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EXPERIENCE, VALUES, BELIEFS, AND THE SOCIOCULTURAL CONTEXT IN GAMBLING DECISION MAKING: A FIELD STUDY OF CASINO BLACKJACK

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ABSTRACT

The study of decision making using gambling-type problems is common among decision researchers in general, as well as among psychologists specifically concerned with understanding gambling behavior and problem gambling. Both groups have focused primarily on the decision makers' cognitive processes to explain their subjects' choices. Yet criticisms suggest that these methods may have inherent limitations specifically because they fail to examine decisions in their real-world contexts. In order to examine the relationship between real-world decision environments and decision-making processes, the current project used participant-observation and interviews to study casino blackjack players in the Las Vegas, Nevada area, in northwestern Indiana, and in Prague, Czech Republic. The project's goals were to document the playing strategies and beliefs common to casino blackjack players, and to examine the role of experience, beliefs, and the sociocultural context in gambling decision making. It involved more than 1.5 years of ethnographic fieldwork as both a blackjack dealer and player and approximately two hundred interviews with gamblers and gambling specialists. The findings suggest that even with relatively well-constrained decision problems, such as gambles, a careful study of the decision-makers' sociocultural context is essential to understanding the decision-making processes.

CONVENTIONS

Since blackjack hands and the cards that make them up are discussed repeatedly throughout the text, Arabic numerals have been used. Thus, a player's hand total of thirteen composed of a six and seven, against a dealer's upcard of five has been written 6,7 against 5. Hands will often be discussed along a range of possibilities, in which case a hyphen will be used. Thus, a player's 11, 12, 13, or 14 against a dealer's 2, 3, 4, or 5 is signified by 11-14 against 2-5. When a sequence is presented the order will progress from low to high. Although ace can in fact be high or low, 2 will be treated as the lowest card and ace as the highest. Since 10s, jacks, queens, and kings are all worth ten points; these cards will all be referred to as 10-value cards.

Expected value will be discussed repeatedly throughout the text. Expected value is calculated by multiplying the probability of each outcome by the amount the player would win or lose given that outcome, then summing these products across all possible outcomes. This is the average amount a player can expect to win or lose given that particular bet, although in practice the amount the player wins or loses may vary widely from the expectation. Expected cost and expected loss are sometimes used to refer to negative expected value. Expected gain and expected win refer to positive expected value. Expectation and expected return are used synonymously with expected value. In most cases these numbers are expressed as a percentage of the amount bet.

CHAPTER ONE

INTRODUCTION

The research presented here explores casino blackjack players' strategies for winning and their subjective understanding of these strategies. It uses surveys, ethnographic interviews, and participant-observation—as both a blackjack player and a dealer—in three locations: northwestern Indiana, the Las Vegas area, and Prague, Czech Republic. The immediate goals were to gain a rich sense of 1) blackjack players' beliefs about winning and strategies for doing so, and 2) the relationship between their values, beliefs, learning and experience during the gambling activity, and the casino sociocultural environment, on the one hand, and the development of playing strategies, on the other. The more general goals were to examine the role of experience, values, beliefs, and the real-world sociocultural environment both in gambling behavior and in decision processes more generally.

The term, *values*, as used above, refers to the semantic content of players' specific range of hopes and goals when playing. The term, *beliefs,* refers to the semantic content of the gamblers' propositional beliefs regarding the structure and dynamics of the games being played and the wider casino environment, beliefs which influences the players' view of what strategies they might use and what the consequences of these potential strategies might be. The stress on the focus of semantic context is to distinguish the

current study from much research in judgment and decision making where values and beliefs are often expressed in terms of utility curves and subjective probabilities, abstract numerical indicators of the strength of values and beliefs with specification of their meaning-laden details.

Learning and experience during the gambling activity refers to the unique subjective experience that blackjack players have as their strategies and beliefs develop over time within the casino environment. This may be quite different, for example, from the learning and experience of gambling theorists and researchers, gamblers playing other games besides blackjack, and even gamblers who play blackjack in different locations. Learning and experience also refers to the changes that occur over time both within individuals and within blackjack playing communities as they gain experience with the game.

The *sociocultural context* as used here refers to several features of the decision making environment, including 1) the *structure and dynamics of the gambling environment*, and 2) the *practices and beliefs shared by the gambling community* within which blackjack players learn their craft. *The structure and dynamics of the gambling environment* refers to the physical design of blackjack and of the casino more generally, the information available given this structure, the rules and norms of play, and how these features interact to create the dynamic experience of playing blackjack. *The practices and beliefs shared by the gambling community* will differ, in part, depending on the particular group with whom the blackjack players usually interact. Thus a person who predominantly plays blackjack may be part of an independent or semi-independent

community and share many different practices and beliefs from a person who predominantly plays slot machines or roulette. Similarly, a person who learned to play blackjack from reading books on card counting and who tends to play or discuss playing with other card counters will have a different community from a blackjack player who learned entirely at the table while playing, and a person who learned to play blackjack at tables in Las Vegas may be part of a different community with different practices and beliefs from a person who learned blackjack in casinos in Prague. Any individual player will be a member of multiple communities depending on their particular experience with and approach to the game.

The remainder of this chapter is composed of five sections. Section one explains why this research is important, with a particular emphasis on its relevance to psychological research into decision making and gambling behavior. Section two provides necessary background information on casino blackjack, including a description of the rules of the game, an introduction to two well-known playing strategies aimed at improving the players expected return, and a brief review of relevant literature on the psychology of blackjack. Section three considers some of the particular questions this research will address. Section four describes the methods used for data collection. Finally, section five introduces the chapters to come.

Purpose

This research has three main goals: first, to describe the playing strategies and beliefs common to casino blackjack players as a means of documenting this widespread

object of economic and leisure activity; second, to provide a case study examining the role of experience, values, beliefs, and the sociocultural context in decision-making processes; and third, to provide a case study examining the role of experience, values, beliefs, and the sociocultural context in why people gamble and in the strategies they use for doing so. This section will consider why these goals are justified. In particular, why study casino blackjack players' decision-making processes as opposed to some other groups'; why focus on the sociocultural context; and why use ethnographic participant-observation and interviews as opposed to conducting experimental research? Each of these questions will be considered in turn below.

Why study casino blackjack players' decision processes?

A better understanding of casino-blackjack players' decision processes has important relevance to two broad areas of inquiry by research psychologists: 1) the study of why people gamble and why they often develop problem or pathological gambling behavior, and 2) inquiry into decision processes more generally.

Gambling behavior and problem gambling

Gambling is a large and growing industry in the United States and around the world. According to Britain's Global Betting & Gaming Consultants, in 2001 gamblers risked an estimated *$900 billion* on wagers around the globe (Morais, 2002). In Europe between 1986 and 1996, legalized casinos expanded from twenty to thirty-two countries (Gu, 2002). In the U.S. alone, revenues from legal gambling grew from $3 billion in 1975 to over $60 billion in 2000, a more than 20-fold increase (Volberg, 2002). In 2002,

Americans spent more on legal gambling than on movies, theme parks, spectator sports, and video games combined (Morais, 2002).

Blackjack itself is the most popular casino table game in the world's largest gambling market (the United States), ahead of craps, poker, and roulette among other games (May, 2001). In Europe, it is the second most popular table game after roulette (Jensen, 1998). It is a standard casino game, offered around the world in nearly every establishment that bears the name "casino". As such, the study of casino blackjack players' strategies and beliefs is worthwhile in its own right as a documentation of a significant economic and leisure activity in America and around the world.

Many non-gamblers, including gambling behavior researchers, find the fact that so many people gamble a somewhat perplexing problem (Wagenaar, 1988; Walker, 1992b). People seem to gamble with the hope or expectation of winning, yet nearly all legally sanctioned gambling activities (casinos, sports books, race tracks, lotteries, etc.) are designed so as to favor the institutions offering the gambles. The more people gamble, the more they should expect to lose. Assuming that people are gambling with the hope of winning money, the reasoning goes, the choice to gamble seems somewhat unreasonable. The continuation of gambling behavior beyond the point where it has created economic and psychological hardships is even more perplexing.[1]

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[1] A meta-analysis of problem and pathological gambling prevalence rates conducted by the Harvard Medical School Division on Addictions (Shaffer, Hall, & Bilt, 1999) concluded that 5.45% of the American adults have gone through periods of problem or pathological gambling behavior throughout the course of their lives.

A common explanation for the widespread choice to gamble, as well as the continuation of gambling behavior to the point where it becomes a problem, is that gamblers have a number of false beliefs, both about their chances of winning and about how best to play the games once the choice to gamble has been made (Baucum, 1985; Cornish, 1978; Kweitel & Allen, 1998; Ladouceur, 1993; Lesieur & Rosenthal, 1991; Wagenaar, 1988; M. B. Walker, 1985; Walker, 1992b; Wildman, 1999). Given this, one of the main reasons for studying blackjack players' decision processes is to gain a better understanding of why people choose to gamble in general (and to play blackjack in particular) and why their particular beliefs about winning and strategies for doing so are often false or suboptimal, or at least appear to be.

The psychological study of decision processes

In experimental studies exploring how people make decisions, psychologists have tended to use gambling-type problems (Goldstein & Weber, 1995). They have done so both because gambles were seen to have the same fundamental characteristics as all decisions and because they provided the most straightforward means by which to test the assumptions of Subjective Expected Utility (SEU) theory, a normative model of rational choice that many researchers and theorists agreed should and perhaps does describe human behavior. The findings from these studies have consistently shown that however well SEU might work as a normative model, actual decision makers consistently violate its expectations (Hogarth, 1981; Kahneman, Slovic, & Tversky, 1982).

Decision researchers have tended to explain these violations with reference to a number of cognitive *heuristics* (or short-cuts) that people use to make decisions. These

heuristics usually work quite well given the common limitations in available information, time, and cognitive processing power that people often bring to a decision task, but they lead to systematic *biases* under certain conditions.[2] Gambling researchers and clinicians have made reference to these same heuristics and biases in order to explain actual gamblers' erroneous beliefs about winning and to identify possible solutions to help gamblers overcome their purportedly biased cognitions (Baucum, 1985; Griffiths, 1993; Kweitel & Allen, 1998; Ladouceur, Sylvain, Letarte, Giroux, & Jacques, 1998; G. Walker, 1985; Walker, 1992a, 1992b). Following from this, a second reason to study casino-blackjack players' decision-making processes, therefore, is as a means through which to study decision-making heuristics and biases, many of which have been identified using gambling-type problems, and many of which have been applied to explain actual gambling behavior, including blackjack players' false beliefs and suboptimal strategies (Gaboury, Ladouceur, Beauvais, Marchand, & Martineau, 1988; Keren & Wagenaar, 1985; Wagenaar, 1988). It will be argued below that studying decision making in situ may produce insights that are different from those that are revealed in the laboratory.

Why focus on the sociocultural context?

There tend to be two perspectives on the source of gamblers' false beliefs about winning and suboptimal strategies for doing so. One group of researchers and clinicians

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[2] These limitations contribute to the well-known concept of bounded rationality, first introduced by Herbert Simon (1955).

sees gamblers as distinct from the greater population. Gamblers, unconsciously motivated—and often desperate—to believe they can win, ignore the overwhelming evidence and commonsense reasoning that contradicts their preferred beliefs. In that sense, they are subject to motivationally biased or irrational thinking about both their ability to win and how best to do so. The second group of researchers, sometimes composed of the same members as the first group, explains the false beliefs of the gambler with reference to cognitive heuristics and biases. While these two perspectives differ in the sense that one sees gamblers' biased or irrational thinking as distinct from that of non-gamblers while the other sees it as a consequence of the cognitive processing mechanisms shared by all people; they are similar in that both tend to emphasize the biased reasoning or observation of the individual.

At the same time, a number of criticisms, made by both decision-making and gambling researchers, have suggested that the study of decision-making processes—including the expression of heuristics and biases—has been too limited to laboratory or classroom settings with novice decision makers engaged in artificial or inconsequential tasks. There has not been enough research into the decision-making processes of real-world decision-makers engaged in their real-world decision tasks. This is true both in the study of decision-making processes more generally (Gigerenzer, 2000; Gigerenzer, Todd, & The ABC Research Group, 1999; Klein, 1998; Wagenaar, 1988) and in the study of gambling decisions in particular (Lesieur, 1984; Wagenaar, 1988; Walker, 1992b; Wildman, 1999). A concern has been that many of the decision processes identified in experimental research may be different from those used by actual decision makers, which

may depend on features of the sociocultural environment that have been specifically removed from consideration as a means for providing experimental control during laboratory or classroom research. Yet psychological research examining how gambling strategies develop and are influenced within real-world sociocultural contexts is largely non-existent (Cornish, 1978; Eadington & Cornelius, 1993; Wildman, 1999).

My own perspective has been largely influenced by cultural psychology as framed by Richard Shweder. Cultural psychology is centrally concerned with the ways in which values, beliefs, goals, and practices shared by a group (culture) reflect back on and influence the ways in which individuals perceive, categorize, reason, remember, feel, want, choose, value, and communicate (psychology) (Shweder, 1999). One of the basic tenets of cultural psychology is that many processes that psychologists have traditionally viewed as universal characteristics of the human cognitive system are, in fact, interdependent with our environment, and in particular with the practices and beliefs that are shared by members of our community, with the implication that what people think is essential to how they think (Fiske, Kitayama, Markus, & Nisbett, 1998; Shweder, 1999). The suggestion here is that decision processes may not be as separable from the sociocultural context as decision researchers have often taken for granted. Perhaps decision processes, including the expression of heuristics and biases, depend importantly on the practices and beliefs developed and selectively available to members within a particular decision-making community. Without an experimental method that examines decision makers within their actual decision-making communities, we would have no way to know.

Why ethnographic participant-observation?

Participant-observation can be distinguished from survey, experimental, or purely observational methods in that the researcher attempts to live within the community being studied and to participate in their lifestyle and practices as opposed to trying to stand outside the community. Where researchers using surveys, experiments, or non-participant-observation often approach subjects with pre-existing categories or concepts to be measured, the participant-observer tends to seek out the categories and concepts widely shared by members of the group being studied. At the same time, "observation" is a key component of the research method, in that maintaining an outsider's perspective while coming to understand the insiders' perspective is seen as one of the goals. My role as participant, then, was as a blackjack dealer and as a fellow gambler, who traveled to the casinos, risked, won, and lost money, and engaged with the other gamblers as one of them.

There are three main strengths that I believe make ethnographic participant-observation ideal for studying gambling behavior in context. First, it reduces the disrupting relationship between "observer" and "observed" that often occurs in purely observational, experimental, or survey studies, where the subjects of study may be keenly aware of, and consciously or unconsciously influenced by, the presence of the researcher. Second, participant-observation allows the researcher a richness of content that is not available with methods using pre-arranged questions and pre-determined causal variables. Participant-observation allows the researcher to be surprised with relevant information that may have been inadvertently screened out by other research methods. Third, and

most importantly, participant-observation allows the researcher richer access to the practices, values, beliefs, and experiences of the people being studied than do other methods. It allows the researcher to share the subjective experiences had by members of the community and it opens the researcher up to both implicit and explicit values and beliefs that will often not be visible to non-participant observers or to others more markedly outside the community being studied. This current project is primarily concerned with how the sociocultural context influences gambling decisions, and to understand this, a rich sense of this context is essential: what are the gamblers' world views, what are their values and beliefs, how is information structured and selectively available within the gambling environment; and what are the components and dynamics both of that environment and of the gambling experience? Non-participant observation, an experimental paradigm, or structured interviews are not as well-suited to answer these questions.

At the same time, two important shortcomings to ethnographic participant-observation should be mentioned. *First,* the researcher often has no means through which to identify causal relationships (such as between thought processes, the environment, and behavior). The real-world is inherently messy, with few if any controls to allow for correlating independent or dependent variables or for replicating results in cases where apparent causal relationships can be identified. Without the ability to rule out confounding variables, to measurably quantify results, or to replicate findings, it is difficult to be sure whether ethnographic findings are really findings at all or simply the idiosyncratic outcome of a complex mish-mash of cause and effect. *The second weakness*

is that what the researcher observes and remembers is necessarily subjective since there are no objective criteria determining what will be recorded or what will be attended to, and there is no permanent record to refer to for verification that what seemed significant actually is or what one remembers actually occurred.

Research psychologists, cognitive psychologists in particular, tend to be implicitly attuned to the weaknesses of ethnographic method or any attempt at a holistic understanding of human behavior. As psychologists, much of their education has been devoted to learning about the inherent biases and failings of human subjectivity. Their methods are designed specifically to overcome these shortcomings through the use of careful control, replication, and hypothesis testing. Yet they also tend to be relatively unreflective about the shortcomings of reductionism and the ways in which behavior in context is more than the sum of individual psychological processes. The psychologists' concerns are just, and the findings presented in this paper should be seen as tentative. At the same time, the shortcomings of experimental methods and the benefits of ethnography should not be overlooked. The current study should be seen, then, as just one part of a larger research program, the part important primarily for its absence from the larger whole, which is currently unbalanced on the side of experimental, quantitative research.

Background on casino blackjack

Casino blackjack is a somewhat complicated game with its own specialized vocabulary, as many as six types of choices per hand, significant consequences on one's

chances of winning depending on these choices, and a variety of rules and norms surrounding play. The current section will provide important background information on casino blackjack that will be useful for understanding and assessing the players' strategies and beliefs. This background will include a brief discussion of 1) the rules of blackjack, 2) the two most widely accepted strategies for how to play blackjack assuming one's goal is to maximize expected returns (or minimize expected losses), and 3) past research examining blackjack players' strategies for and beliefs about winning. Blackjack specific vocabulary will be defined as it is introduced, but the author recognizes there is a lot to digest; for that reason, a glossary of blackjack terms has been included in *Appendix A*.

Blackjack rules

Blackjack rules are detailed and they vary from region to region, casino to casino, and sometimes from table to table within the same casino. For a detailed discussion of blackjack rules as they are offered in Las Vegas, Indiana, and Prague, please consult *Appendix B*. This section will provide a summary of the most essential rules for understanding the game as it is commonly played in casinos around the world.

The goal of blackjack is to get a higher point total than the dealer (who works for the casino) without going over twenty-one points (known as *busting*). Players place their bets and are each dealt two cards. The dealer is dealt one card face up and either a) one card face down (in the U.S.) or b) no second card until the players have finished their turns (the Czech Republic). Cards are worth their face value, except face cards (jacks, queens, and kings), which are all worth ten points, and aces, which are worth either one

or eleven points depending on what works best for the hand. An ace and any 10-value card as the first two cards is a *blackjack*. It wins against all other twenty-ones. If the dealer and player tie, known as *pushing*, he or she neither wins nor loses the original bet. If the player gets a higher point total than the dealer or the player does not bust when the dealer subsequently does, the player wins and the dealer pays the player the amount of his or her original bet. If the dealer gets a higher point total than the player or the player busts, regardless of whether or not the dealer subsequently busts, the player loses, and the dealer removes his or her bet. If the player wins with a blackjack, the dealer pays a bonus of an additional one-half of the original bet.

Players have up to six choices: 1) they can *hit* (take additional cards); 2) they can *stand* (stop taking additional cards and end their turn); 3) after seeing their original two cards but before taking any additional cards, they can *double down* (or just *double*), which involves matching the original bet and receiving exactly one additional card to the first two cards; 4) if their first two cards are of the same value (including any two 10-value cards), they can *split*, which involves separating the two cards, matching the original bet, and playing two separate hands with one of the original cards and one of the bets being used towards each new hand. The final two possible choices are only available if the dealer has an ace showing as his or her first card. In this case, players have the option to 5) take *insurance*, which involves making a side bet of half the original wager that the dealer will have a blackjack, a bet which pays two to one if the dealer does get a blackjack, or 6) if the player also has a blackjack, they can take *even money,* meaning that they get paid one to one, as though they did not have a blackjack, whether or not the

dealer also ultimately gets a blackjack as well. Assuming a player has a blackjack, taking even money and taking insurance have identical consequences: in both cases the player will win exactly the amount of their original bet, whether or not the dealer ends up with a blackjack.

After each player has taken his or her turn, the dealer then plays. The dealer must play according to a set of predetermined rules that do not depend on the players' cards. If the dealer has a total of 16 or less, he or she must hit. If the dealer has a total of 17 or more, he or she must stand. In many casinos, the dealer must also hit a *soft-17* (a hand with an ace and six more points, so that it could take the value of either 7 or 17, and thus would not bust if hit with an additional 10-value card), but in the majority of the casinos where I conducted my research, including the casino outside Las Vegas where I dealt cards, the casino on the Las Vegas Strip where I interviewed players, the casinos in northwestern Indiana, and the casinos in Prague, the dealer stands on soft-17.

Optimal blackjack strategies

Before discussing how people actually play blackjack, it is worth discussing how one might expect people to play blackjack assuming that their goal is to maximize expected winnings or minimize expected losses, a goal that most players strive toward and that most see their strategies as promoting. Strategies that contribute to maximizing expected winnings will be divided into two types: 1) the basic strategy, which corresponds to the statistically best way to play each hand given that the player is not keeping track of cards removed from play; and 2) card counting, which involves tracking cards removed from play from one round to the next and adjusting betting and playing

strategies in order to increase the likelihood of winning. A brief description of the most fundamental features of basic strategy and card counting will be provided below. A more detailed discussion of basic strategy and card counting can be found in *Appendix C* and *Appendix D*, respectively.

The basic strategy relies on only two cues: the player's hand and the dealer's upcard. Thus, for example, if the player has a total of 12, and the dealer has a 6, the player will have three choices—to hit, to stand, or to double down. Each of these choices has a different expected return to the player. Hitting will have an expected cost of 17.05% of the original bet, standing an expected cost of 15.38%, and doubling an expected cost of 34.10% (Cacarulo, 1998). As such, for this particular hand the basic strategy calls for the player to stand, which while having an expected cost of 15.38% of the player's original bet, is still less costly than the second best play by 1.67%. Players who use perfect basic strategy can usually reduce the casino advantage to as low as from 0.2% to 0.5%, depending on the particular casino rules. See *Table 16* on *p. 200* in *Appendix C* for a complete basic strategy chart given the most common rules in Las Vegas, Indiana, and Prague.

Card-counting strategies rely on the fact that the cards are not shuffled after each round of play; instead, several rounds are dealt—with new betting and playing opportunities each round—before the cards are shuffled. In a game using six decks—as do most games in Indiana, Las Vegas, and Prague—dealers usually use from two-thirds to three-quarters of the cards before shuffling. During this time, the composition of cards remaining to be dealt changes significantly over time between shuffles, and players can

use this information to their advantage (or disadvantage if the information is applied incorrectly). Card counters do not remember the value of each card removed from play, rather they use simplifying heuristics. Usually low cards are given a positive value and high cards are given a negative value (in line with the positive and negative value to the player as these cards are removed from the deck, respectively), and these pluses and minuses are summed together as cards of each type are removed from play. This "running count" is usually normalized to account for the number of decks remaining to arrive at a "true count", which is then used to make changes to the basic strategy when appropriate and to make betting decisions (betting more during the infrequent times when the odds have changed to the player's favor and less during the majority of cases when the odds are in the casino's favor). Under simulated conditions, players can gain a positive expected return of approximately two percent (depending on the assumptions of the model, such as the amount of bet variation possible between positive and negative counts). In realistic casino conditions, however, it is unlikely players can gain greater than a one percent advantage, usually even less, since casinos have developed sophisticated techniques for identifying card counters and eliminating their advantage (Uston, 1981).

Players often have their own conceptions of what constitutes basic strategy and what constitutes card counting that vary from correct versions of these systems. These conceptions of basic strategy and card counting will be termed folk-basic strategy and folk-card counting to distinguish them from the mathematically correct versions. Folk-basic strategy and folk-card counting share many of the fundamental features of the basic

strategy and card-counting systems described above, yet they often entail false beliefs about outcome probabilities and causal relationships.

Basic strategy and card counting should be seen as only tentative measures of playing quality. Although gambling researchers often implicitly or explicitly assume that an assessment of the rationality of gambling choices should be based on the implications of these choices for expected return, the gamblers themselves may get more out of other aspects of the gambling experience, in which case expected return—and thus both basic strategy and card counting—will be a poor standard for the normative assessment of gambling behavior. Nonetheless, the two strategies have been the standard used by past researchers studying blackjack gambling behavior, and in the current study they are used as organizing themes to help sort out and evaluate the various playing decisions and strategies displayed by players in the casino. This has been accomplished by considering the following three questions. 1) To what degree do common playing strategies correspond to or deviate from these two strategies? 2) What are the consequences of the deviations when they occur? And 3) how are the deviations and their consequences understood by the players?

Review of relevant previous blackjack research

I could locate only three published series of studies documenting blackjack playing strategies among casino blackjack players. The first two were individual studies and they were purely observational (Bond, 1974; Griffin, 1991). The third was primarily observational (Keren & Wagenaar, 1985; Wagenaar, 1988). By “purely observational”, I mean that the studies observed casino players as they played their hands and recorded

how they played without asking questions about strategies or beliefs and without the "participant" component of participant-observation. The recorded playing choices were documented in terms of basic-strategy cues (i.e., the player's hand and the dealer's upcard), and the quality of the plays were assessed in terms of their correspondence to basic strategy. Keren & Wagenaar's study went an extra step by interviewing players about their strategies and beliefs. It also specifically considered psychological factors that might explain the players' deviations from basic strategy (which the other two studies did not). This review will only consider Keren & Wagenaar's study, not only because they were the only ones to consider psychological processes and the gamblers' beliefs, but also because they were far more extensive and detailed in their examination of playing decisions in terms of basic-strategy cues.

In one part of their study, Karen & Wagenaar observed 574 players playing thirty hands each. They found that no more than 3.8% of players followed basic strategy perfectly and that on average the casino enjoyed an expected return of 2.9%, well above the 0.4% expected return that the casino would have enjoyed if all players followed basic strategy, but well below the 6% expected return the casino would have enjoyed if players mimicked the dealer's strategy, and even further below the 28% expected return the casino would enjoy if players decided randomly a) whether or not to take insurance, b) whether or not to double down, and c) whether to hit or to stand. In interviews with 77 habitual blackjack players (a median of 2 visits to the casino per week with 22 players gambling four or more times per week), they found that only two had even considered

learning how to count cards. Thus, two of their main questions were why so few players counted cards or played according to basic strategy.

They offered three main reasons. First, the utility many players get from playing blackjack is not limited to the desire to maximize expected value. Second, players believed other factors besides basic-strategy cues and card-counting variables were important, such as hot and cold patterns in luck and sequential patterns in the cards. Third, players did not believe the published basic strategies were correct. They arrived at these conclusions from interviews with players, from a within subject analysis of playing consistency given basic-strategy cues (players were not consistent over time, suggesting other factors were influencing their choices besides basic-strategy cues), and from an analysis of players' folk-basic strategies (that is, player's strategies given the basic-strategy cues of player's hand and dealer's upcard) across subjects (n=112, median number of observations per subject = 74)

They identified two patterns from their analysis of folk-basic strategies. First, the frequency of players' violations were larger when players should have hit than when they should have stood (41.8% over-standing vs. 9.3% over-hitting for hard hands—hands that can only take a single value—and 49.1% over-standing vs. 3.2% over-hitting for soft hands—hands with an ace that can take two values depending on whether the ace is used as a one or an eleven).[3] When the play choices are adjusted for expected cost given the

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[3] Note, these averages were computed from the given matrix using Microsoft Excel. They are different from the averages provided by Keren & Wagenaar in their text (43.8% vs. 15.8% for hard hands and 50.0% vs. 2.7% for soft hands). The reason for this discrepancy has not been determined, but seems to reflect either misprinted matrix numbers or a miscalculation of the average error rates by Keren & Wagenaar.

frequency of play violations, this pattern holds up. That is, the average expected cost per basic-strategy cue is higher with cues for which the player should have hit than with cues for which the player should have stood (3.7% average cost for over-standing vs. 0.5% for over-hitting on hard hands and 5.7% average cost for over-standing vs. 0.6% for over-hitting on soft hands). Second, players depart from basic strategy in an orderly way that depends on two constraints, a) their own probability of busting given their hand total (this probability increases as the players' total gets higher), and b) (with a few exceptions) the dealer's probability of busting given the dealer's upcard (this probability is highest for 2 to 6 increasing as it goes up, and lowest from 7 to ace, this time decreasing as it goes up). They explain these two patterns with the label "conservatism" which they see as due to an excessive fear of busting.[4]

Questions remaining to be addressed by the current research

Keren & Wagenaar's study of casino gamblers was outstanding. Their choice to study real-world gamblers was motivated in part by the recognition that more real-world decision research is called for; the same concern that motivated the current study. Furthermore, while most of their analyses were restricted to expected value given basic-strategy cues, they took the time to interview gamblers about other factors that might be important to their playing strategy, and they identified several strategies and beliefs that largely agree with my own findings. At the same time, their study leaves open a number

[4] It should be noted that there is no risk of busting when hitting soft hands, so their explanation cannot explain the observed conservatism demonstrated on soft hands.

of questions regarding the influence of the sociocultural context that the current research attempts to address. These questions can be divided into two groups (that correspond to *Chapters 2* and *3* of this dissertation), the first concerned specifically with their study of folk-basic strategy and the second with moving beyond players' folk-basic strategies to a more nuanced understanding of strategies and beliefs and the role of the sociocultural context.

Folk-basic strategy

To determine players' conformity to the basic strategy, Keren & Wagenaar observed casino players unobtrusively as they actually played their hands and recorded the results. That method had the benefit of capturing actual behavior as it occurred in the casino, but it also had three important shortcomings with regard to identifying folk-basic strategies. *First*, Keren & Wagenaar had to assume players were limiting their decisions to basic-strategy cues, but they had no means by which to confirm this. Indeed, they acknowledged that the assumption was made for simplifying purposes and that it is probably incorrect (indeed they later discuss other important influences besides basic-strategy cues). *Second*, they could not collect background information on the players being observed, including how much or what kind of experience players had with the game. Thus it is not clear to what degree folk-basic strategies are the consequence of *inexperience* with the game and to what degree they are the consequence of *experience*, and it is not clear how *particular* kinds of experience with the game might influence

strategies.[5] *Third*, they were limited by the natural outcome distribution of the hands. Certain basic-strategy cues occur far more frequently than others, and those decisions can thus be observed more often. For example, the choice to hit, stand, or double with a twelve against a dealer's ten makes up 2.56% of all starting conditions, whereas a player's choice of whether or not to split two sevens against a dealer's seven makes up only 0.04% of all starting conditions (occurring 1.58% as often). As such, Keren & Wagenaar only collected sufficient observations to construct folk-basic strategies for hit-stand choices (which occur relatively frequently) and not for double-down or split choices (which occur relatively infrequently).

