticipated Rewards

on Goal Difficulty and Job Performance,” *Journal of Applied Psychology* 63, no. 2 (1978): 163; Gary P. Latham and Gerard H. Seijts, “The Effects of Proximal and Distal Goals on Performance on a Moderately Complex Task,” *Journal of Organizational Behavior* 20, no. 4 (1999): 421–29; Gary P. Latham and J. James Baldes, “The ‘Practical Significance’ of Locke’s Theory of Goal Setting,” *Journal of Applied Psychology* 60, no. 1 (1975): 122; Gary P. Latham and Craig C. Pinder, “Work Motivation Theory and Research at the Dawn of the Twenty-First Century,” *Annual Review of Psychology* 56 (2005): 485–516; Edwin A. Locke and Gary P. Latham, “Building a Practically Useful Theory of Goal Setting and Task Motivation: A Thirty-Five-Year Odyssey,” *American Psychologist* 57, no. 9 (2002): 705; A. Bandura, “Self-Regulation of Motivation and Action Through Internal Standards and Goal Systems,” in *Goal Concepts in Personality and Social Psychology*, ed. L. A. Pervin (Hillsdale, N.J.: Erlbaum, 1989), 19–85; Travor C. Brown and Gary P. Latham, “The Effects of Goal Setting and Self-Instruction Training on the Performance of Unionized Employees,” *Relations Industrielles/Industrial Relations* 55, no. 1 (2000): 80–95; Judith F. Bryan and Edwin A. Locke, “Goal Setting as a Means of Increasing Motivation,” *Journal of Applied Psychology* 51, no. 3 (1967): 274; Scott B. Button, John E. Mathieu, and Dennis M. Zajac, “Goal Orientation in Organizational Research: A Conceptual and Empirical Foundation,” *Organizational Behavior and Human Decision Processes* 67, no. 1 (1996): 26–48; Dennis L. Dossett, Gary P. Latham, and Terence R. Mitchell, “Effects of Assigned Versus Participatively Set Goals, Knowledge of Results, and Individual Differences on Employee Behavior When Goal Difficulty Is Held Constant,” *Journal of Applied Psychology* 64, no. 3 (1979): 291; Elaine S. Elliott and Carol S. Dweck, “Goals: An Approach to Motivation and Achievement,” *Journal of Personality and Social Psychology* 54, no. 1 (1988): 5; Judith M. Harackiewicz et al., “Predictors and Consequences of Achievement Goals in the College Classroom: Maintaining Interest and Making the Grade,” *Journal of Personality and Social Psychology* 73, no. 6 (1997): 1284; Howard J. Klein et al., “Goal Commitment and the Goal-Setting Process: Conceptual Clarification and Empirical Synthesis,” *Journal of Applied Psychology* 84, no. 6 (1999): 885; Gary P. Latham and Herbert A. Marshall, “The Effects of Self-Set, Participatively Set, and Assigned Goals on the Performance of Government Employees,” *Personnel Psychology* 35, no. 2 (June 1982): 399–404; Gary P. Latham, Terence R. Mitchell, and Dennis L. Dossett, “Importance of Participative Goal Setting and Anticipated Rewards on Goal Difficulty and Job Performance,” *Journal of Applied Psychology* 63, no. 2 (1978): 163; Gary P. Latham and Lise M. Saari, “The Effects of Holding Goal Difficulty Constant on Assigned and Participatively Set Goals,” *Academy of Management Journal* 22, no. 1 (1979): 163–68; Don VandeWalle, William L. Cron, and John W. Slocum, Jr., “The Role of Goal Orientation Fol-

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117 how fast they produced text Gary P. Latham and Gary A. Yukl, “Assigned Versus Participative Goal Setting with Educated and Uneducated Woods Workers,” *Journal of Applied Psychology* 60, no. 3 (1975): 299.

118 “Making yourself break a goal” In an email responding to fact-checking questions, Latham wrote that achieving goals also requires access to the necessary resources and feedback on goal progress. “For long-term/distal goals, proximal/sub goals should be set. Sub goals do two things: maintain motivation for attaining the distal goal as the attainment of one sub goal leads to the desire to attain another sub goal. Second, feedback from pursuit of each sub goal yields information as to whether you are on- or off-track.”

120 Latham wrote in 1990 Edwin A. Locke and Gary P. Latham, “New Directions in Goal-Setting Theory,” *Current Directions in Psychological Science* 15, no. 5 (2006): 265–68.

120 “the right things,” said Latham In an email responding to fact-checking questions, Latham wrote: “When people lack the ability to attain a performance goal, that is, a goal having to do with a specific desired result such as a golf score of 80 or a 23% increase in revenue, [improper focus or tunnel vision] may occur. The solution is to set a specific, challenging learning goal where the emphasis is on discovering/developing a process, procedure, system that will enable you to improve your performance such as [coming] up with 5 ways you can improve your putting as opposed to put the ball in the cup in no more than 2 strokes.”

121 business school, for help Kerr was initially one of twenty-four consultants brought in by Jack Welch to expand Work-Outs throughout GE.

121 more long-term plans Noel M. Tichy and Stratford Sherman, “Walking the Talk at GE,” *Training and Development* 47, no. 6 (1993): 26–35; Ronald Henkoff, “New Management Secrets from Japan,” *Fortune*, November 27, 1995; Ron Ashkenas, “Why Work-Out Works: Lessons from GE’s Transformation Process,” *Handbook of Business Strategy* 4, no. 1 (2003): 15–21; Charles Fishman, “Engines of Democracy,” *Fast Company*, October 1999, <http://www.fastcompany.com/37815/engines-democracy>; Thomas A. Stewart, “GE Keeps Those Ideas Coming,” in Rosabeth Moss Kanter, Barry A. Stein, and Todd D. Jick, *The Challenge of Organizational Change: How Companies Experience It and Leaders Guide It* (New York: The Free Press, 1992): 474–482; Joseph P. Cosco, “General Electric Works It All Out,” *Journal of Business Strategy* 15, no. 3 (1994): 48–50.

121 “turn out great” In an email responding to fact-checking questions, Kerr wrote: “I stressed to the leadership teams that ‘saying no to a bad idea is as useful as saying yes to a good one,’ but that they couldn’t dismiss any recommendation by saying things like: ‘We thought of that already,’ or ‘We tried it before and it didn’t work.’ I always made the point that Work-Outs present a terrific opportunity to teach people about the business, and that they owed people a professional, courteous explanation as to why they didn’t support a particular recommendation.”

121 SMART criteria In an email responding to fact-checking questions, Kerr wrote that he never encouraged people to submit proposals without a rough plan and timeline. “The details of the plan would have to be sketched out after approval,” he wrote.

122 “ideas are fair game” Cosco, “General Electric Works It All Out,” 48–50.

123 Japan’s railway system Ronald Henkoff, “New Management Secrets from Japan,” *Fortune*, November 27, 1995.

123 invent a faster train The story of Japan’s bullet train as it was told to Jack Welch (and has been repeated in popular nonfiction) differs slightly from the historical record. The account given here reflects the story that was told to Welch, but there are some details that story did not include, such as the fact that the concept for high-speed rail was explored but then abandoned by the Japanese railway prior to World War II. In an email responding to fact-checking questions, a representative of the Central Japan Railway Company wrote that in the 1950s the “Tokaido Line, the main line of Japan, was very crowded and [passengers had] been increasing because of the economical growth after the war, and Japan had to meet the growing needs of passengers to move between Tokyo (capital and largest city) and Osaka (second largest city). Actually there was a concept of ‘Bullet train’ before the WWII, [in] 1939 . . . but because of the war, that plan [had] been suspended. Japan National Railway decided to build [a] new line by standard gauge (many of Japanese conventional [lines adopted] narrow gauge) in 1957. The plan [was accepted] in 1958 by the government and construction had started.” It is also worth noting that private efforts at developing faster trains were also occurring at the same time in Japan. The Odakyu Electric Railway, for instance, was developing a train capable of going ninety miles per hour. For a better understanding of the history of the bullet train, I recommend Toshiji Takatsu, “The History and Future of High-Speed Railways in Japan,” *Japan Railway and Transport Review* 48 (2007): 6–21; Mamoru Taniguchi, “High Speed Rail in Japan: A Review and Evaluation of the Shinkansen Train” (working paper no. UCTC 103, University of California Transportation Center, 1992); Roderick Smith, “The Japanese Shinkansen: Catalyst for the

Renaissance of Rail,” *The Journal of Transport History* 24, no. 2 (2003): 222–37; Moshe Givoni, “Development and Impact of the Modern High-Speed Train: A Review,” *Transport Reviews* 26, no. 5 (2006): 593–611.

123 120 miles per hour In an email responding to fact-checking questions, a representative of the Central Japan Railway Company wrote that “in Japan, [a] JNR (Japan National Railway) engineer was considered [the] elite of Japanese engineers at that time, and the engineer who designed Shinkansen (Mr. Shima) was one of the engineers of JNR. . . . He [had] been working in JNR [a] long time already and had knowledge and experience about railways.” Mr. Shima, the spokesperson noted, was asked, starting in 1955, to oversee Tōkaidō Shinkansen. “At the time of the bullet train project in 1939 I mentioned before, they were already planning to design trains which have [a max speed of] 125 mph. [The] engineer of Shinkansen had the clear aim of tying Tokyo to Osaka by 3 hours from the beginning, and [the] prototype called ‘Series 1000’ achieved 256 km/h (160 mph) in 1963.”

124 into the 1980s Andrew B. Bernard, Andreas Moxnes, and Yukiko U. Saito, *Geography and Firm Performance in the Japanese Production Network* (working paper no. 14034, National Bureau of Economic Research, 2014).

125 “bullet train thinking” S. Kerr and S. Sherman, “Stretch Goals: The Dark Side of Asking for Miracles,” *Fortune*, November 13, 1995; Sim B. Sitkin et al., “The Paradox of Stretch Goals: Organizations in Pursuit of the Seemingly Impossible,” *Academy of Management Review* 36, no. 3 (2011): 544–66; Scott Jeffrey, Alan Webb, and Axel K-D. Schulz, “The Effectiveness of Tiered Goals Versus Stretch Goals,” CAAA 2006 Annual Conference Paper (2006); Kenneth R. Thompson, Wayne A. Hochwarter, and Nicholas J. Mathys, “Stretch Targets: What Makes Them Effective?” *The Academy of Management Executive* 11, no. 3 (1997): 48–60; S. Kerr and D. LePelley, “Stretch Goals: Risks, Possibilities, and Best Practices,” *New Developments in Goal Setting and Task Performance* (2013): 21–31; Steven Kerr and Steffen Landauer, “Using Stretch Goals to Promote Organizational Effectiveness and Personal Growth: General Electric and Goldman Sachs,” *The Academy of Management Executive* 18, no. 4 (2004): 134–38; Kelly E. See, “Motivating Individual Performance with Challenging Goals: Is It Better to Stretch a Little or a Lot?” (manuscript presented for publication, Duke University, June 2003); Adrian D. Manning, David B. Lindenmayer, and Joern Fischer, “Stretch Goals and Backcasting: Approaches for Overcoming Barriers to Large-Scale Ecological Restoration,” *Restoration Ecology* 14, no. 4 (2006): 487–92; Jim Heskett, “Has the Time Come for ‘Stretch’ in Management?” Harvard Business School, *Working Knowledge*, August 1, 2008, <http://hbswk.hbs.edu/item/5989.html>.

126 their own workflow Fishman, “Engines of Democracy,” 33.

126 goal would have done that In an email responding to fact-checking questions, a spokesman for General Electric wrote that “the Durham plant was created with the flexibility to make such dramatic change[s]. Many adjustments were in process when the plant was opened in 1992. Durham from its inception was created as an ‘incubator’ for new manufacturing practices at GE Aviation. Yes, Jack [Welch] set the bar high—but given the aggressive competition in the aviation business, these goals were a requirement to be successful and to generate the kind of income necessary to fund new engine developments at that time (namely the GE90).”

127 throughout the firm Thompson, Hochwarter, and Mathys, “Stretch Targets,” 48–60.

127 Thinsulate William E. Coyne, “How 3M Innovates for Long-Term Growth,” *Research-Technology Management* 44, no. 2 (2001): 21–24.

127 “broad search, or playfulness” Sitkin et al., “Paradox of Stretch Goals,” 544–66.

128 the researchers wrote Jeffrey, Webb, and Schulz, “The Effectiveness of Tiered Goals Versus Stretch Goals.”

128 University of Waterloo Ibid.

128 University of Melbourne Thompson, Hochwarter, and Mathys, “Stretch Targets,” 48–60.

129 our in-box Gil Yolanda et al., “Capturing Common Knowledge About Tasks: Intelligent Assistance for To-Do Lists,” *ACM Transactions on Interactive Intelligent Systems (TiiS)* 2, no. 3 (2012): 15; Victoria Bellotti et al., “What a To-Do: Studies of Task Management Towards the Design of a Personal Task List Manager,” *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (2004): 735–42; Gabriele Oettingen and Doris Mayer, “The Motivating Function of Thinking About the Future: Expectations Versus Fantasies,” *Journal of Personality and Social Psychology* 83, no. 5 (2002): 1198; Anja Achtziger et al., “Metacognitive Processes in the Self-Regulation of Goal Pursuit,” in *Social Metacognition*, ed. Pablo Briñol and Kenneth DeMarree, *Frontier of Social Psychology* series (New York: Psychology Press, 2012), 121–39.

131 throughout corporate America Critics of stretch goals say that, if unconstrained, they can negatively impact an organization. For more, please see Lisa D. Ordóñez et al., “Goals Gone Wild: The Systematic Side Effects of Overprescribing Goal Setting,” *The Academy of Management Perspectives* 23, no. 1 (2009): 6–16. And the response of Edwin A. Locke and Gary P. Latham, “Has Goal Setting Gone Wild, or Have Its Attackers Abandoned Good Scholarship?” *The Academy of Management Perspectives* 23, no. 1 (2009): 17–23.

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133 all to blame Mitch Ginsberg, “40 Years On, Yom Kippur War Intel Chiefs Trade Barbs,” *The Times of Israel*, October 6, 2013; “Eli Zeira’s Mea Culpa,” *Haaretz*, September 22, 2004; Lilach Shoval, “Yom Kippur War Intelligence Chief Comes Under Attack 40 Years Later,” *Israel Hayom*, October 7, 2013.

133 “You are lying!” Ibid.

