Description

We will focus on extreme expertise with an emphasis on drawing inferences across different expertises within a cognitive science framework. The course is structured around Gobet’s (2015) recent book, “Understanding Expertise” (his 5th book on expertise). This book will serve as our entry into the expertise literature. As we read the chapters, we will also read and discuss some of the key papers Gobet discusses in that chapter as well as some of the newer research that he does not discuss. Our goal is to gain a broad understanding of the cognitive science underlying expertise, its research progress and deadends, and what the “expertise approach” tells us about cognitive science and our own humanity.

This Syllabus breaks down Gobet’s book by chapters and lists research papers for each of his topics that we may read or discuss. The basic format will be a general class discussion of the chapter (which you all will read before that class) followed by one or several detailed presentations (see Section 100 Requirements) of research papers that extend Gobet’s overview of his topics. Everyone should come to the first class meeting having read the Simon (1992) paper listed for Week 01. Copies of the book should be available at the bookstore [see the citation for (Gobet, 2015) in the Reference list of this syllabus].

Please note that we will NOT read all of the papers listed within each section and
subsection. Rather, these are candidate papers for graduate student class presentations. See Section 100 for more details.

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2 Week 01
  • We will discuss the course structure, requirements, and goals.
• Come to class having read this paper and being prepared to talk about it:


• We will then listen to this broadcast of Freakonomics (thanks Sean for finding this!) and discuss it afterwards – or maybe during . . .

  – click here to download and listen to this Freakonomics broadcast

2 Gobet Ch2: Perception & Categorization

2.2 De Groot’s Seminal Research

In class presentation by **John Lindstedt**:


Abstract: The reported research extends classic findings that after briefly viewing structured, but not random, chess positions, chess masters reproduce these positions much more accurately than less-skilled players. Using a combination of the gaze-contingent window paradigm and the change blindness flicker paradigm, we documented dramatically larger visual spans for experts while processing structured, but not random, chess positions. In addition, in a check-detection task a minimized 3 x 3 chessboard containing a Ring and potentially checking pieces, was displayed. In this task, experts made fewer fixations per trial than less-skilled players, and had a greater proportion of fixations between individual pieces, rather than on pieces. Our results provide strong evidence for a perceptual encoding advantage for experts attributable to chess experience, rather than to a general perceptual or memory superiority.

2.3 Medical Expertise

In class presentation by **Matt Donaldson**:


Abstract: Summary The goal of this study was to examine and characterize changes in the ways that pathology residents examine digital whole slide images as they progress through the residency training. A series of 20 digitized breast biopsy whole slide images (half benign and half malignant biopsies) were individually shown to 4 pathology residents at four points in time—at the beginning of their first, second, third, and fourth years of residency. Their task was to examine each image and select three areas that they would most want to zoom in on in order to view the diagnostic detail at higher resolution. Eye position was recorded as they scanned each whole slide image at low magnification. The data indicate that with each successive year of experience, the residents’ search patterns do change. Overall, with time, it takes significantly less time to view an individual slide and decide where to zoom, significantly fewer fixations are generated overall, and there is less examination of nondiagnostic areas. Essentially, the residents’ search becomes much more efficient. These findings are similar to those in radiology, and support the theory that an important aspect
of the development of expertise is improved pattern recognition (taking in more information during the initial Gestalt or gist view) as well as improved allocation of attention and visual processing resources. Progression in improvements in visual search strategies was similar, but not identical, for the 4 residents.


2.5 Perception in Sport


2.6 Perception in Music


2.7 Perceptual Learning, Perceptual Expertise, and Categorization


2.99 Eye Data in Medicine and Chess


3 Gobet Ch3: Memory

3.4 Is Knowledge Structured as Chunks?

Entire class read:


Abstract: Pioneering work in the 1940s and 1950s suggested that the concept of ‘chunking’ might be important in many processes of perception, learning and cognition in humans and animals. We
summarize here the major sources of evidence for chunking mechanisms, and consider how such mechanisms have been implemented in computational models of the learning process. We distinguish two forms of chunking: the first deliberate, under strategic control, and goal-oriented; the second automatic, continuous, and linked to perceptual processes. Recent work with discrimination-network computational models of long- and short-term memory (EPAM/CHREST) has produced a diverse range of applications of perceptual chunking. We focus on recent successes in verbal teaming, expert memory, language acquisition and learning multiple representations, to illustrate the implementation and use of chunking mechanisms within contemporary models of human learning.