The current study addresses these issues by including a basic-strategy survey, whereby players are instructed to indicate how they would play every hand given only basic-strategy cues. These surveys address the first shortcoming above by explicitly removing other (non-basic-strategy) cues from consideration, allowing for a more accurate construction of players' folk-basic strategies. They address the second shortcoming by explicitly recording background information on each player, including where they learned to play, why they like to play, and how much experience they have with the game. They address the third shortcoming by requiring players to indicate their folk-basic strategy for combinations of basic-strategy cues, no matter how infrequently they might occur naturally, allowing for the construction of a complete folk-basic strategy, including the strategy for splitting and doubling-down choices.

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[5] It should be noted, however, that Keren & Wagenaar were told by casino management that most of the observed players played several times a week.

Beyond folk-basic strategy

Keren & Wagenaar followed up on their observational study by interviewing blackjack players about their strategies, beliefs, and motives, and they discovered several factors beyond basic-strategy cues that were important to how experienced blackjack players made their choices. At the same time, these interviews were secondary to their analysis of the players' folk-basic strategy, and they were highly structured, leaving little room to learn about belief systems the researchers had not already encountered. Furthermore, they limited their concern with players' values and beliefs, experience and learning, and the casino sociocultural environment (see *p. 1* for details on these definitions) to the beliefs prompted during these interviews. The current study takes a far more in depth look at the players' practices and beliefs, moving beyond basic-strategy cues, which for many players are secondary. It also emphasizes other components of the sociocultural context besides practices and beliefs, including 1) learning and experience, and 2) the structure and dynamics of the gambling environment. It does so, as mentioned, both through the use of ethnographic participant-observation (as opposed to just observation) and with open-ended interviews that allow the players to explain their strategies for and beliefs about winning from their own perspective and in detail.

Methods

Two primary methods were used to collect data: ethnographic participant observation (see *p. 10* for a description and justification of this method) and interviews. Each of these components will be discussed separately below.

Participant-observation

To help identify relevant sociocultural influences on the decision process, the participant-observation was comparative at many levels: it compared blackjack players with different levels of experience to see how experience with the game influences strategies and beliefs; it considered how blackjack players differ from gamblers who play other casino games, most notably roulette and slot machines, to see how the specific structure of blackjack and the community of people who play blackjack differentially contributes to playing strategies; it examined strategies and beliefs in different locations, including Prague, Czech Republic, the Las Vegas, Nevada area, and northwestern Indiana, in order to see if cultural or sub-cultural differences across locations impacted strategies and beliefs; and it considered how different perspectives on blackjack influence the endorsed strategies and beliefs about how best to play the game by looking at views held by a) gambling researchers and clinicians, b) players who learned the game primarily from books and other blackjack media, c) players who learned primarily at the table, and d) dealers who learned primarily in opposition to the players and without the same experience of risk, winning, or losing.

Table 1 summarizes the various participant-observation activities and the amount of time devoted to them in each of the three locations. The activities included time in dealer school, work as a dealer, and time as a casino patron. I attended dealer school in Gary, Indiana for approximately 120 hours. This was necessary so that I would be able to work as a dealer, but it also served as a valuable introduction to the "other side" of the blackjack table.

I worked as a blackjack dealer in a casino at the border between California and Nevada along the main highway between Las Vegas and Los Angeles (I-15). The casino is located thirty-five minutes from Las Vegas. It is a mega-resort replete with a roller coaster and approximately 1,200 rooms. The clientele are primarily California residents who prefer the proximity and relative quiet of this casino to the Las Vegas casinos or who are stopping by on their way into, out of, or through Las Vegas. I worked two 10-hour shifts per week for four and a half months. The casino management directly responsible for hiring me knew about the subject of my research, but, as far as I know, none of my direct supervisors or co-workers knew. Dealers get a twenty minute break every forty minutes to an hour, and I would usually use this twenty-minute period to write field notes from the previous dealing session.

Table 1. Participant-observation activities & locations

	LOCATION			
ACTIVITY	**Indiana**	**LV**	**Prague**	**Total**
Calendar time (mo.)	N/A	6.5 mo.	13.5 mo.	**20 mo.**
Dealer School (hrs.)	~120 hrs.	N/A	N/A	**~120 hrs.**
B-jack dealer (hrs.)	N/A	~350 hrs.	N/A	**~350 hrs.**
Casino patron (hrs.)	~100 hrs.	~400 hrs.	~400 hrs.	**~900 hrs.**
Total hrs.	~220 hrs.	~750 hrs.	~400 hrs.	**~1,370 hrs.**

Time as a casino patron included approximately one hundred hours in casinos in northwestern Indiana, four hundred hours in casinos in the Las Vegas area, and four hundred hours in casinos and *hernas* (literally "game rooms", but usually bars with slot machines) in Prague. The fieldwork in Indiana began each Saturday morning when I boarded a casino shuttle leaving a downtown Chicago hotel and arrived at a casino in Hammond, Indiana about an hour later. Along the way, the shuttle picked up passengers, usually casino regulars, and they often served as informants during the ride and throughout the day in the casino. I would return by shuttle after spending eight hours in the casino. During dealer school, I spent approximately twenty more hours in these casinos with some of the other students.

In Las Vegas, the time was divided primarily among casinos on the Las Vegas Strip, down town, and in Henderson. Each area has its own demographic and design, and these differences were important to dominant playing strategies. The Las Vegas Strip is home to Las Vegas's mega-hotel resorts, often replete with amusement parks, convention centers, night clubs and upscale entertainment shows, and dozens of restaurants. Nine of the ten largest casinos in the world (in terms of number of rooms) are located on the Las Vegas Strip (Insider Viewpoint of Las Vegas, 2004). Players tend to be visiting from out of town, many on business for a convention, and many others for a particular sporting event or show. As such, it is not uncommon to find Las-Vegas-Strip casino patrons who do not gamble or who only gamble a few times a year. They tend to play primarily for fun and budget a certain amount they are willing to lose during their trip as part of the vacation cost. Players in the Henderson area are usually Las Vegas locals, many of whom

moved to the Las Vegas area to gamble or to work for the casino industry. They are often daily or weekly gamblers and they are less likely to focus on gambling as entertainment, more likely to play specifically with the expectation of winning, and less likely to have budgeted a certain amount of money they expect to lose. Casino patrons in downtown Las Vegas tend to be some combination of locals and tourists. Those who are tourists tend to be from a lower socioeconomic status from those on the Strip, they are more likely to come to Las Vegas specifically to gamble, and they have usually been going to Las Vegas for longer, seeing the grittier atmosphere of downtown Las Vegas (with pawn shops, strip clubs, and homelessness all more visible) as part of the Las Vegas of old they prefer. Casinos in all locations are open twenty-four hours, one can enter from the street without registering (indeed, people under twenty-one can walk through on their way to their hotel room or other casino venues, and the interior tends to be dark, with incessant bells and flashing lights, and inexpensive multicolored gaudy décor.

In Prague there are approximately twenty casinos (although the number changes regularly) and hundreds of *hernas.* All but a few of the casinos are attached to hotels and located in or near the tourist center. Customers are a mix of expatriates from Western Europe, the United States, Central and Eastern Europe, and East Asia (primarily China and Vietnam); tourists primarily from Western Europe, the United, and Israel; and ethnic Czechs. Customers of the few casinos outside of the tourist center tend to be either Czechs or expatriates from Central and Eastern Europe or East Asia. Casinos are relatively small (with perhaps two or three blackjack tables as compared to twenty or thirty in a Las-Vegas-Strip property), they are often located in part of a historic building

from various architectural periods spanning back to the fourteenth century, they require registration, and they often have a dress code. The Czech Republic was an ideal place for comparative work because gambling has been growing there steadily over the past decade as in the U.S., and the same games with almost identical rules are offered in both locations, yet gambling in the two countries has developed in distinct ways, separated culturally, linguistically, and physically.

In addition to this "live" ethnography, I also participated in several email discussion lists on gambling and studied books on "how to win" in blackjack, roulette, and slot machines. All but one of the email lists were devoted to gambling strategies. Most were concerned with blackjack, in which case the participants were primarily card counters or those learning to count cards. The list not devoted to gambling strategies was a closed discussion group restricted to professionals in the gambling treatment and/or research community (with a strong emphasis on the treatment end). These groups provided unique perspectives on blackjack from those provided by players who learned blackjack in the casinos at the tables.

Interviews

The interviews were of three types: semi-structured, blackjack strategy, and ethnographic. All interviews began with a demographic section (see *Appendix E*) that included a few standardized questions about the players' background with and beliefs about the games along with more traditional demographic questions. *Table 2* indicates the number of each type of survey by game and location. There were a total of 193 subjects,

one hundred sixty-three in Las Vegas and thirty in Prague. Each interview type is discussed separately below.

Table 2. Interview types and game

Interview type	Game			Total
	Blackjack	Roulette	Slots	
Semi-structured (LV only)	33	16	17	**66**
Blackjack Strategy	114	NA	NA	**114**
Las Vegas	91	NA	NA	91
Prague	23	NA	NA	23
Ethnographic	36	21	15	**47**†
Las Vegas	12	4	8	17†
Prague	24	17	7	30†
Total	**149***	**37**	**32**	**193*†**
Las Vegas	125*	20*	25*	163*†
Prague	24*	17*	7*	30*†

**-Columns do not always sum to total because in many cases the same person participated in both the blackjack strategy survey and the ethnographic interview. In these cases the total has been counted as one interview.*

†-Similarly, rows do always sum to total because the same person may have participated in the same interviews for more than one game. In these cases the total has been counted as one interview.

Semi-structured interviews

The semi-structured interviews (*Appendix F*) were conducted in a large Las-Vegas-Strip property alongside a group of blackjack tables. Participants were asked if they would mind being interviewed for a study examining how people like to gamble. Approximately one out of three people agreed to participate but only about one-half of those had experience playing one of the appropriate games (blackjack, roulette, or slot machines) and were thus allowed to participate. Players who agreed to participate and were eligible were then given an informed consent form which they had to sign

(*Appendix G*). On completion participants were given a free tee-shirt ($25 retail value) provided by the casino.

Blackjack strategy surveys

A total of one hundred fourteen blackjack strategy surveys (*Appendix H*) were administered. Eighty-one surveys were conducted under the same conditions as the semi-structured interviews described above, except that these interviews were not tape-recorded. Another ten were administered to Las Vegas subjects in their homes or in public venues as part of longer ethnographic interviews. Twenty-three more were administered to subjects in the Czech Republic during longer ethnographic interviews. Of all *Blackjack Strategy Survey* participants, fourteen worked in the casino industry (primarily as blackjack dealers or supervisors), twelve of whom also occasionally played blackjack.

Ethnographic interviews

A total of forty-seven ethnographic interviews (*Appendix J*) were conducted. Participants were obtained through word of mouth and classified advertisements in local newspapers. Seventeen of these interviews were conducted in the Las Vegas area and thirty in Prague. In cases where the participants played more than one of the focus games, they were asked about both games. Thirteen of the participants worked in the casino industry, all but four of whom were also gamblers at one point or another. These interviews were open-ended and participants were encouraged to discuss any aspects of the gambling experience they wished. These interviews lasted anywhere from one to five

hours, with a mean from two to two and a half hours. Czech participants were often interviewed in English if they spoke English well. Of those who did not, some were interviewed with the help of a translator and others were interviewed in Czech by the author. The latter method was eventually chosen because subjects spoke more slowly and explained their beliefs in details that would otherwise not have become apparent. US participants were paid $10 per hour for their time. Czech participants were paid 200 crowns, equivalent to between $5 and $8 throughout the time the data was being collected.

Summary of what's to come

The remainder of the dissertation is divided into three additional chapters. *Chapter 2* provides a detailed analysis of players' folk-conceptions of basic strategy, referred to throughout as folk-basic strategy. *Chapter 3* moves beyond basic-strategy cues to consider what additional factors players find important to playing strategy and how this varies given unique features of the sociocultural environment. *Chapter 4* concludes the dissertation with a return to the question of how studying blackjack players in context contributes to the understanding of decision making and gambling behavior more generally. It considers two main questions: 1) What is the source of gamblers' suboptimal strategies and false beliefs, and 2) to what extent does the study of blackjack generalize to other domains?

A few comments about what is *not* to come are in order, since the dissertation will not address a number of relevant issues regarding blackjack playing strategies and

beliefs. First, one of the most important aspects in experienced blackjack players' arsenal of strategies for winning concerns betting strategies as opposed to playing strategies; that is, choices of when to increase and when to decrease one's bets. While the dissertation refers briefly to players' betting strategies, particularly when considering risk attitude, it does not give these strategies the attention they deserve in terms of their relevance to overall blackjack strategy. The decision was made to focus on playing as opposed to betting strategies for the sake of length and focus, but it should be remembered that betting strategies make up another important strategic domain for experienced blackjack players.

Second, a significant portion of the participant-observation and the interviews were oriented toward other gambling activities, in particular, slot-machine and roulette playing. Again, for the sake of length and focus, much of this has been removed from consideration except when it was deemed the most relevant to understanding blackjack strategies. While there are a number of interesting similarities and differences between these games and blackjack, they warrant a detailed consideration in their own right, which was not deemed appropriate here.

Third, although a significant portion of the research involved participant-observation, the discussion of players' strategies and beliefs throughout the dissertation is not as ethnographic as a reader familiar with this genre would expect. That is, there is little attempt to provide a rich description of the subjective experience of gambling or to convey the lives of individuals gamblers or the world of gambling. Nor have my own experiences as a participant in this world been conveyed. This choice was made for two

main reasons: 1) for the sake of length and focus, and 2) for the intended audience. My main hope is to convey blackjack playing strategies and how they are understood by most players, and just doing this seemed to be a complete project of its own. To complement this with case studies and rich descriptions of the gambling experience could double the length of the dissertation, and would, I felt, detract from the original goal.

With regard to audience, my hope is to communicate primarily with psychologists, who I believe can benefit most from the recognition that studying behavior in situ can often enhance rather than blur one's understanding of human behavior and psychological functioning (the traditional audience for ethnographic participant-observation already largely accepts this as a given). Yet this same audience, in my judgment, would also be the least open to descriptions of individual lives or of subjective experience as meaningful data regarding more widespread belief systems. As such, although all of the strategies and beliefs presented here have been augmented or entirely informed by the participant-observation, their presentation often remains at a distance that may seem strange to the anthropologist or ethnographer.

Finally, one aspect of playing strategy that is notably absent from this report are cases that involve loss of control or conflicts between actual behavior and what the player deems ideal behavior. The reader should not assume that these factors are not important to how blackjack players or other gamblers actually play. Nearly all casino gamblers, even those who play professionally, are regularly faced with a conflict between what they take to be rational and how they actually behave (see Denes-Raj & Epstein, 1994 for an experimental example), or between what they took to be rational when they were placing

their bets and what they subsequently take to be rational after losing a large sum or gaining distance from the experience. A conscious choice was made in writing this dissertation to focus on a more limited aspect of the gambling experience: the strategies and beliefs that the gamblers take without much conflict to be rational or true. A focus on loss of control and lapse in reason is the norm in research on gambling strategies and beliefs, yet little time has been taken to understand the complexity of the gamblers' strategies and beliefs that seem to them to be reasonable and normative (for some notable exceptions to this see Hayano, 1982; Henslin, 1967; Lesieur, 1984, although it should be noted that all three researchers were trained as sociologists, not psychologists). As such, there is a tendency for researchers to lump all gamblers' strategies for and beliefs about winning into categories of irrationality involving motivated reasoning, cognitive biases, or loss of control. On the contrary, I believe most strategies—even when they involve false beliefs—can be seen as reasonable once time is taken to consider the subjective experience and the range of information most widely available to the casino gambler.

CHAPTER TWO

FOLK-BASIC STRATEGY

This chapter provides a detailed analysis of blackjack playing strategies in terms of two cues, the dealer's upcard and the players' hand total: the two cues used for the construction of blackjack's basic strategy. This data was collected using the structured *blackjack strategy survey* (see *Appendix H* for a copy of the survey). The analysis is important for three reasons. First, it provides useful comparative data, since previous research on blackjack playing strategies has been almost singularly oriented to how people perform with respect to the basic strategy. This data adds to the literature by providing the most complete description of players' folk-basic strategies and by analyzing the strategies as they change with experience, the first study of its kind. Second, knowledge of the best way to play given the player's hand and the dealer's upcard forms the basis not just of basic strategy but also of card-counting systems, the only two widely acknowledged and relatively uncontroversial normative methods for maximizing expected gains (or minimizing expected losses) in blackjack. Thus, cataloging playing strategies in terms of these cues will provide useful preliminary data for making a *normative* assessment of blackjack play, at least when this assessment is limited to considerations of maximizing expected value. Finally, basic-strategy cues provide a useful organizing principle through which to catalogue players' strategies in a

meaningful way, since experienced players themselves use these cues, in part, to determine how to play.

Survey responses were collected on a five-point scale: 1) “hit, double down, or split” (depending on whether the chart referred to “hit-stand”, “double down, do not double down”, or “split, do not split” decisions); 2) “usually hit, double down, or split, but depends on context”; 3) “depends entirely on context” or “no favored strategy”; 4) “usually do not hit, double down, or split, but depends on context”; 5) “do not hit, double down, or split”. Since the goal of this part of the study was to determine how players would choose given only basic-strategy cues, the first two choices were both treated as choices to hit, double down, or split; the last two choices were both treated as choices not to hit, double down, or split; and the middle choice was treated as though the player made one choice half the time and the other choice the other half the time.

The chapter is divided into five sections. Sections one, two, and three discuss players’ choices to hit or stand, double down, and split, respectively. Each of these first three sections is divided into three subsections. The first subsection presents and discusses the frequencies with which players violate basic strategy; the second subsection presents and discusses the average expected cost for these violations; and the third subsection presents and discusses a quantitative comparative summary of the performance across experience levels.

Section four looks at the choice to take insurance or even money when the dealer has an ace showing. Section five takes a departure from the basic-strategy surveys to discuss some observable differences in folk-basic strategies across locations. Finally,

section six concludes the chapter. This includes a summary of average players' performance in terms of expected return in comparison to a perfect basic strategy player, a summary of the important findings in the analysis, and a brief consideration of the relevance of these findings to how heuristics should be conceived.

Each of the first four sections compares players at three levels of experience: 0-60 hours (n=39), 61-600 hours (n=33), and more than 600 hours (n=41).The experience levels were chosen from a preliminary analysis both because the number of subjects is relatively comparable across groups and because these levels of experience were judged to distinguish subjectively different levels of familiarity with the game. The results include subjects from all interviews: the Las-Vegas-Strip sample, the Prague sample, and the Las Vegas sample who were not interviewed on the Strip.

Differences across groups are cross-sectional rather than longitudinal, and as such there is no way to determine whether these differences actually identify change with experience. Perhaps some other variable, such as certain pre-existing false beliefs about probability, influenced both the choice to play more frequently and the particular strategies used by players who play more frequently. Nonetheless, strategies held by the more-experienced groups will often be discussed as "changes with experience" or as though they are the result of learning. This convention was used for simplicity of expression and to convey my belief that the differences involved changes with experience, but the reader should remember that the differences may not in fact involve changes over time, and that instead they may correspond to other characteristics of the

three sample groups that contributed to the amount of time the respective participants spent gambling.

Hit-stand decisions

Violation frequency

Tables 3a to *3c* show the violation frequencies per decision point for hit-stand decisions among blackjack players with 0-60, 61-600, and greater than 600 hours experience, respectively. For these tables, participants were asked to assume that the decision to split or double is no longer available, and thus that their only choice is between whether to hit or to stand. Player totals below 12 or soft 17 were not included because 100% of participants hit with these hands. Player totals above 17 or soft 20 were not included because 100% of participants stood. Each cell within this set of tables refers to the frequency (in percent) with which players violate the basic strategy given the choice to hit or stand and the particular basic-strategy cues indicated by the column (dealer's upcard) and row (player's hand total).

To make it easier for the reader to identify important patterns, cells for which the correct basic-strategy play is to hit (as opposed to stand) are circumscribed with a thick border and the numbers within are in bold. Cell highlighting is provided in cases for which violation frequencies or expected costs are particularly high. Cells are not highlighted if less than 35% of players violated basic strategy, cells are highlighted in *grey* if between 35% and 65% of players violated basic strategy, and cells are highlighted in *black* if more than 65% of players violated basic strategy.

Table 3a: Hit-stand violation frequencies for players with 0-60 hours experience

H-S	2	3	4	5	6	7	8	9	T	A
12	21.8	26.9	67.9	67.9	73.1	2.6	2.6	5.1	2.6	2.6
13	62.8	59.0	57.7	57.7	62.8	7.7	7.7	10.3	7.7	7.7
14	55.1	50.0	47.4	47.4	52.6	14.1	14.1	14.1	14.1	15.4
15	43.6	37.2	34.6	35.9	47.4	34.6	34.6	33.3	33.3	34.6
16	20.5	19.2	19.2	17.9	23.1	60.3	57.7	56.4	55.1	57.7
17	5.1	5.1	5.1	5.1	5.1	9.0	10.3	10.3	12.8	10.3
s17	52.6	52.6	52.6	52.6	55.1	52.6	50.0	50.0	47.4	47.4
s18	7.7	7.7	5.1	5.1	5.1	7.7	7.7	84.6	84.6	87.2
s19	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	1.3	2.6
s20	0.0	7.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 3b: Hit-stand violation frequencies for players with 61-600 hours experience

H-S	2	3	4	5	6	7	8	9	T	A
12	27.2	31.9	58.8	39.4	39.7	5.9	3.1	3.1	0.0	0.0
13	61.9	50.9	46.3	26.9	27.2	5.9	3.1	3.1	4.7	4.7
14	46.6	37.2	34.1	22.7	19.7	9.1	6.3	4.7	6.3	6.3
15	25.9	18.1	11.9	9.4	9.4	25.9	21.4	12.0	9.2	7.7
16	12.0	8.9	5.8	6.1	7.7	46.9	46.9	40.6	37.5	35.9
17	0.0	0.0	0.0	0.0	0.0	0.0	2.8	2.8	4.4	4.4
s17	44.7	47.5	53.8	53.8	56.9	35.9	28.1	28.1	28.1	28.1
s18	6.3	6.3	6.3	6.3	6.3	6.3	10.6	78.4	73.8	80.0
s19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	10.9	10.9
s20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	6.3

Table 3c: Hit-stand violation frequencies for players with over 600 hrs experience

H-S	2	3	4	5	6	7	8	9	T	A
12	42.7	53.7	20.7	19.5	19.5	3.7	0.0	0.0	0.0	0.0
13	29.3	26.8	15.9	9.8	9.8	3.7	0.0	0.0	0.0	0.0
14	17.1	14.6	11.0	9.8	9.8	7.3	3.7	3.7	3.7	3.7
15	12.2	9.8	7.3	7.3	7.3	13.4	8.5	8.5	8.5	8.5
16	4.9	4.9	2.4	2.4	2.4	22.0	17.1	18.3	18.3	19.5
17	2.4	0.0	0.0	0.0	0.0	0.0	2.4	3.7	3.7	3.7
s17	37.8	40.2	45.1	45.1	45.1	31.7	11.0	8.5	7.3	8.5
s18	6.1	4.9	4.9	4.9	4.9	11.0	22.0	61.0	53.7	63.4
s19	7.3	7.3	4.9	4.9	4.9	2.4	2.4	6.1	8.5	8.5
s20	2.4	2.4	2.4	2.4	2.4	0.0	0.0	0.0	2.4	2.4

The percentages shown against the dealer's 10 and ace are potentially misleading. In four of these cells the basic strategy differs in the U.S. and the Czech Republic (splitting 8s against the dealer's 10 and ace, splitting aces against the dealer's ace, and doubling 11 against the dealer's 10, all of which are correct in the U.S., but incorrect in the Czech Republic). In all cells against the dealer's 10 and ace, the expected cost for violating basic strategy is different across the two locations. Since both Czech and U.S. participants were included in each experience level, the results in these cells will not be correct, particularly in the cells where the basic strategy is different between the two populations. The numbers were included here for completeness, because they do provide some information, but summary analysis will not include this information.

Two key points should be noticed. First, for the entire sample (that is, when all three experience levels are taken as a single group), there is a linear trend whereby players are more likely to hit as their hand total moves lower from 17 to 12 ($F(1,107) = 414.84$, $p < 0.001$) and from soft 20 to soft 17 ($F(1,107) = 192.05$, $p < 0.001$), and as the dealer's upcard moves lower from 6 to 2 ($F(1,107) = 17.36$, $p < 0.001$) and higher from 7 to ace ($F(1,107) = 23.53$, $p < 0.001$). The trend against the dealer's upcards is not expressed with beginning players, who are less sensitive to the dealer's upcard than more-experienced players, and who are thus less likely to change their own strategy as the dealer's upcard changes. There are a few exceptions to this trend even when all experience levels are taken as a single sample. The linear trend is not expressed when the dealer's upcard moves from 5 to 6 or from 10 to ace, and the trend is only marginally significant as the dealer's upcard moves from 4 to 5 ($F(1,107) = 3.52$, $p = .063$) and as

the player's hand moves from soft 19 to soft 20 ($F(1,107) = 3.74$, $p = .056$) (perhaps because the hit rate in this last case is nearly zero, as it should be, with both soft 19 and soft 20, and thus there is little room for improvement from one hand to the next).

Keren & Wagenaar (1985; Wagenaar, 1988) identified these trends in their sample as well (although they did not note that the trend does not continue as the dealer's upcard moves from ace to seven, which turns out to be important). They correctly noted that the pattern corresponds to the likelihood of busting for both the player and the dealer. Thus, as the players' total moves from 17 to 12, the player is less likely to bust by hitting, and in turn more likely to incorrectly hit (non-bold, not outlined cells), and less likely to incorrectly stand (bold, outlined cells). Similarly, as the dealer's total moves from 6 to 2 and from 7 to ace, the dealer is less likely to bust and the player is more likely to incorrectly hit and less likely to incorrectly stand. Keren & Wagenaar explained these patterns in terms of conservatism due to fear of busting.

They failed to note two important points, however: first, conservatism due to over-sensitivity to the likelihood of busting does not explain soft hands, for which there is no risk of busting by taking an additional card; and, second, this over-sensitivity to busting is largely normative in terms of expected value. That is, players are more likely to violate basic strategy in just the places where violating basic strategy costs the least. A better interpretation of the noted pattern than the one provided by Keren & Wagenaar, then, might not be fear of busting, but rather sensitivity to expected value.

The cases where players do not show strong sensitivity to the likelihood of busting (i.e., with a 12 to 16 as the dealer's upcard moves from ace to seven, and the

dealer thus becomes more likely to bust) are just the cases where the likelihood of busting is not diagnostic of expected value. On these hands, the expected cost for incorrectly standing actually *increases* as the dealer becomes more likely to bust (i.e., as the dealer's upcard moves from ace to 7), primarily because against these lower dealer upcards the player is more likely to win if he or she takes an extra card and does not then bust.

A second feature to notice about this set of charts is that, with a few exceptions, players' violation frequencies improve markedly with experience, and most dramatically in cases where the player ought to stand with 12-16. These are the only hand totals for which the player ought to stand even though the dealer would have to hit were he or she in the same position. The dramatic improvement may come from learning one of the essential differences between the player and the dealer: the one tie the dealer wins is when both the dealer and the player bust, thus better to wait and hope the dealer busts specifically on hands where both the player and the dealer have relatively high probabilities of busting.

Average expected cost per cell

While the previous set of tables indicating violation frequency are the most straightforward, average total expected cost is a more diagnostic number if the goal is to make normative assessments of the players' strategies (see the in-depth description of basic strategy in *Appendix C* for details on this). Some basic-strategy violations have such a small cost or occur so infrequently that incorrect basic strategy given those particular cues will cost the player essentially nothing as compared to perfect basic-strategy play. Other violations have far more severe consequences. Thus, for example, hitting ace, 2

against a dealer's 5 instead of doubling (the correct basic-strategy play) will only add an additional 0.0002% to the player's expected cost as compared to perfect basic-strategy play (i.e., the player will only lose an additional $0.0002 on average for every $100 wagered). Splitting two 10s against a dealer's 10, on the other hand, will cost the player an additional 2.8384% (or $2.84 on average for every $100 wagered). Clearly players who violate basic strategy in the first case but not in the second will be much better off than those who violate basic strategy in the second case but not the first and they should be evaluated appropriately. Similarly, since players in the former group will be much better off, they will have less significant feedback by which to identify the error in their ways, thus one might expect there to be higher basic-strategy violation frequencies in just these cases. As such, to determine whether violation frequencies indicate conservatism which might be explained by a fear of busting, it is necessary to examine the expected costs for violating basic strategy in each cell.

Tables 4a to *4c* provide these numbers. As with the previous set of tables, numbers are in percent, player hand totals for which 100% of respondents answered correctly were not included, and cells for which the correct basic strategy play is to hit are outlined with a thick border and the numbers inside are bold faced. In this case, cell highlighting is somewhat different to reflect the much smaller percentages corresponding to expected cost. Cells are not highlighted at all if the average total expected cost is less than 0.001%, cells are highlighted in *light grey* if the expected cost is from 0.001% up to 0.005%, cells are highlighted in *dark grey* if the expected cost is from 0.005% up to 0.01%, and cells are highlighted in *black* if the expected cost is 0.01% or greater.

Expected cost for violating basic strategy per cell is calculated by multiplying three variables: 1) the frequency of basic-strategy violations by experience level, 2) the cost of violating the basic strategy given that particular set of cues and the type of decision to be made (data provided by Cacarulo, 1998), and 3) the frequency of occurrence of those particular cue values.

In all cells against the dealer's 10 and ace, the expected cost for violating basic strategy is different between the U.S. and the Czech Republic. Since participants from both locations were included in each experience level, the results in these cells will not be correct, particularly in the cells where the basic strategy is different between the two populations. The numbers were included here for completeness, because they do provide some information, but summary analysis will not include this information.