CHAPTER FIVE: MANAGING OTHERS

134 shoo them away As mentioned in the chapter, the Federal Bureau of Investigation and Frank, Christie, and Colleen Janssen were all provided with summaries of this chapter and asked to respond to the details of this reporting. The FBI declined to comment, except as specified below. The Janssen family did not reply to repeated attempts to seek their comments by telephone and mail. The sources used in reporting details of the Janssen case include interviews as well as documents from *United States of America v. Kelvin Melton, Quantavious Thompson, Jakym Camel Tibbs, Tianna Daney Maynard, Jenna Martin, Clifton James Roberts, Patricia Ann Kramer, Jevante Price, and Michael Martell Gooden* (nos. 5:14-CR-72-1; 5:14-CR-72-2; 5:14-CR-72-3; 5:14-CR-72-4; 5:14-CR-72-5; 5:14-CR-72-6; 5:14-CR-72-7; 5:14-CR-72-8; 5:14-CR-72-9), filed in the U.S. District Court for the Eastern District of North Carolina Western Division; Affidavit in Support of Application for a Court Order Approving Emergency Interceptions, in the Matter of the Application of the United States of America for an Order Authorizing the Interception of Wire and Electronic Communications, no. 5:14-MJ-1315-D, filed in the U.S. District Court Eastern District of North Carolina Western Division; *United States v. Kelvin Melton*, Criminal Case no. 5:14-MJ-1316, filed in the U.S. District Court Eastern District of North Carolina; *United States v. Clifton James Roberts*, Criminal Case no. 5:14-MJ-1313, filed in the U.S. District Court Eastern District of North Carolina; *United States v. Chason Renee Chase, a/k/a “Lady Jamaica,”* Criminal Case no. 3:14-MJ-50, filed in the U.S. District Court for the District of South Carolina, and other court filings related to the alleged Janssen abduction. Details also came from Alan G. Breed and Michael Biesecker, “FBI: NC Inmate Helped Orchestrate Kidnapping,” Associated Press, April 11, 2014; Kelly Gardner, “FBI Now Investigating Wake Forest Man’s Disappearance,” WRAL.com, April 8, 2014; Alyssa Newcomb, “FBI Rescued Kidnap Victim as Suspects Discussed Killing Him, Feds Say,” *Good Morning America*, April 10, 2014; Anne Blythe and Ron Gallagher, “FBI Rescues Wake Forest Man; Ab-

duction Related to Daughter's Work as Prosecutor, Investigators Say," *The Charlotte Observer*, April 10, 2014; Michael Biesecker and Kate Brumbach, "NC Inmate Charged in Kidnapping of DA's Father," Associated Press, April 12, 2014; Lydia Warren and Associated Press, "Bloods Gang Member Who Is Serving Life Sentence 'Masterminded Terrifying Kidnap of Prosecutor's Father Using a Cell Phone He'd Smuggled in to Prison,'" *Daily Mail*, April 11, 2014; Lydia Warren and Associated Press, "Gang Members Who 'Kidnapped Prosecutor's Father and Held Him Captive for Days Had Meant to Capture HER—But They Went to Wrong Address,'" *Daily Mail*, April 23, 2014; Ashley Frantz and AnneClaire Stapleton, "Prosecutor's Dad Kidnapped in 'Elaborate' Plot; FBI Rescues Him," CNN.com, April 10, 2014; Shelley Lynch, "Kidnapping Victim Rescued by FBI Reunited with Family," FBI press release, April 10, 2014, <https://www.fbi.gov/charlotte/press-releases/2014/kidnapping-victim-rescued-by-fbi-reunited-with-family>; Scott Pelley and Bob Orr, "FBI Told How Its Agents Rescued a North Carolina Man Who Was Kidnapped by Gang Members and Terrorized for Five Days," *CBS Evening News*, April 10, 2014; Marcus K. Garner, "Indictment: Kidnapping Crew Had Wrong Address, Took Wrong Person," *Atlanta Journal Constitution*, April 22, 2014; Andrew Kenney, "Prisoner Charged in Kidnap Conspiracy May Have Had Phone for Weeks," *The Charlotte Observer*, April 11, 2014; "Criminal Complaint Filed Against Kelvin Melton in Kidnapping Case," FBI press release, April 11, 2014, <https://www.fbi.gov/charlotte/press-releases/2014/criminal-complaint-filed-against-kelvin-melton-in-kidnapping-case>; Colleen Jenkins and Bernadette Baum, "Two More Charged in Gang-Linked Kidnapping of N.C. Prosecutor's Father," Reuters, April 16, 2014; "McDonald's Receipt Leads to Arrest in Wake Forest Kidnapping," *The News and Observer*, April 17, 2014; "Prosecutor—Not Her Father—Was Intended Victim in Wake Forest Kidnapping, Officials Say," *The News and Observer*, April 22, 2014; Patrik Jonsson, "N.C. Prosecutor Kidnap Plot: Home Attacks on Justice Officials on the Upswing," *The Christian Science Monitor*, April 23, 2014; "NC Kidnapping Victim Writes Thank-You Letter," Associated Press, April 29, 2014; Thomas McDonald, "Documents Detail Kidnapping Plot of Wake Prosecutor's Father," *The Charlotte Observer*, July 23, 2014; Daniel Wallis, "Alleged Gangster Admits Lying in North Carolina Kidnap Probe," Reuters, August 29, 2014; Spink John, "FBI Team Rescues a North Carolina Kidnapping Victim," *Atlanta Journal Constitution*, April 11, 2014.

137 Melton's daughters Some observers of the Janssen case have suggested that authorities used a device known as a "stingray," which can identify the precise location of a cellphone, in this investigation. The FBI, when asked about use of a stingray in this case, replied with a response the agency has provided about cell site simulators to other media requests: "Location information is a

vital component of law enforcement investigations at the federal, state and local levels. As a general matter, the FBI does not discuss specific techniques used by law enforcement to obtain location information, as they are considered Law Enforcement Sensitive, the public release of which could harm law enforcement efforts at all levels by compromising future use of the technique. The FBI only collects and maintains information that has investigative value and relevance to a case, and such data [are] retained in accordance with controlling federal law and Attorney General policy. The FBI does not keep repositories of cell tower data for any purpose other than in connection with a specific investigation. The collection of cell tower records is only performed after required FBI approvals are received in the specific investigation, and only after the appropriate order is obtained from a court. If the records obtained are deemed relevant, the specific records are made part of the investigative case file. The FBI retains investigative case files in accordance with NARA-approved file retention schedules. If the FBI believes the use of any technology or technique may provide information on an individual where case law dictates that person has a reasonable expectation of privacy, it is FBI policy to obtain a search warrant.”

137 directed by Melton himself As noted in the chapter, the details regarding Kelvin Melton, Tianna Brooks (who also allegedly goes by the name Tianna Maynard), and other alleged kidnapers or those allegedly connected to the Janssen kidnapping are contained in court documents or interviews. At the time of writing, Melton, Brooks, and others implicated in this crime have been indicted, but have not gone to trial. Until a trial is conducted and a verdict rendered, allegations remain just that, allegations, and the crimes described in this chapter have not been proven in a court of law. In January 2016, Melton told a court that he was not responsible for the Janssen kidnapping. Other alleged kidnapers are also expected to deny responsibility or guilt. Melton’s attorneys, as well as Brooks’s attorney, were presented with synopses of all details in this chapter and asked to inquire if their clients, who are incarcerated on other charges or awaiting trial, wished to respond. Brooks’s lawyer did not reply. Melton’s lawyer, Ryan D. Stump, in an email wrote: “We are under a court order not to discuss the details of Mr. Melton’s case and what is contained in the discovery. Unfortunately, due to the restrictions, we are not able to make any comments on the case.”

138 predecessors decades before In response to a fact-checking email, a spokeswoman for the FBI said that the bureau’s system prior to Sentinel, in addition to using index cards, also used an electronic indexing system. Interviews with agents confirmed this, but said that the electronic system was often incomplete and thus unreliable.

138 rolled out Sentinel In response to a fact-checking email, a spokeswoman for the FBI detailed Sentinel this way: “Sentinel is a tool that manages

records; it documents case activities and investigations, the information we own and produce. Sentinel provides a piece of the puzzle. It documents the FBI's work products and is used in conjunction with information we collect or access through other partnerships in order to further data."

138 "agile programming" The words "lean" and "agile" have come to mean different things in different settings. There is, for example, lean product development, lean start-ups, agile management, and agile construction. Some of these definitions or methodologies are very specific. In this chapter, I generally use the phrases in their most global sense. However, for more detailed explanations of the various implementations of these philosophies, I recommend Rachna Shah and Peter T. Ward, "Lean Manufacturing: Context, Practice Bundles, and Performance," *Journal of Operations Management* 21, no. 2 (2003): 129–49; Jeffrey K. Liker, *Becoming Lean: Inside Stories of U.S. Manufacturers* (Portland, Ore.: Productivity Press, 1997); J. Ben Naylor, Mohamed M. Naim, and Danny Berry, "Leagility: Integrating the Lean and Agile Manufacturing Paradigms in the Total Supply Chain," *International Journal of Production Economics* 62, no. 1 (1999): 107–18; Robert Cecil Martin, *Agile Software Development: Principles, Patterns, and Practices* (Upper Saddle River, N.J.: Prentice Hall, 2003); Paul T. Kidd, *Agile Manufacturing: Forging New Frontiers* (Reading, Mass.: Addison-Wesley, 1995); Alistair Cockburn, *Agile Software Development: The Cooperative Game* (Upper Saddle River, N.J.: Addison-Wesley, 2006); Pekka Abrahamsson, Outi Salo, and Jussi Ronkainen, *Agile Software Development Methods: Review and Analysis* (Oulu, Finland: VTT Publications, 2002).

139 "aphrodisiac in Northern California" Rick Madrid passed away in 2012. For my understanding of Mr. Madrid, NUMMI, and General Motors, I am deeply indebted to Frank Langfitt of National Public Radio, Brian Reed of *This American Life*, and other reporters from various newspapers and media organizations who were kind enough to share notes and transcripts with me, as well as Madrid's former colleagues, who shared memories of him. Details on Madrid, including his quotes, draw on a variety of sources, including tapes of interviews with him, notes and transcripts from interviews he gave to other reporters, and recollections of colleagues. In addition, I relied upon Harry Bernstein, "GM Workers Proud of Making the Team," *Los Angeles Times*, June 16, 1987; Clara Germani, "GM-Toyota Venture in California Breaks Tradition, Gets Results," *The Christian Science Monitor*, December 21, 1984; Michelle Levander, "The Divided Workplace: Exhibit Traces Battle for Control of Factory," *Chicago Tribune*, September 17, 1989; Victor F. Zonana, "Auto Venture at Roadblock: GM-Toyota Fremont Plant Produces Happy Workers, High-Quality Product—and a Glut of Unsold Chevrolet Novas," *Los Angeles Times*, December 21, 1987; "NUMMI," *This American Life*, WBEZ Chicago, March 26, 2010; Charles O'Reilly III, "New United Motors Manufacturing, Inc. (NUMMI),"

Stanford Business School Case Studies, no. HR-11, December 2, 1998; Maryann Keller, *Rude Awakening: The Rise, Fall, and Struggle for Recovery of General Motors* (New York: William Morrow, 1989); Joel Smith and William Childs, "Imported from America: Cooperative Labor Relations at New United Motor Manufacturing, Inc.," *Industrial Relations Law Journal* (1987): 70–81; John Shook, "How to Change a Culture: Lessons from NUMMI," *MIT Sloan Management Review* 51, no. 2 (2010): 42–51; Michael Maccoby, "Is There a Best Way to Build a Car?" *Harvard Business Review*, November 1997; Daniel Roos, James P. Womack, and Daniel Jones, *The Machine That Changed the World: The Story of Lean Production* (New York: HarperPerennial, 1991); Jon Gertner, "From 0 to 60 to World Domination," *The New York Times*, February 18, 2007; Ceci Connolly, "Toyota Assembly Line Inspires Improvements at Hospital," *The Washington Post*, June 3, 2005; Andrew C. Inkpen, "Learning Through Alliances: General Motors and NUMMI," *Strategic Direction* 22, no. 2 (2006); Paul Adler, "The 'Learning Bureaucracy': New United Motor Manufacturing, Inc." *Research in Organizational Behavior* 15 (1993); "The End of the Line For GM-Toyota Joint Venture," *All Things Considered*, NPR, March 2010; Martin Zimmerman and Ken Basinger, "Toyota Considers Halting Operations at California's Last Car Plant," *Los Angeles Times*, July 24, 2009; Soyoung Kim and Chang-ran Kim, "UPDATE 1—Toyota May Drop U.S. Joint Venture with GM," Reuters, July 10, 2009; Alan Ohnsman and Kae Inoue, "Toyota Will Shut California Plant in First Closure," Bloomberg, August 28, 2009; Jeffrey Liker, *The Toyota Way: 14 Management Principles from the World's Greatest Manufacturer* (New York: McGraw-Hill, 2003); Steven Spear and H. Kent Bowen, "Decoding the DNA of the Toyota Production System," *Harvard Business Review* 77 (1999): 96–108; David Magee, *How Toyota Became #1: Leadership Lessons from the World's Greatest Car Company* (New York: Penguin, 2007).

139 covered his tattoos Keller, *Rude Awakening*, chapter 6.

140 the Fremont plant In a statement sent in response to fact-checking questions, a spokesman for Toyota wrote: "Toyota can't speak to any of the descriptions of the Fremont facility while it operated prior to the independent joint venture with GM. While the broad descriptions of Toyota's philosophy and certain historical facts are consistent with our approach and understanding of events—such as the use of the andon cord, the trip for former GM workers to Japan and the improvement in product quality following the formation of NUMMI—we are unfortunately unable to confirm or provide any other feedback on the specific accounts you provide. However, we can provide the following statement from the company on the NUMMI joint venture, which you are welcome to use if you so choose: 'NUMMI was a groundbreaking model of Japan-U.S. industry collaboration, and we are proud of all its considerable achievements. We remain grateful to all of those involved with NUMMI,

including the suppliers, the local community and, most of all, the talented team members who have contributed to the success of this pioneering joint venture.’” In a statement, a spokeswoman for General Motors wrote: “I can’t comment on the specific points you shared re the experience at Fremont and NUMMI in the early 1980s, but I can *absolutely* confirm that is not the experience in GM plants today. . . . GM’s Global Manufacturing System is a single, common manufacturing system that aligns and engages all employees to use best processes, practices and technologies to eliminate waste throughout the enterprise. . . . While it is true that GMS has its roots in the Toyota Production System (TPS) that was implemented at NUMMI in 1984, many components of GMS grew out of our efforts to benchmark lean manufacturing around the world. . . . While all principles and elements are considered crucial to the successful implementation of GMS, one principle is key to GMS’s adaptability, and that is Continuous Improvement. By engaging our employees, we have seen them use GMS to improve our production systems, ensure a safer work environment and improve product quality for our customers.”