In class presentation by Catherine Sibert:


**Abstract**: A new approach examined two aspects of chess skill, long a popular topic in cognitive science. A powerful computer-chess program calculated the number and magnitude of blunders made by the same 23 grandmasters in hundreds of serious games of slow ("classical") chess, regular "rapid" chess, and rapid "blindfold" chess, in which opponents transmit moves without ever seeing the actual position. Rapid chess led to substantially more and larger blunders than classical chess. Perhaps more surprisingly, the frequency and magnitude of blunders did not differ in rapid versus blindfold play, despite the additional memory and visualization load imposed by the latter. We discuss the involvement of various cognitive processes in human problem-solving and expertise, especially with respect to chess. Prior opposing views about the basis of general chess skill have emphasized the dominance of either (a) swift pattern recognition or (b) analyzing ahead, but both seem important and the controversy appears currently irresolvable and perhaps fruitless.


### 3.5 How Many Chunks are Stored in LTM?

In class presentation by Molly Renaud:


**Abstract**: Pattern recognition lies at the heart of the cognitive science endeavor. In this paper, we provide some criticism of this notion, using studies of chess as an example. The game of chess is, as significant evidence shows, a game of abstractions; pressures; force; open files and ranks; time; tightness of defense; old strategies rapidly adapted to new situations. These ideas do not arise on current computational models, which apply brute force by rote-memorization. In this paper we assess the computational models of CHREST and CHUMP, and argue that chess chunks must contain semantic information. This argument leads to a new and contrasting claim, as we propose
that key conclusions of Chase and Simon’s (1973) influential study stemmed from a non-sequitur. In the concluding section, we propose a shift in philosophy, from “pattern recognition” to a framework of “experience recognition”. (C) 2009 Elsevier Ltd. All rights reserved.

In class presentation by Josh Eaton:

Abstract: There is much evidence that chess skill is based on chunks in memory that represent parts of positions from previously encountered games. However, the content of these chunks is a matter for debate. According to one view, (1) the closer two pieces are to each other on a board (proximity), the more likely they are to be in the same chunk, and (2) skilled players encode the precise locations of pieces. An alternative view is that what information is encoded in a chess chunk is determined more by processing of the attack/defense relations during evaluation. In three experiments, participants evaluated positions and completed recognition tests. Experiment I supported the view that expert players make more use of attack/defense relations than of locations of pieces in a recognition test. Experiments 2 and 3 demonstrated that, for both long and short presentation times, expert players’ recognition for a piece within a position was primed more by a piece related by attack or defense than by a piece merely proximal. These findings challenge theories of expertise for chess that assume a primary role for proximity and location in determining which pieces are grouped together in memory.


3.6 Does Randomization Eliminate Experts’ Superiority?


3.7 Is STM Capacity Limited and Are LTM Encoding Times Slow?


3.8 The Intermediate Effect in Medicine

3.11 Theoretical Accounts

3.11.3 Long-Term Working Memory

Entire class read:


Abstract: To account for the large demands on working memory during text comprehension and expert performance, the traditional models of working memory involving temporary storage must be extended to include working memory based on storage in long-term memory. In the proposed theoretical framework cognitive processes are viewed as a sequence of stable states representing end products of processing. In skilled activities, acquired memory skills allow these end products to be stored in long-term memory and kept directly accessible by means of retrieval cues in short-term memory, as proposed by skilled memory theory. These theoretical claims are supported by a review of evidence on memory in text comprehension and expert performance in such domains as mental calculation, medical diagnosis, and chess.

3.11.4 Revisions of Chunking Theory

3.11.4.1 EPAM-IV


3.11.4.2 Template theory and CHREST


3.11.4.3 Evaluations of EPAM-IV and template theory


3.99 Does Brain Training Work?

3.99.1 No!


Entire class read:


Abstract: In 2014, two groups of scientists published open letters on the efficacy of brain-training interventions, or ‘brain games,” for improving cognition. The first letter, a consensus statement from an international group of more than 70 scientists, claimed that brain games do not provide a scientifically grounded way to improve cognitive functioning or to stave off cognitive decline. Several months later, an international group of 133 scientists and practitioners countered that the literature is replete with demonstrations of the benefits of brain training for a wide variety of cognitive and everyday activities. How could two teams of scientists examine the same literature and come to conflicting “consensus” views about the effectiveness of brain training? In part, the disagreement might result from different standards used when evaluating the evidence. To date, the field has lacked a comprehensive review of the brain-training literature, one that examines both the quantity and the quality of the evidence according to a well-defined set of best practices. This article provides such a review, focusing exclusively on the use of cognitive tasks or games as a means to enhance performance on other tasks. We specify and justify a set of best practices for such brain-training interventions and then use those standards to evaluate all of the published peer-reviewed intervention studies cited on the websites of leading brain-training companies listed on Cognitive Training Data (www.cognitivetrainingdata.org), the site hosting the open letter from brain-training proponents. These citations presumably represent the evidence that best supports the claims of effectiveness. Based on this examination, we find extensive evidence that brain-training interventions improve performance on the trained tasks, less evidence that such interventions improve performance on closely related tasks, and little evidence that training enhances performance on distantly related tasks or that training improves everyday cognitive performance. We also find that many of the published intervention studies had major shortcomings in design or analysis that preclude definitive conclusions about the efficacy of training, and that none of the cited studies conformed to all of the best practices we identify as essential to drawing clear conclusions about the benefits of brain training for everyday activities. We conclude with detailed recommendations for scientists, funding agencies, and policymakers that, if adopted, would lead to better evidence regarding the efficacy of brain-training interventions.

3.99.2 Yes? Maybe . . .


4 Gobet Ch4: Problem Solving

4.4 Expertise Effects in Progressive Deepening


4.5 Macrostructure of Search

doi:10.1080/13546780802265547.


### 4.8 Evaluation

In class presentation by Molly Renaud:


**Abstract**: Many observers of expert decision makers have assumed an Information-Use Hypothesis: the amount of information used, as measured by number of significant cues, should be greater for experts than non-experts. Since prior studies consistently have shown that both expert and naive judgment can be described using few cues, the conclusion has been drawn that experts are limited decision makers. This paper takes a new look at this conclusion by reviewing recent literature on information use of experts and by presenting some new evidence. The results from five studies show that experts often have the same (or fewer) number of significant cues as novices, but that the information used is more relevant. Therefore, the amount of information used does not reflect degree of expertise; however, the type of information used does. This finding has implications for measurement of expertise, analysis of expert tasks, and generalizability of conclusions about experts.

In class presentation by Shannon Briggs:


**Abstract**: Examined the relation of age and skill to problem solving in chess, using 34 16–64 yr old males in 2 experiments. Ss were selected to vary widely in age and skill such that these variables were uncorrelated. Problem-solving and memory tasks were administered. Skill level was the only significant predictor for accuracy in both a choose-a-move task and a speeded end-game evaluation task. Age (negatively) and skill (positively) jointly determined performance in an unexpected recall task. Efficient chunking in recall was positively related to skill, though negatively related to age. Recognition confidence was negatively related to age. Thus, despite age-related declines in encoding and retrieval of information, older Ss matched the problem-solving performance of equivalently skilled younger Ss. Apparently, they can search the problem space more efficiently, as evidenced by taking less time to select an equally good move. Models of chess skill that stress the role of encoding efficiency, as indexed by chunking in recall, need to be modified to account for performance over the life span.


### 4.9 The Role of Pattern Recognition in Problem Solving


4.9.99 Time Constraints: Show Search or Pattern Recognition


4.10 The Role of Perception in Problem Solving


4.11 The Role of Schemata and Conceptual Knowledge in Problem Solving


4.12 The Role of Representations

Entire class read:


4.13 Automatization and Rigidity of Thought

4.13.2 Rigidity of Thought


5 Gobet Ch5: Decision Making

John Lindstedt presents:

Abstract: Fine motor skills like typing involve a mapping problem that trades Fitts’ law against Hick’s law. Eight fingers have to be mapped onto 26 keys. Movement time increases with distance, so Fitts’ law is optimized by recruiting more fingers. Choice difficulty increases with the number of alternatives, so Hick’s law is optimized by recruiting fewer fingers. The effect of the number of alternatives decreases with consistent practice, so skilled typists achieve a balance between Fitts’ law and Hick’s law through learning. We tested this hypothesis by comparing standard typists who use the standard QWERTY mapping consistently with nonstandard typists who use fewer fingers less consistently. Typing speed and accuracy were lower for nonstandard typists, especially when visual guidance was reduced by removing the letters from the keys or covering the keyboard. Regression analyses showed that accommodation to Fitts’ law (number of fingers) and Hick’s law (consistency) predicted typing speed and accuracy. We measured the automaticity of typing in both groups, testing for hierarchical control in 3 tasks: word priming, which measures parallel activation of keystrokes, keyboard recall, which measures explicit knowledge of letter locations, and hand cuing, which measures explicit knowledge of which hand types which letter. Standard and nonstandard typists showed similar degrees of hierarchical control in all 3 tasks, suggesting that nonstandard typists type as automatically as standard typists, but their suboptimal balance between Fitts’ law and Hick’s law limits their ability to type quickly and accurately.