The expected cost is relative to optimal basic-strategy play, which has been normalized to a cost of zero (even though perfect basic strategy might have an expected cost or gain given any particular set of cues). Thus, for example, 21.8% of subjects with from 0-60 hours playing experience violated basic strategy by standing with 12 against the dealer's 2 instead of the correct play, hitting (see *Table 3a* on *p. 40*). This hand makes up 0.63% of basic-strategy starting hands. The expected cost for standing instead of hitting on this hand is 4.0%. Thus the total average expected cost for violating basic strategy on this particular decision point for players with from 0-60 hours experience equals 21.8% * 0.63% * 4.0% or 0.006%. If all members from this group made all other basic-strategy choices perfectly, they would lose, on average, an additional 0.6 cents per $100 wagered over a person who played perfect basic strategy.

Table 4a: Hit-stand expected cost for players with 0-60 hours experience

H-S	2	3	4	5	6	7	8	9	T	A
12	**0.006**	**0.003**	0.001	0.012	0.008	**0.004**	**0.004**	**0.006**	**0.011**	**0.005**
13	0.006	0.015	0.024	0.034	0.033	**0.010**	**0.009**	**0.010**	**0.023**	**0.013**
14	0.021	0.027	0.032	0.041	0.043	**0.012**	**0.011**	**0.009**	**0.024**	**0.019**
15	0.030	0.032	0.036	0.043	0.056	**0.021**	**0.018**	**0.013**	**0.026**	**0.035**
16	0.017	0.019	0.022	0.024	0.027	**0.019**	**0.016**	**0.010**	**0.005**	**0.040**
17	0.009	0.010	0.011	0.011	0.012	0.015	0.005	0.006	0.038	0.004
s17	**0.007**	**0.007**	**0.007**	**0.007**	**0.006**	**0.008**	**0.014**	**0.013**	**0.039**	**0.012**
s18	0.000	0.000	0.000	0.000	0.000	0.002	0.000	**0.007**	**0.011**	**0.000**
s19	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.001
s20	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 4b: Hit-stand expected cost for players with 61-600 hours experience

H-S	2	3	4	5	6	7	8	9	T	A
12	**0.007**	**0.004**	0.001	0.007	0.004	**0.010**	**0.005**	**0.004**	**0.000**	**0.000**
13	0.006	0.013	0.019	0.016	0.014	**0.008**	**0.004**	**0.003**	**0.014**	**0.008**
14	0.018	0.020	0.023	0.020	0.016	**0.008**	**0.005**	**0.003**	**0.010**	**0.008**
15	0.018	0.016	0.012	0.011	0.011	**0.016**	**0.011**	**0.005**	**0.007**	**0.008**
16	0.010	0.009	0.007	0.008	0.009	**0.015**	**0.013**	**0.007**	**0.004**	**0.025**
17	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.013	0.002
s17	**0.006**	**0.006**	**0.007**	**0.007**	**0.006**	**0.005**	**0.008**	**0.007**	**0.023**	**0.007**
s18	0.000	0.000	0.000	0.000	0.001	0.001	0.001	**0.006**	**0.010**	**0.000**
s19	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.002	0.006	0.003
s20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.003

Table 4c: Hit-stand expected cost for players with over 600 hours experience

H-S	2	3	4	5	6	7	8	9	T	A
12	**0.011**	**0.007**	0.000	0.003	0.002	**0.006**	**0.000**	**0.000**	**0.000**	**0.000**
13	0.003	0.007	0.007	0.006	0.005	**0.005**	**0.000**	**0.000**	**0.000**	**0.000**
14	0.007	0.008	0.007	0.008	0.008	**0.006**	**0.003**	**0.002**	**0.006**	**0.005**
15	0.008	0.008	0.008	0.009	0.009	**0.008**	**0.005**	**0.003**	**0.007**	**0.009**
16	0.004	0.005	0.003	0.003	0.003	**0.007**	**0.005**	**0.003**	**0.002**	**0.013**
17	0.004	0.000	0.000	0.000	0.000	0.000	0.001	0.002	0.011	0.001
s17	**0.005**	**0.005**	**0.006**	**0.006**	**0.005**	**0.005**	**0.003**	**0.002**	**0.006**	**0.002**
s18	0.000	0.000	0.000	0.000	0.000	0.002	0.001	**0.005**	**0.007**	**0.000**
s19	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.002	0.005	0.002
s20	0.001	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.005	0.001

Keren & Wagenaar provided a similar analysis of their subjects' hit-stand decisions, but they did not factor in the frequency of occurrence (base rate) of each hand. In any case, conservatism held up in their sample, and if they had factored in hand frequencies it still would have held up. In the current study, however, conservatism is not expressed. Indeed, at every experience level where fear of busting is an appropriate explanation for violations of basic strategy (the player's hard 12 to hard 17), the highest expected costs for violating basic strategy (corresponding to the darker cells) occur when players incorrectly hit when they should stand (12-16 against the dealer's 2-6), directly contradicting the conservative behavior observed by Keren & Wagenaar (if, as Keren & Wagenaar suggest, the failure to correctly hit is appropriately labeled conservatism).

Summary of hit-stand choices

Table 5a provides a summary of the findings from the previous two sets of charts. Below that, *Table 5b* presents a similar summary comparing Keren & Wagenaar's findings to the eighty-one subjects who completed the *blackjack strategy survey* in the Las-Vegas-Strip casino. This group of subjects is the most directly comparable to Keren & Wagenaar's sample, since they were recruited in a casino at the tables and represent a cross-section of players at various experience levels found in the casino.

Table 5a does not include hands against the dealer's 10 or ace, since, as discussed previously, costs for basic-strategy violation on these hands is different depending on whether one is playing in the Czech Republic or in Europe, and thus these numbers are not accurate. *Table 5b* includes hands against the dealer's 10 and ace, but it does not

include player's hands of soft 20, since Keren & Wagenaar did not include these hands in their analysis.

The two summaries consider hard and soft hands separately, as well as under-hitting (conservatism) and over-hitting (risk seeking). They present these trends, on average, at each level of experience for 1) violation frequency (the second major column), 2) violation frequency times the cost given the particular set of basic-strategy cues (the third major column, equivalent to the secondary analysis provided by Keren & Wagenaar which does not take into account hand frequencies), and 3) violation frequency times the cost given the particular hand times the frequency of the particular hand (the fourth major column, equivalent to the previous set of expected cost charts). Finally, it examines the total expected cost by multiplying the previous set of figures by the number of cells to which they apply (the fifth and last major column).

First, notice that Keren & Wagenaar's concept of "conservatism" is in fact not expressed with hard 12-17 at any experience level or with the Las-Vegas-Strip sample, although these hands are the only one's for which their explanation of conservatism ("fear of busting") makes sense. As players gain experience, they improve along both dimensions, but the over-hitting dimension is corrected more quickly, so that among the most experienced players both under-hitting and over-hitting errors average a cost per cell of 0.004%. Soft hands show conservatism across all levels of experience, and there is little improvement in overall performance over time (though there is also little room for improvement, since most of the cost comes from over-hitting, which even the beginners rarely do). Here, however, it is worth noting that while the most experienced players

Table 5a: Summary of hit-stand decisions: comparing experience

Hit-stand summary (hands w/ dealer 10 or ace not included)	Viol. Freq. (V)			V*Cost given Hand (C)			V*C*H (cost to EV per cell)			V*C*H*cells (total EV cost)		
Hours	0-60	61-600	>600	0-60	61-600	>600	0-60	61-600	>600	0-60	61-600	>600
Hard 12-17	Hard 12-17			Hard 12-17			Hard 12-17			Hard 12-17		
Under-hitting ("conservatism")	23.8	17.5	12.1	2.0	1.4	0.7	0.011	0.007	0.004	0.18	0.13	0.07
Over-hitting ("risk seeking")	36.0	20.4	9.1	4.1	1.7	0.8	0.022	0.009	0.004	0.68	0.29	0.14
Total	31.7	19.4	10.2	3.4	1.6	0.8	0.018	0.009	0.004	0.86	0.42	0.21
Soft 17-20	Soft 17-20			Soft 17-20			Soft 17-20			Soft 17-20		
Under-hitting ("conservatism")	55.8	47.5	36.2	9.0	7.1	5.0	0.008	0.006	0.005	0.07	0.06	0.04
Over-hitting ("risk seeking")	2.7	2.4	4.8	0.4	0.3	1.0	0.000	0.000	0.001	0.01	0.01	0.02
Total	17.6	15.0	13.6	2.8	2.2	2.1	0.003	0.002	0.002	0.08	0.06	0.06
Hard & soft hands	Hard & Soft Tot.			Hard & Soft Tot.			Hard & Soft Tot.			Hard & Soft Tot.		
Under-hitting ("conservatism")	34.9	27.9	20.5	4.4	3.3	2.2	0.010	0.007	0.004	0.26	0.18	0.11
Over-hitting ("risk seeking")	21.8	12.7	7.3	2.6	1.1	0.9	0.013	0.005	0.003	0.69	0.30	0.16
Total	26.0	17.6	11.6	3.1	1.8	1.3	0.012	0.006	0.003	0.95	0.48	0.27

Table 5b: Summary of hit-stand decisions: LV Strip versus Keren & Wagenaar

Player's soft 20 not included, but dealer's 10 & ace are included	**Viol. Freq. (V)**		**V*Cost given Hand (C)**		**V*C*H (cost to EV per cell)**		**V*C*H*cells (total EV cost)**	
	K&W	LV Strip	K&W	LV Strip	K&W	LV Strip	K&W	LV Strip
Hard 12-17	Hard 12-17		Hard 12-17		Hard 12-17		Hard 12-17	
Under-hitting ("conservatism")	41.8	17.5	3.7	1.5	0.026	0.010	0.71	0.26
Over-hitting ("risk seeking")	9.3	23.6	0.5	2.5	0.003	0.014	0.09	0.46
Total	24.0	20.8	1.9	2.1	0.013	0.012	0.80	0.72
Soft 17-19	Soft 17-19		Soft 17-19		Soft 17-19		Soft 17-19	
Under-hitting ("conservatism")	49.1	54.7	5.7	7.2	0.007	0.009	0.09	0.11
Over-hitting ("risk seeking")	3.2	3.4	0.6	0.5	0.001	0.000	0.01	0.01
Total	23.1	25.7	2.8	3.4	0.003	0.004	0.10	0.12
Hard & soft hands	Hard & Soft Tot.		Hard & Soft Tot.		Hard & Soft Tot.		Hard & Soft Tot.	
Under-hitting ("conservatism")	44.2	29.6	4.4	3.4	0.020	0.009	0.80	0.38
Over-hitting ("risk seeking")	7.2	16.7	0.5	1.8	0.002	0.009	0.10	0.47
Total	23.7	22.4	2.2	2.5	0.010	0.009	0.90	0.85

perform better than less experienced players in cases where they could under-hit, they actually perform worse in cases where they could over-hit (although the difference was not significant).

Finally, notice the large difference in net performance with experience (all analyses assume unequal variance and use a one-tailed t-test unless otherwise noted). The average expected cost per cell for both hard and soft hands and both over-hitting and under-hitting is 0.012% for beginners, 0.006% for intermediate players ($t(65) = 2.97$, $p = .002$), and 0.003% for advanced players ($t(58) = 2.41$, $p = .010$, comparing intermediate and advanced players). In comparison, the average expected cost per cell for Keren & Wagenaar's sample once it is adjusted to account for hand frequency is 0.010%. For the Las-Vegas-Strip sample it is almost identical at 0.009%. But, again, notice the difference in errors due to conservatism versus risk-seeking, even when soft-hands are taken into account. Keren & Wagenaar's sample has an average expected cost per cell of 0.020% for under-hitting and an average of only 0.002% for over-hitting, a ten-fold difference, averaging out to 0.010%. The Las-Vegas-Strip sample, on the other hand, has an average cost of 0.009% per cell for both over-hitting and under-hitting. Thus, while their performance is almost identical, their strengths and weaknesses appear quite different.

Double vs. do-not-double decisions

Violation frequency

Tables 6a to *6c* show the violation frequencies per cell for double versus do-not-double decisions among blackjack players at each experience level. There is one change

Table 6a: Double-down violation freq. for players with 0-60 hours experience

Db	2	3	4	5	6	7	8	9	T	A
7	5.1	5.1	5.1	5.1	5.1	0.0	0.0	0.0	0.0	0.0
8	3.8	3.8	3.8	3.8	3.8	1.3	1.3	1.3	1.3	1.3
9	14.1	**80.8**	**80.8**	**78.2**	**78.2**	14.1	2.6	2.6	2.6	2.6
10	**55.1**	**52.6**	**52.6**	**52.6**	**57.7**	**71.8**	**79.5**	**79.5**	12.8	10.3
11	**42.3**	**42.3**	**42.3**	**44.9**	**44.9**	**55.1**	**62.8**	**62.8**	**67.9**	24.4
12	6.4	6.4	6.4	6.4	3.8	3.8	3.8	3.8	6.4	6.4
s13	5.1	7.7	10.3	**84.6**	**87.2**	7.7	5.1	2.6	2.6	2.6
s14	5.1	7.7	10.3	**84.6**	**87.2**	7.7	5.1	2.6	2.6	2.6
s15	1.3	3.8	**91.0**	**88.5**	**91.0**	3.8	1.3	1.3	1.3	1.3
s16	0.0	2.6	**92.3**	**89.7**	**92.3**	2.6	0.0	0.0	0.0	0.0
s17	0.0	**92.3**	**89.7**	**89.7**	**92.3**	0.0	0.0	0.0	0.0	0.0
s18	2.6	**94.9**	**94.9**	**94.9**	**94.9**	2.6	0.0	0.0	0.0	0.0
s19	1.3	1.3	1.3	2.6	2.6	2.6	1.3	1.3	1.3	1.3
s20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 6b: Double-down violation freq. for players with 61-600 hours experience

Db	2	3	4	5	6	7	8	9	T	A
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	9.4	9.4	9.4	15.6	12.5	6.3	1.6	0.0	0.0	1.6
9	29.7	**57.8**	**57.8**	**56.3**	**59.4**	28.1	20.3	0.0	0.0	1.6
10	**29.7**	**28.1**	**28.1**	**31.3**	**31.3**	**43.8**	**53.1**	**59.4**	14.1	18.8
11	**18.8**	**18.8**	**18.8**	**21.9**	**21.9**	**25.0**	**23.4**	**26.6**	**54.7**	35.9
12	4.7	4.7	4.7	4.7	4.7	1.6	1.6	1.6	1.6	1.6
s13	23.4	23.4	23.4	**75.0**	**73.4**	3.1	3.1	3.1	3.1	3.1
s14	23.4	23.4	29.7	**70.3**	**70.3**	3.1	3.1	3.1	3.1	3.1
s15	26.6	26.6	**65.6**	**67.2**	**67.2**	3.1	3.1	3.1	3.1	3.1
s16	26.6	29.7	**67.2**	**67.2**	**67.2**	3.1	3.1	3.1	3.1	3.1
s17	29.7	**64.1**	**64.1**	**70.3**	**70.3**	6.3	3.1	3.1	3.1	3.1
s18	17.2	**79.7**	**79.7**	**79.7**	**79.7**	4.7	4.7	0.0	0.0	0.0
s19	14.1	14.1	14.1	10.9	7.8	4.7	4.7	0.0	0.0	0.0
s20	9.4	9.4	9.4	6.3	6.3	4.7	4.7	4.7	0.0	0.0

Table 6c: Double-down violation freq. for players with over 600 hrs experience

Db	2	3	4	5	6	7	8	9	T	A
7	7.3	9.8	13.4	15.9	15.9	0.0	0.0	0.0	0.0	0.0
8	11.0	11.0	20.7	23.2	23.2	2.4	0.0	0.0	0.0	0.0
9	30.5	**50.0**	**28.0**	**25.6**	**25.6**	24.4	17.1	2.4	0.0	2.4
10	**23.2**	**18.3**	**8.5**	**7.3**	**7.3**	**34.1**	**43.9**	**57.3**	7.3	4.9
11	**15.9**	**11.0**	**6.1**	**4.9**	**4.9**	**17.1**	**24.4**	**36.6**	**65.9**	29.3
12	0.0	0.0	0.0	1.2	1.2	0.0	0.0	0.0	0.0	0.0
s13	12.2	23.2	37.8	**54.9**	**51.2**	0.0	0.0	0.0	0.0	0.0
s14	12.2	23.2	37.8	**56.1**	**52.4**	0.0	0.0	0.0	0.0	0.0
s15	11.0	20.0	**53.7**	**52.4**	**48.8**	0.0	0.0	0.0	0.0	0.0
s16	9.8	22.0	**53.7**	**52.4**	**48.8**	0.0	0.0	0.0	0.0	0.0
s17	17.1	**70.7**	**61.0**	**59.8**	**57.3**	0.0	0.0	0.0	0.0	0.0
s18	9.8	**82.9**	**78.0**	**78.0**	**78.0**	7.3	0.0	0.0	0.0	0.0
s19	7.3	9.8	12.2	12.2	12.2	7.3	4.9	0.0	0.0	0.0
s20	4.9	4.9	7.3	7.3	7.3	4.9	2.4	2.4	0.0	0.0

in basic strategy between the Czech and U.S. samples. In the U.S., players should double with an eleven against the dealer's 10, whereas in the Czech Republic, players should hit this hand. Since there is only one Czech (out of 39) in the beginner group and six Czechs (out of 33) in the intermediate group, the violation frequency should be relatively accurate in this cell at these two experience levels. The advanced group was composed of sixteen Czechs, however, so this violation frequency is essentially meaningless, and a speckled background is used to indicate this fact. See *p. 39* for a reminder of how the charts are formatted.

The main point to notice about these charts is that the highest violations of basic strategy are in cells for which basic strategy calls for doubling. Among beginners, these are the only cells where more than 30% of players violate basic strategy. Indeed, at least 42.3% of beginners violate basic strategy on all hard doubling hands, and at least 84.6%

violate it on all soft doubling hands. Similarly, at most 24.4% of beginners violate basic strategy by incorrectly doubling with hard hands, with an 11 against an ace, and at most 10.3% incorrectly double on soft hands.[1] This corresponds strongly with the conservatism identified by Keren & Wagenaar, although in this case it decreases with experience and it cannot be explained by fear of busting since there is no risk of busting in any of the cases where it would be appropriate to double. In this case, the label conservatism also makes more intuitive sense, since it corresponds to reduced risk (the choice not to double one's bet, and thus not to double the amount of money one might potentially lose) as opposed to simply the choice to stand rather than hit, which has no impact on money risked.

More-experienced players improve dramatically on hard hands ($t(65) = 4.35$, $p < .001$, comparing beginner and advanced players), to the point where they often double in violation of basic strategy. They also improve on soft-doubling hands, though not as dramatically ($t(71) = 2.52$, $p = .007$, comparing beginner and advanced players). As with the hard hands, this improvement in correct doubling comes with the cost of an increase in incorrect doubling.

Average expected cost per cell

Again corresponding to the hit-stand analysis, *Tables* 7a to *7c* show the average expected cost per cell at each of the three levels of experience being examined. See *p. 43* for a reminder of how these charts are formatted. The main point to notice is that

[1] Doubling with an 11 against an ace actually corresponds to basic strategy in single deck blackjack and it is often indicated as the standard basic strategy on published basic strategy charts that do not distinguish between number of decks, since single deck blackjack was long the most popular form of blackjack in Las Vegas, although this has not been the case for more than a decade.

Table 7a: Double-down expected cost for players with 0-60 hours experience

Db	2	3	4	5	6	7	8	9	T	A
7	0.003	0.003	0.002	0.002	0.002	0.000	0.000	0.000	0.000	0.000
8	0.001	0.001	0.001	0.000	0.000	0.001	0.001	0.001	0.005	0.001
9	0.000	**0.006**	**0.013**	**0.020**	**0.027**	0.002	0.001	0.002	0.009	0.003
10	**0.027**	**0.030**	**0.034**	**0.038**	**0.046**	**0.028**	**0.020**	**0.007**	0.005	0.002
11	**0.037**	**0.041**	**0.045**	**0.052**	**0.055**	**0.035**	**0.028**	**0.016**	**0.059**	0.002
12	0.010	0.010	0.009	0.009	0.005	0.007	0.009	0.010	0.068	0.020
s13	0.001	0.001	0.000	**0.000**	**0.002**	0.002	0.002	0.001	0.004	0.001
s14	0.000	0.000	0.000	**0.002**	**0.004**	0.002	0.002	0.001	0.004	0.001
s15	0.000	0.000	**0.000**	**0.003**	**0.005**	0.001	0.000	0.000	0.002	0.001
s16	0.000	0.000	**0.002**	**0.004**	**0.007**	0.000	0.000	0.000	0.000	0.000
s17	0.000	**0.002**	**0.005**	**0.008**	**0.011**	0.000	0.000	0.000	0.000	0.000
s18	0.000	**0.002**	**0.006**	**0.009**	**0.009**	0.000	0.000	0.000	0.000	0.000
s19	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.001	0.001
s20	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Table 7b: Double-down expected cost for players with 61-600 hours experience

Db	2	3	4	5	6	7	8	9	T	A
7	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
8	0.003	0.002	0.002	0.002	0.000	0.003	0.001	0.000	0.000	0.002
9	0.001	**0.004**	**0.010**	**0.015**	**0.021**	0.005	0.007	0.000	0.000	0.002
10	**0.015**	**0.016**	**0.018**	**0.023**	**0.025**	**0.017**	**0.013**	**0.005**	0.005	0.005
11	**0.016**	**0.018**	**0.020**	**0.025**	**0.027**	**0.016**	**0.010**	**0.007**	**0.048**	0.003
12	0.007	0.007	0.006	0.007	0.006	0.003	0.003	0.004	0.017	0.005
s13	0.002	0.002	0.001	**0.000**	**0.002**	0.001	0.001	0.001	0.005	0.002
s14	0.002	0.001	0.000	**0.001**	**0.003**	0.001	0.001	0.001	0.004	0.001
s15	0.002	0.001	**0.000**	**0.002**	**0.004**	0.001	0.001	0.001	0.004	0.001
s16	0.001	0.000	**0.001**	**0.003**	**0.005**	0.001	0.001	0.001	0.004	0.001
s17	0.000	**0.002**	**0.004**	**0.006**	**0.008**	0.000	0.001	0.001	0.003	0.001
s18	0.000	**0.002**	**0.005**	**0.007**	**0.007**	0.001	0.001	0.000	0.000	0.000
s19	0.002	0.001	0.001	0.000	0.000	0.001	0.002	0.000	0.000	0.000
s20	0.002	0.002	0.002	0.001	0.001	0.002	0.002	0.003	0.000	0.000

Table 7c: Double-down expected cost for players with over 600 hours experience

Db	2	3	4	5	6	7	8	9	T	A
7	0.004	0.005	0.006	0.005	0.005	0.000	0.000	0.000	0.000	0.000
8	0.004	0.003	0.004	0.002	0.001	0.001	0.000	0.000	0.000	0.000
9	0.001	**0.003**	**0.005**	**0.007**	**0.009**	0.004	0.006	0.002	0.000	0.002
10	**0.011**	**0.010**	**0.006**	**0.005**	**0.006**	**0.013**	**0.011**	**0.005**	0.003	0.001
11	**0.014**	**0.011**	**0.006**	**0.006**	**0.006**	**0.011**	**0.011**	**0.009**	0.057	0.002
12	0.000	0.000	0.000	0.002	0.001	0.000	0.000	0.000	0.000	0.000
s13	0.001	0.002	0.001	**0.000**	**0.001**	0.000	0.000	0.000	0.000	0.000
s14	0.001	0.001	0.001	**0.001**	**0.002**	0.000	0.000	0.000	0.000	0.000
s15	0.001	0.001	**0.000**	**0.002**	**0.003**	0.000	0.000	0.000	0.000	0.000
s16	0.000	0.000	**0.001**	**0.003**	**0.004**	0.000	0.000	0.000	0.000	0.000
s17	0.000	**0.002**	**0.003**	**0.005**	**0.007**	0.000	0.000	0.000	0.000	0.000
s18	0.000	**0.002**	**0.005**	**0.007**	**0.007**	0.001	0.000	0.000	0.000	0.000
s19	0.001	0.001	0.001	0.000	0.000	0.002	0.002	0.000	0.000	0.000
s20	0.001	0.001	0.001	0.001	0.001	0.002	0.001	0.001	0.000	0.000

although the pattern of under-doubling continues, many of the higher average expected costs are for incorrectly doubling, such as with a 12 for beginners and intermediate players and with a 7 against a 4 and 5 for advanced players.

Summary of double, do-not-double choices

Table 8 provides a quantitative summary of double-down choices across experience levels. As with the hit stand summary, hands against the dealer's 10 or ace are not included in the analysis, since Czechs and Americans have different costs for violating basic strategy against these dealer's upcards. Hands are again grouped by hard and soft hands and by errors involving failure to correctly act or omission errors (under-doubling) and commission errors (over-doubling). Unlike the hit-stand summary, this summary does not include Keren & Wagenaar's findings or averages from the Las-

Table 8: Summary of double vs. do-not-double decisions

Doubling summary (hands w/ dealer 10 or ace not included)	Viol. Freq. (V)			V*Cost given Hand (C)			V*C*H (cost to EV per cell)			V*C*H*cells (total EV cost)		
Hours	0-60	61-600	>600	0-60	61-600	>600	0-60	61-600	>600	0-60	61-600	>600
Hard double	Hard double			Hard double			Hard double			Hard double		
Under-doubling ("conservatism")	60.8	35.5	22.5	9.7	5.2	2.7	0.030	0.016	0.008	0.60	0.32	0.16
Over-doubling ("risk seeking")	4.4	5.9	7.9	0.8	0.7	0.9	0.003	0.003	0.002	0.10	0.07	0.05
Total	27.9	18.4	14.2	4.5	2.6	1.7	0.014	0.008	0.005	0.69	0.39	0.22
Soft Double	Soft double			Soft double			Soft double			Soft double		
Under-doubling ("conservatism")	90.7	71.0	60.6	5.0	3.9	3.4	0.005	0.004	0.003	0.08	0.06	0.06
Over-doubling ("risk seeking")	2.5	10.6	7.6	0.4	1.1	0.6	0.000	0.001	0.001	0.02	0.05	0.03
Total	27.3	27.6	22.5	1.7	1.9	1.4	0.002	0.002	0.001	0.10	0.11	0.08
Hard & soft hands	Hard & Soft Tot.			Hard & Soft Tot.			Hard & Soft Tot.			Hard & Soft Tot.		
Under-doubling ("conservatism")	75.0	52.3	40.5	7.4	4.6	3.0	0.018	0.010	0.006	0.69	0.38	0.22
Over-doubling ("risk seeking")	3.2	8.9	7.9	0.5	1.0	0.8	0.001	0.002	0.001	0.11	0.12	0.08
Total	27.5	23.6	18.9	2.9	2.2	1.5	0.007	0.004	0.003	0.79	0.50	0.30

Vegas-Strip sample, since doubling hands are relatively infrequent and thus Keren & Wagenaar were not able to obtain a sufficient number of observations of doubling decisions. See the description of the hit-stand summary chart on *p. 47* for a reminder of how the chart is formatted. Looking first at violation frequencies, the key points from the summary follow.

With hard hands, beginners incorrectly failed to double in an average of 60.8% of cases, whereas they incorrectly doubled down in an average of just 4.4% of cases ($t(35) = 8.26$, $p < .001$). With soft hands, the findings are even more extreme. Beginners fail to double when they should in an average of 90.7% of cases, yet double when they should not in only 2.5% of cases ($t(35) = 20.21$, $p < .001$). Interestingly, with experience, this gap narrows in both directions. That is, while players become more likely to double in cases where it is correct to do so ($t(73) = 5.42$, $p < .001$, comparing beginner and advanced players), they also become more likely to double in cases where they should not ($t(73) = -1.72$, $p = .045$). The pattern here seems to match that found in the hit-stand charts in the sense that the process of learning to double leads to an over-application of the rule, just as a child might over-apply a grammatical rule before adjusting for the exceptions. Looking at the soft hands, one can see that the rate of over-doubling jumps from 2.5% to 10.6% from beginner to intermediate players ($t(37) = -2.35$, $p = .012$) then falls back to 7.6% for the most experienced players (although this latter change from intermediate to advanced is not significant.

Now compare this to the expected cost per cell. Notice that even though the rate of over-doubling on hard hands increases at each level of experience (from 4.4% to 5.9%

to 7.9%, although these increases are not significant), the average expected cost per cell actually decreases at each level (from 0.0034% to 0.0025% to 0.0019%, respectively), which is marginally significant ($t(37) = 1.65$, $p = .054$, comparing beginner and advanced players). How could the violation rate increase while the expected cost decreases? The higher frequency of over-doubling occurs in cells for which the cost of over-doubling is lower. As such, intermediate and advanced players can improve their performance even while increasing their violation rates. At the same time, the average improvement across experience levels on the hard under-doubling domain is dramatic, moving from a cost of 0.030% to 0.016% ($t(63) = 2.15$, $p = .018$, comparing beginner and intermediate players) and then to 0.008% ($t(43) = 1.97$, $p = .028$, comparing intermediate and advanced players).

Soft hands are more ambiguous. Here one finds the same pattern: players become more likely to correctly double (showing a lower frequency of under-doubling) and more likely to incorrectly double (showing a higher frequency of over-doubling), but the cost for incorrectly doubling increases as well, more than tripling (from 0.0003% to 0.0010% per cell) from beginner to intermediate players, before falling back to twice the cost of beginners at 0.0006% for advanced players, although these differences are not significant). Indeed, in the step from beginner to intermediate player, the cost of over-doubling on soft hands is not compensated for by the gain from increased correct doubling. Looking at the total expected cost for both hard and soft hands (the bottom right corner of the summary chart), we see that players improve steadily along the under-doubling dimension, moving from a cost of 0.69% to 0.38% to 0.22% (comparing

beginner and intermediate, and intermediate and advanced players, respectively, $t(63) = 2.24$, $p=.014$ and $t(44) = 1.98$, $p = .027$). Along the over-doubling dimension, the cost actually increases slightly from 0.11% to 0.12% before moving back to 0.08% among the most advanced players, although these differences are not significant. The overall performance displays essentially linear improvement from a total cost of 0.79% to 0.50% to 0.30%, respectively (comparing beginner and intermediate, and intermediate and advanced players, respectively, $t(63) = 1.71$, $p = .046$ and $t(37) = 2.10$, $p = .021$). Nonetheless, relative conservatism (greater errors for under-doubling relative to over-doubling) is displayed at every level (comparing under-doubling to over-doubling for beginner, intermediate, and advanced players, respectively, $t(35) = 3.21$, $p = .001$; $t(29) = 2.01$, $p = .027$; and $t(39) = 3.21$, $p = .001$).