140 low costs in Japan In a fact-checking email, Jeffrey Liker, who has studied and written extensively about Toyota, wrote: “Toyota realized that to be a global company they needed to set up operations overseas and they had little experience doing it outside of sales. They believed that the Toyota Production System was vital to their success and it was highly dependent on people deeply understanding the philosophy and continuously improving in an environment of trust. They saw NUMMI as a grand experiment to test whether they could make TPS work in the United States with American workers and managers. In fact, in the original agreement with GM they planned on only making Chevy vehicles and when these did not sell because of the negative image of the Chevy brand they brought over the Toyota Corolla. For GM the main attraction was to get some small cars built of good quality profitably and learn how to do this. They seemed to have a passing interest in TPS. For Toyota NUMMI was considered a critical milestone to their future and they studied what was happening every single day to learn as much as they possibly could about operating in the US and developing the Toyota culture overseas.”

145 prove their assertion right In response to a fact-checking email, Baron wrote: “Our focus was a bit broader than ‘culture.’ We were interested in how founders’ early choices about organizational design and structuring of employment relationships affected the evolution of their nascent enterprises.”

145 “answer a questionnaire” In response to a fact-checking email, Baron wrote that the sources they turned to exceeded just the *San Jose Mercury News*: “We scoured a variety of sources, including the ‘Merc,’ to try to identify evidence of new foundings. That was supplemented by industry listings from companies like CorpTech (which focuses on marketing targeted to small

tech companies). From these sources we put together listings of companies by subsector (biotechnology, semiconductors, etc.). Then we sampled from those listings, seeking to get a representative sampling of firms in terms of age, venture-backed versus not, etc. Somewhat later, after ‘the Internet’ had emerged as a discernible sector, we replicated the research design focusing specifically on that sector, to see if things were similar or different among the new net companies from the others that we had been studying, and we found the patterns were the same.”

146 close to two hundred firms James N. Baron and Michael T. Hannan, “The Economic Sociology of Organizational Entrepreneurship: Lessons from the Stanford Project on Emerging Companies,” in *The Economic Sociology of Capitalism*, ed. Victor Nee and Richard Swedberg (New York: Russell Sage, 2002), 168–203; James N. Baron and Michael T. Hannan, “Organizational Blueprints for Success in High-Tech Start-Ups: Lessons from the Stanford Project on Emerging Companies,” *Engineering Management Review, IEEE* 31, no. 1 (2003): 16; James N. Baron, M. Diane Burton, and Michael T. Hannan, “The Road Taken: Origins and Evolution of Employment Systems in Emerging Companies,” *Articles and Chapters* (1996): 254; James N. Baron, Michael T. Hannan, and M. Diane Burton, “Building the Iron Cage: Determinants of Managerial Intensity in the Early Years of Organizations,” *American Sociological Review* 64, no. 4 (1999): 527–47.

146 collected enough data In response to a fact-checking email, Baron wrote: “Perhaps this is nit-picking, but what we were looking at were firms whose founders had similar cultural ‘blueprints’ or premises underlying their creation. I emphasize this because we were not using observable practices as the basis for differentiation, but instead the way in which founders thought and spoke about their nascent enterprises.”

146 one of five categories There were also a sizable number of firms that did not fit neatly into any of the five categories.

147 “on the same path” In response to a fact-checking email, Baron said that he should not be considered an expert on Facebook, and that participants in the study were promised anonymity. He added: “We found that engineering firms fairly frequently evolved, either into bureaucracies or into commitment firms. Those transitions were much less disruptive than others, suggesting that one reason for the popularity of the engineering blueprint at start-up is that it is amenable to being ‘morphed’ into a different model as the firm matures.”

147 “You get paid,” Baron said Baron, in response to a fact-checking email, said that the bureaucratic and the autocratic models have differences but are similar in that “(1) they are both quite infrequent within this sector

among start-ups; and (2) they are both unpopular with scientific and technical personnel.”

148 successful companies in the world The researchers promised confidentiality to companies that participated in the study, and would not divulge specific firms they had studied.

148 culture came through James N. Baron, Michael T. Hannan, and M. Diane Burton, “Labor Pains: Change in Organizational Models and Employee Turnover in Young, High-Tech Firms,” *American Journal of Sociology* 106, no. 4 (2001): 960–1012.

148 California Management Review Baron and Hannan, “Organizational Blueprints for Success in High-Tech Start-Ups,” 16.

150 “strong advantage” In response to a fact-checking email, Baron expanded upon his comments: “What this doesn’t explicitly capture is that commitment firms tended to compete based on superior relationships with their customers over the longer term. It is not just relationships with salespeople, but rather that stable teams of technical personnel, working interdependently with customer-facing personnel, enable these companies to develop technologies that met the needs of their long-term customers.”

151 “viability of the Company” Steve Babson, ed., *Lean Work: Empowerment and Exploitation in the Global Auto Industry* (Detroit: Wayne State University Press, 1995).

151 preserve their jobs In a fact-checking email, Jeffrey Liker wrote that Toyota’s head of human resources had told a UAW representative that “before laying off any workers they would insource work, then management would take a payout and then they would cut back hours before considering layoffs. In return he said the union needed to agree on three things: 1) competence would be the basis for workers advancing, not seniority, 2) there had to be a minimum of job classifications so they had the flexibility to do multiple jobs, and 3) management and the union would work together on productivity improvements. Within the first year the Chevy Nova was not selling well and they had about 40% too many workers and they kept them all employed in training and doing *kaizen* for several months until they could get the Corolla into production.”

154 Harvard researchers wrote Paul S. Adler, “Time-and-Motion Regained,” *Harvard Business Review* 71, no. 1 (1993): 97–108.

155 shared power It is important to note that, despite NUMMI’s success, the company was not perfect. Its fortunes were tied to the automotive industry, and so when overall car sales declined, NUMMI’s profits dipped as well. The NUMMI factory was more expensive to operate than some low-cost foreign

competitors, and so there were stretches when the firm was undersold. And when GM tried to export NUMMI's culture to other plants, they found, in some places, it wouldn't take. Enmities between union leaders and managers were simply too deep. Some executives refused to believe that workers, if empowered, would use their authority responsibly. Some employees were unwilling to give GM the benefit of the doubt.

155 “devoted to each other” When the Great Recession hit the automotive industry, NUMMI was one of the casualties. GM, headed toward bankruptcy because of liabilities in other parts of the company, pulled out of the NUMMI partnership in 2009. Toyota concluded it couldn't continue to operate the plant on its own. NUMMI closed in 2010, after manufacturing nearly eight million vehicles.

156 no end in sight Details on development of the Sentinel system come from interviews and Glenn A. Fine, *The Federal Bureau of Investigation's Pre-Acquisition Planning for and Controls over the Sentinel Case Management System*, Audit Report 06-14 (Washington, D.C.: U.S. Department of Justice, Office of the Inspector General, Audit Division, March 2006); Glenn A. Fine, *Sentinel Audit II: Status of the Federal Bureau of Investigation's Case Management System*, Audit Report 07-03 (Washington, D.C.: U.S. Department of Justice, Office of the Inspector General, Audit Division, December 2006); Glenn A. Fine, *Sentinel Audit III: Status of the Federal Bureau of Investigation's Case Management System*, Audit Report 07-40 (Washington, D.C.: U.S. Department of Justice, Office of the Inspector General, Audit Division, August 2007); Raymond J. Beaudet, *Sentinel Audit IV: Status of the Federal Bureau of Investigation's Case Management System*, Audit Report 09-05 (Washington, D.C.: U.S. Department of Justice, Office of the Inspector General, Audit Division, December 2008); Glenn A. Fine, *Sentinel Audit V: Status of the Federal Bureau of Investigation's Case Management System*, Audit Report 10-03 (Washington, D.C.: U.S. Department of Justice, Office of the Inspector General, Audit Division, November 2009); *Status of the Federal Bureau of Investigation's Implementation of the Sentinel Project*, Audit Report 10-22 (Washington, D.C.: U.S. Department of Justice, Office of the Inspector General, March 2010); Thomas J. Harrington, “Response to OIG Report on the FBI's Sentinel Project,” FBI press release, October 20, 2010, https://www.fbi.gov/news/pressrel/press-releases/mediareponse_102010; Cynthia A. Schnedar, *Status of the Federal Bureau of Investigation's Implementation of the Sentinel Project*, Report 12-08 (Washington, D.C.: U.S. Department of Justice, Office of the Inspector General, December 2011); Michael E. Horowitz, *Interim Report on the Federal Bureau of Investigation's Implementation of the Sentinel Project*, Report 12-38 (Washington, D.C.: U.S. Department of Justice, Office of the Inspector General, September 2012);

Michael E. Horowitz, *Audit of the Status of the Federal Bureau of Investigation's Sentinel Program*, Report 14-31 (Washington, D.C.: U.S. Department of Justice, Office of the Inspector General, September 2014); William Anderson et al., *Sentinel Report* (Pittsburgh: Carnegie Mellon Software Engineering Institute, September 2010); David Perera, "Report Questions FBI's Ability to Implement Agile Development for Sentinel," *FierceGovernmentIT*, December 5, 2010, <http://www.fiercегovernmentit.com/story/report-questions-fbis-ability-implement-agile-development-sentinel/2010-12-05>; David Perera, "FBI: We'll Complete Sentinel with \$20 Million and 67 Percent Fewer Workers," *FierceGovernmentIT*, October 20, 2010, <http://www.fiercегovernmentit.com/story/fbi-well-complete-sentinel-20-million-and-67-percent-fewer-workers/2010-10-20>; Jason Bloomberg, "How the FBI Proves Agile Works for Government Agencies," *CIO*, August 22, 2012, <http://www.cio.com/article/2392970/agile-development/how-the-fbi-proves-agile-works-for-government-agencies.html>; Eric Lichtblau, "FBI Faces New Setback in Computer Overhaul," *The New York Times*, March 18, 2010; "More Fallout from Failed Attempt to Modernize FBI Computer System," Office of Senator Chuck Grassley, July 21, 2010; "Technology Troubles Plague FBI, Audit Finds," *The Wall Street Journal*, October 20, 2010; "Audit Sees More FBI Computer Woes," *The Wall Street Journal*, October 21, 2010; "FBI Takes Over Sentinel Project," *Information Management Journal* 45, no. 1 (2011); Curt Anderson, "FBI Computer Upgrade Is Delayed," Associated Press, December 23, 2011; Damon Porter, "Years Late and Millions over Budget, FBI's Sentinel Finally On Line," *PC Magazine*, July 31, 2012; Evan Perez, "FBI Files Go Digital, After Years of Delays," *The Wall Street Journal*, August 1, 2012.

156 Toyota Production System philosophy to other industries For more on lean and agile management and methodologies, please see Craig Larman, *Agile and Iterative Development: A Manager's Guide* (Boston: Addison-Wesley Professional, 2004); Barry Boehm and Richard Turner, *Balancing Agility and Discipline: A Guide for the Perplexed* (Boston: Addison-Wesley Professional, 2003); James Shore, *The Art of Agile Development* (Farnham, UK: O'Reilly Media, 2007); David Cohen, Mikael Lindvall, and Patricia Costa, "An Introduction to Agile Methods," *Advances in Computers* 62 (2004): 1–66; Matthias Holweg, "The Genealogy of Lean Production," *Journal of Operations Management* 25, no. 2 (2007): 420–37; John F. Krafcik, "Triumph of the Lean Production System," *MIT Sloan Management Review* 30, no. 1 (1988): 41; Jeffrey Liker and Michael Hoseus, *Toyota Culture: The Heart and Soul of the Toyota Way* (New York: McGraw-Hill, 2007); Steven Spear and H. Kent Bowen, "Decoding the DNA of the Toyota Production System," *Harvard Business Review* 77 (1999): 96–108; James P. Womack and Daniel T. Jones, *Lean Thinking: Banish Waste and Create Wealth in Your Corporation* (New York: Simon & Schuster, 2010);

Stephen A. Ruffa, *Going Lean: How the Best Companies Apply Lean Manufacturing Principles to Shatter Uncertainty, Drive Innovation, and Maximize Profits* (New York: American Management Association, 2008); Julian Page, *Implementing Lean Manufacturing Techniques: Making Your System Lean and Living with It* (Cincinnati: Hanser Gardner, 2004).

156 how software was created “What Is Agile Software Development?” Agile Alliance, June 8, 2013, <http://www.agilealliance.org/the-alliance/what-is-agile/>; Kent Beck et al., “Manifesto for Agile Software Development,” Agile Manifesto, 2001, <http://www.agilemanifesto.org/>.

157 among many tech firms Dave West et al., “Agile Development: Mainstream Adoption Has Changed Agility,” *Forrester Research 2* (2010): 41.

157 “fix what’s broken?” Ed Catmull and Amy Wallace, *Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration* (New York: Random House, 2014).

157 wrote in 2005 J. P. Womack and D. Miller, *Going Lean in Health Care* (Cambridge, Mass.: Institute for Healthcare Improvement, 2005).

158 get Sentinel working Jeff Stein, “FBI Sentinel Project Is over Budget and Behind Schedule, Say IT Auditors,” *The Washington Post*, October 20, 2010.

158 plan everything in advance This method of planning is often known as a “waterfall approach,” because it is a sequential design methodology in which progress “flows” downward from conception to initiation, analysis, design, construction, testing, production/implementation, and maintenance. At the core of this approach is the belief that each stage can be anticipated and scheduled.

158 unfettered themselves In response to a fact-checking email, Fulgham expanded his comments: “I assigned the CTO (Jeff Johnson) as the day to day executive for oversight. We hired an Agile Scrum Master (Mark Crandall) to serve as a coach and mentor (not as a project manager). We created an open physical workspace in the basement that allowed collaborative communications between team members. We assigned three Cyber Special Agents as the front end development leads, and the Director, Deputy Director and I empowered them to recommend any process improvements and/or form consolidations (in order not to just digitize any potentially outdated processes/forms). I worked with the CEOs of our top vendors for the products that were going to make up Sentinel to get their support and their best cleared personnel. The team adopted (under Mark’s coaching) the agile methodology. All FBI stakeholders were part of the business side of the Sentinel team to ensure their needs were met. The technical team conducted self directed two-week sprints. We had nightly automated builds. A dedicated QA team was located

with the development team, and I held a meeting every two weeks to view fully functional code (no mockups) and personally signed off on requirements. All stakeholders, the DOJ, the DOJ IG, the White House and other interested government agencies, attended these demo days to observe our progress and process.”