5.2 Rationality and Bounded Rationality

Entire class read:


Abstract: Herbert Simon’s research endeavor aimed to understand the processes that participate in human decision making. However, despite his effort to investigate this question, his work did not have the impact in the “decision making” community that it had in other fields. His rejection of the assumption of perfect rationality, made in mainstream economics, led him to develop the concept of bounded rationality. Simon’s approach also emphasized the limitations of the cognitive system, the change of processes due to expertise, and the direct empirical study of cognitive processes involved in decision making. In this article, we argue that his subsequent research program in problem solving and expertise offered critical tools for studying decision-making processes that took into account his original notion of bounded rationality. Unfortunately, these tools were ignored by the main research paradigms in decision making, such as Tversky and Kahneman’s biased rationality approach (also known as the heuristics and biases approach) and the ecological approach advanced by Gigerenzer and others. We make a proposal of how to integrate Simon’s approach with the main current approaches to decision making. We argue that this would lead to better models of decision making that are more generalizable, have higher ecological validity, include specification of cognitive processes, and provide a better understanding of the interaction between the characteristics of the cognitive system and the contingencies of the environment.

5.4 Biases in Experts

Entire class read:

Abstract: The hindsight bias manifests in the tendency to exaggerate the extent to which a past event could have been predicted beforehand. This bias has particularly detrimental effects in the domain of medical decision making. I present a demonstration of the bias, its contribution to overconfidence, and its involvement in judgments of medical malpractice. Finally, I point out that physicians and psychologists can collaborate to the mutual benefit of both professions.

Josh Eaton presents:


Abstract: This paper begins by reviewing research on the cognitive processing used by residential burglars when choosing targets. We then attempt to make links between this processing and the notion of expertise in the broader cognitive literature, to the extent that, in comparison with novices, processing appears removed from explicit deliberation, tasks are carried out speedily and methodically, and recognition of relevant stimuli or cues is extremely fast, if not instantaneous. We then present new data from interviews with 50 experienced burglars. We cover the initial decision to burgle and selection of the target followed by, for the first time in the UK, a detailed discussion of search strategies within the property. Forty five out of 50 burglars had a predictable search pattern and 37 spontaneously described their searches using terms signifying automaticity—an underlying feature of expertise. We discuss the implications of these findings in terms of primary and secondary crime prevention.


5.7 The SoS Effect

Shannon Briggs presents:


Abstract: The objective of our research is to understand the perception of multiple abnormalities in an imaging examination and to develop strategies for improved diagnostic. We are one of the few laboratories in the world pursuing the goal of reducing detection errors through a better understanding of the underlying perceptual processes involved. Failure to detect an abnormality is the most common class of error in diagnostic imaging and generally is considered the most serious by the medical community. Many of these errors have been attributed to "satisfaction of search," which occurs when a lesion is not reported because discovery of another abnormality has "satisfied" the goal of the search. We have gained some understanding of the mechanisms of satisfaction of search (SOS) traditional radiographic modalities. Currently, there are few interventions to remedy SOS error. For example, patient history that the prompts specific abnormalities, protects the radiologist from missing them even when other abnormalities are present. The knowledge gained from this programmatic research will lead to reduction of observer error.
5.8 Shanteau's Framework

5.9 Decision Making in Sports
5.9.1 Using Task-Specific Probabilities
Ava Faitakes Presents:

Abstract: We review contemporary research on perceptual-cognitive expertise in sport and consider implications for those working in the field of applied cognitive psychology. We identify the important perceptual-cognitive skills that facilitate anticipation in sport and illustrate how these skills interact in a dynamic manner during performance. We also highlight our current understanding of how these skills are acquired and consider the extent to which the underlying processes are specific to a particular domain and role within that domain. Next, we briefly review recent attempts to facilitate the acquisition of perceptual-cognitive expertise using simulation training coupled with instruction and feedback on task performance. Finally, we discuss how research on elite athletes can help inform applied cognitive psychologists who are interested in capturing and enhancing perceptual-cognitive expertise across various domains.