Why do we see conservatism so strongly displayed among beginners and why does it remain with experienced players? I would suggest three main reasons. First, players do not need to know the doubling rule in order to play blackjack. Many beginning players in fact do not know the rule, or if they know it, they are often not sure how to do it or when it is legal. From this perspective, the fact that beginners rarely over-double but frequently under-double should come as no surprise: it is in part a consequence of not having encountered doubling as an option, and not needing to know how to do it to play the game.

Second, hands for which doubling is appropriate are far less frequent than hands for which either hitting or standing is appropriate (9.29% versus 88.18%, respectively). Thus, not only do players not need to learn to double in order to be able to play, their

opportunities for learning are far fewer. This makes the likelihood of learning an incorrect rule higher as well. Thus, for example, a player may begin their experiment with doubling down all hard hands that would reach the standing range of 17-21 if they were to receive a 10-value card (that is, hand totals from 7 to 11) against dealer's hands that are most likely to bust (2 through 6).[2] Using this decision heuristic, they will suffer a cumulative expected loss in excess of perfect basic strategy across those cells (7-11 against the dealer's 2-6) of 0.302%. This far outperforms the choice to never double across these same cells (a cost of 0.934%). Learning to distinguish between hands totaling 7 and 8 (where the expected value for doubling against 2-6 is negative) versus hands totaling 9-11 (where the expected value is positive) could take quite some time even if players were *perfect* intuitive statisticians, at least for some percentage of the players. A player may actually be more successful doubling 7 against a 2-6 than not doubling it over the course of tens of hours of play, simply because hand totals of 7 against the dealer's 2-6 do not occur very frequently (0.90% of all hands will involve 7 against 2-6), and the likelihood of successful doubling when these hands do occur is only marginally worse than the likelihood of failure (44.1% versus 55.9%), so that the few times the player encounters such hands, by chance alone they may win their doubles more often than lose them. This is assuming the player even distinguishes between doubles with hand totals of 7, 8, 9, 10, or 11.

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[2] Remember that 10-value cards are four times more likely than any other value, thus players are often hoping for a 10-value card when they double.

Third, as suggested earlier, unlike conservatism in the hit-stand domain, conservatism in the doubling domain does in fact involve reduced risk. If the player wants to double, as the name implies, they must double the amount of their bet. This increases the variance in their win-loss rate (as a percentage of their original bet). In most cases, the improvement in expected value more than accounts for the increased risk, but in some cases, such as with an ace-2 against a dealer's 4, a justifiable argument can be made against doubling, since the gain in expected value is so slight in exchange for the increased risk that particularly risk averse players could be advised not to double. Other reasons why players may fail to double will be considered later when players' beliefs, values, and culture, and the casino environment are considered.

Split vs. do-not-split decisions

Violation frequency

Tables 9a to *9c* show the frequencies with which players violate basic strategy for splitting decisions at each of the three levels of experience. See *p. 39* for a reminder of how the charts are formatted. Just as double-down violations were highest in cases where basic strategy indicates the player should double down, these charts indicate that the highest violation frequencies for splitting were almost always in cases where basic strategy calls for splitting (as opposed to not splitting). The two exceptions are with aces, which players tend to split correctly, particularly as they become more advanced, and with 10s, which beginners tend to split incorrectly, although this decreases with experience.

Table 9a: Split violation freq. for players with 0-60 hours experience

Sp	2	3	4	5	6	7	8	9	T	A
22	74.4	74.4	71.8	71.8	71.8	84.6	12.8	10.3	7.7	7.7
33	76.9	76.9	74.4	74.4	74.4	84.6	12.8	10.3	7.7	7.7
44	24.4	24.4	24.4	73.1	70.5	19.2	16.7	14.1	11.5	11.5
55	19.2	19.2	19.2	16.7	14.1	10.3	7.7	7.7	7.7	7.7
66	78.2	78.2	73.1	75.6	78.2	9.0	9.0	7.7	7.7	7.7
77	73.1	73.1	70.5	70.5	73.1	82.1	14.1	12.8	12.8	11.5
88	65.4	65.4	62.8	57.7	62.8	76.9	82.1	80.8	80.8	80.8
99	73.1	73.1	71.8	71.8	74.4	21.8	78.2	80.8	11.5	11.5
TT	34.6	34.6	34.6	37.2	37.2	32.1	24.4	21.8	17.9	15.4
AA	23.1	23.1	23.1	23.1	23.1	30.8	30.8	30.8	35.9	35.9

Table 9b: Split violation freq. for players with 61-600 hours experience

Sp	2	3	4	5	6	7	8	9	T	A
22	57.6	60.6	54.5	57.6	57.6	81.8	12.1	12.1	4.5	0.0
33	66.7	60.6	57.6	57.6	57.6	84.8	9.1	9.1	3.0	0.0
44	18.2	18.2	18.2	75.8	75.8	6.1	6.1	9.1	6.1	3.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
66	72.7	69.7	69.7	62.1	62.1	10.6	6.1	7.6	7.6	4.5
77	66.7	63.6	60.6	57.6	51.5	77.3	15.2	12.1	15.2	9.1
88	31.8	28.8	31.8	34.8	37.9	43.9	50.0	54.5	60.6	66.7
99	74.2	71.2	68.2	65.2	62.1	19.7	78.8	75.8	7.6	4.5
TT	7.6	7.6	7.6	7.6	7.6	4.5	4.5	3.0	1.5	1.5
AA	13.6	13.6	13.6	9.1	9.1	18.2	18.2	21.2	28.8	34.8

Table 9c: Split violation freq. for players with over 600 hrs experience

Sp	2	3	4	5	6	7	8	9	T	A
22	64.6	54.9	28.0	24.4	24.4	81.7	6.1	4.9	2.4	2.4
33	62.2	54.9	30.5	24.4	22.0	74.4	11.0	7.3	4.9	4.9
44	18.3	23.2	35.4	53.7	56.1	8.5	6.1	4.9	2.4	2.4
55	4.9	7.3	13.4	13.4	13.4	2.4	2.4	2.4	2.4	2.4
66	72.0	64.6	50.0	41.5	41.5	18.3	3.7	0.0	0.0	0.0
77	67.1	57.3	40.2	36.6	41.5	67.1	6.1	2.4	2.4	2.4
88	46.3	37.8	23.2	23.2	23.2	43.9	46.3	56.1	63.4	70.7
99	78.0	76.8	72.0	72.0	72.0	17.1	80.5	78.0	2.4	0.0
TT	14.6	14.6	14.6	14.6	14.6	7.3	7.3	4.9	4.9	4.9
AA	7.3	7.3	7.3	7.3	7.3	8.5	8.5	12.2	24.4	41.5

Average expected cost per cell

Tables 10a to 10c show the average expected cost per cell at each of the three levels of experience. See *p. 43* for a reminder of how these charts are formatted. Notice how different these numbers are from the violation frequency numbers. Although the costs for under-splitting remain relatively high, the costs for over-splitting, specifically with 10s is the highest of all, and it remains high even among the most experienced players. Furthermore, although it appears that players improve with experience, it is not clear whether or to what degree this is actually the case.

Summary of split, do-not-split choices

Table 11 provides a quantitative summary of split decisions across the three experience levels. Unlike the hit-stand, and double-down charts, the split summary does not distinguish between hard and soft hands, because this category does not apply for splitting decisions. As with the double-down charts, it does not include a comparison with Keren & Wagenaar's sample, because split opportunities are relatively rare, and Keren & Wagenaar did not collect enough observations of split choices to determine splitting strategies. Other features of the chart formatting follow the hit-stand and double-down summaries (see *p. 47* for a description). Key points from the summary follow.

Looking at the violation frequencies, relative conservatism (that is, the relative tendency toward higher rates of under-splitting as compared to rates of over-splitting) is high across experience levels (for beginner, intermediate, and advanced players respectively, $t(35) = 6.82$, $p < .001$; $t(30) = 8.16$, $p < .001$; $t(40) = 8.83$, $p < .001$) (notice

Table 10a: Split expected cost for players with 0-60 hours experience

Sp	2	3	4	5	6	7	8	9	T	A
22	**0.001**	**0.002**	**0.004**	**0.006**	**0.007**	**0.004**	0.000	0.001	0.003	0.001
33	**0.000**	**0.002**	**0.004**	**0.006**	**0.007**	**0.004**	0.000	0.001	0.003	0.001
44	0.002	0.001	0.000	**0.001**	**0.001**	0.002	0.002	0.002	0.008	0.002
55	0.006	0.005	0.005	0.004	0.003	0.003	0.003	0.003	0.010	0.003
66	**0.002**	**0.005**	**0.007**	**0.009**	**0.010**	0.000	0.001	0.001	0.004	0.001
77	**0.005**	**0.007**	**0.009**	**0.010**	**0.013**	**0.009**	0.000	0.001	0.004	0.001
88	**0.011**	**0.012**	**0.012**	**0.012**	**0.016**	**0.025**	**0.014**	**0.004**	**0.009**	**0.005**
99	**0.002**	**0.003**	**0.005**	**0.006**	**0.006**	0.000	**0.004**	**0.003**	0.003	0.000
TT	0.142	0.123	0.103	0.088	0.075	0.122	0.141	0.167	0.509	0.112
AA	**0.004**	**0.004**	**0.005**	**0.005**	**0.005**	**0.004**	**0.004**	**0.003**	**0.016**	**0.002**

Table 10b: Split expected cost for players with 61-600 hours experience

Sp	2	3	4	5	6	7	8	9	T	A
22	**0.001**	**0.002**	**0.003**	**0.005**	**0.006**	**0.004**	0.000	0.001	0.002	0.000
33	**0.000**	**0.001**	**0.003**	**0.005**	**0.006**	**0.004**	0.000	0.001	0.001	0.000
44	0.001	0.001	0.000	**0.001**	**0.001**	0.001	0.001	0.001	0.004	0.000
55	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
66	**0.002**	**0.004**	**0.006**	**0.007**	**0.008**	0.000	0.000	0.001	0.004	0.001
77	**0.005**	**0.006**	**0.007**	**0.008**	**0.009**	**0.009**	0.000	0.001	0.005	0.001
88	**0.005**	**0.005**	**0.006**	**0.007**	**0.009**	**0.014**	**0.009**	**0.003**	**0.006**	**0.004**
99	**0.002**	**0.003**	**0.004**	**0.006**	**0.005**	0.000	**0.005**	**0.003**	0.002	0.000
TT	0.031	0.027	0.023	0.018	0.015	0.017	0.026	0.023	0.043	0.011
AA	**0.002**	**0.003**	**0.003**	**0.002**	**0.002**	**0.002**	**0.002**	**0.002**	**0.013**	**0.002**

Table 10c: Split expected cost for players with over 600 hours experience

Sp	2	3	4	5	6	7	8	9	T	A
22	**0.001**	**0.002**	**0.001**	**0.002**	**0.002**	**0.004**	0.000	0.000	0.001	0.000
33	**0.000**	**0.001**	**0.002**	**0.002**	**0.002**	**0.003**	0.000	0.000	0.002	0.000
44	0.001	0.001	0.001	**0.001**	**0.001**	0.001	0.001	0.001	0.002	0.000
55	0.001	0.002	0.003	0.003	0.003	0.001	0.001	0.001	0.003	0.001
66	**0.002**	**0.004**	**0.005**	**0.005**	**0.005**	0.000	0.000	0.000	0.000	0.000
77	**0.005**	**0.006**	**0.005**	**0.005**	**0.007**	**0.008**	0.000	0.000	0.001	0.000
88	**0.008**	**0.007**	**0.004**	**0.005**	**0.006**	**0.014**	**0.008**	**0.003**	NA	NA
99	**0.003**	**0.004**	**0.005**	**0.006**	**0.006**	0.000	**0.005**	**0.003**	0.001	0.000
TT	0.060	0.052	0.044	0.035	0.029	0.028	0.042	0.037	0.138	0.035
AA	**0.001**	**0.001**	**0.001**	**0.002**	**0.002**	**0.001**	**0.001**	**0.001**	**0.011**	NA

Table 11: Summary of split vs. do-not-split decisions

Splitting summary (hands w/ dealer 10 or ace not included)	Viol. Freq. (V)			V*Cost given Hand (C)			V*C*H (cost to EV per cell)			V*C*H*cells (total EV cost)		
Hours	0-60	61-600	>600	0-60	61-600	>600	0-60	61-600	>600	0-60	61-600	>600
Splitting	Splitting			Splitting			Splitting			Splitting		
Under-splitting ("conservatism")	65.9	53.0	44.4	14.6	10.5	8.5	0.006	0.005	0.004	0.30	0.22	0.18
Over-splitting ("risk seeking")	19.2	7.5	10.2	7.3	1.4	3.0	0.031	0.006	0.011	1.01	0.19	0.35
Total	47.2	34.8	30.7	11.7	6.9	6.3	0.016	0.005	0.007	1.31	0.41	0.53

that here that the beginner players are the most likely to over-split, a different pattern from the double-down summary, and an issue that will be discussed soon), and this is also the case when the cost given particular basic-strategy cues are taken into account (the column titled, "V*Cost given Hand") (again, for beginner, intermediate, and advanced players respectively, $t(35) = 3.72$, $p < .001$; $t(30) = 7.11$, $p < .001$; $t(40) = 6.03$, $p < .001$). When the frequency of each hand is taken into account, however, one can see that the apparently higher cost for conservatism is an illusion. Players actually lose more (both per cell and summed across cells) for over-splitting than for under-splitting, though the results are not significant for intermediate players and are only marginally significant for advanced players (for average total cost *per cell*, $t(35) = -3.15$, $p = .002$ for beginners and $t(40) = -1.50$, $p = .071$ for advanced players; and for average total cost *summed across cells*, $t(35) = -3.098$, $p = .002$ for beginners and $t(40) = -1.48$, $p = .073$ for advanced players).

On first consideration, these results seem contrary to the explanations suggested as to why so few players double. Recall there were three hypothesized explanations: 1) players must know the hit-stand rules before being able to play, but they can learn the double rules as they go, thus it is not surprising that players become more likely to double with experience, simply through the process of learning the rule; 2) hands for which doubling is appropriate are far less frequent than hands for which either hitting or standing is appropriate, thus it is not surprising that player's have more trouble learning correct doubling rules than they have learning correct hit-stand rules; and 3) unlike

conservatism in the hit-stand domain, conservatism in the doubling domain does in fact involve reduced risk, since players must double their bet.

All three of these conditions are true of splitting as well. Indeed, hands for which it is appropriate to split occur far less frequently than hands for which it is appropriate to double (2.53% versus 9.29%, respectively), thus one might assume conservatism would be even more dramatic for split decisions. This paradox makes sense, to some degree, when the particular hand that costs players most is considered: incorrectly splitting 10s. Recall that this was one of the most frequent play violations for beginners, and though it was not frequent for more-experienced players, it nonetheless remained the most costly at every level of experience.

Why is there such a high cost for splitting 10s? The main influence is the frequency with which 10,10 hands occur compared to other split hands (9.40% of all hands involve a pair of 10-value cards, compared to 0.57% for each other hand that can be split). The cost for incorrectly splitting 10s would be relatively low if 10s occurred as infrequently as other hands. Still, the fact that they do occur so frequently might have led to better calibration with 10s, as is seen in other cases, and one might wonder why players do not more consistently learn that splitting 10s is a problem.

Before considering likely reasons, it should be stressed that most players *do* learn not to split 10s. Only 14.6% (six out of forty-one) of the most experienced players split their 10s against even the weakest dealer upcards. Only two of thirty-three intermediate players split their 10s. For a third participant from this intermediate group, the choice to split 10s depended entirely on context. All three of these intermediate players primarily

split 10s against 2-6, hands for which splitting 10s is the least harmful. Nonetheless, even with these small numbers, this is a point for which my blackjack strategy data does not mesh with my ethnographic experience. Other than beginners and card counters, I have almost *never* seen experienced players split 10s, and card counters only do so when other factors besides basic-strategy cues are being considered. This is one of the golden rules of blackjack and the surest way to anger other players at the table. When experienced players are asked how they "identify a bad blackjack player," the most consistent answer given is: "They split 10s." Indeed, while beginners often split 10s, the habit will often be un-learned within a few hours of play, because the opportunity arises often and the reaction against it is predictably and emphatically negative. Indeed, it would be noteworthy if a player split his or her 10s at a full or nearly full table and no one vocally reprimanded them. As often as not the dealer is the first to speak, "Are you sure you want to do that?" or "Put those 10s back together, Dear, you don't want to break up a 20." Players are often less friendly: "Do that once more and you'll be playing alone," or more simply, "What are you doing?" As one player commented, "When I want to play alone, you know what I do, I split my 10s, and then [the other players] leave the table."[3]

The reason beginners often believe splitting 10s is appropriate (before being confronted by other players) is most likely due to the ease of justifying it. "A total of 10 is a great hand. If I split my 10s, sure I'll be splitting a 20, but I'll have two new good

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[3] Why players prefer to play alone and why they care about how others play will be discussed in the next chapter when influences on strategy beyond basic-strategy cues are considered.

hands with twice the money out there."[4] As mentioned earlier, beginners learn not to use this strategy quickly, but the rational appeal is strong. And the rationale is nearly correct. Indeed, if counting cards, splitting 10s against a dealer's 5-6 is often called for (that is, a small increase in the ratio of 10s to non-10s remaining in the deck makes splitting 10s a better strategy than standing with 20 against the dealer's 5 or 6).

For advanced players, the higher frequency of splitting 10s as compared to intermediate players may be influenced by a number of factors. First, it could be due to over-application of heuristics these players have learned for other hands, as well as a general self-confidence in their own strategies as opposed to conventional wisdom, which many experienced players have decided (correctly) is often wrong. The heuristic referred to is that of assuming subsequent cards will be 10s. Generally, this heuristic works quite well, but in this particular case it would lead to overestimating the value of splitting 10s as well as the likelihood that the dealer will bust with a 2-6. So, it may be that advanced players are simply over-applying this rule, which generally contributes to greater success.

Another probable factor is that even when players split 10s, they often have a positive expected value. They will win more than they lose when splitting 10s against the dealer's 2-7. Thus, in some sense they will be rewarded for their choice to split 10s. True, they would be rewarded even more if they simply stayed with their 20, but these hands

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[4] The dealer is in fact not "probably going to bust anyway." With the weakest dealer upcard, a 6, the dealer busts in only 42.3% of hands, and with the strongest of the dealer's "bust cards", the 2, the dealer busts in only 35.4% of hands. Nonetheless, the heuristic of treating dealer's 2-6 as bust hands contributes to a common discourse regarding these hands as though the dealer will probably bust, and many of even the most experienced players believe the dealer is more likely than not to bust with a 4-6 up.

are some of the few for which the second best play still has a positive expectation, and this may account for it's relatively high rate even among advanced players.

Another possibility, at least addressing the discrepancy between ethnographic data and the blackjack strategy interviews, is simply that players answered the question according to what they think is best, but they in fact play differently. Certainly this is the case for two of the respondents, who indicated that they would not *in fact* split 10s if they were playing with other people because it angers the other players; if they were playing alone, however, which they prefer to do, they would. The fact that most experienced players prefer to play alone, combined with the fact that even those who do not mind playing with others may only split their 10s when alone, may account for the fact that, with few exceptions, I never see experienced players split 10s. In any event, the high rate of splitting 10s accounts for many of the anomalies in the summary chart discussed earlier.

A last possibility is simply that the survey data is not representative. The cost for incorrectly splitting 10s is extremely high since this opportunity occurs so frequently and it requires doubling one's bet. Thus, even one or two anomalous subjects who incorrectly hit 10s can swing the results significantly.

The last part of the summary charts should be noticed are the total expected costs at each level of experience. The expected cost for beginning, intermediate and advanced players for under-splitting is 0.30%, 0.22%, and 0.18%, respectively, suggesting steady improvement with experience, as might be expected as more-experienced players learn to split, although the difference is only marginally significant between intermediate and

advanced players ($t(65) = 2.41$, $p = .009$, between beginner and intermediate players, and $t(62) = 1.51$, $p = .067$, between intermediate and advanced players). The total expected cost for over-splitting, on the other hand, is 1.01%, 0.19%, and 0.35%, respectively, showing dramatic improvement in terms of expected cost from beginner to intermediate player ($t(43) = 3.06$, $p = .002$), but a subsequent decline between intermediate and advanced players (though here the difference is not significant). Thus, unlike doubling hands, players generally improve with experience across both the conservatism and risk-seeking dimensions. The total expected cost for all splitting decisions is 1.31%, 0.41%, and 0.53%, respectively, for beginner, intermediate, and advanced players ($t(44) = 3.27$, $p = .001$, comparing beginner and intermediate players, and there is no significant difference between intermediate and advanced players), providing the first case where a more-experienced group (the advanced players) performs worse (albeit insignificantly so) than a less experienced group (the intermediate players) across a whole decision category (splitting). As with other anomalies in this chart, this pattern, too, no longer exists when the cost for incorrectly splitting 10s is removed from analysis.

Insurance and even money

Both the casino and players frame the insurance decision in two ways depending on whether or not the player has a blackjack along with the dealer's ace. If the player has a blackjack, casinos will generally offer players the option to receive the amount of their original bet, a payout called even money, distinguishing it from the payout players would receive if they waited and the dealer did not get a blackjack (three to two) or if they

waited and the dealer did have a blackjack (nothing). While the even money option is framed differently from insurance, it has identical consequences: if players take either even money or insurance when they have a blackjack, they will win exactly the amount of their original bet. It turns out that players treat the even money bet differently from other insurance bets, many of them always taking even money but never taking insurance. For this reason, players were asked about even money and insurance separately.

The even-money question asked, "How often do you take even money?" The insurance question asked, "How often do you take insurance, assuming your own hand is not a blackjack?" Each question was presented with the following five answer options: 1) always, 2) usually, 3) sometimes, 4) rarely, and 5) never. *Figures 1a* and *1b*, respectively, show the frequency of respondents' answers to each of these two questions. The white bar is for players with from 0 to 60 hours playing experience, the grey bar for players with from 61 to 600 hours experience, and the black bar is for players with more than 600 hours experience. As a reminder, players using basic strategy should neither take even money nor insurance.

Perhaps the most striking feature in these two charts is how little performance changes with experience. Participants from all three experience levels are more likely to take even money than insurance (using a two-tailed paired t-test, for beginner, intermediate, and advanced players, respectively, $t(33) = 3.63$, $p = .001$; $t(28) = 2.66$, $p = .006$; and $t(35) = 4.29$, $p < .001$). From each experience level, there is a high frequency of both players who always take even money and those who never take it, although the

Figure 1a. How often do you take even money?

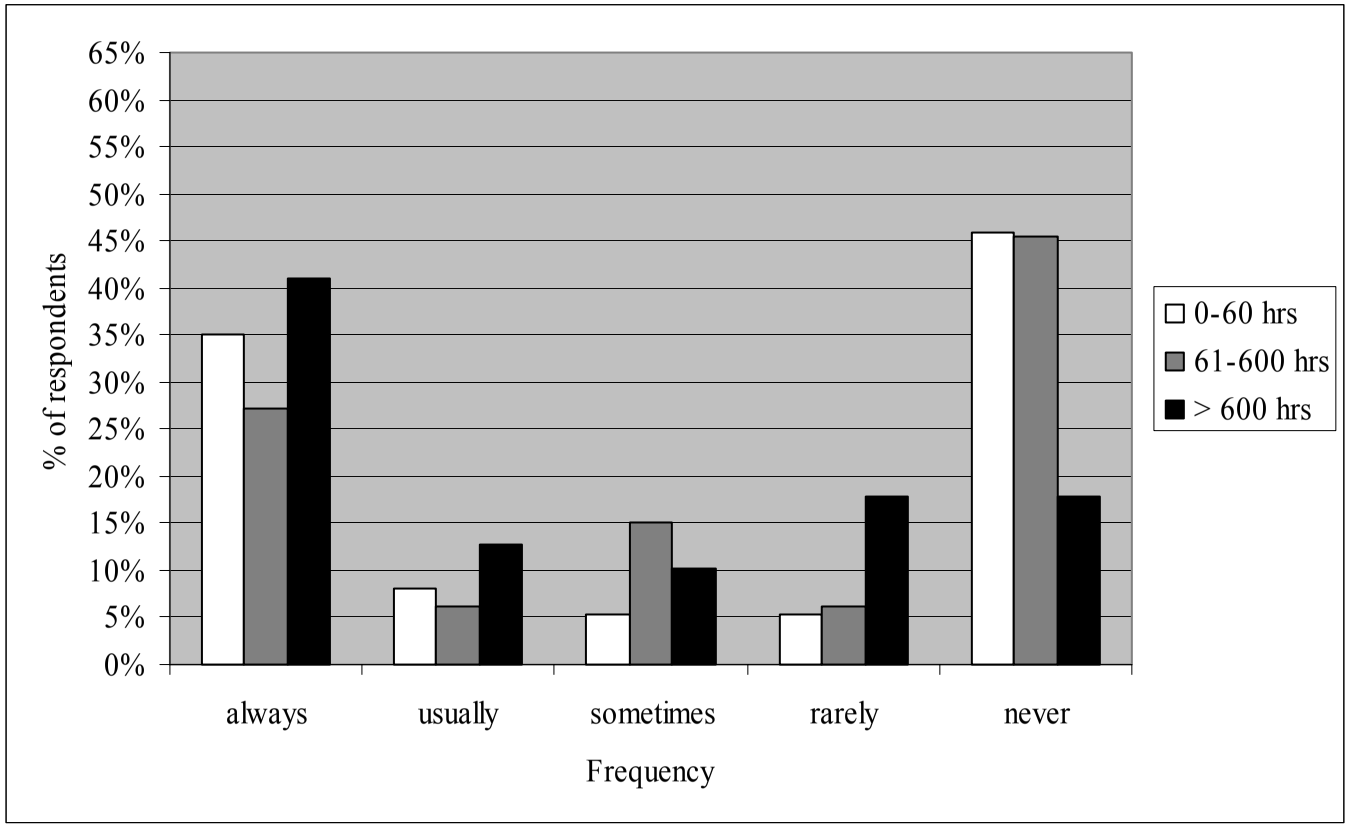
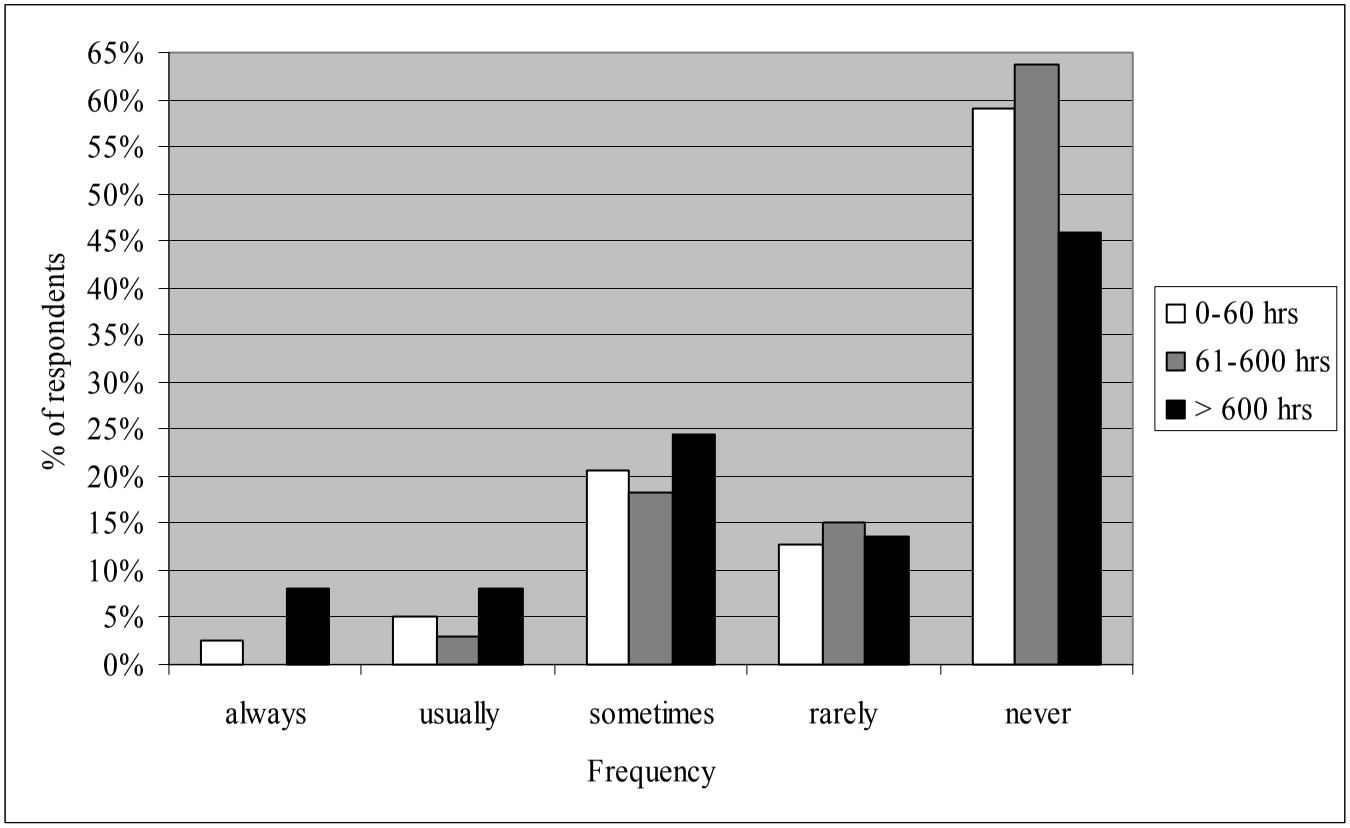


Figure 1b. How often do you take insurance?



frequency of players who never take even money decreases with experience (χ^2 (1, N = 73) = 7.13, p = .008, comparing the most advanced players with beginner players). Advanced players approach being significantly more likely to always take even money than to never take it (χ^2 (1, N = 23) = 3.52, p = .061). Looking at insurance, on the other hand, one can see that players across experience levels are more likely never to take insurance (M = 56.0%) than to always take it (M = 3.7%) (χ^2 (1, N = 63) = 48.0, p < .001). Interestingly—in violation of basic strategy—the most experienced group of players is also the most likely of any group to always take both even money and insurance (though neither of these trends are significant) and the least likely to never take them, though the trend is only borderline significant with insurance (χ^2 (1, N = 69) = 8.02, p = .005; and χ^2 (1, N = 67) = 2.88, p = .090, comparing the frequency with which intermediate and advanced players never take even money and insurance, respectively).