160 solve thousands of crimes In response to a fact-checking email, a spokeswoman for the FBI wrote, regarding Sentinel: “We are not predicting crime. We may identify trends and threats.”

160 “is capable of” Jeff Sutherland, *Scrum: The Art of Doing Twice the Work in Half the Time* (New York: Crown Business, 2014).

162 “cultural mindset” Robert S. Mueller III, “Statement Before the House Permanent Select Committee on Intelligence,” Washington, D.C., October 6, 2011, <https://www.fbi.gov/news/testimony/the-state-of-intelligence-reform-10-years-after-911>.

CHAPTER SIX: DECISION MAKING

167 worth \$450,000 Throughout this chapter, chips are referred to by their notional dollar value. However, it is important to note that in tournaments like this one, chips are tokens that are collected to determine winners—they are not traded in for cash on a one-to-one basis. Rather, prize money is paid out based on how someone places in the competition. So someone could have \$200,000 in chips and take fifth place in a tournament and win \$300,000, for instance. In this particular tournament, the prize was \$2 million and, by coincidence, the total number of chips was also \$2 million.

167 prize for second place The 2004 Tournament of Champions is described in slightly different chronological order than what occurred in order to highlight the salient points of each hand. Beyond describing hands out of order, no other facts have been changed. For my understanding of the 2004 Tournament of Champions as well as poker more generally, I am indebted to Annie Duke, Howard Lederer, and Phil Hellmuth for their time and advice. In addition, this account relies upon the taped version of the 2004 TOC, provided by ESPN; Annie Duke, with David Diamond, *How I Raised, Folded, Bluffed, Flirted, Cursed and Won Millions at the World Series of Poker* (New York: Hudson Street Press, 2005); “Annie Duke: The Big Things You Don’t Do,” *The Moth Radio Hour*, September 13, 2012, <http://themoth.org/posts/stories/the-big-things-you-dont-do>; “Annie Duke: A House Divided,” *The Moth Radio Hour*, July 20, 2011, <http://themoth.org/posts/stories/a-house-divided>; “Dealing with Doubt,” *Radiolab*, season 11, episode 4, <http://www>

.radiolab.org/story/278173-dealing-doubt/; Dina Cheney, “Flouting Convention, Part II: Annie Duke Finds Her Place at the Poker Table,” *Columbia College Today*, July 2004, http://www.college.columbia.edu/cct_archive/jul04/features4.php; Ginia Bellafante, “Dealt a Bad Hand? Fold ‘Em. Then Raise,” *The New York Times*, January 19, 2006; Chuck Darrow, “Annie Duke, Flush with Success,” *The Philadelphia Inquirer*, June 8, 2010; Jamie Berger, “Annie Duke, Poker Pro,” *Columbia Magazine*, March 4, 2013, <http://www.columbia.edu/cu/alumni/Magazine/Spring2002/Duke.html>; “Annie Duke Profile,” *The Huffington Post*, February 21, 2013; Del Jones, “Know Yourself, Know Your Rival,” *USA Today*, July 20, 2009; Richard Deitsch, “Q&A with Annie Duke,” *Sports Illustrated*, May 26, 2005; Mark Sauer, “Annie Duke Found Her Calling,” *San Diego Union-Tribune*, October 9, 2005; George Sturgis Coffin, *Secrets of Winning Poker* (Wilshire, 1949); Richard D. Harroch and Lou Krieger, *Poker for Dummies* (New York: Wiley, 2010); David Sklansky, *The Theory of Poker* (Two Plus Two Publishers, 1999); Michael Bowling et al., “Heads-Up Limit Hold’em Poker Is Solved,” *Science* 347, no. 6218 (2015): 145–49; Darse Billings et al., “The Challenge of Poker,” *Artificial Intelligence* 134, no. 1 (2002): 201–40; Kevin B. Korb, Ann E. Nicholson, and Nathalie Jitnah, “Bayesian Poker,” *Proceedings of the Fifteenth Conference on Uncertainty in Artificial Intelligence* (San Francisco: Morgan Kaufmann, 1999).

167 she was going to win Gerald Hanks, “Poker Math and Probability,” *Pokerology*, <http://www.pokerology.com/lessons/math-and-probability/>.

170 win a Nobel Prize Daniel Kahneman and Amos Tversky, “Prospect Theory: An Analysis of Decision Under Risk,” *Econometrica: Journal of the Econometric Society* 47, no. 2 (1979): 263–91.

174 a million television viewers The tournament drew an estimated 1.5 million viewers.

174 She’s not sure Annie, in a phone call to check facts in this chapter, expanded upon her thinking: “If Greg had jacks or better, I was in a bad situation. I was very undecided about the hand he could be holding, and I was in a situation where I really did have to create more certainty for myself. I really needed to decide if he had aces or kings, and then fold. Also, Greg Raymer, at that point, was an unknown quantity, but my brother and I had been watching videotapes of him play, and we had seen what we thought was a “tell,” something he did physically when he had a good hand, and I saw him do this particular thing that suggested to me that he had a strong hand. That’s not a certain thing, you don’t know if a tell is 100 percent, but it helped tip me into thinking he had a strong hand.”

175 “intelligence forecasts” “Aggregative Contingent Estimation,” Office of the Director of National Intelligence (IARPA), 2014, Web.

176 some fresh ideas For my understanding of the Good Judgment Project, I am indebted to Barbara Mellers et al., “Psychological Strategies for Winning a Geopolitical Forecasting Tournament,” *Psychological Science* 25, no. 5 (2014): 1106–15; Daniel Kahneman, “How to Win at Forecasting: A Conversation with Philip Tetlock,” *Edge*, December 6, 2012, <https://edge.org/conversation/how-to-win-at-forecasting>; Michael D. Lee, Mark Steyvers, and Brent Miller, “A Cognitive Model for Aggregating People’s Rankings,” *PloS One* 9, no. 5 (2014); Lyle Ungar et al., “The Good Judgment Project: A Large Scale Test” (2012); Philip Tetlock, *Expert Political Judgment: How Good Is It? How Can We Know?* (Princeton, N.J.: Princeton University Press, 2005); Jonathan Baron et al., “Two Reasons to Make Aggregated Probability Forecasts More Extreme,” *Decision Analysis* 11, no. 2 (2014): 133–45; Philip E. Tetlock et al., “Forecasting Tournaments Tools for Increasing Transparency and Improving the Quality of Debate,” *Current Directions in Psychological Science* 23, no. 4 (2014): 290–95; David Ignatius, “More Chatter than Needed,” *The Washington Post*, November 1, 2013; Alex Madrigal, “How to Get Better at Predicting the Future,” *The Atlantic*, December 11, 2012; Warnaar et al., “Aggregative Contingent Estimation System”; Uriel Haran, Ilana Ritov, and Barbara A. Mellers, “The Role of Actively Open-Minded Thinking in Information Acquisition, Accuracy, and Calibration,” *Judgment and Decision Making* 8, no. 3 (2013): 188–201; David Brooks, “Forecasting Fox,” *The New York Times*, March 21, 2013; Philip Tetlock and Dan Gardner, *Seeing Further* (New York: Random House, 2015).

176 A group of At various points during the GJP, the precise number of researchers involved fluctuated.

176 questions as the experts In response to a fact-checking email, Barbara Mellers and Philip Tetlock, another of the GJP leaders, wrote: “We had two different types of training in the first year of the tournament. One was probabilistic reasoning and the other was scenario training. Probabilistic reasoning worked somewhat better, so in subsequent years, we implemented only the probabilistic training. Training was revised each year. As it evolved, there was a section on geopolitical reasoning and another on probabilistic reasoning. . . . Here is a section that describes the training: We constructed educational modules on probabilistic-reasoning training and scenario training that drew on state-of-the-art recommendations. Scenario training taught forecasters to generate new futures, actively entertain more possibilities, use decision trees, and avoid biases such as over-predicting change, creating incoherent scenarios, or assigning probabilities to mutually exclusive and exhaustive outcomes that exceed 1.0. Probability training guided forecasters to consider reference classes, average multiple estimates from existing models, polls, and expert panels, extrapolate over time when variables were continuous, and avoid judgmental traps such as overconfidence, the confirmation bias, and base-rate neglect.

Each training module was interactive with questions and answers to check participant understanding.”

177 abilities to forecast the future In response to a fact-checking email, Don Moore wrote: “On average, those with training did better. But not everyone who got trained did better than all the people who did not get it.”

180 “tremendously useful” Brooks, “Forecasting Fox.”

181 “things you aren’t sure about” In response to a fact-checking email, Don Moore wrote: “What makes our forecasters good is not just their high level of accuracy, but their well-calibrated humility. They are no more confident than they deserve to be. It’s ideal to know when you have forecast the future with accuracy and when you haven’t.”

183 or roughly 20 percent In an email, Howard Lederer, a two-time World Series of Poker champion, explained the further nuances required in analyzing this hand: “The hand you use as an example is MUCH more complicated than it appears.” Given what’s known, Lederer said, there is actually a better than 20 percent chance of winning. “Here’s why. If you KNOW your opponent has an A or a K, then you know seven cards. Your two [cards], your opponent’s one card, and the four [communal cards] on the board. This means there are 45 unknown cards (you have no information on your opponent’s other card). This would mean you have nine hearts to win, and 36 non-hearts to lose. The odds would be 4 to 1, or 1 in 5. The percentages are 20%. As long as you are not putting more than 20% of the money into the pot, it’s a good call. Here’s where you might ask: if I am only 20% to win against an A or K, then how can I be better than [20%] to win? Your opponent might not have an A or K! He could have a spade flush draw without an A or K, he could have a straight draw with a 5–6. He could have a lower heart draw. That would be great for you! There’s also a chance he just has garbage and is trying to bluff you with nothing. In general, I’d calculate the chances that your opponent has one of these drawing or bluffing hands at about 30% (given how many of these possibilities there are). So let’s do some probabilistic math: 70% of the time he has an A or K, and you win 20% of those times. 25% of the time he has a draw and you win about 82% of those hands (I’m combining various possible odds given his range of holdings when he is drawing). And 5% of the time he has a total bluff and you win 89% of the time when he has garbage. Your total chances of winning are: $(.7 \times .2) + (.25 \times .82) + (.05 \times .89) = 39\%$! This is a simple ‘expected value’ calculation. You can see that the .7, .25 and .05 part of the calculation adds up to 1. Meaning we have covered all the possible holdings and assigned them probabilities. And we are making our best guess as to our chances against each holding. At the table, you don’t have time to do all the math, but ‘in your gut’ you can feel the odds and make the easy call.

One other note, if you miss your flush and your opponent bets, you should seriously consider calling anyway. You will be getting well over 10–1, and the chances he is bluffing are probably higher than that. This is just a simple taste of the complexity of poker.”

183 they’ll quit For more on calculating odds in poker, please see Pat Dittmar, *Practical Poker Math: Basic Odds and Probabilities for Hold’em and Omaha* (Toronto: ECW Press, 2008); “Poker Odds for Dummies,” CardsChat, <https://www.cardschat.com/odds-for-dummies.php>; Kyle Siler, “Social and Psychological Challenges of Poker,” *Journal of Gambling Studies* 26, no. 3 (2010): 401–20.

185 “odds work for you” In response to a fact-checking email, Howard Lederer wrote: “It’s more complex than that. Amateurs players make many different kinds of errors. Some play too loose. They crave the uncertainty and favor action over prudence. Some players are too conservative, favoring a small loss in a hand over taking the chance to win, but also the chance to take a large loss. Your job as a poker pro is to simply play your best each hand. In the long run, your superior decisions will defeat your opponent’s poor decisions, whatever they may be. The societal value of poker is that it is a great training ground for learning sound decision-making under conditions of uncertainty. Once you get the hang of playing poker, you develop the skills necessary to make probabilistic decisions in life.”

185 Annie’s brother, Howard Though it does not bear on the events described in this chapter, disclosure compels mentioning that Lederer was a founder and board member of Tiltware, LLC, the company behind Full Tilt Poker, a popular website that was accused of bank fraud and illegal gambling by the U.S. Department of Justice. In 2012, Lederer settled a civil lawsuit with the Department of Justice related to Full Tilt Poker. He admitted no wrongdoing, but did agree to forfeit more than \$2.5 million.

186 winning this hand Technically, Howard has an 81.5 percent chance of winning—however, because it is hard to win half a hand of poker, this has been rounded up to 82 percent.

187 remaining cards on the table In response to a fact-checking email, Howard Lederer wrote: “I would say that in a 3 handed situation, [a pair of sevens] is close to 90% to be best before the flop. This is the hand where I agree anyone would have played her hand and my hand the same way; all in before the flop. After we had all the money in, I am not a slight favorite, but instead a large favorite. This [is] a unique feature of hold’em. If you have a slightly better hand than your opponent, you are often a big favorite. 7–7 is about 81% to beat 6–6.”

188 “they tell you might occur” In response to a fact-checking email, Howard Lederer wrote: “It’s not an easy thing to choose a profession where you

lose more often than you win. One has to focus on the long run, and realize that if you get offered 10–1, on enough 5–1 shots, you will come out ahead, while also realizing that you will lose 5 out of 6 times.”

188 humans process information Tenenbaum, in an email responding to fact-checking questions, described his research this way: “Often we start with what looks like a gap between humans and computers, where humans are outperforming standard computers with intuitions that may not look like computations. . . . But then we try to close that gap, by understanding how human intuitions actually have a subtle computational basis, which then can be engineered in a machine, to make the machine smarter in more human-like ways.”

189 “seeing just a few examples” Joshua B. Tenenbaum et al., “How to Grow a Mind: Statistics, Structure, and Abstraction,” *Science* 331, no. 6022 (2011): 1279–85.

189 “examples of each?” Ibid.