5.9.2 Option Selection


6 Gobet Ch6: Intuition, Insight, and Creativity
Class discussions of chapter 6 only.

7 Gobet Ch7: Talent, Individual Differences, and Gender Differences
7.2 Talent Approaches Based on Intelligence
7.2.4 IQ as Predictor of Expert Performance

8 Gobet Ch8: Learning and Education – Week 11

8.3 Approaches Based on Practice

8.4 The Question of Transfer

8.8 Deliberations on Deliberate Practice
8.8.1 Arguments for Deliberate Practice
Entire class read:
Abstract: Exceptional performance is frequently attributed to genetic differences in talent. Since Sir Francis Galton’s book, Hereditary Genius, many scientists have cited heritable factors that set limits of performance and only allow some individuals to attain exceptional levels. However, thus far these accounts have not explicated the causal processes involved in the activation and expression of unique genes in DNA that lead to the emergence of distinctive physiological attributes and cognitive capacities (innate talent). This article argues on the basis of our current knowledge that it is possible to account for the development of elite performance among healthy children without recourse to innate talent (genetic endowment)—excepting the innate determinants of body size. Our account is based on the expert-performance approach and proposes that the distinctive characteristics of exceptional performers are the result of adaptations to extended and intense practice activities that selectively activate dormant genes that are contained within all healthy individuals’ DNA. Furthermore, the theoretical framework of expert performance explains the apparent emergence of early talent by identifying factors that influence starting ages for training and the accumulated engagement in sustained extended deliberate practice, such as motivation, parental support, and access to the best training environments and teachers. In sum, our empirical investigations and extensive reviews show that the development of expert performance will be primarily constrained by individuals’ engagement in deliberate practice and the quality of the available training resources.

8.8.2 Then come the critics


Entire class read:


**Abstract:** Why are some people so much more successful than other people in music, sports, games, business, and other complex domains? This question is the subject of one of psychology’s oldest debates. Over 20 years ago, Ericsson, Krampe, and Tesch-Romer (1993) proposed that individual differences in performance in domains such as these largely reflect accumulated amount of “deliberate practice.” More controversially, making exceptions only for height and body size, Ericsson et al. explicitly rejected any direct role for innate factors (“talent”) in the attainment of expert performance. This view has since become the dominant theoretical account of expertise and has filtered into the popular imagination through books such as Malcolm Gladwell’s (2008) Outliers. Nevertheless, as we discuss in this chapter, evidence from recent research converges on the conclusion that this view is not defensible. Recent meta-analyses have demonstrated that although deliberate practice accounts for a sizeable proportion of the variance in performance in complex domains, it consistently leaves an even larger proportion of the variance unexplained and potentially explainable by other factors. In light of this evidence, we offer a “new look” at expertise that takes into account a wide range of factors.


**Abstract:** Controversies surrounding nature and nurture determinants of expert/elite performance have arisen many times since antiquity, and remain sources of concern in the present day. Extreme positions on this controversy are fundamentally silly — both nature and nurture are necessary determinants of expert/elite performance, but neither alone represents a sufficient causal factor. The central issues surrounding the so-called “talent myth” and the “deliberate practice theory” (also referred to as the “10,000 h rule”) are reviewed. Also provided is a discussion of the science of individual differences related to talent, the fundamental characteristics of talent and the role of talent in predicting individual differences in expert/elite performance. Finally, a review of the critical psychometric and statistical considerations for the prediction of individual differences in the acquisition of expert/elite performance is presented. Conclusions focus on how these various issues fit together, to provide an integrated view of the importance of talent, but also the limitations of talent identification procedures for discovering which individuals will ultimately develop expert/elite
levels of performance.


Abstract: Why are some people more skilled in complex domains than other people? According to one prominent view, individual differences in performance largely reflect individual differences in accumulated amount of deliberate practice. Here, we investigated the relationship between deliberate practice and performance in sports. Overall, deliberate practice accounted for 18% of the variance in sports performance. However, the contribution differed depending on skill level. Most important, deliberate practice accounted for only 1% of the variance in performance among elite-level performers. This finding is inconsistent with the claim that deliberate practice accounts for performance differences even among elite performers. Another major finding was that athletes who reached a high level of skill did not begin their sport earlier in childhood than lower skill athletes. This finding challenges the notion that higher skill performers tend to start in a sport at a younger age than lower skill performers. We conclude that to understand the underpinnings of expertise, researchers must investigate contributions of a broad range of factors, taking into account findings from diverse subdisciplines of psychology (e.g., cognitive psychology, personality psychology) and interdisciplinary areas of research (e.g., sports science).