By assigning numerical quantities to the subjective frequency categories, one can estimate the overall frequency of taking even money or insurance and in turn estimate the expected cost of violating basic strategy by taking insurance and even money. For this analysis, always was defined as 100%, usually as 75%, sometimes as 50%, rarely as 25%, and never as 0%. It should be stressed that these frequencies are approximations for terms that likely subjectively mean something different to the players. This caveat is specifically true for the middle three answer categories—"usually", "sometimes", and "rarely". Those who answered "always" or "never" are likely relatively well calibrated.

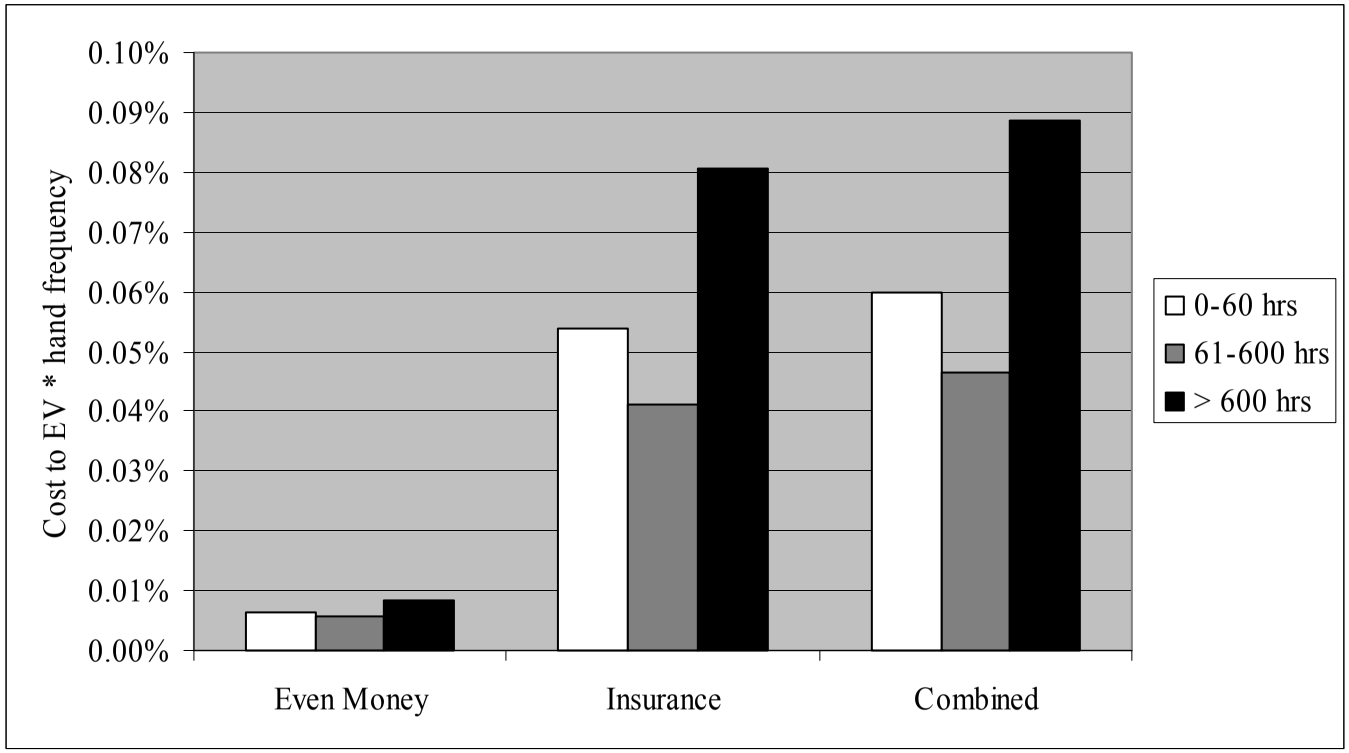
Figure 2 displays the total expected cost for violating basic strategy by taking even money or insurance. Even money has a much lower net cost, since the opportunity

to take it occurs far less frequently than the opportunity to take insurance. The total expected cost for all even money and insurance decisions is 0.06% for beginners, 0.05% for intermediate players, and 0.09% for the most advanced players (differences were not significant comparing beginning and intermediate players; $t(62) = -2.03$, $p = .047$, using a two-tailed test comparing beginner and intermediate players).

Why do so many players take even money but not insurance (even though the two decisions have identical consequences)? Why does this continue with experience? And why do experienced players continue to take both insurance and even money at a higher rate than beginning players? A few possibilities are presented below.

With regard to the first question, insurance and even money are framed differently—by both the casinos and the players. As such, most players (and many, perhaps most, dealers) have no idea that when the player has a blackjack the two options have the same consequences. In most casinos in Las Vegas, players have the option to take either even money or insurance when they have a blackjack and the dealer has an ace. I have had a handful of players tell me explicitly that they would never take insurance with a blackjack, but they always take even money. The experience of receiving even money involves instantly winning the amount of your original bet. The insurance experience requires adding an additional bet to the table (the "insurance" bet, which loses on average 69.1% of the time, but pays off at two to one), then waiting to see if it or the original bet wins or pushes (pushing only if the player wins the insurance bet). It is not straightforward that the player will receive exactly their original bet when taking insurance, regardless of the outcome (given that he or she has a blackjack), and as such,

Figure 2. Total expected cost for taking even money or insurance



insurance may seem like a riskier option than even money, requiring the player to place extra money at risk, rather than guaranteeing that the player wins. Indeed, except in the relatively rare case when the player has a blackjack, taking insurance does indeed involve placing more money at risk rather than guaranteeing a win.

Another factor involved in the even-money preference does not concern framing, but rather actual differences in the insurance and even money conditions: the latter offers a chance for a certain gain in place of a risky—though higher expected return—choice, whereas the former does not provide this "sure gain" feature, except when the player also has a blackjack. This factor helps explain both why players prefer even money to insurance and why this preference continues with experience. Kahneman & Tversky (1979) found that people tend to overvalue sure gains to risky choices, even when the risky choice has the same—and to some extent even higher—expected value. Taking insurance when the player has a blackjack is the only case where the player has a sure win, but only if he or she takes the even money option. In all other cases of insurance, the player potentially loses their original hand even if they also lose the insurance bet. Kahneman & Tversky's findings, however, do not concern repeated gambles or people who appear to be risk seeking in the first place (as do casino gamblers); as such, one might expect this group to be risk seeking in insurance decisions, particularly given the fact that the risk (of not taking even money) has a positive expectation for the player. In any event, even money has a "sure thing" characteristic, and that provides the choice with different psychological appeal from other insurance decisions which may account, in part, for its preference. Players are often cognizant of this characteristic. For example,

"It's the only sure thing in Vegas," is a common justification for taking insurance among Las Vegas players.

Even without the "sure thing" characteristic, taking insurance with a good hand serves as a means of minimizing regret (Keren & Wagenaar, 1985), and blackjack is the best of all hands (both in terms of probability of winning, and in terms of the payoff), thus the hand for which the most regret is surely experienced if the player does not win. In support of this, it is worth noting that many players who do not usually take insurance will nonetheless do so when they have a total of 19 or 20 (20 more than 19) even though insuring these hands does not create a sure thing. In terms of expected value, insuring a 20 is no different from insuring any other hand (including a blackjack), but a 20 is generally a very good hand, whereas a 15 is a poor hand.[5] All other things being equal, players generally expect not to lose with a 20 (and they in fact lose only 12% of the time), and expect to lose with a 15 (and they do 72% of the time). By insuring a 20, players keep the likelihood of losing down to 18% (thirteen of which costs the player only half their original bet) whereas without taking insurance players will lose 36% of the time. Insuring a 17 decreases the likelihood of losing as well, but with a hand where most players expect to lose anyway. With a 20, the loss in expected value for taking insurance

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[5] Actually, it is not entirely true that the expected value is the same when insuring a 20 as when insuring any other hand. Hands of twenty are composed of two 10-value cards, which means that fewer 10s than usual will be available for the dealer to get a blackjack. Thus the probability of the dealer getting a blackjack, and the value of taking insurance, will be slightly lower than the norm. With six decks, the likelihood the dealer will receive the needed 10 for a blackjack goes from 30.4% when the player has a 20, to 30.7% when the player has a single 10-value card (such as when the player has a blackjack) to 31.1% if the player has no 10-value cards. The likelihood would have to be greater than one in three for the insurance bet to have a positive expected value.

may be compensated for by the psychological gain in “saved” regret, whereas with a 17 this gain will not occur. With a player blackjack this tendency toward trying to minimize regret can only be higher, since blackjack is the best of all hands.

As with taking the sure thing, many players are consciously aware of the motive of reducing regret when they choose to take even money. In one example, when I was dealing to a group, a more-experienced player told another to take even money. They were friendly, and we had been talking about strategy, so I told them that according to basic strategy, it is better not to take even money. The player who had given the wrong advice said, "Yeah, I know. That's not why you take even money. You do it to avoid the bad feelings you'll have if the dealer does have a blackjack."

Returning to the question of why experienced players continue to take insurance and even money, and at an even higher rate than less experienced players: one reason may be that the most experienced players are often the most risk averse. Often the beginners are at the casino for a once-in-a-rare-while splurge. They are there “to gamble”. Players who have played for thousands of hours are often playing “to make some money” or “to make my money last”. It is ironic that it is precisely because they have been playing for thousands of hours (and will often continue to play for thousands more) that the argument for risk management does not apply. These players are essentially in the long-term and their expected value will be very close to their actual winnings (or losses); as such, concerns with risk management have little relevance to insurance decisions. On the other hand, one should not expect these gamblers to have had the prescience to know that they would ultimately play blackjack for thousands of hours.

Indeed, most of them never expected to spend so many hours playing. Furthermore, even if they had planned to play for thousands of hours over the course of their life, if they are living week to week these long-term expectations are less relevant than their present day wins and losses, and thus insurance as a form of risk management can make sense, particularly for very large bets.

Differences across locations

Two of the original motives for conducting this study were 1) the desire to explore the influence of culture and beliefs on decision-making processes and 2) the observation that blackjack players in casinos in the Czech Republic played noticeably differently from those on the Las Vegas Strip. In particular, they were conspicuously more likely to stand on hard hands for which they should have hit. This seemed to present an ideal case for which to examine how culture might influence basic decision processes. It also corresponds precisely with the differences in "conservatism" found between the Las-Vegas-Strip sample and Keren & Wagenaar's Dutch sample. Unfortunately, the quantitative study of playing strategies was not comparable across the different locations where this study was conducted. As such the description of differences in folk-basic strategy will be limited to observations during the fieldwork and to insights gained during the ethnographic interviews.

There were three main observable differences in terms of basic-strategy play between the Czech and Las Vegas samples. First, Czech players were more conservative with hard hit-stand decisions in line with Keren & Wagenaar's observations, more likely

to incorrectly stand with 14, 15, 16 against the dealer's 7-ace, and less likely to incorrectly hit with 12-16 against the dealer's 2-6. Second, Czech players were also more economically conservative than their Las Vegas counterparts, doubling down and splitting less frequently, and taking even money and insurance more often. Third, there was more variation in folk-basic strategy among experienced Czech players. Thus for example, it was not unheard of to see an experienced Czech player make basic-strategy violations that would almost never be seen among experienced U.S. players, such as splitting 10s or hitting a soft-19.

Interestingly, and originally a great surprise to me, players in northwestern Indiana were more like Czech players than like Las-Vegas-Strip players with regard to all three differences as well as in some of their most common beliefs about important playing strategies beyond basic strategy. Some of the reasons for these differences (and for the similarity in Prague and northwestern Indiana) will be discussed in more detail in the following chapter. There are other important differences between Prague, Indiana, and Las Vegas players, and if it had been possible to collect a sufficient number of blackjack strategy surveys among all three groups in a comparable manner, I believe there would have been several quantifiable differences even at the level of the basic strategy. As it stands, however, a detailed discussion of cross-cultural differences will wait until next chapter when the topic moves beyond basic strategy.

Summary and conclusion

The summary is composed of three parts. Part one summarizes the average expected cost for players assuming the only information they use for their decisions are basic strategy cues. Part two summarizes the main findings from the data analysis. Part three concludes the chapter with some brief thoughts on how this relates to the nature of heuristics and biases and the role of the sociocultural environment, and with an introduction to *Chapter 3*.

Net performance in terms of basic-strategy cues

When the expected cost for all different decision points are summed, taking into account different rules for players in each location, average performance at each level of experience can be assessed. *Table 12* summarizes these results. Numbers include hands against the dealer's 10 and ace, which in this case took into account rule differences based on where interviewees primarily played. The first row of numbers, labeled "expected cost" is the average total player cost relative to a player who uses perfect basic strategy. The second row is the average expected cost for the basic-strategy player, which differed slightly between the U.S. and Czech casinos where I conducted my fieldwork. The last row is the sum of these two numbers, which is the expected loss the average player from each sample group can expect when playing casino blackjack, assuming the only influences on their play are basic-strategy cues. Four basic-strategy-survey participants were excluded from this analysis because the rules in their primary location of play could not be determined (and thus the appropriate basic strategy and corresponding costs for violations could not be determined).

The first three columns, "Location (>1,000 hrs)", indicate the performance of players with more than 1,000 hours experience. These players are divided between participants in the U.S. and participants in the Czech Republic, where there was no significant difference in terms of average expected return. Players with less experience were not included in this cross-cultural comparison because the sample sizes across experience levels were not comparable across locations. The second column compares Keren & Wagenaar's Dutch sample to my Las-Vegas-Strip interview set, the most comparable sample to theirs for a cross-cultural comparison. Again, these two groups performed almost identically overall (though, remember, their types of errors with respect to "conservatism" versus "risk-seeking behavior" were quite different, at least within the hard hit-stand domain). Finally, the third column indicates performance at the three experience levels combined across locations. Here, one can see a steady improvement, such that less experienced players will lose an average of $4.60 for every $100 risked, whereas the most experienced players will lose an average of only $1.90 ($t(62) = 4.52$, $p < .001$, with no significant difference between intermediate and advanced players).

Table 12. Summary of expected cost for folk-basic strategy

	Location (>1,000 hrs)			K&W vs. LV Strip		Experience level			
	Czech	US	Total	LV Strip	K&W	0-60	61-600	>600	Total
n=	*15*	*23*	*38*	*77*	*112*	*36*	*31*	*41*	*108*
Expected cost	1.3%	1.6%	1.5%	2.8%	2.5%	4.2%	1.9%	1.5%	2.5%
Casino advantage	0.5%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%	0.4%
Total player EV	1.8%	2.0%	1.9%	3.2%	2.9%	4.6%	2.3%	1.9%	2.9%

Variance across individual subjects was quite high. There was one beginning player who only made one basic-strategy error because he used a card to make his playing decisions and the card had an error on it. One advanced player outperformed him,

one of the two proficient card counters in my sample (both of whom were Czech). The other card counter changed basic strategy on a few double-down choices in order to reduce risk and he always took even money for the same reason. He knew these plays had negative expected value, but believed reducing his risk was more important. There were twelve advanced, two intermediate, and two beginning players who had an expected cost (before factoring in the casinos advantage given perfect basic strategy) under 0.5%. There were two advanced, two intermediate, and ten beginning players who had an expected cost greater than 5.0%. And there were one advanced, one intermediate, and three beginning players who had an expected cost greater than 10.0%. No players at any level had an expected cost greater than 11.0% (again, before factoring in the expected cost for perfect basic strategy play).

Summary of main findings

Conservatism

Given the results of the current study, Keren & Wagenaar's main finding, that players express what they called conservatism (a relative tendency to under-hit, under-double, and under-split as compared to over-hitting, over-doubling, and over-splitting) related to a fear of busting (at least with hard hit-stand hands), does not seem appropriate; or, if appropriate, it depends on sociocultural and/or individual differences. Average performance across all three levels of experience directly contradicted the expectations of conservatism across hard hands, as was average performance among players in the Las-Vegas-Strip sample, contrasting sharply with Keren & Wagenaar's findings. At the same time, my own interest in conducting this research began with the observation that Czech

blackjack players tend to be conservative on just the domain identified by Keren & Wagenaar, incorrectly standing on potentially busting hands far more than their Las-Vegas-Strip counterparts, and expecting others to do the same. Thus, it appears that the conservatism bias identified by Keren & Wagenaar is context specific and varies from culture to culture even given a blackjack game with almost identical rules, where choices are narrowly prescribed, outcome probabilities can be exactly determined, and rewards are unambiguously provided in monetary units.

The label of conservatism is quite different depending on whether one is referring to hit-stand decisions on the one hand, and split and double down decisions on the other. Players tended to become more conservative with experience with regard to hit-stand decisions, while becoming less conservative with regard to double down and split decisions, and in all of these examples, the changes in conservatism with experience are normative with respect to basic strategy. Hit-stand decisions do not actually involve increased economic risk, except to the degree one play has a better or worse expected return. At the same time, players tend to see the choice not to hit as conservative, describing it as such repeatedly during ethnographic interviews and while playing, and commonly indicating they would hit more either with more money, with more alcohol, when they are feeling lucky, and in other cases when they are willing to risk more. Thus, there seems to be a subjective sense that the choice to hit involves greater risk even if it does not.

While the label of conservatism may apply with hit-stand hands, at least subjectively, it remains unclear whether even Keren & Wagenaar's sample should be

seen as risk averse (or whether mine should be seen as risk-seeking). They specifically excluded from analysis hands with a total below soft 17 and hard 12, since all players hit perfectly on these hands, just as they excluded hands above soft 19. If they had included these hands, players would no longer appear risk averse at all, since their average error rate for over-standing on these hands would be zero. It is not at all clear that conservatism as a general objective category should be applied at all, since its expression varies widely depending on the types of hands being considered and it variably refers to 1) inaction without decreased financial risk or decreased variance, 2) decreased financial risk regardless of its effect on outcome variance, and 3) decreased variance without regard to it's effect on financial risk. It does make sense as a comparative category, however, since different groups can be compared across the same set of cells with the same type of risk.

The other set of choices (splitting, doubling, and taking insurance), all do influence both financial risk and variance, since they require the player to place more money on the table, though in the case of insurance there is a correlation between the additional money and the probability the player will lose everything, reducing the variance in outcome in some cases, while increasing it in others. Here, players across all samples appear to be risk-averse, but this cannot be explained due to a fear of busting since these hands do not involve a risk of busting. Rather this conservatism seems to be due to the sometimes-justifiable fear of losing more money than one can afford.

The apparent conservatism (or lack thereof) is also in part probably due to player familiarity with the game, and to the fact that the dealer would not play according to basic strategy in these domains. That is, dealers themselves never split or double down

and they always hit to seventeen regardless of the players' cards. Thus, with hard hit-stand choices, players become more conservative with experience, learning not to always hit their 12-16 (in contrast to what the dealer would do with an equivalent hand) against certain dealer upcards. Yet they become more risk-seeking with experience with soft hit-stand, double down, and split choices, learning to hit, double, and split in certain cases in contrast to what the dealer would do with an equivalent hand. In all of these cases the net result of these changes with experience are normative in that the average expected return improves across these domains (even though the players are making more errors in terms of over-soft-hitting and over-doubling).

Finally, it should be noted that while Keren & Wagenaar's sample and my own sample differed greatly in terms of the types of errors that most contributed to their expected loss, their net performance was nearly identical. To some extent this may be coincidence, but it lends support to a particular conceptual emphasis regarding the value of heuristics that I believe is appropriate. This emphasis is on the adaptive nature of heuristics rather than on the biases that they sometimes induce. It suggests that while heuristics do not optimize, they nonetheless improve performance, allowing the decision maker to be relatively successful in environments where bounds on time, available information, or mental capacity make optimization impossible (Gigerenzer, 2000, 2001; Gigerenzer et al., 1999; Jungermann, 1983; Payne, Bettman, & Johnson, 1993). Any particular heuristic will lead to errors in certain contexts. The heuristics that survive, however, will compensate for these occasional errors by their general good performance and their simplicity of use. Perhaps each of the two communities from which these

samples were drawn has developed a unique distribution of beliefs that make up their blackjack playing heuristics, essentially equally adaptive overall, but contributing to unique patterns of violations. By using more conservative heuristics, Keren & Wagenaar's sample makes fewer errors along one domain of decisions (those for which it is appropriate to stand), but more errors along another (those for which it is appropriate to hit). The result are two non-optimal sets of strategies that lead to systematic errors in different contexts, but that work quite well (and largely equivalently) overall.

Changes with experience

The main points to note about changes with experience are that players do, indeed, improve over time. As suggested by the previous paragraph, however, these changes tend to involve decreased performance in particular domains. Thus, players become more likely to over-hit on soft hands, yet this is more than compensated for by the decreased frequency with which they under-hit. Similarly, more-experienced players over-double more often, but again their net performance improves because of their decreased expected cost for under-doubling. A similar pattern obtains with splitting decisions.

Conclusion

These findings lend support to the recent claim that the heuristics learned with experience are adaptive even though they may lead to decreased performance in certain contexts. Importantly, they also suggest that many important decision-making heuristics are domain specific (in this case applying specifically to blackjack) and are learned

through experience within the decision domain. Since this is true with blackjack, a game that is easily analyzed in terms of expected value, one might expect it to be all the more true in more complex social decision tasks where choices, probabilities, possible outcomes, and the values of those outcomes are all less accessible, and thus where the need for heuristics in place of attempted expected utility maximization is all the more apparent.

Basic-strategy cues are an important factor in how blackjack players decide to play. Experienced players tend to have a well-developed folk-basic strategy, and they tend to believe it corresponds to the statistically best way to play each hand when nothing but those cues is being considered. The current chapter examined the influence of one aspect of the sociocultural environment on players' folk-basic strategy: experience with the decision-making task. At the same time, basic-strategy cues contribute just a fraction of the information blackjack players find relevant to their strategy. Previous research that has primarily limited its focus to these cues, including the current chapter, has essentially missed these other important factors. The next chapter attempts to move beyond basic strategy by presenting a picture of the players' conceptions of what, besides the dealer's upcard and their own hand, is important to winning in blackjack, as well as how this is influenced by characteristics of the sociocultural environment.

CHAPTER THREE

BEYOND BASIC STRATEGY

The basic-strategy analysis assumed that the only cues players should or do use to determine how to play are the dealer's upcard and the player's two-card total. During the blackjack-strategy surveys, however, most participants had trouble explaining how they play given just the dealer's upcard and their own total. Players who did not have trouble had already been exposed, in one form or another, to the basic strategy. Players could generally say how they would play each hand after "all other things being equal" had been stressed, but this caveat usually needed to be repeated several times during an interview, and the answer category, "It depends entirely on context," was common for players at all levels. Even when players could say how they would usually play, they would often stress that "it *really* depends on other factors". Sixty-eight of the one hundred twelve participants (60.7%) who filled out the basic-strategy section of the survey had at least a few cells for which they could not say how they would usually play, all other things being equal. When broken down by experience, the percentages responding in this category were 69.2%, 68.8%, and 46.3%, respectively, for beginner, intermediate, and advanced players (*ns* between beginner and intermediate players and χ^2

(1, N = 108) = 5.29, p = .022, between advanced players and the first two groups).[1] Even among the many players who could say how they would play, all but five would violate their version of the basic strategy on certain occasions depending on other factors. Clearly there is far more to players' decisions besides basic-strategy cues.

The current chapter moves beyond basic-strategy dimensions to consider what additional information players find important and why. It is comprised of four main sections. Section one describes the main strategies and belief systems held by experienced blackjack players. Section two examines gambling utility, reconsidering the question of whether blackjack players' primary goal is to maximize expected value, and presenting some of the other reasons they play. Section three considers differences across locations in the players' values (utility), strategies, and beliefs as well as in the structure of the socio-cultural environments. It is here that the strong relationship between the players' decision-making processes and their sociocultural context is most evident. Finally, section four concludes the chapter with a summary of the findings presented here and an introduction to the concluding chapter.

Strategies and beliefs of the experienced blackjack player

The current section will summarize four of the most important strategy-belief complexes held by experienced casino blackjack players. The term strategy-belief

[1] The fact that more-experienced players are more certain about how they like to play their hands given basic-strategy cues (and thus are less likely to have cases where they could not say how they would play given such cues) should not be taken to mean that more-experienced players are not as concerned with context as less experienced players. As mentioned later in this paragraph, nearly all players were influenced by context. These frequencies only refer to cases where players cannot say how they would play if context is removed a very different measure.

complex is used here to refer to both the set of beliefs that make a particular strategy seem reasonable to the gambler, and the strategy itself. They include 1) beliefs about the relationship between past cards removed from the deck and future outcome probabilities, and the folk-card counting strategies used to exploit this believed relationship; 2) beliefs about patterns in luck and natural order, and systems for maintaining, disrupting, and benefiting from these patterns; 3) beliefs about intuition and its use as a decision-making tool; and 4) attitudes towards risk in relation to past wins and losses and its influence on betting and playing strategies.

Folk-card counting

Very few blackjack players could be considered actual card counters. Of all 149 players who I interviewed about their blackjack playing strategies, only two were knowledgeable card counters, and one of these two had a number of beliefs about how to play that contradicted common card counting theory, although it is likely the player still performed well enough to gain an advantage. The other card counter would not have been an interview participant at all if I had not known him from the card counting community where he is well-known for his programming expertise. During the participant-observation, I only encountered three players (out of hundreds), who understood and practiced card counting well enough to gain an advantage, and two of them were at the poker table, having given up on card counting as too risky and not sufficiently profitable.[2]

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[2] One now played live poker and video poker for a living. The other played live poker and bet on sports for a living. This is common among those who give card counting a serious effort, and suggests what many believe to be true from empirical rather than theoretical evidence: that card counting in practice may not be as effective as it consistently appears to be in simulations.

At the same time, most players—beginning and experienced—have heard of card counting. Popular conceptions of what card counting actually involves varies among players and across experience. Beginners commonly believe that card counting involves memorizing the specific cards that have been played out of the deck and then making complex statistical inferences based on relative frequencies of remaining cards to predict what will follow. Many if not most long-term players realize card counting involves a much less cognitively demanding process of ascribing a positive or negative point value to the cards depending on whether they are good or bad for the player and memorizing the counts at which playing strategies and/or bet sizes should change. Indeed, most players who are relatively well experienced know that high cards and aces remaining in the shoe are good for the player and low cards are bad, and they know that they should hit more when there is a disproportionate number of low cards remaining and stand, double down, and split more when there is a disproportionate number of high cards remaining. Indeed, many casino blackjack players (though a clear minority) say that they count cards, although they generally qualify it with terms such as "a little" or "when I want to get serious", and, when pressed for details, they generally do not know the fundamentals of card counting, including a correct basic strategy.

Nonetheless, although there are very few players who actually count cards, a large majority of experienced players—including those who would not call themselves card counters—adjust their play based on previous cards removed from the deck in what could be seen as a kind of pseudo-card counting. Thus, just as players make choices according to a folk-basic strategy that takes into account their own two-card total and the dealer's

upcard, they also use folk-card-counting systems that are sensitive to cards removed from the shoe and the directional consequences of these cards. Unlike actual card counting systems, however, these strategies do not change the odds to the players' favor (except in very rare cases); most players would almost certainly do better to stick to their folk-basic strategies (except in cases where these strategies are wrong, in which case, of course, anything that leads to a change will improve their lot).

Folk-card-counting strategies play an essential role in the strategies of experienced blackjack players, and the frequency with which players tend to violate basic strategy in practice cannot be understood without taking them into account. There tend to be three main folk-card-counting strategies, all of which may or may not be used by a particular gambler. First, and least frequently, players may attempt to estimate relative frequencies of tens to non-tens remaining in the entire shoe. Thus, like actual card counters, they will be attuned to how many cards have been dealt since the previous shuffle, and they will have been watching for what appears to be a disproportionate relatively frequency of 10s to non-tens. If they think many more non-tens have been removed than is usual, they may increase their bet for the following round, take insurance if the dealer has an ace, double down with hand totals of eleven or less more than usual, and stand more often than they normally would with potentially busting hands. This group is the most sophisticated member of the pseudo-card-counting group. They tend to be very experienced and serious players and they have often studied card counting at some point in the past. Since they do not have a method for estimating actual ratios of tens to non-tens, and since they do not know what ratio would be significant for particular

strategy or bet changes, they are still largely involved in guess work. While they would generally be better off by simply sticking to the basic strategy, the expected cost for their pseudo-card counting will generally be quite low, and it may be compensated for by the added enjoyment or excitement that comes from implementing their strategy. While such players will commonly be encountered at the blackjack table, they nonetheless make up a small minority, perhaps five or ten percent of all people at the table, perhaps less than that.

Players of a second type are far more common (and often people from the first group fall into this category as well). While these players are also concerned with the relative frequency of tens to non-tens, they are not focused on the total number of cards dealt from the shoe. They believe that if tens and non-tens are approximately equally represented in a deck of cards, then even small samples from the shoe should approximate this distribution. If the small samples do not, then these players expect subsequent cards to "even things out", or bring the short-term relative frequency back to approximately fifty-fifty (or whatever distribution they see as normal). If asked, these players will be fully cognizant of the fact that there are a certain number of high and low cards in the deck, and that when low cards are removed, this leaves a certain number behind, but they have the additional expectation that even small samples of cards from the shoe should represent the larger distribution. This corresponds to what Tversky & Kahneman (Tversky & Kahneman, 1974) call the representativeness heuristic, and more particularly what they call the "law of small numbers," (Tversky & Kahneman, 1971), the belief that small sample sizes should be more representative of the population from which

they are drawn than is warranted. The belief is taken a step further in this case, however, and in related expressions of what is commonly termed “the gambler’s fallacy”. These players do not simply believe the unrepresentative frequency of high or low cards is less usual than it in fact is, but also that it will tend to be set right by immediately following cards. As a consequence, members of this group see the current round of play as the most important, and since it is easier to simply pay attention to the current round, they tend to do so. Unlike the first group, these players generally do not use this information in making betting decisions; rather, they use it only to decide how to play their hands as well as to try to influence what cards the dealer will subsequently receive.