191 (which has no strong pattern) In an email responding to fact-checking questions, Tenenbaum said that many of the examples they used were fairly complex, and “the reasons for the prediction functions having these shapes are the combination of (1) the priors, plus (2) a certain assumption about when an event is likely to be sampled (the ‘likelihood’), (3) Bayesian updating from priors to posteriors, and (4) using the 50th percentile of the posterior as the basis for prediction. What’s correct about what you have is that in our simple model, only (1) varies across domains—between movies, representatives, life spans, etc.—while (2–4) are the same for all the tasks. But [it’s] because of these causal processes (which vary across domains) together with the rest of the statistical computations (which are the same across domains) that the prediction functions have the shape they do.” It is important to note that the graphs in this text do not represent accurate empirical results, but rather patterns of predictions—the estimations that represent the 50th percentile of being right or wrong.

191 You read about a movie These are summaries of the questions asked. The direct wording of each question was: “Imagine you hear about a movie that has taken in 60 million dollars at the box office, but don’t know how long it has been running. What would you predict for the total amount of box office intake for that movie?” “Insurance agencies employ actuaries to make predictions about people’s life spans—the age at which they will die—based upon demographic information. If you were assessing an insurance case for a 39-year-old man, what would you predict for his life span?” “Imagine you are in somebody’s kitchen and notice that a cake is in the oven. The timer shows that it has been baking for 14 minutes. What would you predict for the

total amount of time the cake needs to bake?” “If you heard a member of the House of Representatives had served for 11 years, what would you predict his total term in the House would be?”

192 variation of Bayes’ rule In an email responding to fact-checking questions, Tenenbaum wrote that “the most natural way to make these kinds of predictions in computers is to run algorithms which effectively implement the logic of Bayes’ rule. The computers typically don’t explicitly ‘use’ Bayes’ rule, because the direct computations of Bayes’ rule are typically intractable to carry out except in simple cases. Rather the programmers give the computers prediction algorithms whose predictions are made to be approximately consistent with Bayes’ rule in a wide range of cases, including these.”

193 data and your assumptions Sheldon M. Ross, *Introduction to Probability and Statistics for Engineers and Scientists* (San Diego: Academic Press, 2004).

195 skewed, as well “Base rate” typically refers to a yes-or-no question. In the Tenenbaum experiment, participants were asked to make numerical predictions, rather than answer a binary question, and so it’s most accurate to refer to this assumption as a “prior distribution.”

195 failures we’ve overlooked In an email responding to fact-checking questions, Tenenbaum wrote that “It’s not clear from our work that predictions for events in a certain class improve progressively with more experience with events of that type. Sometimes they might, sometimes they don’t. And this is not the only way to acquire a prior. As the pharaohs example shows, and other projects by us and other researchers, people can acquire a prior in various ways beyond direct experience with a class of events, including being told things, making analogies to other classes of events, forming analogies, and so on.”

197 “the Poker Brat” Eugene Kim, “Why Silicon Valley’s Elites Are Obsessed with Poker,” *Business Insider*, November 22, 2014, <http://www.businessinsider.com/best-poker-players-in-silicon-valley-2014-11>.

198 “bluff when it matters” In response to a fact-checking email, Hellmuth wrote: “Annie is a great poker player, and she has stood the test of time. I respect her, and I respect her Hold’em game.”

199 He folds In response to a fact-checking email, Hellmuth wrote: “I think she was trying to tilt me (get me emotional and upset) by showing a nine in that situation. A lot of players would have gone broke with my hand there (top pair) w[ith] a ‘Safe’ turn card, but I’ve made a living deviating from the norm and trusting my instincts (my white magic, my reading ability). I trusted it and folded.”

201 middle of the table In response to a fact-checking email, Hellmuth wrote: “With the chips I had at that time I had to go all in w[ith] 10–8 on that

flop (I had top pair and there were flush draws, and straight draws possible). Completely standard. If you're trying to imply that I put the money because I was emotionally tilted, you're wrong. Nothing I could do there."

202 Phil is out In response to a fact-checking email, Hellmuth contends that he and Annie had struck a deal when the tournament came down to the two of them in which they pledged to guarantee each other \$750,000 regardless of the winner, and play for the last \$500,000. Annie Duke confirmed this deal.

CHAPTER SEVEN: INNOVATION

205 movie everyone is talking about For my understanding of *Frozen's* development, I am particularly indebted to Ed Catmull, Jennifer Lee, Andrew Millstein, Peter Del Vecho, Kristen Anderson-Lopez, Bobby Lopez, Amy Wallace, and Amy Astley, as well as other Disney employees, some of whom wished to remain anonymous, who were generous with their time. Additionally, I relied upon Charles Solomon, *The Art of Frozen* (San Francisco: Chronicle Books, 2015); John August, "Frozen with Jennifer Lee," *Scriptnotes*, January 28, 2014, <http://johnaugust.com/2014/frozen-with-jennifer-lee>; Nicole Laporte, "How *Frozen* Director Jennifer Lee Reinvented the Story of the Snow Queen," *Fast Company*, February 28, 2014; Lucinda Everett, "Frozen: Inside Disney's Billion-Dollar Social Media Hit," *The Telegraph*, March 31, 2014; Jennifer Lee, "Frozen, Final Shooting Draft," Walt Disney Animation Studios, September 23, 2013, <http://gointothestory.blcklst.com/wp-content/uploads/2014/11/Frozen.pdf>; "Frozen: Songwriters Kristen Anderson-Lopez and Robert Lopez Official Movie Interview," YouTube, October 31, 2013, <https://www.youtube.com/watch?v=mzZ77n4Ab5E>; Susan Wloszczyna, "With *Frozen*, Director Jennifer Lee Breaks Ice for Women Directors," *Indiewire*, November 26, 2013, <http://blogs.indiewire.com/womenandhollywood/with-frozen-director-jennifer-lee-breaks-the-ice-for-women-directors>; Jim Hill, "Countdown to Disney *Frozen*: How One Simple Suggestion Broke the Ice on the Snow Queen's Decades-Long Story Problems," *Jim Hill Media*, October 18, 2013, http://jimhillmedia.com/editor_in_chief1/b/jim_hill/archive/2013/10/18/countdown-to-disney-quot-frozen-quot-how-one-simple-suggestion-broke-the-ice-on-the-quot-snow-queen-quot-s-decades-long-story-problems.aspx; Brendon Connelly, "Inside the Research, Design, and Animation of Walt Disney's *Frozen* with Producer Peter Del Vecho," *Bleeding Cool*, September 25, 2013, <http://www.bleedingcool.com/2013/09/25/inside-the-research-design-and-animation-of-walt-disneys-frozen-with-producer-peter-del-vecho/>; Ed Catmull and Amy Wallace, *Creativity, Inc.: Overcoming the Unseen Forces That Stand in the Way of True Inspiration* (New York: Random House, 2014); Mike P. Williams,

“Chris Buck Reveals True Inspiration Behind Disney’s *Frozen* (Exclusive),” Yahoo! Movies, April 8, 2014; Williams College, “Exploring the Songs of *Frozen* with Kristen Anderson-Lopez ’94,” YouTube, June 30, 2014, <https://www.youtube.com/watch?v=ftddAzabQMM>; Dan Sarto, “Directors Chris Buck and Jennifer Lee Talk *Frozen*,” Animation World Network, November 7, 2013; Jennifer Lee, “Oscars 2014: *Frozen*’s Jennifer Lee on Being a Female Director,” *Los Angeles Times*, March 1, 2014; Rob Lowman, “Unfreezing *Frozen*: The Making of the Newest Fairy Tale in 3D by Disney,” *Los Angeles Daily News*, November 19, 2013; Jill Stewart, “Jennifer Lee: Disney’s New Animation Queen,” *LA Weekly*, May 15, 2013; Simon Brew, “A Spoiler-Y, Slightly Nerdy Interview About Disney’s *Frozen*,” *Den of Geek!*, December 12, 2013, <http://www.denofgeek.com/movies/frozen/28567/a-spoiler-y-nerdy-interview-about-disneys-frozen>; Sean Flynn, “Is It Her Time to Shine?” *The Newport Daily News*, February 17, 2014; Mark Harrison, “Chris Buck and Jennifer Lee Interview: On Making *Frozen*,” *Den of Geek!* December 6, 2013, <http://www.denofgeek.com/movies/frozen/28495/chris-buck-and-jennifer-lee-interview-on-making-frozen>; Mike Fleming, “Jennifer Lee to Co-Direct Disney Animated Film *Frozen*,” *Deadline Hollywood*, November 29, 2012; Rebecca Keegan, “Disney Is Reanimated with *Frozen*, *Big Hero 6*,” *Los Angeles Times*, May 9, 2013; Lindsay Miller, “On the Job with Jennifer Lee, Director of *Frozen*,” *Popsugar*, February 28, 2014, <http://www.popsugar.com/celebrity/Frozen-Director-Jennifer-Lee-Interview-Women-Film-33515997>; Trevor Hogg, “Snowed Under: Chris Buck Talks About *Frozen*,” *Flickering Myth*, March 26, 2014, <http://www.flickeringmyth.com/2014/03/snowed-under-chris-buck-talks-about.html>; Jim Hill, “Countdown to Disney *Frozen*: The Flaky Design Idea Behind the Look of Elsa’s Ice Palace,” *Jim Hill Media*, October 9, 2013, http://jimhillmedia.com/editor_in_chief1/b/jim_hill/archive/2013/10/09/countdown-to-disney-quot-frozen-quot-the-flaky-design-idea-behind-the-look-of-elsa-s-ice-palace.aspx; Rebecca Keegan, “Husband-Wife Songwriting Team’s Emotions Flow in *Frozen*,” *Los Angeles Times*, November 1, 2013; Heather Wood Rudolph, “Get That Life: How I Co-Wrote the Music and Lyrics for *Frozen*,” *Cosmopolitan*, April 27, 2015; Simon Brew, “Jennifer Lee and Chris Buck Interview: *Frozen*, Statham, *Frozen 2*,” *Den of Geek!*, April 4, 2014, <http://www.denofgeek.com/movies/frozen/29346/jennifer-lee-chris-buck-interview-frozen-statham-frozen-2>; Carolyn Giardina, “Oscar: With *Frozen*, Disney Invents a New Princess,” *The Hollywood Reporter*, November 27, 2013; Steve Persall, “Review: Disney’s *Frozen* Has a Few Cracks in the Ice,” *Tampa Bay Times*, November 26, 2013; Kate Muir, “Jennifer Lee on Her Disney Hit *Frozen*: We Wanted the Princess to Kick Ass,” *The Times*, December 12, 2013; “Out of the Cold,” *The Mail on Sunday*, December 29, 2013; Kathryn Shattuck, “*Frozen*

Directors Take Divide-and-Conquer Approach,” *The New York Times*, January 16, 2014; Ma’ayan Rosenzweig and Greg Atria, “The Story of *Frozen*: Making a Disney Animated Classic,” *ABC News Special Report*, September 2, 2014, <http://abcnews.go.com/Entertainment/fullpage/story-frozen-making-disney-animated-classic-movie-25150046>; Amy Edmondson et al., “Case Study: Teaming at Disney Animation,” *Harvard Business Review*, August 27, 2014.

207 surprised by all the criticisms In an email sent in response to fact-checking questions, Andrew Millstein, president of Disney Animation Studios, wrote: “These are the kind of notes that fuel our creative process and help propel the forward progress of all of our films in production. The creative leadership on any film often gets too close to their films and loses objectivity. Our Story Trust functions like a highly critical and skilled audience that can point to flaws in the story-telling and, more important, provide potential solutions. . . . You’re describing a process of experimentation, exploration and discovery that are key components of all our films. It’s not a question of if this will happen, but to what degree. This is a constant part of our process and the expectation [of] every filmmaking team. It is what contributes to the high standards that our films set.”

207 Book of Mormon In an email sent in response to fact-checking questions, Bobby Lopez made clear that Kristen was a sounding board for him in writing *Avenue Q* and *Book of Mormon* but was not formally credited on those shows.

208 dozens of others popped up In an email sent in response to fact-checking questions, a spokeswoman for Walt Disney Animation Studios wrote that the studio wished to emphasize “how typical this process is for every film at Disney Animation since John [Lasseter] and Ed [Catmull] have become our studio leaders—the screening process, the notes sessions, the taking apart of the film and putting it back together. This is typical, not atypical.”

209 “good ideas are suffocated” In an email sent in response to fact-checking questions, Ed Catmull, president of Disney Animation, wrote that the various anecdotes in this chapter are “viewpoints of different snapshots in time as the film developed. . . . In truth, you could substitute different words and it would pretty much describe how *every* film goes through searching and change. This is worth emphasizing so that people don’t have the impression that *Frozen* was different in that way.”

209 Frozen was winding down In an email sent in response to fact-checking questions, Millstein wrote: “Creativity needs time, space and support to fully explore multiple ideas simultaneously. Our creative leadership has to have the confidence and trust in each other to experiment, fail and try again and

again until the answers to story questions and problems get better and more refined. There also needs to be a relentless focus on finding the best solutions to difficult and thorny problems and never settling for sub-optimum solutions because of time issues. Our creative teams need to trust that the executive management fundamentally believes in and supports this process.”