8.8.3 Responses to Critics


Abstract: In their original article, Ericsson, Krampe, and Tesch-Romer (1993) reviewed the evidence concerning the conditions of optimal learning and found that individualized practice with training tasks (selected by a supervising teacher) with a clear performance goal and immediate informative feedback was associated with marked improvement. We found that this type of deliberate practice was prevalent when advanced musicians practice alone and found its accumulated duration related to attained music performance. In contrast, Macnamara, Moreau, and Hambrick's (2016, this issue) main meta-analysis examines the use of the term deliberate practice to refer to a much broader and less defined concept including virtually any type of sport-specific activity, such as group activities, watching games on television, and even play and competitions. Summing up every hour of any type of practice during an individual's career implies that the impact of all types of practice activity on performance is equal—an assumption that I show is inconsistent with the evidence. Future research should collect objective measures of representative performance with a longitudinal description of all the changes in different aspects of the performance so that any proximal conditions of deliberate practice related to effective improvements can be identified and analyzed experimentally.

Abstract: Ericsson and colleagues' view that individual differences in expertise can largely be accounted for by accumulated deliberate practice is not supported by the available empirical evidence. Extending earlier work (Macnamara, Hambrick, & Oswald, 2014), we found that deliberate practice accounted for a sizeable amount of variance in sports performance (18%), but it left a much larger amount unexplained. Ericsson's (2016, this issue) evaluation of our research is undercut by contradictions, omissions, and errors. We agree with Ericsson that future longitudinal research will deepen understanding of expertise, but our goal was to evaluate the importance of deliberate practice based on existing evidence.

8.8.4 British Journal of Sports Medicine


Abstract: Elite sporting performance results from the combination of innumerable factors, which interact with one another in a poorly understood but complex manner to mould a talented athlete into a champion. Within the field of sports science, elite performance is understood to be the result of both training and genetic factors. However, the extent to which champions are born or made is a question that remains one of considerable interest, since it has implications for talent identification and management, as well as for how sporting federations allocate scarce resources towards the optimisation of high-performance programmes. The present review describes the contributions made by deliberate practice and genetic factors to the attainment of a high level of sporting performance. The authors conclude that although deliberate training and other environmental factors are critical for elite performance, they cannot by themselves produce an elite athlete. Rather, individual performance thresholds are determined by our genetic make-up, and training can be defined as the process by which genetic potential is realised. Although the specific details are currently unknown, the current scientific literature clearly indicates that both nurture and nature are involved in determining elite athletic performance. In conclusion, elite sporting performance is the result of the interaction between genetic and training factors, with the result that both talent identification and management systems to facilitate optimal training are crucial to sporting success.


Abstract: With the recent advances in genome-wide mapping studies and the emerging findings on the relation between athletes’ training histories and their performance, this should be a time for integrating these two bodies of knowledge for a more complete understanding of the complex development of elite performance.1 In their recent article, Tucker and Collins criticised a popularised but simplistic view of our work circulated on the internet, which suggests that anyone who has accumulated sufficient number of hours of practice in a given domain will automatically become an expert and a champion. Unfortunately they incorrectly attributed this view to me and my colleagues and criticised our research on deliberate practice.
9 Gobet Ch9: Development and Aging

9.3 Expertise and Aging

9.3.2 A Paradox


Abstract: Adult age differences in a variety of cognitive abilities are well documented, and many of those abilities have been found to be related to success in the workplace and in everyday life. However, increased age is seldom associated with lower levels of real-world functioning, and the reasons for this lab-life discrepancy are not well understood. This article briefly reviews research concerned with relations of age to cognition, relations of cognition to successful functioning outside the laboratory, and relations of age to measures of work performance and achievement. The final section discusses several possible explanations for why there are often little or no consequences of age-related cognitive declines in everyday functioning.

10 Gobet Ch10: Neuro-Expertise

10.4 Proposed Mechanisms

10.4.1 The Fixed Localization vs. Perceptual Expertise Debates


13 Gobet Ch13: Philosophy

13.8 Philosophy and Expertise: Applications


15 Gobet Ch15: Putting It All Together

15.2 Good and Bad News

99 Extreme Expertise – At the Knife Edge of the Jello Mold

Description: Extreme experts show exquisite adaptations to their task environments.
99.1 Rethinking Expertise


Abstract: Scientific interest in expertise-superior performance within a specific domain has a long history in psychology. Although there is a broad consensus that a long period of practice is essential for expertise, a long-standing controversy in the field concerns the importance of other variables such as cognitive abilities and genetic factors. According to the influential deliberate practice theory, expert performance is essentially limited by a single variable: the amount of deliberate practice an individual has accumulated. Here, we provide a review of the literature on deliberate practice, expert performance, and its neural correlates. A particular emphasis is on recent studies indicating that expertise is related to numerous traits other than practice as well as genetic factors. We argue that deliberate practice theory is unable to account for major recent findings relating to expertise and expert performance, and propose an alternative multifactorial gene-environment interaction model of expertise, which provides an adequate explanation for the available empirical data and may serve as a useful framework for future empirical and theoretical work on expert performance.