The third group is similar to the second, and might be seen as simply a more extreme version. For members of this group, as for the last, the most recent cards are the most diagnostic of future probabilities, but for this group this is true even if it is clear that a representative sample of high and low cards have occurred. Thus if three tens are followed by three fives, players commonly believe a high card is due to occur, since the three low cards (the fives) occurred most recently. This corresponds to a sequential response bias (Wagenaar, 1972) and was identified by Keren & Wagenaar (1985) in their study of blackjack players in Holland. The specific concern with the most recent cards, independent of relative frequency, is often expressed by even the most experienced players, even if the cards are all displayed side by side face up on the table, and even if there are exactly the same number of each type of card: the most recent cards are seen as the most diagnostic of immediately following cards. As such, these players often prefer to sit at the final spot before the dealer, where they will sometimes take cards when they

normally would not, or not take cards when they normally would, specifically to influence what cards the dealer will subsequently receive. For example, if a high card is judged "due", and this high card would help the player but also hurt the dealer, the player may stand with the belief they are leaving the high card for the dealer.

While the first of these three folk-card-counting systems is relatively rare, the latter two, in one form or the other, are quite common, used by a clear majority of long-term players. Nonetheless, while all three systems can in some respect be seen as expressing a kind of gambler's fallacy, it should be noted that they are closely tied to the structure of blackjack and the fact that events are not independent in this particular game. Most of these same players would not use corresponding *betting* strategies, increasing their bets after a series of losses or decreasing their bets after a series of wins. And two players expressly stated on being asked that the same strategy would not work in roulette because roulette is "completely random".

It should be noted that the particular hands that players are most likely to vary their play with based on previous cards tend to also be those hands for which the difference in expected value between the choice options is quite low. These are often just the hands for which a small change in the proportion of 10s to non-10s in turn changes the basic strategy. Thus, while players may be wrong in thinking the most recent cards during a shoe are more important than earlier cards dealt from the same shoe, the heuristic of paying attention to recent cards likely costs very little in expected value.

Indeed, in several cases, even with a six-deck shoe, removing just one ten changes the basic strategy. If a player were only to attend to the final card before his or her own,

he or she would improve over basic strategy by assuming their next card would not be a 10-value card on all of the following eight hands: 13 versus 2 (hit instead of stand), 12 versus 4 (hit instead of stand), 12 versus 6 (hit instead of stand), 9 versus 3 (hit instead of double), ace-4 versus 4 (hit instead of double), ace-2 versus 5 (hit instead of double), 3-3 versus 2 (hit instead of split), 4-4 versus 5 (hit instead of split). Similarly, with just one extra 10-value card in the deck, the player would improve their expected value by violating basic strategy on all of the following eight hands: 12 versus 3 (stand instead of hit), 16 versus 10 (stand instead of hit), ace-7 versus ace (stand instead of hit), 9 versus 2 (double instead of hit), 11 versus ace (double instead of hit), ace-7 versus 2 (double instead of stand), ace-6 versus 2 (double instead of hit), and ace-8 versus 6 (double instead of stand). All of these hands are ones for which players indicated with relatively high frequency that how they would play depended entirely on context. Indeed, many experienced players who systematically violate basic strategy because of closely preceding high and low value cards may actually improve their performance as a result, since they tend to be selective about both how many preceding high or low cards they must see and which hands they are willing to change their play with, and this sensitivity tends to accord with the hands that are in fact most sensitive to change (and the least costly to violate). Based on empirical observation, I would expect few experienced players to significantly reduce their performance given their selective use of this heuristic.

Luck and natural order

> Any mathematician will tell you that the cards at the poker table are distributed randomly, that we remember the remarkable and forget the mundane, and that 'luck' is an illusion. Any poker player knows—to the contrary—that there are phenomenal runs of luck which defy any mathematical explanation--there are periods in which one cannot catch a hand, and periods in which one cannot not catch a hand, and that there is such a thing as absolute premonition of cards: the rock-bottom surety of what will happen next. These things happen in contravention of scientific wisdom and common sense. The poker player learns that sometimes both science and common sense are wrong; that the bumblebee can fly; that, perhaps, one should never trust an expert; that there are more things in heaven and earth than are dreamt of by those with an academic bent. (Mamet, 1986, pp. 93-94)

Although David Mamet's words above were spoken in reference to poker, similar—though less eloquent—words are frequently spoken by experienced blackjack players as well. Among the majority of experienced players, natural patterns in luck and in the cards—and strategies for identifying and manipulating these patterns—are the single most important aspect of playing and betting strategy, more important than how one plays his or her hands and more important than what cards have been removed from the deck. Indeed, among long-term players who learned to play at the casinos, the belief that wins and losses run hot and cold, and that this information can be used to the players' advantage, is nearly universal and is endorsed even by players who know it contradicts probability theory.

As one player put it, when explaining how it was possible to be a winner over the long run, even though the casino has a positive expected return:

> The theory in blackjack is that the longer the house [that is, the casino] has got this advantage if you don't card count, the house has always got this advantage. So if you play and play and play eventually you're gonna lose because that's the theory of gambling. That's why the casinos are in

> business. But in real life, in practice, if you do it where you go and [if] you win then you push [increase] your bet, and sort of like when your streak is over… then you just quit and walk away from it… then it's possible to win over the long term.

The advantage the player is referring to is the built in statistical advantage of the game being played. In this case blackjack. Thus, in the first sentence, the player recognizes that in blackjack the casino always has a long-term statistical advantage over the players. The unspoken distinction is between what many players see as a difference between long and short-term advantages. He says, correctly, that given the casino's (implicit long-term) advantage, the theory is the casino *always* has this advantage (that is, has it each an every time a player sits down to play, i.e., in the short-term). "In real life, in practice," however, it is possible, he believes, to gain a short-term advantage by pushing (increasing) one's bet during hot streaks and decreasing one's bet during cold streaks. Given this world-view that includes the concept of streaks, it is possible to believe both that the casino has a long-term advantage and that it is possible for individual players to have an advantage (as long as they are selective about when they play and do not continue through the cycles of hot and cold periods, after which the casino's statistical advantage will take its toll). Similar arguments were expressed so frequently and so consistently from long-term experienced blackjack players (and other casino gamblers), that I began to wonder if it might possibly be true, while aware that the belief contradicted sacred assumptions of probability theory.

There are three main concerns, and associated strategies, relating to luck and proper order. The first concern is simply with identifying when a positive or negative trend is occurring, which corresponds to good or bad luck. Good or bad luck can be

associated with any unique aspect of experience that can be correlated with an improbable sequence of wins or losses. In blackjack, in practice, the most common factors associated with good or bad luck are patterns in the cards, followed by the player and/or the dealer. As such, players may devote a great deal of attention to determining whether cards at a particular table are running well or badly, whether a particular dealer is hot or cold, or whether their own trends in wins and losses are positive or negative.

The degree with which a method is or is not formalized varies from gambler to gambler and often depends on the particular time when the person is gambling. Some players rely almost entirely on their intuition, which advanced players see as having developed over years of experience and being a key factor in gambling success. Other players use a strict method, whereby they count past wins and losses, and increase or decrease their bets by a particular amount or percentage based on these past events. Most gamblers use some combination of the two, beginning with a set of clear guidelines, but deviating from these guidelines depending on various contextual factors, including intuition, mood, self-discipline, and external cues they believe are important but which they have not formalized into a rule for action. Ways to determine when a hot or cold streak is occurring may include watching a table to see if other player are winning, asking players at a table how the dealer is or how the cards are falling, or judging by their own previous wins and losses. In blackjack, the most common method for determining when a streak is occurring is simply to increase the size of one's bet after wins and decrease it after losses with the belief that this pattern naturally maximizes the benefits of hot trends while minimizing the costs of cold trends. The amount of increase and decrease and how

long it will continue varies widely from gambler to gambler, and often with the same gambler depending on how well they are doing overall.

The second concern—which is also accomplished by the method of bet variation just discussed—is with maximizing one's gains during periods of good luck (hot streaks) and minimizing one's losses during periods of bad luck (cold streaks). This almost always involves betting more than usual during hot periods and less than usual, or stopping gambling altogether, during cold periods. If the hot or cold streak has been associated with the gambler him- or herself, then the most common solutions are to take a break, quit for the day, or simply minimize one's bet size until the trend has changed. If the hot or cold streak is associated with the cards or dealer, however, instead of taking a break or stopping, players will usually just play at a different table, assuming one is available.

The third and final concern is with how to maintain periods of good luck and disrupt periods of bad luck. If the luck has been associated with the player or with a particular dealer, many gamblers believe nothing can be done to change the trend but time. Thus bad dealers should simply be avoided, good ones sought out, and players' own bad luck should be waited out until the good luck returns. If the cards are hot or cold, however, this is generally seen to be related to patterns in the cards that can be disrupted or maintained using a variety of techniques which are crucial to blackjack playing strategy.

Maintaining hot streaks and disrupting cold streaks is fundamentally concerned with what players see as the proper or normal order of the cards. This proper or normal

order depends on a number of factors. First, how *consistently* is everyone at the table playing from one round to the next? Consistency is measured in terms of basic strategy cues. Thus, for example, a consistent player will either always hit or always stand with a sixteen against a dealer's 10. A player who sometimes hits and sometimes stands depending on previous cards removed from the shoe would be violating this rule. Second, how *well* does everyone at the table play? Playing quality is assessed in terms of the judge's folk-basic strategy. If players do not play according to the correct folk-basic strategy, they are changing the proper order of the cards. Third, how many hands are played from one round to the next? Playing a different number of hands from round to round, or having players join or leave the table, changes the pattern the cards would "normally" have fallen in, thus disrupting the order. Fourth, shuffling the cards or—with an even greater impact—replacing old cards with new ones, again disrupts the pattern. Thus, it is okay for players to join the table, or to change the number of hands they are playing, as long as the shoe has been completed and the dealer is shuffling the cards.

Disrupting proper order is seen by most players as more often negative than positive even if players are not sure whether the cards are hot or card. There are two reasons for this. First, it makes it impossible for a pattern to develop, and thus for players to ever determine how the cards are falling. Since identifying and taking advantage of hot streaks is seen as the key to gaining an advantage, or at least to minimizing losses, playing strategies that do not allow these patterns to develop have a net negative effect. Second, strategies that disrupt proper or natural order are often judged to simply usually lead to losses. Thus, for example, if a player sits down for just one hand with someone

else who violates their folk-basic strategy, this first player will tend to believe that the second player's choice will lead to more losses, on average, than if the second player had played "correctly".

Given the above, the ideal conditions for an experienced blackjack player follow. If the cards are hot, everyone at the table should play well according to folk-basic strategy, and they should play consistently from one round to the next. They should play the same number of hands and no one should join the table until the end of the shoe, when the shuffle will change the order anyway. If the cards are running badly, then it is good if someone joins the table, if someone violates folk basic strategy or somehow plays inconsistently, if someone switches the number of hands they are playing, or if the dealer shuffles the cards. These changes should only occur once, however, specifically to change the pattern, both because these types of violations have a net negative effect, and so that future positive or negative patterns can be identified.

Not all players are equally concerned with all aspects of this ideal strategy. In particular, not all players are as concerned that everyone plays consistently as they are that everyone plays well. Some players may not believe that disrupting proper order has an inherent negative effect, and may only be opposed to it because disrupting proper order makes it difficult to identify patterns. Many players do not have consciously available causal models as to why they think disrupting proper order is bad, but they believe it nonetheless. And some players are clear that they do not really think it has a negative consequence, but they do not like it anyway, because it is frustrating to lose a

bet that would have been won if everyone at the table played as it had been expected they would.

Notice that the idea that people should play consistently contradicts folk-card counting strategies. Players who are consciously concerned with playing consistently are usually *not* the players who use folk-card counting strategies. But this is not always the case, contributing to a common distinction between *playing for oneself* and *playing for the table*. For example, using folk-card counting, a player may determine that several high cards are due and want to split his or her 10s even though he or she normally would not. Assuming the cards are running well, the same player might decide not split his or her 10s anyway, even after judging it would be self-interested, because it would hurt the rest of the table, disrupting the natural order of the cards.

While these strategies and beliefs may seem foreign to a non-gambler, it should be stressed that some variety of them are nearly universal among experienced blackjack players who have learned to play in the casinos. Indeed, beliefs about patterns in luck and how to identify, manipulate, and benefit from them are widespread among other gambling activities. Furthermore, casino employees—including management—are not immune to them. Thus, roulette and slot machine players, while using different systems and often having unique beliefs about causal mechanisms, also tend to find patterns in luck as the most important aspect to gaining an advantage or minimizing losses. Mamet's quotation suggests poker players have a similar concern. I was repeatedly told by players and dealers of cases where the casino management changed a dealer in order to disrupt a

players' luck, and when I was dealing floor supervisors sometimes discussed changing a dealer to break the streak of a particularly lucky gambler.

Why are these beliefs so widespread among experienced gamblers? In my view, it is largely due to unique characteristics common to casino gambling that are quite different from most other activities. Improbable streaks of positive and negative outcomes over a brief enough period of time for a participant to notice how improbable they are rarely occur outside the casino domain. Most choices are not repeated as many times in such a short period as are gambling choices. Furthermore, very few choices in nature have such a small range of possible outcomes that occur with such near equal probability, characteristics that have been intentionally designed into casino games. These structural characteristics contribute to a world where somewhat improbable series of positive and negative events are experienced frequently by the gambler, and very improbable series are not uncommon.[3] Since most non-gamblers do not have these experiences, they are not familiar with the subjective characteristics of random variation under casino conditions. This is true even among non-gamblers theoretically trained in probability theory, who may see the gamblers' false beliefs as due to a cognitive bias which their own training has allowed them to overcome, without ever having experienced

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[3] The term "improbable", as used here, refers only to the series taken in isolation. When considered in light of the total number of trials, such improbabilities often become not only probable, but even essentially inevitable. Thus, flipping heads six times in a row is improbable when taken on its own (occurring only one in sixty-four attempts on average), but doing so during a day long coin-flipping session is almost certain. Even so, the particular periods where one flips heads (or tails) several times in a row might be thought of as hot or cold streaks, while recognizing that such streaks will inevitably occur given enough trials.

the naturally occurring streaks that gamblers face every day. As such, non-gamblers are generally not aware of the power of the cognitive illusion.

Furthermore, outside the casino, during the vast majority of life that even non-gamblers face, there is little opportunity to learn that these cognitive illusions are in fact illusions. If other aspects of life afforded the same experiences, perhaps training and education that would dispel the false beliefs would have been institutionalized into popular culture or contradictory evidence could accumulate. As it stands, however, gamblers are some of the only people who are likely to experience these patterns. Furthermore, within the casinos, most information that could dispel the beliefs instead reaffirms them. The language of gambling entails the idea that luck runs hot and cold. Employees at the highest level often believe it, as do the most knowledgeable and experienced gamblers from whom the novices learn. One of the few other domains outside the casino where the same structural conditions are met is organized sports where the hot hand cognitive illusion with similar characteristics has been well documented (Gilovich, Vallone, & Tversky, 1985; Tversky & Gilovich, 1989a).

In short, players are critically concerned with patterns in luck and natural or proper order. They have systems for identifying these patterns, for maximizing the benefits and minimizing the costs, and for maintaining the patterns when they are positive for the player and disrupting them when they are negative. Though the particular set of strategies and beliefs regarding luck and proper order vary widely from one player to the next, and from game to game, some variety of these strategies and beliefs is almost universal among experienced gamblers who learned to play in the casinos, and it extends

to non-gamblers who work in the casino, including most dealers and many managers. These strategies and beliefs are perhaps more important than any other to how blackjack players play and to what they see as influencing whether or not they win.

Intuition

A third important aspect of blackjack playing strategy is intuition. There are different types of intuition and different degrees of belief in it, depending on the gambler and his or her experience. Many gamblers use intuition as a tool for psychic premonition. Some of these gamblers will say they do not believe it works while behaving as if they did. Since success or failure in casino gambling, at least over the short term and with most games, is primarily the outcome of random chance, many players use their intuition simply to make the games more fun. Also, similar to the clichéd person who says he or she does not believe in god, but then becomes religious when near death, or prays to god for a positive outcome during a critical situation, many gamblers will make a kind of Pascal's wager, deciding that even if the odds are low that using intuition will help, the benefits of believing (winning instead of losing money) still outweigh the costs (essentially nothing since the outcome is random anyway).

Other gamblers who use intuition as a means for psychic prediction actually believe it works. To some degree, gamblers probably develop this belief from their experience gambling, where the frequent success of intuition, selective attention to the times where it works, and the ability to dismiss failure as due to a poorly developed sense, may lead to the cognitive illusion that their intuition works. At the same time, many gamblers believed this before they started gambling, and gamblers in general may

be disproportionately likely to believe in psychic intuition, since the belief provides a reasonable motive for deciding to gamble in the first place.

Another group of gamblers uses intuition to refer to the unconscious cognitive processing that occurs in any skilled activity. Even in games where the outcome depends purely on chance or where intuition has no predictive influence on outcome, the sense of intuition may develop with experience, and certain types of skill may develop. Thus, for example, I would not be surprised if experienced blackjack players were better than novices at intuitively recognizing patterns in previous series of wins and losses, even though this skill will not be useful for improving their chances of future success. To some extent, this intuition may help, such as with folk-card counting, where experienced players may have an intuitive sense for when the ratio of 10s to non-10s has changed enough to warrant taking insurance or changing one's play. While players may be wrong to believe in their intuition in these cases, in my view it would be a mistake to consider the belief irrational, since the players may have few realistic means at their disposal to identify the error of their ways, and they may be truly developing intuitive skills that happen to depend on false causal models.

Might experienced gamblers actually improve their expected value by using intuition? Perhaps they do in rare cases, if intuition refers to the second definition related to implicit learning in skill development. But in the vast majority of even these cases, players would probably be better off by simply sticking to their folk-basic strategies. At the same time, as mentioned earlier, the hands for which the most experienced players change their strategy tend to also be the hands for which the difference between the best

and the second best play is small, and the best play really does vary with a relatively slight change in the count. Some players may have enough experience and be selective enough in when they change their play that they really do use intuition to violate their folk-basic strategy in cases where it tends to help them more than hurt them. Furthermore, since it is often these hands for which their folk-basic strategy is incorrect, they may also sometimes be switching to the correct basic strategy as a result.

Risk attitude in relation to previous wins and losses

As with streaks of winning or losing, players who are up overall or who have a lot of money remaining to gamble with tend to bet more than other gamblers, and this includes changes in playing strategy related to both actual and perceived economic risk—doubling down, splitting, and hitting more often, and taking insurance less often. It is worth noting that this category likely involves two distinct influences. Money that people bring to the casino has a different psychological impact from money people have won.

There is a tendency for money won during the gambling session to have less psychological value than money won during an earlier gambling session, which in turn has less value than earned or saved money (see Thaler & Johnson, 1990 for an example of an experimental study demonstrating this effect). This is not to say that someone who has received a big paycheck the day before will not also be influenced by the amount of money. They will. But having won the same amount during the playing session tends to have a larger impact on the player's willingness to take risks (see Reb & Connolly, 2003 for a discussion of plausible psychological mechanisms in this).

This difference tends to be both normatively endorsed by the players (and often by casino employees) and behaviorally expressed by them. That is, not only do players usually bet more and take more risks with money won from the casino, they also believe this is the best way to gamble. As one British casino manager in Prague explained to me, "As a manager, the thing we fear most is a player using the house's money. That's what casinos don't like, [players] using the house's money. Because then you're not using your own money and the casino can really get hit." This is a person who had been managing casinos for nine years and had been in the industry for nineteen years, and it is a belief that runs directly counter to normative decision theory. From both an expected value and a risk perspective, it should make no difference to the casino whether the player is betting big with money they brought to the casino or money they won from the casino. The only questions ought to be how well the player is playing, how much the player is betting, and whether the casino can afford the risk.

Notice, however, that the manager is not framing the player's money as money won from the casino. It is "the casino's money." Of course, any sensible casino would fear a gambler betting with the casino's money rather than with the gambler's own money. Thus, the framing of the money as still belonging to the casino itself likely contributes to the gambler's sense that being risky with money won from the casino is more acceptable than being risky with money brought to the casino from somewhere else. At the same time, this money is likely framed as the casino's money in part because it *seems* to the player as though the money still belongs to the casino.

On the other hand, while most gamblers increase the size of their bets after winning a large amount, and most endorse this as normative, the most experienced players often identify thinking about money won as though it is still the casino's money as a mistake. "One thing I've learned," explained one gambler conveying a view shared by many long-term gamblers not (overtly) struggling with a gambling problem, "The second that money goes from the rack [the tray that holds the dealer's chips] to my pocket, it's no longer the casino's money. The second it goes from my pocket to the rack, it's no longer my money. The worst thing a gambler can do is forget that." Furthermore, since being ahead during a gambling session is closely correlated with improbable streaks of wins, many gamblers may increase their bets because they see themselves as being on a lucky streak, and not because they are ahead for the day. It is not uncommon to find an experienced gambler who believes it is critical to lower one's bets after a big win, or even leave the casino, but only after they get signs the hot streak it over.

All this is not to say that the only reason players increase the size of their bets when ahead is because they believe it is the right thing to do; rather, this compounds the effect of the lessening in subjective value of won money. Many players will increase their bets when ahead even while they would say this is not wise. There can be little doubt that money won in the casinos has less subjective value to the players than money they brought to the casinos, even among gamblers who would prefer this not to be the case. In line with the Kenny Rogers song, *The Gambler*, knowing when to walk away (and having the discipline to do so), is seen by many gamblers as their greatest challenge, the difference between whether they can be a long-term winning or losing gambler.

It is tempting to dismiss this dictum as meaningless and perhaps irrational. After all, when is it the right time to walk away from a game whose outcome depends on luck? If past outcomes in wins and losses have no relevance to future outcome probabilities, then that information cannot help in deciding when to walk away. Are players simply remembering the point at which their random walk in wins and losses was at the highest point, and reflecting that they should have (magically) known to leave at that point? Or perhaps recalling an actual thought they had at that point, "perhaps I should leave," while dismissing or not remembering the many other times they had that same thought, including before the great win? To some degree they are. But players often have real rules for when to stop after a big win, rules that are related to a change in pattern of their past wins and losses, rules that would require them to stop gambling or take a break, and rules that they lack the discipline to follow, and that really would have made the difference between whether they left the casino that day a winner or a loser.

The utility of playing blackjack

Perhaps one reason for players' particular blackjack playing strategies is that the players have other goals in addition to or instead of maximizing their expected return. This section will discuss other factors, in addition to maximizing expected value, that are important to blackjack players. Not only is blackjack playing about more than just the hope of winning, but when the hope of winning itself is examined more carefully, it can be seen that the concept has multiple meanings, most of which do not concern maximizing expected return.

There is more to gambling utility than *expected return*

Table 13 shows interview participants' answers to the question, "Do you believe it is possible for players to win more than they lose in blackjack over the long run, if the correct strategy is used?" The main point to notice from this table is that even though the percentage of players who believe it is possible to have an advantage is higher among more-experienced players (74.0% for the advance group versus 47.8% for the beginner group, (χ^2 (1, N = 93) = 6.51, p = .011), 24.0% of even the most experienced group do not think it is possible to gain a long-term advantage over the casino. The fact that they still choose to play strongly suggests that at lease some players are not trying to maximize expected value by playing blackjack. Among beginning players this number approaches fifty percent at the very least.

Table 13. Is it possible for players to win more than they lose over the long run?

Experience	0-60 hrs	61-600 hrs	> 600 hrs	Total
n=	*46*	*51*	*50*	*147*
Yes	47.8% (22)	64.7% (33)	74.0% (37)	62.6% (92)
I am not sure	4.3% (2)	2.0% (1)	2.0% (1)	2.7% (4)
No	47.8% (22)	33.3% (17)	24.0% (12)	34.7% (51)

Table 14 shows answers to the question, "Are *you* able to implement this strategy well enough to win more than you lose over the long run?" Here the numbers make the case even more strongly: 58.0% of the most experienced players and 93.5% of the least experienced players do not believe they are skilled enough to gain an advantage over the casino (χ^2 (1, N = 96) = 16.08, p < .001, comparing the frequency of beginner versus

advanced players who do not think they can win more than they lose over the long run).[4] Looking at each level of experience separately, and comparing the percentage of players who do not think they have an advantage with those who either do or are not sure, one can see that most players at each experience level do not think they have an advantage (using a *z*-approximation of a binomial test, $p < .001$, for beginner players, $p = .049$ for intermediate players, and the results were not significant for advanced players). Clearly expected return is not a decisive concern for a large majority of blackjack players, even if it is for some.

Table 14. Can you win more than you lose over the long run?

Experience	0-60 hrs	61-600 hrs	> 600 hrs	Total
***n*=**	*46*	*51*	*50*	*147*
Yes	6.5% (3)	29.4% (15)	40.0% (20)	25.9% (38)
I am not sure	0% (0)	5.9% (3)	2.0% (1)	2.7% (4)
No	93.5% (43)	64.7% (33)	58.0% (29)	71.4% (105)

There is more to gambling utility than the hope of winning

One possibility is that while many gamblers are not playing with the *expectation* of winning, they are playing with the *hope* of winning. To explore this question, interview participants were asked why they liked to play blackjack. After providing their

[4] Why are more-experienced players more likely to believe it is possible to have an advantage (and that they themselves have an advantage)—a trend that is shared among roulette and slot machine players as well? Two common explanations are 1) that people who have false beliefs about their chances of winning will tend to gamble more (and to develop gambling problems) and 2) problem gamblers are motivated to believe they can win and thus to have false beliefs about their chances of winning, and problem gambling happens to be correlated with more time playing. While these two explanations are likely true as well, one of the important reasons more-experienced players are more likely to believe it is possible to gain an advantage over the casino comes from learning and experience in the casino itself, where complex and reasonable systems for gaining an advantage are encountered by players that would generally not have been encountered by less experienced (or non-) gamblers who often assume out of hand that it could not be possible to gain an advantage or the casinos would not be in business.

own answers, they were asked to rate five influences in terms of how important they were. The potential influences were chosen a) in response to a literature review examining common gambling motivations and b) because of experience as a participant-observer during which additional reasons for gambling were commonly discussed and expressed. Responses were given on a six point scale where 1 equals "extremely important" and 6 equals "not at all important". *Table 15* shows these responses. Notice that while "The hope of winning" was an important factor for the vast majority of blackjack players and was the most important on average of all categories, the categories "entertainment" and "excitement" were rated nearly as highly. For many players these factors were more important than the hope of winning.

Table 15. Why do you like to play blackjack?

Why do you like to play blackjack?	←extremely important					not at all important→	
n=145	**1**	**2**	**3**	**4**	**5**	**6**	**mean**
Hope of winning	49.7%	17.9%	19.3%	7.6%	2.8%	2.8%	2.0
Excitement/thrill	35.9%	31.7%	17.2%	8.3%	2.8%	4.1%	2.2
Entertainment/fun	32.4%	24.8%	25.5%	6.2%	5.5%	5.5%	2.4
To get away from it all	15.2%	13.1%	15.9%	5.5%	15.2%	35.2%	4.0
Social interaction	12.4%	9.7%	16.6%	12.4%	12.4%	36.6%	4.1

While "To get away from it all," and "Social interaction," were both rated relatively low, it should be noted that only about 36% of players saw either of these factors as not at all important. Furthermore, there are reasons to believe that both categories were rated as less important than they actually are. "To get away from it all," was seen by many gamblers as associated with problem gambling (which it often is), and thus some percentage of respondents likely answered this category in a misleading way.

Thus, it was not uncommon for respondents to answer this question "6", yet to say at another point in the interview that the main reason they played was to get away from home for a while, to get their mind off work, to get a break from the children, or just to relax.

Similarly, I believe the category "social interaction," was rated lower than it actually is because players may underestimate or not like to admit the degree to which they play blackjack in order to be around other people. Blackjack is potentially a very social game. This is contributed to by the fact that all the players at the table tend to win more if the dealer is getting bad hands and tend to lose more if the dealer is getting good hands, all players are hoping for the dealer to lose, and for the most part players have no incentive to see other players lose, because it will not help them (and it is correlated to their own losses). Thus, for example, when all the players have finished their hands, they wait together to see whether their hand will beat the dealer's. If the dealer busts (which happens almost a third of the time at 28.2%), all players at the table who are still waiting to see if they have won (that is, all players who did not have a blackjack or who have not already busted themselves) have cause to celebrate together—they have all won. With this common goal, it is not uncommon at the blackjack table in Las Vegas or Indiana (but less common in Prague for reasons that will be discussed soon) to see players who would be unlikely to approach one another outside the blackjack context—players who are distinctly separated by race, education, socioeconomic status, and age—sharing stories of past wins and losses; discussing upbringing, family, and home; and vocally and dramatically celebrating one another's wins.

On the other hand, since players often *believe* that the playing style of others influences their own chances of success, there are also aspects of the social experience that provide a kind of negative utility that influences the playing experience, including playing strategies. A clear majority of experienced blackjack players in Indiana and Las Vegas will watch a table to see how well the other players play (according to their folk-conception of the proper playing strategy) before joining.[5] It is common to see players getting quite angry at one another, often either verbally reprimanding others who they see as poor or moving to another table. Thus, for example, it is would not be strange to see a player risk $100 on a single hand out of frustration after betting and losing several $25 bets in a row. If another player at the table makes a play that this big bettor sees as incorrect, and this "incorrect" play results in the dealer getting a winning hand where the "correct" play would have led to the dealer busting, the first player may get extremely angry and blame the first for playing "wrong" even if they see the outcome as purely the result of luck. If, as is the case for most experienced players, they see this folk-suboptimal play as causing their loss, they may verbally abuse the other player, or make an insincere threat loud enough for everyone at the table to hear, such as, "If he does that one more time, I swear I'll get out of my seat right now and hit him." Thus, one of the common responses as to why many players would not split 10s was not because they thought it was a bad play, but because they did not want to get yelled at by other players.

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[5] This is less the case on the Las Vegas Strip where more players are on holiday and there just to have fun than to win, and it is not the case in the Czech Republic where there is often only one blackjack table available and thus fewer opportunities to choose.

Similarly, just as many players preferred to sit at the final position before the dealer, many intermediate players said, “anywhere but third base [the last spot before the dealer]” because they did not like the responsibility or the blame that came with sitting in that position.