209 avant-garde on Broadway Amanda Vaill, *Somewhere: The Life of Jerome Robbins* (New York: Broadway Books, 2008); “Q&A with Producer Director Judy Kinberg, ‘Jerome Robbins: Something to Dance About,’” directed by Judy Kinberg, *American Masters*, PBS, January 28, 2009, <http://www.pbs.org/wnet/americanmasters/jerome-robbins-q-a-with-producerdirector-judy-kinberg/1100/>; Sanjay Roy, “Step-by-Step Guide to Dance: Jerome Robbins,” *The Guardian*, July 7, 2009; Sarah Fishko, “The Real Life Drama Behind West Side Story,” NPR, January 7, 2009, <http://www.npr.org/2011/02/24/97274711/the-real-life-drama-behind-west-side-story>; Jeff Lundun and Scott Simon, “Part One: Making a New Kind of Musical,” NPR, September 26, 2007, <http://www.npr.org/templates/story/story.php?storyId=14730899>; Jeff Lundun and Scott Simon, “Part Two: Casting Calls and Out of Town Trials,” NPR, September 26, 2007, <http://www.npr.org/templates/story/story.php?storyId=14744266>; Jeff Lundun and Scott Simon, “Part Three: Broadway to Hollywood—and Beyond,” NPR, September 26, 2007, <http://www.npr.org/templates/story/story.php?storyId=14749729>; “West Side Story Film Still Pretty, and Witty, at 50,” NPR, October 17, 2011, <http://www.npr.org/2011/10/17/141427333/west-side-story-still-pretty-and-witty-at-50>; Jesse Green, “When You’re a Shark You’re a Shark All the Way,” *New York Magazine*, March 15, 2009; Larry Stempel, “The Musical Play Expands,” *American Music* 10, no. 2 (1992): 136–69; Beth Genné, “‘Freedom Incarnate’: Jerome Robbins, Gene Kelly, and the Dancing Sailors as an Icon of American Values in World War II,” *Dance Chronicle* 24, no. 1 (2001): 83–103; Bill Fischer and Andy Boynton, “Virtuoso Teams,” *Harvard Business Review*, July 1, 2005; Otis L. Guernsey, ed., *Broadway Song and Story: Playwrights/Lyricists/Composers Discuss Their Hits* (New York: Dodd Mead, 1985); Larry Stempel, *Showtime: A History of the Broadway Musical Theater* (New York: W. W. Norton, 2010); Robert Emmet Long, “West Side Story,” in *Broadway, the Golden Years: Jerome Robbins and the Great Choreographer-Directors: 1940 to the Present* (New York: Continuum, 2001); Leonard Bernstein, “A West Side Log” (1982); Terri Roberts, “West Side Story: ‘We Were All Very Young,’” *The Sondheim Review* 9, no. 3 (Winter 2003); Steven Suskin, *Opening Night on Broadway: A Critical Quotebook of the Golden Era of the Musical Theatre, Oklahoma! (1943) to Fiddler on the Roof (1964)* (New York: Schirmer Trade Books, 1990); Amanda Vaill, “Jerome Robbins—About the Artist,” *American Masters*, PBS, January 27, 2009, <http://www.pbs.org/wnet/americanmasters/jerome-robbins-about-the-artist/1099/>.

210 actor on the stage There are a few outliers to this musical formula, most notably *Oklahoma!*, in which dance was used to express plot and emotional moments.

210 “me a ballet?” Tim Carter, “Leonard Bernstein: West Side Story. By Nigel Simeone,” *Music and Letters* 92, no. 3 (2011): 508–10.

210 would be *West Side Story* *West Side Story* went through numerous names before the final title was chosen.

211 musical’s main characters Excerpts of letters come from the Leonard Bernstein Collection at the Library of Congress as well as from records made available by various authors and the New York Public Library system.

211 “jitterbugging” This was written by Leonard Bernstein, as quoted in *The Leonard Bernstein Letters* (New Haven, Conn.: Yale University Press, 2013).

211 “we’re boring the audience” Jerome Robbins, as quoted in *The Leonard Bernstein Letters* (New Haven, Conn.: Yale University Press, 2013).

211 “two intermissions” Vaill, *Somewhere*.

211 “Shakespeare standing behind you” Ibid.

211 “Forget Anita” Deborah Jowitt, *Jerome Robbins: His Life, His Theater, His Dance* (New York: Simon & Schuster, 2004).

212 *Science in 2013* Brian Uzzi et al., “Atypical Combinations and Scientific Impact,” *Science* 342, no. 25 (2013): 468–72.

212 Brian Uzzi and Ben Jones For more on Uzzi and Jones’s work, please see Stefan Wuchty, Benjamin F. Jones, and Brian Uzzi, “The Increasing Dominance of Teams in Production of Knowledge,” *Science* 316, no. 5827 (2007): 1036–39; Benjamin F. Jones, Stefan Wuchty, and Brian Uzzi, “Multi-University Research Teams: Shifting Impact, Geography, and Stratification in Science,” *Science* 322, no. 5905 (2008): 1259–62; Holly J. Falk-Krzesinski et al., “Advancing the Science of Team Science,” *Clinical and Translational Science* 3, no. 5 (2010): 263–66; Ginger Zhe Jin et al., *The Reverse Matthew Effect: Catastrophe and Consequence in Scientific Teams* (working paper 19489, National Bureau of Economic Research, 2013); Brian Uzzi and Jarrett Spiro, “Do Small Worlds Make Big Differences? Artist Networks and the Success of Broadway Musicals, 1945–1989” (unpublished manuscript, Evanston, Ill., 2003); Brian Uzzi, and Jarrett Spiro, “Collaboration and Creativity: The Small World Problem,” *American Journal of Sociology* 111, no. 2 (2005): 447–504; Brian Uzzi, “A Social Network’s Changing Statistical Properties and the Quality of Human Innovation,” *Journal of Physics A: Mathematical and Theoretical* 41, no. 22 (2008); Brian Uzzi, Luis A.N. Amaral, and Felix Reed-Tsochas, “Small-World Networks and Management Science Research: A Review,” *European Management Review* 4, no. 2 (2007): 77–91.

214 creative and important In response to a fact-checking email, Uzzi wrote: “The other thing is that teams are more likely to get this sweet spot of creativity right. They are more likely than individuals to put together atypical combinations of prior sources. Also, a paper with the right mix of conventional and atypical ideas by a team does better than a single author, given the same mix of conventional and atypical ideas. This means teams are better than individuals at sourcing and deriving insights from atypical combinations.”

214 bought lottery tickets Amos Tversky and Daniel Kahneman, “Availability: A Heuristic for Judging Frequency and Probability,” *Cognitive Psychology* 5, no. 2 (1973): 207–32; Daniel Kahneman and Amos Tversky, “Prospect Theory: An Analysis of Decision Under Risk,” *Econometrica: Journal of the Econometric Society* 47, no. 2 (1979): 263–91; Amos Tversky and Daniel Kahneman, “Judgment Under Uncertainty: Heuristics and Biases,” *Science* 185, no. 4157 (1974): 1124–31; Amos Tversky and Daniel Kahneman, “The Framing of Decisions and the Psychology of Choice,” *Science* 211, no. 4481 (1981): 453–58; Daniel Kahneman and Amos Tversky, “Choices, Values, and Frames,” *American Psychologist* 39, no. 4 (1984): 341; Daniel Kahneman, *Thinking, Fast and Slow* (New York: Farrar, Straus and Giroux, 2011); Daniel Kahneman and Amos Tversky, “On the Psychology of Prediction,” *Psychological Review* 80, no. 4 (1973): 237.

214 how genes evolve Qiong Wang et al., “Naive Bayesian Classifier for Rapid Assignment of rRNA Sequences into the New Bacterial Taxonomy,” *Applied and Environmental Microbiology* 73, no. 16 (2007): 5261–67; Jun S. Liu, “The Collapsed Gibbs Sampler in Bayesian Computations with Applications to a Gene Regulation Problem,” *Journal of the American Statistical Association* 89, no. 427 (1994): 958–66.

214 “railway and mining” Andrew Hargadon and Robert I. Sutton, “Technology Brokering and Innovation in a Product Development Firm,” *Administrative Science Quarterly* 42, no. 4 (1997): 716–49.

215 gambling techniques René Carmona et al., *Numerical Methods in Finance: Bordeaux, June 2010*, Springer Proceedings in Mathematics, vol. 12 (Berlin: Springer Berlin Heidelberg, 2012); René Carmona et al., “An Introduction to Particle Methods with Financial Application,” in *Numerical Methods in Finance*, 3–49; Pierre Del Moral, *Mean Field Simulation for Monte Carlo Integration* (Boca Raton, Fla.: CRC Press, 2013); Roger Eckhardt, “Stan Ulam, John von Neumann, and the Monte Carlo Method,” *Los Alamos Science*, special issue (1987): 131–37.

215 in the shape of a hat Andrew Hargadon and Robert I. Sutton, “Technology Brokering and Innovation in a Product Development Firm,” *Administrative Science Quarterly* 42, no. 4 (1997): 716–49; Roger P. Brown, “Polymers

in Sport and Leisure,” *Rapra Review Reports* 12, no. 3 (November 2, 2001); Melissa Larson, “From Bombers to Bikes,” *Quality* 37, no. 9 (1998): 30.

215 child-rearing techniques Benjamin Spock, *The Common Sense Book of Baby and Child Care* (New York: Pocket Books, 1946).

215 “evaluated as valuable” Ronald S. Burt, “Structural Holes and Good Ideas,” *American Journal of Sociology* 110, no. 2 (2004): 349–99.

215 succeeded somewhere else In an email sent in response to fact-checking questions, Burt wrote: “Managers offered their best idea for improving the value of their function to the company. The two senior executives in the function evaluated each idea (stripped of personal identification). The summary evaluation of each idea turned out to be primarily predicted by the extent to which the person who articulated the idea had a network that reached across boundaries (structural holes) between network groups, functions, divisions in the company.”

215 pushed the right way For more on the concept of brokerage, please see Ronald S. Burt, *Structural Holes: The Social Structure of Competition* (Cambridge, Mass.: Harvard University Press, 2009); Ronald S. Burt, “The Contingent Value of Social Capital,” *Administrative Science Quarterly* 42, no. 2 (1997): 339–65; Ronald S. Burt, “The Network Structure of Social Capital,” in B. M. Staw and R. I. Sutton, *Research in Organizational Behavior*, vol. 22 (New York: Elsevier Science JAI, 2000), 345–423; Ronald S. Burt, *Brokerage and Closure: An Introduction to Social Capital* (New York: Oxford University Press, 2005); Ronald S. Burt, “The Social Structure of Competition,” *Explorations in Economic Sociology* 65 (1993): 103; Lee Fleming, Santiago Mingo, and David Chen, “Collaborative Brokerage, Generative Creativity, and Creative Success,” *Administrative Science Quarterly* 52, no. 3 (2007): 443–75; Satu Parjanen, Vesa Harmaakorpi, and Tapani Frantsi, “Collective Creativity and Brokerage Functions in Heavily Cross-Disciplined Innovation Processes,” *Interdisciplinary Journal of Information, Knowledge, and Management* 5, no. 1 (2010): 1–21; Thomas Heinze and Gerrit Bauer, “Characterizing Creative Scientists in Nano-S&T: Productivity, Multidisciplinarity, and Network Brokerage in a Longitudinal Perspective,” *Scientometrics* 70, no. 3 (2007): 811–30; Markus Baer, “The Strength-of-Weak-Ties Perspective on Creativity: A Comprehensive Examination and Extension,” *Journal of Applied Psychology* 95, no. 3 (2010): 592; Ajay Mehra, Martin Kilduff, and Daniel J. Brass, “The Social Networks of High and Low Self-Monitors: Implications for Workplace Performance,” *Administrative Science Quarterly* 46, no. 1 (2001): 121–46.

216 plot’s central tensions I am indebted to the New York Public Library for making an early draft version of the *West Side Story* script available to me. This is an abridgment of that script, shortened for ease of representation.

219 communicated through dance This text is a combination of finished versions of the *West Side Story* script, Robbins's notes, and interviews providing a description of the choreography from the first staging of the show and other sources.

220 "essential dramatic information" Larry Stempel, "The Musical Play Expands," *American Music* (1992): 136–69.

220 the original Maria Fishko, "Real Life Drama Behind *West Side Story*."

221 coffee cups and to-do lists The *Frozen* core team included Buck, Lee, Del Vecho, Bobby Lopez and Kristen Anderson-Lopez, Paul Briggs, Jessica Julius, Tom MacDougall, Chris Montan, and, at times, others from various departments.

222 upstate New York In an email sent in response to fact-checking questions, a spokeswoman for Walt Disney Animation Studios wrote that Lee "and her sister fought, as kids do; they grew together as they grew older. They were never estranged. . . . In college, they became close. They lived together in NYC for a while, even."

223 "ourselves on the screen" In an email sent in response to fact-checking questions, Millstein wrote: "Solutions to story issues [are often] connected to personal emotional experiences. We draw from our own stories, history and emotional lives as a wellspring of inspiration. . . . We also draw on the experiences of others throughout the studio and deep research into specific areas that a film may attempt to explore. In the case of *Frozen*, we had a built-in research group at Disney Animation: employees who are sisters. They can describe firsthand what it's like to have a sister as a sibling and the life experiences they've had. This is wonderful firsthand source material."

223 "their experiences than other people" Gary Wolf, "Steve Jobs: The Next Insanely Great Thing," *Wired*, April 1996.

223 "pushed to use it sometimes" In an email sent in response to fact-checking questions, Catmull wrote: "It is too simple to say that people need to be pushed. Yes, they do, but they also need to be allowed to create, and we must make it safe for them to find something new. Andrew and I both need to be a force to make things move along, while at the same time, trying to keep fear from slowing them down or getting stuck. This is what makes the job so hard."

224 make them stay put Art Fry, "The Post-it note: An Intrapreneurial Success," *SAM Advanced Management Journal* 52, no. 3 (1987): 4.

224 from wine spills P. R. Cowley, "The Experience Curve and History of the Cellophane Business," *Long Range Planning* 18, no. 6 (1985): 84–90.

224 middle of the night Lewis A. Barness, “History of Infant Feeding Practices,” *The American Journal of Clinical Nutrition* 46, no. 1 (1987): 168–70; Donna A. Dowling, “Lessons from the Past: A Brief History of the Influence of Social, Economic, and Scientific Factors on Infant Feeding,” *Newborn and Infant Nursing Reviews* 5, no. 1 (2005): 2–9.

224 psychologist Gary Klein Gary Klein, *Seeing What Others Don't: The Remarkable Ways We Gain Insights* (New York: PublicAffairs, 2013).

226 of people's expectations In an email sent in response to fact-checking questions, Bobby Lopez wrote: “From our perspective—we hit ‘send’ on an email with our mp3 attached, and then count the minutes, hours, or sometimes days before we hear back from them. Sometimes it means something and sometimes it doesn't. We didn't hear back right away, so we began to doubt the song, but when they did call us it was clear they were very excited.”

226 “feel like one of us” In an email sent in response to fact-checking questions, a spokeswoman for Walt Disney Animation Studios wrote that Lee “had written a draft of the script already in April [2012 in] which Elsa was a more sympathetic character but there was still a plan for her to turn evil halfway through the film. [“Let It Go”] first appeared in [an] August 2012 screening. “Let It Go” helped shift the tone of the Elsa character. It should be noted that John Lasseter felt a personal tie to this as well—when thinking of Elsa, he thought of his son, Sam, and his juvenile diabetes. When Sam was getting poked and prodded as a child, he turned to John and said, ‘Why me?’ It wasn't Sam's fault he had diabetes, just as it is not Elsa's fault she has these icy powers.”