99.2 Details of Expertise


99.2.1 Blunders


Abstract: Five protocol-analysis experiments with tactical, endgame, and strategic positions were conducted to study cognitive errors in chess players’ thinking. It will be argued that chess players’ errors can be only partially explained in terms of unspecified working-memory overload, because the working-memory loads caused by the solution paths are usually small. It is therefore necessary to consider apperceptive mechanisms also, as these control information intake. Subjects fail either because they are not able to see the right prototypical problem space at all, or because they fail to close them as a result of missing some crucial task-relevant cue. This makes chess players lose their “belief in the idea” and restructure, after which the apperceptive information-selection mechanisms make the fording of the solution still more unlikely.


Abstract: Blindfold chess is a special type of chess game where both the board and pieces are not visible to its players. This paper aims to determine whether the quality of the game played blindfolded is lower than when played under normal conditions. The best chess program was used to analyze games played by the world’s top Grandmasters under both conditions. We have analyzed the Monaco 1993-1998 data set introduced by Chabris and Hearst (2003). The results showed that although a larger number of mistakes occurred while playing blindfolded, no significant statistical
difference between the rapid and blindfold games has been found. Nevertheless, by applying the same methodology to the Monaco 2002-2007 data set a substantial difference between the blindfold and the rapid chess game was noticed. In this paper, we have addressed the possible improvement of the chess game quality and the advances in chess programs that may be responsible for detecting more blunders.


**Abstract**: In a wide range of problem-solving settings, the presence of a familiar solution can block the discovery of better solutions (i.e., the Einstellung effect). To investigate this effect, we monitored the eye movements of expert and novice chess players while they solved chess problems that contained a familiar move (i.e., the Einstellung move), as well as an optimal move that was located in a different region of the board. When the Einstellung move was an advantageous (but suboptimal) move, both the expert and novice chess players who chose the Einstellung move continued to look at this move throughout the trial, whereas the subset of expert players who chose the optimal move were able to gradually disengage their attention from the Einstellung move. However, when the Einstellung move was a blunder, all of the experts and the majority of the novices were able to avoid selecting the Einstellung move, and both the experts and novices gradually disengaged their attention from the Einstellung move. These findings shed light on the boundary conditions of the Einstellung effect, and provide convergent evidence for Bilalic, McLeod, & Gobet (2008)’s conclusion that the Einstellung effect operates by biasing attention towards problem features that are associated with the familiar solution rather than the optimal solution.


**Abstract**: An increasing number of domains are providing us with detailed trace data on human decisions in settings where we can evaluate the quality of these decisions via an algorithm. Motivated by this development, an emerging line of work has begun to consider whether we can characterize and predict the kinds of decisions where people are likely to make errors. To investigate what a general framework for human error prediction might look like, we focus on a model system with a rich history in the behavioral sciences: the decisions made by chess players as they select moves in a game. We carry out our analysis at a large scale, employing datasets with several million recorded games, and using chess tablebases to acquire a form of ground truth for a subset of chess positions that have been completely solved by computers but remain challenging even for the best players in the world. We organize our analysis around three categories of features that we argue are present in most settings where the analysis of human error is applicable: the skill of the decision-maker, the time available to make the decision, and the inherent difficulty of the decision. We identify rich structure in all three of these categories of features, and find strong evidence that in our domain, features describing the inherent difficulty of an instance are significantly more powerful than features based on skill or time.
99.2.2 New Techniques


Abstract: The investigation of how users make sense of the data provided by information systems is very important for human computer interaction. In this context, understanding the interaction processes of users plays an important role. The analysis of interaction sequences, for example, can provide a deeper understanding about how users solve problems. In this paper we present an analysis of sequences of interactions within a visualization system and compare the results to previous research. We used log file analysis and thinking aloud as methods. There is some indication based on log file analysis that there are interaction patterns which can be generalized. Thinking aloud indicates that some cognitive processes occur together with a higher probability than others.