Players’ open-ended responses as to why they liked to play blackjack often emphasized aspects of one of the categories in the most recent chart, but they also tended to focus on why they preferred blackjack to other casino games, rather than why they played blackjack at all. Of the 149 participants interviewed about blackjack, at least twenty-nine respondents referred to the belief that blackjack offered a better chance to win than other casino games. These claims included the belief that blackjack has better odds than other casino games (14 respondents), that it is easier to win in blackjack (9 respondents), and that one could play longer without losing as much (7 respondents). Sixteen respondents noted the fact that blackjack involves skill and gave players a chance to influence their outcomes, and five others indicated that they liked the competition with the dealer. Five players noted the social aspect of the game, two of whom specifically emphasized the belief that the players are working together against the dealer. Seventeen respondents indicated that they liked to play because blackjack is easy and/or because they know the game better than other casino games. Related to this, five other interviewees made the somewhat counterintuitive statement that they liked to play blackjack because it helped them relax. Twenty-five others stressed that they played because it was entertaining, exciting, or fun, and four others because it gave them something to do. The point to notice here is that blackjack players get much more from

the game than the hope of winning, and to imagine that the hope of winning money is or should be an appropriate measure for gambling utility is a mistake—even if this hope of winning is seen as distinct from the desire to maximize expected return.

At the same time, the hope of winning is a very important aspect for the vast majority of blackjack players. Just as I argued that social interaction and "getting away from it all" may have been under-represented as a reason for playing blackjack, Michael Walker (1992b) has argued that winning is really the main goal for all gamblers. He believes survey responses underestimate its importance because gamblers often know the odds favor the casino, and thus, in his view, know that it is irrational to think they can win. Even though they are *really* playing to win, he believes they will be disingenuous with the interviewer (and perhaps with themselves), because they do not want to appear irrational. I do not believe this interpretation is correct. The hope of winning is quite distinct from the expectation of winning. It is reasonable to hope to win, even while it might not be reasonable to expect to win, as winning happens quite often due to the high variance in outcomes of most casino gambling activities. Furthermore, gamblers are generally not at all uncomfortable discussing the hope of winning, and I have never heard a gambler in a casino talk about it as though it is irrational. Indeed, gamblers who said they were not hoping to win would be far more provocative than gamblers who said they were playing to win. Furthermore, gamblers choices are often noticeably influenced by other factors. Nonetheless, the survey responses themselves show that the hope of winning is the single most important factor for gamblers, and there are relatively few

gamblers who do not see the hope of winning as an important part of why they like to gamble.

"The hope of winning" has many meanings, each with a distinct utility

Gambling researcher Robert Williams conveyed a common view among gambling researchers when he explained to a journalist for the Vancouver Sun, "When you ask young people why they gamble, the most common reason is to win money, which doesn't make any sense" (Blain, 2003). There is a tendency for gambling researchers to equate "playing to win" with "playing with the belief I am maximizing my expected return". If a gambler hopes to win in a game with a long-term negative expectation, it is often suggested, they are at best on the wrong track, and at worst irrational and heading for danger. An important point that comes out of the participant-observation and the ethnographic interviews, however, is that even among players who are playing primarily in the hope of winning, this hope can mean many things, and it is *rarely* equivalent to the belief that one is maximizing expected return. This was suggested by the responses in *Table 14* where most players acknowledge they do not believe they have an advantage while still choosing to gamble. Similarly, of all open-ended responses about why players like to play, including the twenty-nine related to one's chances of winning, only one player indicated an expectation of winning. It is by no means unreasonable to hope to win while recognizing that the expected value is negative, just as it is reasonable to hope not to lose even when one is playing with an advantage. This is true because the odds are almost even in blackjack and the variance across playing sessions is high. As such, actual

returns usually differ from expected returns, at least over the short term. There are at least seven distinct aspects of the hope of winning that each has its own utility.

1) Maximizing expected return

First, there is among some players, in fact, the belief that one is maximizing expected return. Thus, as can be seen from the responses in *Table 14,* 40.0% of the most experienced blackjack players and 29.4% of intermediate players believe they have an advantage over the casino. *Table 13* shows that a far greater percentage believes it is *possible* to get an advantage (62.6% across experience levels). Often players who do not see themselves as having an advantage hope to one day have one, and see themselves as playing in order to develop the skill that will allow them to have a positive expected return and to ultimately win more than they have lost.[6]

2) The experience of winning and losing

Second, many gambles are playing for the experience of winning and losing, which each has its own positive and negative utility, respectively, quite separate from whether the long-term expected return from the chain of wins and losses is positive or negative.[7] Thus, many gamblers who acknowledge they are playing primarily with the

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[6] Rationally determining whether or not one has an advantage can often be more difficult than most non-gamblers realize and is a challenge that faces professional gamblers with a working system as well as non-professionals without working systems.

[7] Indeed, for some gamblers, at some points in time, losing itself has a positive utility. For example, losing all of one's money may provide the only way for a compulsive player—who would like to stop but does not have the discipline—to quit and clear his or her head. Thus, it is not uncommon to see a gambler at the end of the night actively making losing choices, and verbally acknowledging that they are trying to lose all their money so they can go home for the night. Similarly, although the explanation is

hope of winning also acknowledge that they have lost more than they have won in the past and that they expect to continue to do so in the future. They often budget a certain amount to lose each day, and say these losses are worth it for the thrill of the wins, when they occur. Many players claim to (and appear to) have enough fun from the experience of winning and losing that this experience more than compensates for their overall losses.

Gamblers playing with a negative expected return have winning sessions far more often than many non-gamblers may suppose, just as those with a positive expected return have losing sessions more than non-gamblers may suppose. To give an example from my own gambling experience during the study, I had a total of ninety-six losing sessions and seventy-seven winning sessions. The only other dependable gambling records I could obtain were from a friend and informant who is a full-time professional gambler and who keeps daily records of all wagers by type of gamble. He shared his records over the period from June 23, 1999 to February 17, 2003. Out of the 1,193 days on which he placed wagers during this period, he had 609 winning days and 584 losing days. When days are broken down by the type of game on which he bet, he had 1,937 net wins, 1,814 net losses, and twenty-nine washes (i.e., bets for which he broke even), winning an average of $18,478 per quarter of a year. Of course, neither of these records should be seen as representative. Very few casino gamblers are long-term winners, and of the losers, few have studied the dynamics of the games they are playing or are as concerned

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currently out of style, one of the most influential theories of problem gambling argues that gamblers have an unconscious wish to lose their money, and this is the reason they gambling (Bergler, 1957).

with losing as little as possible as I was. Nonetheless, they are useful for conveying the huge variance in wins and losses that a casino gambler will commonly experience.

A simulated example taken from Stanford Wong's well-respected book on card counting, Professional Blackjack (Wong, 1994), conveys similar data in a slightly different format. A card counter who is using the hi-lo card counting system and spreading his or her bets between $10 and $100 according to one common betting system can expect to win $16 per hour on average, but with a standard deviation of $415 per hour. A person sticking to the basic strategy, betting the average bet of the card counter each hand, $26.54 in the example case, has an *expected loss* of $15 per hour, but with a standard deviation of $301. The important points to notice here are 1) that basic strategy players frequently win during a particular hour, and will often in fact win several hundred dollars, and 2) that even card counters, with a positive expected return, will have bigger average losses during their losing sessions than the non-card counter (although this will be balanced by even higher average winning sessions). As such, if the experience of winning itself has some utility distinct from expected return, then gamblers could be quite reasonable to play in the hope of winning. Indeed, if they are sensitive to the amount risked, as essentially all gamblers are, they may be rational to choose not to count cards (even if their were no investment cost in counting cards, which there is), since card counters must risk losing a greater amount in order to earn the aforementioned gain in expected returns.

3) The excitement of winning and losing

Third—and often connected to the utility of winning and losing noted above—many blackjack players get utility from the "rush", excitement, or thrill of the winning and losing. The neurotransmitters released in the nervous system, the emotional thrill, the sense of risk and of "just making it", the fear that one will spend more than he or she can afford, the realization that one can suddenly afford a fancy show or an expensive dinner, extensive losses followed by a dramatic recovery, a large improbable win followed by an even larger and less probable losses—all of these experiences work together to create a subjective thrill and excitement that has a meaningful and often decisive influence on a person's decision to play blackjack and to continue playing blackjack.

4) The size of wins and losses

Fourth—usually in combination with an emphasis on the *frequency* of wins and losses—the *size* of wins and losses may itself have a unique utility. While non-counting blackjack players cannot improve on their expected return beyond using basic strategy, various betting systems can significantly influence the size of average wins and average losses, and the frequency with which wins and losses occur. By betting increasingly large amounts when behind, and increasingly small amounts when ahead, a blackjack player will increase the likelihood of finishing a playing session a winner (as compared to a person betting the same amount every hand), decrease the likelihood of having a very big win during the playing session, and increase the likelihood of having a very big loss. Alternatively, by betting increasingly large amounts when ahead and increasingly small amounts when behind, they will increase the likelihood of finishing a playing session

with a loss, but the average size of their loss will be relatively small while the average size of their win will be relatively large. All three strategies—1) decreasing one's bet size in proportion to the amount won and increasing it in proportion to the amount lost, 2) betting the same amount every round, or 3) increasing one's bet size relative to the amount won and decreasing it relative to the amount lost—as well as various combinations and various degrees of each, have the same expected value assuming the same playing strategy is used and the same average bet is made. But each has a unique consequence on the variance in size of wins and losses, on the maximum and minimum amounts won or lost, on the average length of playing sessions, and on the frequency of winning versus losing sessions. And all of these aspects of the gambler experience have unique phenomenological characteristics that are related to "the hope of winning", but that provide unique utility.

Evidence from both the interviews and the participant observation consistently show that while many beginning gamblers use the first strategy (increasing bets when losing and decreasing bets when winning), the vast majority of experienced blackjack players use the third strategy (increasing bets when winning while decreasing bets when losing), and endorse it as normative, while being highly critical of the first strategy. As gambling researcher Nigel Turner (personal communication, March 3, 2003) has noted, the pattern in wins and losses that the preferred betting system creates (less frequent wins, but larger average wins and smaller average losses), is built into the design of most slot machines, where an infrequent large jackpot compensates for the far more common small losses. If the ability to occasionally win a large sum without the risk of extreme

losses is a major factor of gambling utility—and I would propose that it is—this would help explain both why blackjack players tend to use such a betting system and why slot machines are the most profitable and popular casino gambling activity. It could also provide the winning and losing experience of gambling with a positive utility, even while the expected return remains negative. Indeed, judging from the participant-observation and ethnographic interviews, I believe the utility of occasional large wins while avoiding large losses is the single most valued aspect of the blackjack experience for players across locations. Achieving this experience is the object that experienced players' strategies are most consistently oriented towards, suggesting that advanced players have succeeded quite well at optimizing their expected utility even at the occasional expense of expected value.[8]

5) The fantasy of a life-changing big win

A fifth factor related to the hope of winning but distinct from the desire to maximize expected value is the fantasy of potentially winning, even if the fantasy may be quite far from a reasonable hope. This is more common among lottery and progressive-jackpot-slot-machine players, where the gambler often has the chance, however slight, to win millions of dollars. Players themselves almost always know the expected value is negative. Many recognize that the expected return is lower than in games such as

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[8] It should be noted that while virtually all long-term blackjack players endorse betting less when behind and more when ahead, they can often acknowledge (and can be observed) losing control and increasing their bet size when losing, in many cases betting more than they can afford to lose. Thus, while the most experienced gamblers tend to endorse a strategy that may optimize their expected utility, many of them do not have the control to stick to such a strategy and thus make choices that have a distinctly negative utility.

blackjack. Yet the possibility of winning itself provides a utility somewhat distinct from expected value. Similarly, even blackjack players who are only willing to risk $100 will occasionally get extremely lucky and win tens of thousands of dollars. An individual player may recognize that the odds they will ever experience this are extremely low, but the possibility itself affords a chance to fantasize about what could be, and this ability to fantasize has a clear utility of its own that may compensate for the negative expected return. As with most of the other sources of utility, however, since the fantasy can lead to a loss of control and extensive losses that are more than the gambler can afford, there are potential costs that will often—though by no means always—outweigh the gain in expected utility.

6) Winning as an entertainment-enhancing scoring system

A sixth aspect of the hope of winning that gives the gambling experience utility is as a marker of success, not dissimilar to non-monetary point systems common to many games. The money won or loss is the primary marker of success or failure in gambling activities, just as the number of points scored is the primary marker of success in video games and in most sports, even to the point where players will often break the rules in a game in order to improve scores that have no other value than as markers of success. Having points as a marker of success, striving to score as much as possible, improving with experience, and reaching new high scores, are all aspects of the game playing experience that provide it with utility for many players. Money is in many ways an ideal score-keeping system, since it has objective currency beyond the value of winning and losing in other games. In this sense, the hope of winning is not dissimilar to the hope of

getting a lower score in golf or a higher score in Pac-Man, though it will often have more emotional salience because of what the wins and losses enable. This goes a long way toward making the gambling activity fun, just as a system for keeping track of one's success makes other games fun that otherwise might not be.

7) Maximizing playing time

Finally, winning has utility for many gamblers simply because it allows for continued play. Among the locations of my field research, players on the Las Vegas Strip expressed this most. These players were most likely to be gambling as part of a two, three, or four day holiday. Often they expect to lose during their trip, but they want their money to last for as long as possible. They know they could be unlucky or make particularly poor choices that would lead to their losing all their money on the first night, in which case they would no longer be able to gamble, an activity which they find entertaining enough to justify the expense for the holiday. Thus, many gamblers in the interviews specifically noted that they liked to play blackjack because it allowed them to play for longer than other games without losing as much. Many others explicitly calculated an entertainment cost into their gambling budget. Thus, if they lost $100 or less a day, for example, they might count themselves as winners, whereas only if they lost more than $100 would they see themselves as having lost. During the ethnographic

interviews it was common to have players claim to have won more than they lost, only to find out after probing that they had included an entertainment cost into their calculations.[9]

Consequences of utility on playing strategy

Even while recognizing that casino blackjack may have many sources of utility, it is reasonable to wonder whether or not these various utilities have consequences on playing strategy and, if so, what these consequences are. While most blackjack players, when asked, think their playing strategies maximize their expected return even if their choice to gamble does not, the many sources of gambling utility nonetheless seem to have significant consequences on playing strategy. Gamblers whose primary aim is to make a profit will often focus more on developing a winning playing and betting strategy than those whose primary aim is to enjoy themselves. They will often have studied books on how to play. They tend to have more highly developed folk-card counting systems that involve such characteristics as sitting at the final spot before the dealer and trying to influence what cards the dealer will get, working with other players, or studying actual card counting. Often these players are more conservative, specifically with regard to taking insurance and even money.

Players who are playing primarily for the thrill of wins and losses often double down and split more often and take insurance less often than the norm. “I came here to gamble,” is a common statement made by such players before they make a particularly

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[9] This creates a problem for gambling researchers who consistently find that players tend to remember wins preferentially to losses. While part of this is undoubtedly due to attentional and motivational biases as well as to false reporting, a significant cause may simply be because the interviewers are measuring wins and losses differently from the interview subjects.

risky play. The statement acknowledges that the play depends on luck rather than expected return. These players often focus more on intuition than strategy, and they will use intuition to make plays that they know are not normative in terms of expected return, since winning based on their own guesses makes the game more enjoyable for many of these players. These same players will often vary their bets more dramatically as well, and they will usually not care as much about how other people play, or where they themselves are sitting.

As noted earlier, players who are trying to maximize their number of winning sessions often use different betting strategies (i.e., decrease bet size when ahead and increase bet size when behind) than those trying to maximize the size of their average win while minimizing the size of their average loss (i.e., increase bet size when ahead and decrease bet size when behind). A player who is trying to play for as long as possible will often bet less, as well as double down and split less often than one primarily concerned with the thrill of gambling or with maximizing expected return. And in all these cases, the differences in strategy tend to have the desired consequences.

A player who is playing primarily for entertainment will often make riskier choices that allow for more participation in the game. Thus, one player explained, “I always split twos no matter what. Splitting is much more fun and twos often turn into a good hand, so why not.” Similarly, a player may avoid particular plays in order to reduce regret. Thus, one player explained that he knew taking even money was a bad play statistically, but said that he likes to do it anyway, because “it’s the worst feeling in the world to get a blackjack and then not win anything at all.” Players concerned with getting

along with others at the table should and often do stick more closely to folk-basic strategies. All of these are examples where other goals besides maximizing expected value influence playing decisions.

Cross-cultural differences and the role of the sociocultural context

This section will discuss common differences in blackjack playing strategy that were observed across the three main locations of the field research—Indiana, Las Vegas, and the Czech Republic—and it will consider possible reasons why these differences exist. It turns out that distinct characteristics on gambling utility, casino design, and the social structure of the casino go a long way toward explaining observed differences in playing strategy and in beliefs about winning. The discussion is divided into three subsections. The first subsection examines distinct sources of gambling utility across the locations, and considers how they may contribute to blackjack strategies. The second subsection considers distinct playing strategies not directly concerned with basic-strategy cues. These include strategies related to beliefs about natural patterns in luck and in the cards, and folk-card-counting strategies, both of which vary significantly across locations. The third subsection discusses cross-cultural differences in the expression of the folk-basic strategy, specifically the expression of so-called conservatism (more frequent and more costly violations of basic strategy in cases where the player should hit, double down, or split than in cases where the player should stand, not double down, or not split) and the degree of conformity to folk-basic strategy.

Gambling utility

There was only one apparent difference in gambling utility across locations, although the difference is important, and I believe it has significant consequences on common differences in playing strategies across locations. Las-Vegas-Strip gamblers were more likely to emphasize the thrill and entertainment aspects of gambling and less likely to believe they have a positive expectation than their Prague counterparts. Interestingly, Indiana riverboat casino gamblers, as well as Las Vegas off-Strip gamblers were more like Prague gamblers than Las-Vegas-Strip gamblers in this respect, and they share some of the playing strategies that may be related to the unique utility. I believe the reason for the differences across locations has to do a difference in the type of customer these casinos attract.

Gamblers on the Las Vegas Strip tend to be of a much higher socioeconomic status than gamblers in the other locations. As such, they can generally afford the losses more. They also spend a smaller portion of their time, on average, gambling. Thus, many of the players in Prague, Indiana, and in Las Vegas off the Strip go to the casinos once or more a week every week, whereas Las-Vegas-Strip gamblers tend to go every day, but only during one or a few 2-4 day holidays per year. Their trips to the casino are part of a vacation where they have budgeted money to lose and they can usually afford the loss. As a consequence, Las-Vegas-Strip blackjack players tend to be playing for the fun or thrill of the gamble, whereas players from the other locations tend to be playing either with the belief that they can win and/or with a more desperate hope to win than the Las-Vegas-Strip group, even if they do not believe they have an advantage.

The consequences of these differences in gambling utility are that Las-Vegas-Strip gamblers tend to stand less often and to take insurance and even money less often, outperforming their counterparts in the other locations in their insurance choices, and in cases where it is appropriate to hit, but underperforming their counterparts in places where it is appropriate to stand. Related to this, the Las-Vegas-Strip group is less likely to know or to use strategies that the most experienced players tend to endorse, such as pseudo- or real card-counting systems or attempts to identify and manipulate patterns in wins and losses. They are less likely to care about how other people at the table play, and less likely to move to different tables to avoid bad players or lucky dealers. As such, Las-Vegas-Strip players may look more rational and reasonable to an observer simply because they have not developed many of the strategies for winning that tend to develop with players with more extensive experience and who are particularly motivated to find a way to win. In fact, however, non-Las-Vegas-Strip players probably outperform Las-Vegas-Strip gamblers in terms of expected value and in terms of achieving other aspects of gambling utility, even while having more of the false beliefs that are associated with playing strategies developed during experience with the game, since the costs of their false beliefs tend to be negligible, and their conformity to basic strategy tends to be higher.

Differences beyond basic strategy

Luck and proper order

As mentioned in the previous section on differences in utility across locations, Las-Vegas-Strip players tend to be less concerned with strategies for winning. This

extends to beliefs about hot and cold waves of luck and to strategies for manipulating patterns in the cards. As such, both Indiana and Prague players are noticeably more concerned with patterns in luck and the cards than are their Las-Vegas-Strip counterparts.

While part of this almost certainly has to do with differences in utility across the locations, it is also in part related to the average amount of time players in the different locations have spent gambling (which is correlated to the differences in utility). Although I do not have numbers, it is far more common for Las-Vegas-Strip gamblers to be there for a business trip, gambling for their first time or for them to gamble only a few times a year on holidays. Many, if not most, of the off-Strip Las Vegas, Indiana, and Prague gamblers are locals, going to the casino every week, sometimes several times a week. These players are not only more likely to be playing with the primary goal of winning money, they simply have more experience with the game, and thus have developed more advanced strategies for trying to win during this extended experience. Blackjack design, however, has developed over decades with the aim of encouraging people to play while maximizing the casino's advantage. Particularly in blackjack, a game which began to outperform all other table games in popularity after successful card counting methods were developed in the 1960s, one of the ways that casinos encourage people to play is by maintaining the perception that the game can be beaten by the skilled player. As such, it might not be surprising that more advanced players have more strategies for winning or that these strategies tend not to work. The same could be said of card counting, since casino conditions make this very rational strategy in theory quite impractical in practice.

Furthermore, the experience of gambling tends to teach players that in the short-term gambling success has more to do with luck than with skill. They learn, correctly, that on a particular day the least skilled blackjack player is almost equally likely to win as the most skilled blackjack player. This contributes to a greater emphasis on patterns in luck than on playing strategy among more-experienced players.[10]

Interestingly, there is a further connection between beliefs about the importance of luck versus skill and rules differences between the Czech Republic and the U.S. In the Czech Republic, players are allowed to bet on other players' hands, while they are not in Las Vegas or Indiana. Players commonly use this allowed play in the Czech Republic. These gamblers will watch a crowded table for players who seem to be getting hot, and bet on them rather than on their own hands. I asked players in different locations if they would do this if the rules allowed for it, and U.S. respondents—even those off the Las Vegas Strip—were universal in saying no, usually with emphasis, such as, "Are you kidding? Not the way most people play." Czech Players, however, tended to be quite open to this, with comments such as, "if they were winning a lot." While I would have expected both Czech and Indiana players to be more open to betting on other players' hands based on who seemed, or did not seem, lucky, Indiana players were not, and it was quite a surprise to see how frequently Czech players did this.

The best reason I can think of for the difference in openness to this type of play between Indiana and the Czech Republic is that something about the rule availability led

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[10] This is true even while the less experienced may depend more on luck in making playing decisions simply because they do not know how best to play given basic strategy cues.

Czech gamblers to be more open to the choice. Similarly, most blackjack players in the U.S. say they would never "surrender" if given the option. Surrender is a special rule that is rarely advertised and usually unavailable. It allows the player to sacrifice half of his or her bet after seeing the initial two-card hand and the dealer's upcard. Players say such things as, "If it wasn't good for the casino, they wouldn't offer it," or, "I came here to gamble," in explaining why they would not surrender. In a relatively new version of blackjack called, "Double-fun 21," however, which advertises the option to surrender and has included the option from its inception, players frequently do surrender. It seems that inclusion of the rule as part of the initial structure of the game and making its availability transparent encourages not only the use of the rule, but also rationalizations for why the rule might be acceptable.

Similarly, Czech casinos often only have one or two dealers, and thus the players have little or no freedom to move from one table to another based on previous wins or losses associated with the luck of the cards or a particular dealer. Interestingly, if Czech players are asked whether they would move to another table if available because of a dealer or because of streaks of losses, they are much more likely than members of the U.S. sample to say no, and to say that the particular dealer is not very important to their chances of winning.

Of course, there could well be other reasons why Czech gamblers are more willing to bet on other players and why they believe the dealer is less correlated to luck than their U.S. counterparts. Perhaps the difference in ability to bet on other players' hands exists in the Czech Republic because players were more likely to want to do so in

the first place. Czech casino gamblers are much more likely to play roulette than blackjack, whereas U.S. gamblers are more likely to play blackjack than roulette. In roulette, there is no role for playing strategy other than the numbers on which players bet, and the structure of this game contributes to strategies that involve betting on the numbers that winning players are betting on. Perhaps Czech players are simply transferring this strategy that they learned in roulette to blackjack. Or perhaps there are other cross-cultural differences of which I am not aware that explain the difference. In any case, while some of the cross-location differences in beliefs about patterns in luck and proper order are probably closely tied to differences in gambler utility and motivations, and on the average amount of time gamblers in each location have spent playing, other differences seem to depend on structural features in the games and on unique experiences of the gamblers in each location.

Folk-card counting

As with beliefs about luck and natural order, Czech and Indiana players are more likely to have integrated folk-card counting strategies into their playing repertoire. Czech gamblers, however, display this far more than their Indiana counterparts. I would suggest that the difference between Indiana and Las-Vegas-Strip gamblers is largely due to differences in gambling utility and average time spent gambling, quite similar to the reasons why these two groups differ in their emphasis on natural patterns in luck and the cards. The difference between the Indiana and Czech locations, however, is more extreme and requires an alternative explanation, since Czech and Indiana gamblers seem to have largely identical backgrounds in terms of their motivations for and time spent playing

(although obviously there may be other differences in practices, values, and beliefs across the two locations about which I was unaware).

Experienced Czech blackjack players will often play in pairs whereas I have never seen players working together who were not card counters in the U.S. These players will pool their money, and have one player sit at an earlier spot on the table with a large bet and another player sit at the last spot before the dealer with the minimum possible bet. The player just before the dealer will sacrifice his or her hand, playing purely in order to try to influence the cards that will go to the dealer so that the player in the first position has a better chance of winning.[11] In general, Czech players are far more concerned with how well the person at the final spot before the dealer plays and with the quality of the other players, specifically with regard to whether they pay attention to previous cards removed from play and adjust their strategies accordingly. Thus, it is not uncommon to see a group of three or four players at the blackjack table in Prague confer with one another about who is or is not going to hit before making play choices, and agreeing on an overall strategy of hitting and standing depending on what cards have occurred, what cards would hurt the dealer most, and the size of each player's bet. This level of concern with previous cards removed from play is unheard of in my experience with U.S. blackjack players, although it is not uncommon with Czech players.

The degree of difference, however, might be entirely due to the one important rule change across the two countries. In the Czech Republic, dealers do not receive a second,

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[11] In fact the influence of the latter hand on the former is purely random. The playing style of the final player will neither help nor hurt the first player.

face down card (the hole card), whereas in the U.S. they do. Thus, in the U.S. the next card dealers will receive after the final player finishes is already under their face-up card. No matter how people at the table play, that card will remain the same, since it was already there. Playing strategy will influence the second and subsequent unseen cards, but not the first. U.S. players will still often try to influence the dealer's hand, assuming the face down card is a 10-value card and trying to influence the third card the dealer will receive, but such strategies are less transparent, appear less certain to the players, and depend on an extra inferential step. This may go a long way to explaining the differences across locations.

It should also be noted that even more than Indiana gamblers, Czech gamblers may be desperate to win, unable to afford the losses and depending on their gambling success for money on which to live. Such gamblers are more likely to look for systems for winning and to believe they have a system when they do not. Thus, even if the hole-card difference did not exist in the Czech Republic, Czech gamblers might still be more likely to express these particular playing strategies. Similarly, there could be other reasons for the cross-cultural difference that I simply did not have access to. Nonetheless, the rule change itself probably contributes to the difference in playing strategies, and without it, there might have been little if any cross-cultural difference at all.

Differences in folk-basic strategy

It was mentioned in the chapter on players' folk-basic strategies that Czech players were generally more conservative than Las Vegas gamblers and that they showed higher variance in the preferred folk-basic strategies among experienced subjects. Indiana

players were somewhere between Czech and Las Vegas players along both dimensions, though closer to Las Vegas players in their conformity to folk-basic strategy while closer to Czech players in their conservatism. Interestingly, in terms of conformity to a folk-basic strategy, Las Vegas off-strip players appeared to display the most conformity, although I cannot be sure. This subsection will discuss some of the possible reasons for these differences across locations.

As far as I can tell, the main reason for the difference in conservatism stems from the players' motivations for gambling, as well as from the corresponding amount of time spent playing by the average gambler in each location. The influence of subjective wealth on player conservatism was expressed repeatedly in the interviews, where gamblers made clear that they became more conservative the less money they felt they could afford to lose, and gamblers who played primarily for excitement or fun were less conservative. These same differences correspond to differences across the locations in terms of how much the person gambling could afford the losses, whether they thought they had an advantage, why they said they were gambling, and how much time the average gambler at the table had spent gambling. Importantly, this conservatism among Czech and Indiana gamblers but not among Las-Vegas-Strip gamblers corresponds to the main difference between Keren & Wagenaar's sample and my own. It may be that the Dutch gamblers observed by Keren & Wagenaar were similar to the Czech gamblers in this respect.

In terms of the difference in the relative frequency of players who depart from regional conceptions of folk-basic strategy, there are three main explanations that seem plausible. First, the difference between the Las Vegas gamblers, on the one hand, and the

Czech and Indiana gamblers on the other may be connected to the length of time and the institutionalization of gambling in each location. In both Indiana and the Czech Republic, casino gambling is a relatively recent addition (just over a decade in each location) as compared to Las Vegas (where casino gambling has been legal and the main industry of the city for more than fifty years). In interviews with several casino managers in the Czech Republic, I was repeatedly told that Czech gamblers were not as skilled as their foreign counterparts, or alternatively, that they were much less superstitious or more self-disciplined than they had been a decade earlier when casino gambling was introduced. Similar comments were made by a few of the dealers and floor supervisors who had worked in both Las Vegas and the Midwest. Blackjack players were seen as less skilled and knowledgeable in the Midwest than those in Las Vegas. While these claims might simply be stereotypes that are not borne out in fact, I think it is likely that the relatively longer gambling tradition in Las Vegas has contributed to a more coherent set of beliefs about how to gamble that in turn correspond more closely to folk-conceptions of optimal play held by most long-term blackjack players.