226 “It had to feel real” In an email sent in response to fact-checking questions, a spokeswoman for Walt Disney Animation Studios wrote that Chris Buck had a vision for how the film would end. “The ending—making it work emotionally[—]was a puzzle. By October 2012, Jennifer had the ending envisioning the four main characters in a blizzard of fear, which story artist John Ripa boarded. Ripa's boards received a standing ovation from John Lasseter in the room. As Jennifer says, ‘We knew the end, we just needed to earn it.’”

227 pressure that comes from deadlines Teresa M. Amabile et al., “Assessing the Work Environment for Creativity,” *Academy of Management Journal* 39, no. 5 (1996): 1154–84; Teresa M. Amabile, Constance N. Hadley, and Steven J. Kramer, “Creativity Under the Gun,” *Harvard Business Review* 80, no. 8 (2002): 52–61; Teresa M. Amabile, “How to Kill Creativity,” *Harvard Business Review* 76, no. 5 (1998): 76–87; Teresa M. Amabile, “A Model of Creativity and Innovation in Organizations,” *Research in Organizational Behavior* 10, no. 1 (1988): 123–67.

227 “Lee a second director” In an email sent in response to fact-checking questions, Catmull wrote that it is important to emphasize that Lee was a second director, not a “codirector,” which has multiple meanings in Hollywood. “There is an actual title of ‘Co-director’ which is at a lower level than ‘director.’ At Disney we frequently have two directors who both have the title of ‘director.’ In this case, both Jenn and Chris were equal directors. . . . Jenn was made director along with Chris.”

228 spinning in place In an email sent in response to fact-checking questions, Millstein wrote: “Jenn’s promotion to an equal directing partner with Chris provided an opportunity to alter the team dynamics in a positive way and their receptivity to potential new ideas. . . . Jenn is a very sensitive and emphatic filmmaker. Her sensitivity to team dynamics, her role and voice and deep need to maintain a deep collaboration is what helped make *Frozen* successful.” One additional factor influencing the decision to promote Lee to director, according to Buck, was that at that time, one of his children had a health issue that required attention, and as a result “John and Ed and Andrew saw my personal need, and they asked me, right before, what would you think of having Jenn as a co-director? And I said yes, I said absolutely, I would love that.”

228 ecologically bland I am indebted to the help of Stephen Palumbi of Stanford’s Hopkins Marine Station and Elizabeth Alter of the City University of New York for their assistance in my understanding of the intermittent disturbance hypothesis.

228 distributed so unevenly Joseph H. Connell, “Diversity in Tropical Rain Forests and Coral Reefs,” *Science*, n.s. 199, no. 4335 (1978): 1302–10.

230 intermediate disturbance hypothesis Like many scientific theories, the intermediate disturbance hypothesis has many parents. For a more complete history, please see David M. Wilkinson, “The Disturbing History of Intermediate Disturbance,” *Oikos* 84, no. 1 (1999): 145–47.

230 “nor too frequent” John Roth and Mark Zacharias, *Marine Conservation Ecology* (London: Routledge, 2011).

230 staple of biology For more on the intermediate disturbance hypothesis, including the perspectives of those who challenge the theory, please see Wilkinson, “The Disturbing History of Intermediate Disturbance”; Jane A. Catford et al., “The Intermediate Disturbance Hypothesis and Plant Invasions: Implications for Species Richness and Management,” *Perspectives in Plant Ecology, Evolution and Systematics* 14, no. 3 (2012): 231–41; John Vandermeer et al., “A Theory of Disturbance and Species Diversity: Evidence from Nicaragua After Hurricane Joan,” *Biotropica* 28, no. 4 (1996): 600–613; Jeremy

W. Fox, “The Intermediate Disturbance Hypothesis Should Be Abandoned,” *Trends in Ecology and Evolution* 28, no. 2 (2013): 86–92.

233 Lee sat down with John Lasseter In an email sent in response to fact-checking questions, Catmull wrote that figuring out *Frozen*’s ending was a team effort. John Ripa, an animator at Disney, storyboarded the ending. “This was a powerful and influential part of the development of the story. . . . [In addition] there was a particularly impactful offsite where a great deal of progress was made.”

234 “tell the team,” said Lasseter In an email sent in response to fact-checking questions, a spokeswoman for Walt Disney Animation Studios wrote: “Jennifer feels this is very, very important: This was a story Jennifer and Chris did together. This was a partnership. [The emails] Kristen shared were based on conversations Jennifer was having with Chris daily. Chris is just as much a part of these conversations as Jennifer, Kristen and Bobby. . . . This is [Chris Buck’s] film, first and foremost.”

CHAPTER EIGHT: ABSORBING DATA

238 multiplication quiz “Dante Williams” is a pseudonym used to protect the privacy of a student who was a minor when these events occurred.

239 “Peace Bowl” Ben Fischer, “Slaying Halts ‘Peace Bowl,’” *Cincinnati Enquirer*, August 13, 2007.

240 guide Cincinnati’s efforts Marie Bienkowski et al., *Enhancing Teaching and Learning Through Educational Data Mining and Learning Analytics: An Issue Brief* (Washington, D.C.: U.S. Department of Education, Office of Technology, October 2012), <https://tech.ed.gov/wp-content/uploads/2014/03/edm-la-brief.pdf>.

240 “we were on board” For more on Elizabeth Holtzapple’s research and Cincinnati Public Schools’ approach to data usage, I recommend Elizabeth Holtzapple, “Criterion-Related Validity Evidence for a Standards-Based Teacher Evaluation System,” *Journal of Personnel Evaluation in Education* 17, no. 3 (2003): 207–19; Elizabeth Holtzapple, *Report on the Validation of Teachers Evaluation System Instructional Domain Ratings* (Cincinnati: Cincinnati Public Schools, 2001).

240 basic educational benchmarks “South Avondale Elementary: Transformation Model,” Ohio Department of Education, n.d.

240 the “Elementary Initiative” Information on the EI and other Cincinnati Public Schools reforms came from various sources, including Kim McGuire, “In Cincinnati, They’re Closing the Achievement Gap,” *Star Tribune*, May 11,

2004; Alyson Klein, “Education Week, Veteran Educator Turns Around Cincinnati Schools,” *Education Week*, February 4, 2013; Nolan Rosenkrans, “Cincinnati Offers Toledo Schools a Road Map to Success,” *The Blade*, May 13, 2012; Gregg Anrig, “How to Turn an Urban School District Around—Without Cheating,” *The Atlantic*, May 9, 2013; John Kania and Mark Kramer, “Collective Impact,” *Stanford Social Innovation Review* 9, no. 1 (Winter 2011): 36–41; Lauren Morando Rhim, *Learning How to Dance in the Queen City: Cincinnati Public Schools’ Turnaround Initiative*, Darden/Curry Partnership for Leaders in Education (Charlottesville: University of Virginia, 2011); Emily Ayscue Hassel and Bryan C. Hassel, “The Big U Turn,” *Education Next* 9, no. 1 (2009): 20–27; Rebecca Herman et al., *Turning Around Chronically Low-Performing Schools: A Practice Guide* (Washington, D.C.: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education, 2008); *Guide to Understanding Ohio’s Accountability System, 2008–2009* (Columbus: Ohio Department of Education, 2009), Web; Daniela Doyle and Lyria Boast, *2010 Annual Report: The University of Virginia School Turnaround Specialist Program*, Darden/Curry Partnership for Leaders in Education, Public Impact (Charlottesville: University of Virginia, 2011); Dana Brinson et al., *School Turnarounds: Actions and Results*, Public Impact (Lincoln, Ill.: Center on Innovation and Improvement, 2008); L. M. Rhim and S. Redding, eds., *The State Role in Turnaround: Emerging Best Practices* (San Francisco: WestEd, 2014); William S. Robinson and LeAnn M. Buntrock, “Turnaround Necessities,” *The School Administrator* 68, no. 3 (March 2011): 22–27; Susan McLester, “Turnaround Principals,” *District Administration* (May 2011); Daniel Player and Veronica Katz, “School Improvement in Ohio and Missouri: An Evaluation of the School Turnaround Specialist Program” (CEPWC Working Paper Series no. 10, University of Virginia, Curry School of Education, June 2013), Web; Alison Damast, “Getting Principals to Think Like Managers,” *Bloomberg Businessweek*, February 16, 2012; “CPS ‘Turnaround Schools’ Lift District Performance,” *The Cincinnati Herald*, August 21, 2010; Dakari Aarons, “Schools Innovate to Keep Students on Graduation Track,” *Education Week*, June 2, 2010; “Facts at a Glance,” Columbia Public Schools K–12, n.d., Web.

241 how to use it The Cincinnati Public School system’s Elementary Initiative had other components in addition to instructing teachers in how to use data. Those included using data and analysis to guide evidence-based decisions; implementing a new principal evaluation system aligned to the district’s strategic plan that included student performance scores; expanding school-site learning teams of teachers to build capacity in all schools; training primary and intermediate content specialists in core subjects; and becoming more family friendly and community engaged. “Using data and evidence, we

will improve practice, differentiate instruction, and track learning results for every student,” the district wrote in a summary of the initiative. “Our goal is to create a collaborative learning culture that involves families, is embraced in schools and is supported by the Board, central office and the community. Such a culture is at the heart of the elementary school initiative. . . . Just as the medical community uses diagnostics to determine treatment for critical care patients, so are we using data and analysis with 15 critical care schools to reshape training, support and delivery of services aligned to the academic, social and emotional needs of the students.” (“Elementary Initiative: Ready for High School,” Cincinnati Public Schools, 2014, <http://www.cps-k12.org/academics/district-initiatives/elementary-initiative>.) It is also worth noting that, though everyone spoken to in reporting this chapter credits a data-driven approach with fueling South Avondale’s transformation, they also noted that such changes were possible only because of strong leadership at the school and commitment from teachers.

241 inner-city reform “Elementary Initiative: Ready for High School.”

241 state math exam Ibid.; South Avondale Elementary School Ranking,” School Digger, 2014, <http://www.schooldigger.com/go/OH/schools/0437500379/school.aspx>; “South Avondale Elementary School Profile,” Great Schools, 2013, Web.

241 the school district read “School Improvement, Building Profiles, South Avondale,” Ohio Department of Education, 2014, Web.

242 but more useful For more on the role of data in classroom improvement, please see Thomas J. Kane et al., “Identifying Effective Classroom Practices Using Student Achievement Data,” *Journal of Human Resources* 46, no 3 (2011): 587–613; Pam Grossman et al., “Measure for Measure: A Pilot Study Linking English Language Arts Instruction and Teachers’ Value-Added to Student Achievement” (CALDER Working Paper no. 45, Calder Urban Institute, May 2010); Morgaen L. Donaldson, “So Long, Lake Wobegon? Using Teacher Evaluation to Raise Teacher Quality,” Center for American Progress, June 25, 2009, Web; Eric Hanushek, “Teacher Characteristics and Gains in Student Achievement: Estimation Using Micro-Data,” *The American Economic Review* 61, no. 2 (1971): 280–88; Elizabeth Holtzapple, “Criterion-Related Validity Evidence for a Standards-Based Teacher Evaluation System,” *Journal of Personnel Evaluation in Education* 17, no. 3 (2003): 207–19; Brian A. Jacob and Lars Lefgren, *Principals as Agents: Subjective Performance Measurement in Education* (working paper no. w11463, National Bureau of Economic Research, 2005); Brian A. Jacob, Lars Lefgren, and David Sims, *The Persistence of Teacher-Induced Learning Gains* (working paper no. w14065, National Bureau of Economic Research, 2008); Thomas J. Kane and Douglas O. Staiger, *Esti-*

inating Teacher Impacts on Student Achievement: An Experimental Evaluation (working paper no. w14607, National Bureau of Economic Research, 2008); Anthony Milanowski, “The Relationship Between Teacher Performance Evaluation Scores and Student Achievement: Evidence from Cincinnati,” *Peabody Journal of Education* 79, no. 4 (2004): 33–53; Richard J. Murnane and Barbara R. Phillips, “What Do Effective Teachers of Inner-City Children Have in Common?” *Social Science Research* 10, no. 1 (1981): 83–100; Steven G. Rivkin, Eric A. Hanushek, and John F. Kain, “Teachers, Schools, and Academic Achievement,” *Econometrica* 73, no. 2 (2005): 417–58.

243 less stressful Jessica L. Buck, Elizabeth McInnis, and Casey Randolph, *The New Frontier of Education: The Impact of Smartphone Technology in the Classroom*, American Society for Engineering Education, 2013 ASEE Southeast Section Conference; Neal Lathia et al., “Smartphones for Large-Scale Behavior Change Interventions,” *IEEE Pervasive Computing* 3 (2013): 66–73; “Sites That Help You Track Your Spending and Saving,” *Money Counts: Young Adults and Financial Literacy*, NPR, May 18, 2011; Shafiq Qaadri, “Meet a Doctor Who Uses a Digital Health Tracker and Thinks You Should Too,” *The Globe and Mail*, September 4, 2014; Claire Cain Miller, “Collecting Data on a Good Night’s Sleep,” *The New York Times*, March 10, 2014; Steven Beasley and Annie Conway, “Digital Media in Everyday Life: A Snapshot of Devices, Behaviors, and Attitudes,” Museum of Science and Industry, Chicago, 2011; Adam Tanner, “The Web Cookie Is Dying. Here’s the Creepier Technology That Comes Next,” *Forbes*, June 17, 2013, <http://www.forbes.com/sites/adamtanner/2013/06/17/the-web-cookie-is-dying-heres-the-creepier-technology-that-comes-next/>.

243 harder to decide For more on information overload and information blindness, please see Martin J. Eppler and Jeanne Mengis, “The Concept of Information Overload: A Review of Literature from Organization Science, Accounting, Marketing, MIS, and Related Disciplines,” *The Information Society* 20, no. 5 (2004): 325–44; Pamela Karr-Wisniewski and Ying Lu, “When More Is Too Much: Operationalizing Technology Overload and Exploring Its Impact on Knowledge Worker Productivity,” *Computers in Human Behavior* 26, no. 5 (2010): 1061–72; Joseph M. Kayany, “Information Overload and Information Myths,” Itera, n.d., http://www.itera.org/wordpress/wp-content/uploads/2012/09/ITERA12_Paper15.pdf; Marta Sinclair and Neal M. Ashkanasy, “Intuition Myth or a Decision-Making Tool?” *Management Learning* 36, no. 3 (2005): 353–70.

243 blanket of powder Snow blindness can also refer to a burn of the cornea, which is the front surface of the eye, by ultraviolet B rays.