99.2.3 Skill Acquisition and Retention


99.2.4 Perceptual Learning


99.2.5 Methods of Learning


99.3 Domain Specific Expertises

99.3.1 Typing


**99.3.2 Fingerprint Experts**

[see Section 5.4]


**99.3.3 Medical Expertise**


**99.3.4 Musical Expertise**

**99.3.5 Recent Readings on Chess**

**99.3.6 Action Video Games**


**99.4 Inflexibility of Experts?**

[see 4.11]

100 REQUIREMENTS

• Group discussion.
  – The most important contribution each person can make is to our discussions of the readings. I believe a seminar course in which everyone actively participates can be the most productive and educational forum in grad school (often for the instructor as well). Bringing together the various backgrounds and training of everyone in the room generally leads to a much richer perspective than would otherwise be possible. There is a lot of individual variability in tendency to speak up in this type of environment, but it is critical to an academic career to be comfortable doing so. You cannot succeed in this field without a willingness (and desire) to share your ideas in the face of criticism, and this is perhaps the best context to practice. If you are someone who has no qualms about dominating a debate, this is also a good place to practice restraint and listening.
  – Students (graduate and undergraduate) will take a turn leading a discussion of a section or subsection of Gobet’s book that we are discussing that week. No slides or other advanced preparation, other than having read the chapter, is required. Undergraduates will not be asked to do this until after week 3.

• Response Papers
  – For each week students will be asked to write a short one-page “response paper” on one or more readings. One response paper will be on that week’s reading from Gobet (2015). Other response papers will reflect readings relevant to Gobet’s topic that week.

• Paper presentations.
  – Each week will feature a group discussion of all or parts of our current chapter, followed by one to three detailed presentations on research papers listed in the syllabus as being key or relevant to that section or subsection of Gobet’s book. Basically, one graduate student will be responsible for each presentation and there will be 2-3 presentations each week, one each by 2-3 different grad students. The number of presentations per student will be inversely proportional to class size (which is topped at 10 students). Longer or survey papers may be divided among several students.

In general, each presentation should be 20-25 minutes long and structured as though you were presenting your own work at a conference. A useful strategy is to copy key figures and tables out of each article and supplement with (scant) text stating the major points. Focus on summarizing the research, as the authors present it (including motivation, background, methods, results, and conclusions), but also allow us to hear your voice as well – however, be sure we know when the author is speaking and when you are speaking.

  – Undergraduate presentations.
    * As this is a communication intensive course, I will be asking our undergraduates (if we have any) to also do presentations on our external readings (i.e., read-
ings other than Gobet’s book). These will be fewer in number than the graduate student assignments; however, I will ask each undergraduate to prepare her/his presentation a week in advance, in time for it to be delivered in a practice session to me or to one of the senior graduate students. This extra meeting is intended as a “practice” session to get you comfortable with this type of presentation.

100.1 PreRequisites
Permission of the instructor. This is a graduate research seminar in the Cognitive Science Department. However, all interested undergraduates and interested graduate students from other departments are encouraged to contact the instructor to discuss their participation in the seminar. Responsibilities and assignments for undergraduates will be discussed and agreed on, in writing, by the student and the instructor.

100.2 About the Instructor
Professor Gray has been a member of the Cognitive Science Department at RPI since the Fall of 2002. For details on his research interests and activities see his homepage.

101 Honors Policy
• My expectation is that all of the work you do for me in this class will be the work of one individual. Exceptions to this rule will be broadcast to the class by email.

• As you will all find out, I explicitly encourage you to engage in public (using email and other media to broadcast a message to the entire) or private (one-to-one) discourse regarding the readings and topics raised in this class. Study groups are encouraged.

• If any of you have any questions regarding current situations or future situations, remember that I am your first contact on this. Please come and see me.

102 Grading Policy
• Examinations – none

• Group Discussion
  – 35% Grad Students; 45% Undergrads
  – For active participation in all discussions on all weeks in which the seminar is held. Exceptions due to professional travel or other activities need to be discussed with the instructor ahead of time.

• Response Papers
  – 35% Grad Students; 45% Undergrads
  – Prior to each week’s meeting, one or more readings will be assigned and, for each reading, all students are expected to write a short, one-page Response Paper. The Response Paper should not merely summarize or outline the assigned reading but
should reflect your thoughts on the author’s arguments, the strength of evidence, alternative hypotheses, implications, and so on.

– Response papers are due to the Instructor by 5:00 pm the day before the seminar.

• Presentations

– 35% Grad Students; 15% Undergrads

– Throughout the semester, an average of one or two students each week will be asked to present the findings of a published research paper, assigned by the instructor. The presentation should be in the range of 20-30min. The student should assume the role of the paper’s author and present the case made by the author in her paper. Use of figures, tables, and headings from the paper is encouraged, as well as original visualizations created by the student, as appropriate. The student may also step out of their role as “surrogate author” for various “meta” comments on the material but should, generally, maintain and represent the case made by the original author in her paper.

• Yes. I expect 105% out of you!

103 References


This document contains 109 references.