243 enroll in 401(k) plans Sheena S. Iyengar, Gur Huberman, and Wei Jiang, “How Much Choice Is Too Much? Contributions to 401(k) Retirement

Plans,” *Pension Design and Structure: New Lessons from Behavioral Finance* (Philadelphia: Pension Research Council, 2004): 83–95.

244 more than thirty plans In an email sent in response to fact-checking questions, Tucker Kuman, a colleague of the paper’s lead author, Sheena Sethi-Iyengar, wrote: “What was observed in the analysis was that, everything else being equal, every ten funds added was associated with a 1.5 percent to 2 percent drop in employee participation rate (peak participation—75%—occurred when 2 funds were offered). . . . As the offerings increased in number, the decline in participation rates is exacerbated. If you look at the graphic representation [Figure 5–2 in the paper] of the relationship between participation and number of funds offered, you’ll notice we begin to see a *steeper* decline in participation rates when the number of funds hits about 31.”

244 information overload Jeanne Mengis and Martin J. Eppler, “Seeing Versus Arguing the Moderating Role of Collaborative Visualization in Team Knowledge Integration,” *Journal of Universal Knowledge Management* 1, no. 3 (2006): 151–62; Martin J. Eppler and Jeanne Mengis, “The Concept of Information Overload: A Review of Literature from Organization Science, Accounting, Marketing, MIS, and Related Disciplines,” *The Information Society* 20, no. 5 (2004): 325–44.

245 “winnowing” or “scaffolding” Fergus I. M. Craik and Endel Tulving, “Depth of Processing and the Retention of Words in Episodic Memory,” *Journal of Experimental Psychology: General* 104, no. 3 (1975): 268; Monique Ernst and Martin P. Paulus, “Neurobiology of Decision Making: A Selective Review from a Neurocognitive and Clinical Perspective,” *Biological Psychiatry* 58, no. 8 (2005): 597–604; Ming Hsu et al., “Neural Systems Responding to Degrees of Uncertainty in Human Decision-Making,” *Science* 310, no. 5754 (2005): 1680–83.

245 hardly aware it’s occurring For more on the decision-making aspect of scaffolding and cognition, please see Gerd Gigerenzer and Wolfgang Gaissmaier, “Heuristic Decision Making,” *Annual Review of Psychology* 62 (2011): 451–82; Laurence T. Maloney, Julia Trommershäuser, and Michael S. Landy, “Questions Without Words: A Comparison Between Decision Making Under Risk and Movement Planning Under Risk,” *Integrated Models of Cognitive Systems* (2007): 297–313; Wayne Winston, *Decision Making Under Uncertainty* (Ithaca, N.Y.: Palisade Corporation, 1999); Eric J. Johnson and Elke U. Weber, “Mindful Judgment and Decision Making,” *Annual Review of Psychology* 60 (2009): 53; Kai Pata, Erno Lehtinen, and Tago Sarapuu, “Inter-Relations of Tutor’s and Peers’ Scaffolding and Decision-Making Discourse Acts,” *Instructional Science* 34, no. 4 (2006): 313–41; Priscilla Wohlstetter, Amanda Datnow, and Vicki Park, “Creating a System for Data-Driven Decision Making: Applying the Principal-Agent Framework,” *School Effectiveness and School Improve-*

ment 19, no. 3 (2008): 239–59; Penelope L. Peterson and Michelle A. Comeaux, “Teachers’ Schemata for Classroom Events: The Mental Scaffolding of Teachers’ Thinking During Classroom Instruction,” *Teaching and Teacher Education* 3, no. 4 (1987): 319–31; Darrell A. Worthy et al., “With Age Comes Wisdom: Decision Making in Younger and Older Adults,” *Psychological Science* 22, no. 11 (2011): 1375–80; Pat Croskerry, “Cognitive Forcing Strategies in Clinical Decisionmaking,” *Annals of Emergency Medicine* 41, no. 1 (2003): 110–20; Brian J. Reiser, “Scaffolding Complex Learning: The Mechanisms of Structuring and Problematizing Student Work,” *The Journal of the Learning Sciences* 13, no. 3 (2004): 273–304; Robert Clowes and Anthony F. Morse, “Scaffolding Cognition with Words,” in *Proceedings of the Fifth International Workshop on Epigenetic Robotics: Modeling Cognitive Development in Robotic Systems* (Lund, Sweden: Lund University Cognitive Studies, 2005), 101–5.

246 make a choice For more on disfluency, please see Adam L. Alter, “The Benefits of Cognitive Disfluency,” *Current Directions in Psychological Science* 22, no. 6 (2013): 437–42; Adam L. Alter et al., “Overcoming Intuition: Metacognitive Difficulty Activates Analytic Reasoning,” *Journal of Experimental Psychology: General* 136, no. 4 (2007): 569; Adam L. Alter, *Drunk Tank Pink: And Other Unexpected Forces That Shape How We Think, Feel, and Behave* (New York: Penguin, 2013); Adam L. Alter et al., “Overcoming Intuition: Metacognitive Difficulty Activates Analytic Reasoning,” *Journal of Experimental Psychology: General* 136, no. 4 (2007): 569; Adam L. Alter and Daniel M. Oppenheimer, “Effects of Fluency on Psychological Distance and Mental Construal (or Why New York Is a Large City, but New York Is a Civilized Jungle),” *Psychological Science* 19, no. 2 (2008): 161–67; Adam L. Alter and Daniel M. Oppenheimer, “Uniting the Tribes of Fluency to Form a Metacognitive Nation,” *Personality and Social Psychology Review* 13, no. 3 (2009): 219–35; John Hattie and Gregory C. R. Yates, *Visible Learning and the Science of How We Learn* (London: Routledge, 2013); Nassim Nicholas Taleb, *Antifragile: Things That Gain from Disorder* (New York: Random House, 2012); Daniel M. Oppenheimer, “The Secret Life of Fluency,” *Trends in Cognitive Sciences* 12, no. 6 (2008): 237–41; Edward T. Cokely and Colleen M. Kelley, “Cognitive Abilities and Superior Decision Making Under Risk: A Protocol Analysis and Process Model Evaluation,” *Judgment and Decision Making* 4, no. 1 (2009): 20–33; Connor Diemand-Yauman, Daniel M. Oppenheimer, and Erikka B. Vaughan, “Fortune Favors the Bold (and the Italicized): Effects of Disfluency on Educational Outcomes,” *Cognition* 118, no. 1 (2011): 111–15; Hyunjin Song and Norbert Schwarz, “Fluency and the Detection of Misleading Questions: Low Processing Fluency Attenuates the Moses Illusion,” *Social Cognition* 26, no. 6 (2008): 791–99; Anuj K. Shah and Daniel M. Oppenheimer, “Easy Does It: The Role of Fluency in Cue Weighting,” *Judgment and Decision Making* 2, no. 6

(2007): 371–79. In an email sent in response to fact-checking questions, Adam Alter, a professor at NYU who has studied disfluency, explained disfluency as “the sense of mental difficulty that people experience when they try to process (make sense of) certain pieces of information—complex words; text printed in ornate fonts; text printed against background of a similar color; drawing dimly remembered ideas from memory; struggling to remember a phone number; etc. You don’t have to be manipulating or using data, per se, for an experience to be disfluent. Some of this turns on how you define data—it sounds like you’re defining it very broadly, so perhaps your definition comes close to mine if you think of every cognitive process as ‘using data.’”

246 easier to digest Alter wrote in an email that some recent work “challenges the disfluency literature. . . . Some of my friends/colleagues have written another piece [“Disfluent Fonts Don’t Help People Solve Math Problems”] that shows how finicky the effect is; [and] how hard it can be to replicate at least one of the effects (the cognitive reflection test effects).”

247 “using it in conversations” In an email sent in response to fact-checking questions, Adam Alter expanded on his quote to note that disfluency causes learning to be “longer lasting, perhaps, but certainly deeper. We don’t comment much on decay rates—how long the information is retained—but it probably follows that ideas last longer when they’re processed more deeply. . . . The more they elaborate on that information, the more they tend to remember it. That’s a general principle from cognitive psychology. If I ask you to remember the word ‘balloon,’ you’ll remember it more easily if, at the point of storing it in memory, you imagine a red balloon floating into the sky, or you think of a baboon carrying a balloon, or you otherwise do more than just trying to cram the word into your already overstuffed memory bank.”

247 pay their credit card bills Chase Manhattan Bank, now known as JPMorgan Chase, was provided with a summary of all facts contained in this chapter. A representative for the company wrote: “Given that more than 15 years have passed [since] the merger of Bank One and J. P. Morgan Chase in 2004, it’s been difficult to find the right internal sources for this.”

251 “pick up on things” In an email sent in response to fact-checking questions, Fludd wrote that there were other elements to her management style that she believes contributed to her success: “I also was able to identify that the collectors had different learning styles that caused them to interpret the data in different ways that could either negatively or positively impact their performance. . . . Management would accuse me of spoiling my collectors because sometimes I would cook them breakfast on the weekends. Food always helped. Being a minister often helped me relate to the collectors and assist them in ways that other managers couldn’t. I would visit family members in

the hospital, perform marriages, prayer requests. Collectors knew I was a no nonsense manager, but they also knew I cared about them. . . . Knowing how to interpret data and explaining it in a way that is meaningful and relevant is important. The collectors having access to data that was relevant to their performance was important. However if you cannot give the employee a road map on how to take the data that they are receiving and show them how to get to their desired performance destination, then it means nothing. How you relay that data is just as important. The important thing every manager needs to remember is not to forget the human side of the data they are relating.”

252 various experiments In an email sent in response to fact-checking questions, Niko Cantor wrote: “It is also true that Charlotte was a better manager than most peers, more engaging, more enrolling her people in a quest to become better. She did make the job feel more like a game. I think some of the effects of the collectors listening better and therefore connecting better because the collectors were more engaged were important.”

253 “So you’re Ms. Johnson” Johnson started her teaching career at Pleasant Hill Elementary, and then later joined South Avondale, serving as a teacher coach.

255 over the PA system The “Hot Pencil Drills” were unique to South Avondale, and not done in all of the schools participating in the Elementary Initiative.

256 Delia Morris was a “Delia Morris” is a pseudonym used to protect the privacy of a student who was a minor when these events occurred.

258 “the engineering design process” Yousef Haik and Tamer Shahin, *Engineering Design Process* (Independence, Ky.: Cengage Learning, 2010); Clive L. Dym et al., *Engineering Design: A Project-Based Introduction* (New York: Wiley, 2004); Atila Ertas and Jesse C. Jones, *The Engineering Design Process* (New York: Wiley, 1996); Thomas J. Howard, Stephen J. Culley, and Elies Dekoninck, “Describing the Creative Design Process by the Integration of Engineering Design and Cognitive Psychology Literature,” *Design Studies* 29, no. 2 (2008): 160–80.

258 teacher’s manual explained “What is the Engineering Design Process?” Innovation First International, <http://curriculum.vexrobotics.com/curriculum/intro-to-engineering/what-is-the-engineering-design-process>.

261 their own experiences Stephen J. Hoch, “Availability and Interference in Predictive Judgment,” *Journal of Experimental Psychology: Learning, Memory, and Cognition* 10, no. 4 (1984): 649.

261 question was framed In an email sent in response to fact-checking questions, the author of this study, Stephen Hoch, wrote: “The only other thing that I might add is that old ideas can get in the way of new ideas, cre-

ating interference and essentially blocking the thought process. One way to overcome the interference is to take a break so that the old ideas die down in terms of their salience.”

261 hard to dislodge Irwin P. Levin, Sandra L. Schneider, and Gary J. Gaeth, “All Frames Are Not Created Equal: A Typology and Critical Analysis of Framing Effects,” *Organizational Behavior and Human Decision Processes* 76, no. 2 (1998): 149–88; Hilary A. Llewellyn-Thomas, M. June McGreal, and Elaine C. Thiel, “Cancer Patients’ Decision Making and Trial-Entry Preferences: The Effects of ‘Framing’ Information About Short-Term Toxicity and Long-Term Survival,” *Medical Decision Making* 15, no. 1 (1995): 4–12; David E. Bell, Howard Raiffa, and Amos Tversky, *Decision Making: Descriptive, Normative, and Prescriptive Interactions* (Cambridge: Cambridge University Press, 1988); Amos Tversky and Daniel Kahneman, “Rational Choice and the Framing of Decisions,” *The Journal of Business* 59, no. 4, part 2 (1986): S251–78.

262 “inside their heads” In response to a fact-checking email, Johnson wrote: “The idea is that we think of a subset of the relevant information.”

264 program named “Gen-1” Lekan Oguntoyinbo, “Hall Sweet Home,” *Diverse Issues in Higher Education* 27, no. 25 (2011): 8; Dana Jennings, “Second Home for First Gens,” *The New York Times*, July 20, 2009.

265 the difference between students Pam A. Mueller and Daniel M. Oppenheimer, “The Pen Is Mightier Than the Keyboard: Advantages of Longhand over Laptop Note Taking,” *Psychological Science* 25, no. 6 (2014).

265 verbatim phrases In a note sent in response to fact-checking questions, the first author of this study, Pam Mueller of Princeton, wrote: “Only because a lot of people (on the Internet) seem to assume that we didn’t randomly assign participants to groups, and therefore the conclusions are invalid, it might be worth mentioning that the two groups were, in fact, randomly assigned. We did ask students about their underlying note-taking preference, but due to small numbers of participants in certain conditions (e.g., longhand-preferring students at Princeton assigned to the laptop condition) we can’t draw strong conclusions about any interactions there. There is some suggestion that those who preferred longhand in their regular note taking were more effective than others when using a laptop (i.e., continuing to take shorter, non-verbatim notes). One thing to note is that a strong majority of students at Princeton reported that they generally took notes on a laptop, while a majority of UCLA students reported that they took notes longhand. It is heartening that our second study (run at UCLA) did replicate our first study (run at Princeton).”

265 the lecture’s content In a note sent in response to fact-checking questions, Mueller wrote: “Laptop note-takers had far more content in their notes. Thus, we thought that the laptop note-takers’ performance would rebound

when they had a chance to look back on their notes—the laptop note takers just had so much more information available at the time of study. However (as we were quite surprised to find), it seems that if they didn't process the information at the time of encoding (i.e., during the lecture), the increased quantity of notes didn't help, or at least didn't help within a short study period. Perhaps with a longer time to study, they could piece together the content of the lecture, but at that point, the process is pretty inefficient, and it would be better to have taken 'better' (i.e., longhand-style, with less verbatim overlap) notes the first time around."