A second possible influence concerns the availability of blackjack media that teaches basic strategy. I could only find one book on gambling strategies published in the Czech Republic. It was translated from the English, referred to somewhat different blackjack rules than were available in the Czech Republic, and had a brief section on card counting and basic strategy. It was available in one bookstore in Prague. None of the casinos had gift shops or sold books on gambling, and laminated credit-card sized basic-strategy cards were non-existent. The only easily-accessible source for gambling

information available to Czechs is through the Internet, where there were two Czech language sites devoted to blackjack strategy, and perhaps hundreds, certainly dozens of English-language sites. Blackjack media was somewhat more available to Indiana gamblers. Casinos have gift stores in the buildings to which the boats are docked, and sometimes these stores sell books on how to play blackjack which include information on card counting and basic strategy. The gift stores did not sell basic-strategy cards, however, and bookstores outside the casino tended to have a choice between just a few books on blackjack if any at all. In Las Vegas, on the other hand, books and other types of media on how to play blackjack are plentiful. Convenience stores and grocery stores throughout Las Vegas will often sell basic-strategy cards and books on how to win at blackjack. Bookstores may sell a half-dozen or more books just on blackjack. Virtually every casino has gift shops where several blackjack books are available and basic-strategy cards can be purchased. Many casinos will give basic-strategy cards to players at the table or offer them for free with other promotional material. As such, a standard model for how to play blackjack is most widely available in Las Vegas, less easily available in Indiana, and almost entirely unavailable in the Czech Republic, and this may have an important influence on the difference in the degree to which experienced players conform to their community's folk-basic strategy.

Finally, there are two differences between the U.S. and Czech casino social environments that make the transfer of information among gamblers less fluid in the Czech Republic. I believe this plays an essential role in the difference across locations in terms of agreement among community members as to what constitutes the proper folk-

basic strategy. The first difference is in the degree with which players tend to talk with one another or the dealers in a friendly manner. Dealers in the Czech Republic are usually trained not to ask the players personal questions and not to give advice. This is partly because the players themselves tend to be more serious about the game than their U.S. counterparts, particularly than the Las-Vegas-Strip group. It is also because casino gambling in the Czech Republic is more stigmatized. Czech gamblers are more likely to be embarrassed about the fact that they gamble, and ensuring gambler anonymity is part of the training of the casino dealers. Furthermore, Czech gamblers are stereotyped as being associated with organized crime, as having earned their money illegally, and as engaging in gambling as a means of money laundering, and for some percentage of Czech gamblers I would not be surprised if this were the case.[12] As such, communication among Czech gamblers, in cases where they do not already know one another, is often to reprimand the gambler or to complain about their choices. Czech players rarely share friendly advice, and the casino staff is even less likely to give playing advice.

The second difference in the social environment concerns a difference in dealer motives between the U.S. and Czech casinos. U.S. dealers depend primarily on tips for their income, much as waiters and waitresses do (I earned more than two-thirds of my wages in tips). Players tend to tip more when they win than when they lose, and when they like the dealer more than when they do not like the dealer. They also usually place

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[12] I have only anecdotal evidence about this, but stories about the corruption of both casinos and gamblers are plentiful, and Czech non-gamblers regularly express surprise at the fact I would go to a casino, which many Czechs see as corrupt and somewhat dangerous.

their tips as a bet on their hand which only goes to the dealer if the bet wins, in which case the tip doubles in size. As such, the dealers in the U.S. generally want the players to win, and they often give players friendly advice about how to play their hands. Dealers in the Czech Republic rarely receive tips, however; in the less touristy casinos they often do not even know how to do so. Furthermore, in most Czech casinos the tips do not go to the dealer, but are instead kept as profit by the casino (although this information is of course not advertised to the players). The dealers usually earn a bonus at the end of the month based on the total amount won that month by the casino. As a consequence, quite the contrary to U.S. dealers, Czech dealers are rarely hoping for the players to win. Dealers often intentionally mislead players about how best to play, and in interviews with dealers I was repeatedly told that in most cases they wanted the players to lose and hoped to win as much as possible. These differences in the social dynamics between casinos in the U.S. and the Czech Republic make communication about proper folk-basic strategy far less frequent in the Czech Republic as compared to the U.S., and I believe they go a long way toward explaining the higher relative frequency with which experienced players in Prague (as compared to those in Las Vegas at the other extreme) deviate from folk-conceptions of the basic strategy.

Summary and conclusion

The current chapter examined common casino blackjack playing strategies and beliefs other than those concerned with basic-strategy cues. *Section one* described the main set of strategies and corresponding beliefs—beyond basic-strategy cues—that

blackjack players use to make their decisions. These include a) beliefs about the relationship between cards removed from play and future card probabilities, and a set of folk-card-counting strategies that are used to exploit this perceived relationship, b) beliefs about natural patterns in luck and in the cards, and developed strategies to identify, manipulate, and benefit from these perceived patterns, c) beliefs about intuition and its appropriate use in making choices, and d) beliefs about risk attitude in relation to previous wins and losses. *Section two* examined gambling utility and the role that utility plays in gamblers' choices and in the quality of these choices. The findings here suggest that there is much more to gambling utility than expected value and that many strategies that appear irrational or suboptimal when analyzed in terms of expected value are, in part at least, a consequence of the unique values and motives commonly held by gamblers. Finally, section three considered differences across the three main locations in terms of gambling utility, folk-basic strategy, and strategies unrelated to folk-basic. Although there are a number of similarities across locations, this section makes clear that subtle differences in the casino environment and in gambler utility can lead to a variety of changes in blackjack players' strategies and beliefs, suggesting that the sociocultural environment is crucial to the expression of strategies for and beliefs about winning.

A few final comments as to the degree to which the differences across locations described above should be seen as sociocultural are in order. The amount of time a person has spent playing blackjack seems to be an issue of learning and experience quite distinct from the sociocultural environment. Similarly, the utility of gambling for the average Czech or Las Vegas gambler and their respective need (subjective or objective) to win

could easily be framed as an individual difference. Perhaps there is something about Prague (or Czech) and Las Vegas (or American) culture that helps explain the distributions of these individual differences, but as described the individual differences themselves seem to be responsible for the variation in strategies and beliefs across locations. If an American gambler had the same individual characteristics as the average Czech gambler but learned to play on the Las Vegas Strip, would they not develop the same strategies and beliefs as the average Czech gambler, at least to the degree those strategies and beliefs were related to utility, average time playing, and socioeconomic status? Indeed, the one aspect of the sociocultural environment that might be deemed least controversial, belief systems that differ across Czech and American cultures, are notably absent as causal variables from the current analysis.

There are several responses to these questions and concerns. First, it is quite true that experience playing, utility, and socioeconomic status all might be seen as important causal variables in blackjack players' strategies for and beliefs about winning, distinct from the sociocultural environment. I believe this to be the case and have sometimes grouped these variables in with sociocultural ones for the sake of space and convenience, since they came out of the ethnographic study of casino gamblers. Thus, I would expect a gambler who learns to play blackjack in the Las-Vegas-Strip casino subculture, but who approaches the game with the individual characteristics of the average Czech gambler, to develop many of the strategies and beliefs more common to Czech gamblers, such as the expression of more conservative doubling, splitting, and hitting choices, a greater

emphasis on patterns in luck and in the cards, and a greater concern with cards previously removed from the deck.

At the same time, I would also expect the player who learned on the Las Vegas Strip but who had the characteristics of the average Prague gambler to learn many of the strategies and beliefs held by the average Las-Vegas-Strip player. Players do not learn their strategies and beliefs in isolation. Rather, a major part of the learning comes from the reaction of other players at the table and the dealer and from other aspects of the sociocultural environment. This is the case even in the Czech Republic, where the responses are not friendly, but may be more effective.

When players first sit at the blackjack table, they are generally quite nervous, flooded with a new terminology and with a set of norms regarding how to exchange one's money for chips, where to place one's bet, how to request additional cards, whether or not to hold the cards, how to stop requesting additional cards, how to double down and split and when or whether such plays are possible, when to take insurance, and whether and how to tip the dealer. On top of this they usually have no idea how to play their hands, and are under few illusions that they can calculate the correct probabilities or the degree to which past outcomes might influence future possibilities. Often they have learned a few tips from a friend: stand with 12 or more if the dealer has a six or lower and with 17 or more if the dealer has a 7 or higher. Always split aces and eights. Never split 5s or 10s. Double down with a 9, 10, or 11 against 2-6. The rest they learn at the table from their own idiosyncratic experience of winning and losing which *often* violates long-term probabilities, and from other players, many of whom have been playing for years

and who can answer questions about all the norms and all the activities that seem so strange and bewildering to the novice. These are the beliefs that most gamblers will take with them as they continue to play over the years, and although they will adjust these strategies to some degree based on idiosyncrasies in individual experience and in personal background, I believe they will also keep many of these beliefs for as long as they play. It is in this sense that playing experience, gambling utility, and all other cross-cultural differences should be seen as sociocultural: the strategies and beliefs that may develop in part as a consequence of them, unavoidably come to be a part of the social community of the gamblers in that location, even of the gamblers who do not share the same goals, playing experience, or socioeconomic status as most members of the community.

What of the final concern expressed above: the lack of focus on society-wide cross-cultural differences in belief systems as causally relevant variables? Two responses are in order here. First, to some extent, this is a consequence of the research focus. I was primarily interested in the influence of the casino subculture on strategies for and beliefs about winning rather than influences of the broader culture. Czech and American gamblers are by no means representative of Czech and American populations more generally, and group members may have more in common as casino gamblers, at least with regard to their strategies and beliefs about blackjack, than they do as Czechs or Americans. Nonetheless, if the emphasis had been more on the broader American or Czech cultures (or indeed Las Vegas, Indiana, and Prague cultures), there likely would have been more of an emphasis here on differences in values and beliefs across cultures.

It should be noted in this respect, for example, that the cross-cultural differences in gambling utility—that is, in gambling for fun or excitement as compared to gambling for the need of the money—and the respective greater conservatism of the Czech gamblers, corresponds with broader cultural differences that I will not go into here, but which are likely important.

Second, I actually expected and hoped to find a larger role for cross-cultural differences in belief systems than I did. After observing differences between Prague and Las Vegas gamblers in terms of conservatism, I had hoped to find clear correlates to unique belief systems among Czechs and Americans more generally, rather than primarily an association between the need and expectation of winning and the amount of time spent playing. I was very surprised to find that Indiana gambling strategies were more similar to the Prague strategies than to the Las-Vegas-Strip strategies. The difference in the average gambler between Las Vegas and Indiana, however, was undeniable, as was the similarity in this respect between Indiana and Prague gamblers. As such, at least with regard to casino blackjack players among these particular populations, it seems that gambling motive, socioeconomic status, and time spent playing is more important to playing strategy than other cross-cultural differences. It should be noted, however, that I would not expect more culture-specific belief systems to play the relatively small role they appear to play here across all populations of gamblers in all locations, nor would I expect to find this across these particular populations given more complex and less well defined social-decision making tasks.

Finally, in more general conclusion to this chapter, it is hoped that a compelling case has been made for examining decision makers' strategies and beliefs in the sociocultural context within which decisions are actually made. Much research into decision making processes in general, and gambling decisions in particular, begins with the assumption of a normative model, and identifies decision-making processes with respect to how choices deviate from this model. This is the path toward Keren & Wagenaar's label of conservatism in explanation of blackjack players' violation of the received normative model, basic strategy. The assumption seems to be that cognitive processes inherent to the individual can be identified in this way, with little attention paid to how these strategies and beliefs develop and vary with subtle changes in belief systems, experience, utility, or the sociocultural environment. Yet even the degree with which blackjack players tend to hit or stand more or less than they should is closely tied to all of these factors, and cannot be understood in isolation from them. A label such as conservatism not only does essentially nothing to advance one's understanding of blackjack playing strategies, to the degree it provides a facile label to describe a broad range of behaviors outside one's scope of understanding, it actually does harm, contributing to an illusion of understanding and a license for evaluation in cases where neither is warranted.

CHAPTER FOUR

CONCLUSION

The following goals were stated in the introduction: 1) to describe the playing strategies and beliefs common to casino blackjack players, and 2) to examine the role of experience, values, beliefs, and the sociocultural context in decision-making processes as well as in 3) why people gamble and in the strategies they use for doing so. The content of the two substantive chapters (*Chapters 2* and *3*) addressed the first goal by providing the most detailed study to date of both the degree to which blackjack playing strategies accord to the basic strategy, and of other strategy-belief complexes common to experienced blackjack players. The ways in which those two chapters address the second and third goals will be discussed in more detail here.

As was mentioned in the introduction, decision and gambling researchers tend to explain gamblers' strategies and beliefs with reference to either motivated reasoning or heuristics and biases. This is particularly true in cases where the strategies and beliefs are seen to be suboptimal or false. To some extent these explanations are appropriate. Gamblers (like many non-gamblers) almost certainly do ignore evidence—at some point or another—that they would otherwise not have ignored if not for their hopes and desires. Similarly, with respect to heuristics and biases, there can be little doubt that gamblers—like all people—do use a number of decision-making shortcuts (that is, heuristics), and

that these heuristics lead to systematically biased (read suboptimal) decisions in certain contexts. Indeed, much of this dissertation has been concerned with trying to describe some of these heuristics and what their consequences might be with respect to the quality of the gamblers' decisions. Furthermore, if all gamblers' false beliefs could be identified, *one* of the important solutions to correcting them would likely be through education and training about both the nature of the casino gambling environment and about the nature of probability.

The criticism being put forth here is *not* that gamblers are not influenced by motivated reasoning, that they do not use heuristics, or that the heuristics used do not sometimes lead to suboptimal choices. *Rather, it is that both decision processes (including heuristics) and their normative evaluation are far more content- and context-specific than is commonly recognized by decision researchers,* and in particular by researchers focused on gambling-type decisions. Even apparently basic decision processes usually will not occur independent of 1) the semantic content of the values and beliefs that they act upon, 2) the structure and dynamics, including the semantic content, of the physical and sociocultural environment within which they act, and 3) the learning and experience that takes place within this environment while engaged in the decision task. The previous two chapters demonstrated empirically how each of these three types of context are important to understanding the decision processes even of casino blackjack players, a group who are making particularly well-constrained decisions with respect to the range of decisions people make throughout their lives. More than with almost any other real-world decision, normative decision models such as SEU Theory might be seen

to apply to gambles, from which SEU Theory was largely derived and to which it can most easily be applied. Yet when the time is taken to carefully consider the content of values and beliefs, the sociocultural environment, and the subject's learning and experience as they contribute to gambling decision making, it is clear that even in the gambling domain, these contextual factors are critical to both understanding the decision processes and to assessing how well those processes work.

The remainder of this chapter is divided into four sections. The first section provides an empirical example from the research that demonstrates just how important content and context are to decision-making processes. The second section considers two important implications of the current research for the psychological study of decision making. The third section discusses two anticipated objections to the proposed implications. Finally, the fourth section considers the degree to which the current study should be expected to generalize, either to other gambling activities, or to decision making more broadly framed.

An example from the research

Before going further it is worth bringing up an example from the research that demonstrates how each type of contextual factor (a) the semantic content values and beliefs, b) the structure and dynamics of the sociocultural and physical environment, and c) learning and experience within the domain) is important to both decision processes and their normative evaluation. For this example, one widely recognized heuristic and two purported consequent biases will be considered. The heuristic is the representativeness

heuristic in the form of the "law of small numbers" (Tversky & Kahneman, 1971). The two biases are the gambler's fallacy (Keren & Lewis, 1994; Tversky & Kahneman, 1974; Wagenaar, 1988) and the hot hand cognitive illusion (Gilovich et al., 1985; Tversky & Gilovich, 1989a, 1989b). Other researchers who are critical of the lack of specificity of heuristics have noted that these two apparent biases, while predicting opposite behaviors, can both be "explained" by the same heuristic (Ayton, 2000; Burns, Under review; Burns & Corpus, In press; Gigerenzer, In press; Hertwig & Todd, 2000). One of the reasons that both behaviors can be explained by the same heuristic is because as a rule the expression of heuristics depends on the variety of contextual factors listed above.

Different *beliefs* will contribute to either the "gambler's fallacy" or the "hot hand" illusion depending, for example, on players' beliefs about the design of the game being played. Since players believe, correctly, that as cards are removed from play in blackjack, future cards of the same type are less probable, they are more likely to express the gambler's fallacy in this domain. Since they believe that luck itself runs in a wave-like pattern of ups and downs, they are more likely to express the hot hand illusion when faced with series of wins and losses. Many slot machine players believe the machines are designed to repeatedly cycle through every possible payout option, giving the casino an advantage because the payouts are less than the amount required to cycle through. This might or might not be true (and depending on the location and the particular design of the machine, *is* or *is not* true). But players who believe it to be the case are more likely to demonstrate behavior corresponding the gambler's fallacy, avoiding machines that have just paid a large jackpot and seeking out machines that have not. Many other slot-

machine players believe that the casino changes the payback percentage of their games on a regular basis. These players are more likely to demonstrate a behavior corresponding to the hot hand cognitive illusion, avoiding machines that have recently paid out poorly and seeking out machines that have recently paid out well. In both cases, the players' *beliefs* about the design of the machines, beliefs that as far as the players can know through reason and their limited experience alone might or might not be true, systematically influence which alleged "cognitive bias" they express.

Different *values and goals* can contribute alternatively to belief in the gambler's fallacy or belief in the hot hand (or in this case, more accurately, hot and cold streaks of luck), depending, for example, on whether players' will be satisfied with occasional big wins while minimizing the risk of occasional big losses (a goal to which the belief in hot and cold streaks of luck contributes), or, alternatively, do not mind occasional big losses and rare big wins, as long as they can usually leave the casino a winner (a goal to which a belief in the gambler's fallacy contributes). In these cases, it is not necessarily the goals themselves that lead to the beliefs, although this may play a role. Rather, the degree to which a particular set of beliefs and consequent strategies contributes to or hinders the achievement of one's goals seems to influence whether the belief continues to be endorsed over time, or is discarded and exchanged for another that has not been shown by experience to contradict one's goals.

The structure and dynamics of the physical environment will sometimes contribute to belief in the hot hand, such as in games where successes and failures have a near equal probability of occurring and trials are repeated on a somewhat regular basis

(such as in blackjack outcomes, but not, for example, the lottery). At other times, they will contribute to behavioral expressions of the gambler's fallacy, such as in the European version of blackjack where the dealer does not take a second card until after players' choices have been made.

The structure and dynamics of the sociocultural environment will sometimes contribute to the hot hand illusion, such as within casinos where most of the players have extensive experience playing blackjack and teach beginning players that luck runs in streaks. In other cases it will contribute to expression of the gambler's fallacy, such as in casinos where most players do not have extensive experience with the game (as in the U.S., but not the Czech Republic). In this case, it is not uncommon to hear players with an intermediate-level of experience explaining systems that depend on the gambler's fallacy. This is not as common in the Czech Republic, in my view, because enough players have enough experience that they have suffered the consequences of the gambler's fallacy or have heard from others what these consequences are.

Finally, the amount of *individual learning and experience* with a game (as it interacts with the other contextual factors) will also influence whether people express either the hot hand illusion or the gambler's fallacy. Thus, in all of the locations where I conducted my field work, blackjack players with more experience are far more likely to believe wins will follow wins and less likely to believe wins will follow losses than their less experienced counterparts. In the short-term, belief in the gambler's fallacy tends to work. That is, players may end several gambling sessions in a row as winners rather than losers. When they eventually do lose, even if the loss is more than the sum of all their

previous losses, they can reasonably dismiss it as simply involving bad luck ("my system *seems* sound, after all," they might say, "and it *was* only one loss. Perhaps that was just a fluke; I need to give the system more time."). Only with extended experience (or a social community who can share its cumulative experience) does the individual learn of the long-term harmful consequences of belief in the gambler's fallacy. Belief in the hot hand has the opposite long-term consequences, protecting the player from single sessions with extensive losses that can contribute to a loss of control and consequent debilitating losses.

Implications for the psychology of decision making

I will discuss two common shortcomings among psychologists studying decision making (including gambling decision making) to which the failure to adequately recognize the importance of semantic content and context contributes. *First, there is a tendency to over-generalize or over-apply particular cognitive processes to explain behaviors, and a corresponding inability to adequately predict or specify when a specific cognitive process will or will not be evoked.* This issue was supported in some detail earlier with the empirical example concerning the use of the representativeness heuristic and the law of small numbers to explain both the gamblers' fallacy and the hot hand cognitive illusion. My expectation for the future of heuristics and biases research is that it will continue to involve a growing list of allegedly *basic* cognitive process until the list eventually becomes so long and so context-specific that it is generally recognized that neither the heuristics nor the biases represent "basic" processes at all.

Finally, and directly related to the previous shortcomings, decision and gambling researchers often present a narrow and incomplete depiction of what goes in to making decisions. The desire to abstract individual-, cultural-, and otherwise domain-specific goals, beliefs, and environments into numerical weights and frequencies (if they are considered at all) is understandable. It allows for the ability to make broad generalizations, concrete predictions, and simple models. But the general practice of doing so has contributed to a habit of thinking about decisions processes as though the content and context of goals, beliefs, and environments are less important than they actually are, while the generalizations, predictions, and simplified models can be expected to systematically fall short when applied to real-world decision contexts. Unfortunately, very little research in the psychology of decision making concerns itself with the context of the sociocultural and physical environments within which these decisions naturally occur. Yet the actual processes involved in making decisions are causally intertwined with this context.

To some extent, I may be echoing the concerns of William Goldstein and Elke Weber when they write, "The point is not merely that the experimental practice of using content-impoverished stimuli would have failed to discover a number of interesting phenomena, but that the particular phenomena that would have been overlooked are those that *conflict* with the overarching theoretical framework" (1995, p. 92). The "content-impoverished stimuli" they were referring to are the gambling-type decisions that many judgment and decision researchers have used to study decision processes more generally.

The rationale for using such stimuli has been specifically because gambles are seen to involve largely content-free choices that nonetheless share the same fundamental characteristics of all decisions: 1) a set of possible choices, 2) a set of possible outcomes that might result from each choice, 3) a subjective probability that each possible outcome will occur, and 4) a subjective value (or *utility*) for each possible outcome.[1] Because of their purported content-free, domain-general nature, gambling problems were (and often still are) seen to be an ideal stimulus to get at basic cognitive processes.

These assumptions have been an integral part of the heuristics and biases tradition. Consider, for example, the words of two of the fathers of this tradition, who state their case well:

> Risky choices, such as whether or not to take an umbrella and whether or not to go to war, are made without advance knowledge of their consequences. Because the consequences of such actions depend on uncertain events such as the weather or the opponent's resolve, the choice of an act may be construed as the acceptance of a gamble than can yield various outcomes with different probabilities. It is therefore natural that the study of decision making under risk has focused on choices between simple gambles with monetary outcomes and specified probabilities, in the hope that these simple problems will reveal basic attitudes toward risk and value. (Kahneman & Tversky, 1984, p. 341)

Goldstein & Weber's point, as I understood it, was that the content-impoverished nature of gambling-type stimuli will often not generalize to other decision domains (such as, in Kahneman & Tversky's words, "whether or not to take an umbrella and whether or not to go to war"), because we should expect content, in fact, to matter, even to "basic

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[1] With gambling-type decisions subjective probability is often collapsed with objective probability, that is, the relative frequency of each possible outcome as defined by the researcher or the structure of the gambling problem, and utility is often collapsed with objective pre-defined values, expressed in dollars or other unitary amounts that can be less ambiguously measured.

attitudes toward risk and value". The argument being presented here takes their point a step further. It is not just that using content-impoverished stimuli may not be the appropriate tool to identify decision processes, but also that gambling-type problems themselves are *loaded* with semantic content. Indeed, different types of gambles have different semantic content, and even the same gamble (as defined by some external categorical standard) may be subjectively different depending again on the semantic content of the values and beliefs of the decision maker him- or her-self. Finally, all of this great variety of semantic content depends inseparably on the structure and dynamics of the social and physical environment within which a decision is made and on the decision maker's learning and experience with the decision task within this environment.

More emphasis needs to be placed on studying real-world decisions in real-world environments. This should include an emphasis on the meaning-laden characteristics of the sociocultural environments and of the individuals' values and beliefs. It should also include consideration of the interaction between the individuals and their environments, and of the process of learning and development within such complex domains. There are certainly costs to such a prescription, both in terms of the extra investment required to conduct the research and in terms of the loss of parsimony and theoretical coherence. The gains will include a more accurate and complete (though admittedly messier) picture of the psychological processes involved in decisions, and a better (though admittedly less general) ability to explain and predict behavior in real world contexts.

Objections and response

At this point it is worth addressing two likely objections to these claims. *The first objection is that the decision-research tradition is being misrepresented and over-generalized*. Even core members of the heuristics and biases tradition already actively examine a number of the contextual influences I have mentioned. Indeed, the virtue of SEU Theory as a normative model is that it specifically allows for the subjective beliefs and values of the decision maker. Subjective beliefs are measured in terms of *subjective probability*, a quantifiable measure of the strength of belief that goes back at least as far as 1713 with Jakob Bernoulli's publication of *Ars Conjectandi* (J. Bernoulli, 1713/1969,1975; Goldstein & Hogarth, 1997). Subjective values and goals are measured in terms of utility, a quantifiable measure of the strength of subjective value that goes back at least as far as 1738 with Daniel Bernoulli's publication of *Exposition of a New Theory on the Measurement of Risk* (D. Bernoulli, 1738/1954; Goldstein & Hogarth, 1997). Furthermore, there is a diverse group of people studying the psychology of judgment and decision making, many of whom share (and have already made) a number of the criticisms expressed here. Rather than make such a widespread (and domain-general!) criticism of decision research, perhaps I should restrict my focus to specific researchers or particular studies.

In response to the first part of this criticism, that SEU Theory already accounts for values and beliefs in the form of utility and subjective probability, I hope I have made the point clearly enough that the strength of values and beliefs measured in numerical units does not correspond to what I mean by taking into account the content of values and

beliefs. Measuring subjective probability does not allow the researcher to discover how subjects believe a slot machine is designed, what subjects believe the influence of high and low cards are in blackjack, or whether subjects believe luck runs in hot and cold waves such that good luck is more likely to follow good luck than to follow bad luck (unless the researcher already has these belief categories in mind, in which case the subjective probability is not so much identifying the belief as it is determining the subjects' confidence in a potential belief that has already been identified through other means). Nor does constructing subjects' utility curves provide a means by which to discover what their particular values are, such as whether they want to play as long as possible, to win as often as possible, to lose as little as possible, or to achieve one or several of the variety of other goals gamblers might have when playing blackjack (again, unless of course the researcher already has the relevant value categories in mind). Yet the content of these differences in beliefs and values helps one to understand, evaluate, and predict how the decision maker will decide in ways that neither SEU Theory and other context-free normative models, nor heuristics derived from violations of these normative models, can.

The latter part of this first objection raises the important point that decision researchers are a varied lot with different methods, perspectives, interests, and commitments. The picture presented so far might suggest an exaggerated and artificial degree of uniformity. Indeed, many decision researchers do and have echoed most of the criticisms presented in this study. It would be a misrepresentation of both gambling and decision researchers to suggest a *lack* of concern with the structure of the decision task. If

asked, I imagine that essentially all gambling researchers would acknowledge that the design of the games that gamblers play has important influences on the strategies and beliefs common to these gamblers. A small but growing group of gambling researchers are specifically concerned with the role of slot machine design in the set of false beliefs and ineffective strategies commonly adopted by slot players (see, for example, Griffiths & Parke, 2003). Among judgment and decision researchers there is a large core group whose primary concern might be described as understanding the interaction between the decision maker and the decision environment (see the website of the academic organization, *The Brunswik Society*, http://www.brunswik.org, for links to a network of decision researchers concerned with just this issue).

While recognizing that gambling and decision researchers do *realize* the environment is important to decision processes, and that there is a great deal of exemplary decision research concerned with the interaction between environments and decision processes, the criticism being made in this dissertation is that *most* decision research continues to identify, describe, and evaluate decision processes in relation to researcher-defined normative models of behavior, and *most* decision research continues to examine decision processes in laboratory or classroom settings largely divorced from the real-world context in which they naturally occur. Even in cases where the environmental structures are taken into account, there is usually little if any attempt to move beyond the physical or verbal structure of the decision task or, alternatively, the numerical representation of the environment in terms of distributions, validities, and weights, a notable exception being a group studying what they term “Naturalistic

Decision Making" (Klein, 1998; Lipshitz, Klein, Orasanu, & Salas, 2001). The subjective experience of engaging in the decision task, the practices and beliefs shared by the decision making community, the unique values and goals of the decision maker are all important aspects of the decision environment that reflect on, influence, and are part of the decision process.

The second objection is that rather than having a disagreement, most psychologists studying decision making—particularly cognitive psychologists—are simply approaching the question from a different level of analysis. It is their goal (and perhaps should be the goal of psychology more generally) to find the information processing mechanisms common to the human mind. They accept that individual- and culture-specific values and beliefs influence decision processes, just as there is an infinite (though constrained) variety of computer software that can function on a computer operating system and influences its "behavior". But they want to understand the information processing system itself. It is through understanding this system that one can predict how a particular set of values and beliefs will be processed and thus lead to a particular behavior. Indeed, the strong version of this objection might argue, if psychology is to be a successful science at all, a science that can predict and generalize, their approach and not mine is the only one that can ultimately succeed, just as if one wants to understand the "mind" of a computer one must try to get beyond the potentially infinite variety of application software to the operating system that acts upon it. True, they would admit, this is no easy task. Much of the previous research may have confused an individual- or culture- specific value or belief with a cognitive mechanism, just as one

might confuse the application software for the operating system when trying to understand a computer's "mind" (or the computer's software more generally with its CPU). But science is a cumulative and group process. Scientists are closer to understanding the basic processes than they were twenty years ago, and they will be still closer twenty years from now.

In response, three points should be made. *First*, important aspects of the objection *might* turn out to be true. It may end up to be the case that information processing mechanisms can be neatly separated from the content of the information they process. Perhaps there is a limited variety of types of content that are each processed differently, but even then the different information processing mechanisms, for each type of information, could eventually be specified. While this might be true, I do not expect it to be. Acceptance of the idea that information processing mechanisms can be causally separated from the information they process seems to me to involve an unjustified inferential step. Indeed, this is true even with the computer metaphor with which the idea is most convincingly conveyed. Is there really a meaningful line that can be drawn between Microsoft Word (the application software) and Microsoft Windows (the operating system), when trying to understand the "behavior" of Microsoft Word (the functioning program)? Even if there is in the artificial world of computers (artificial with respect to the human mind) where application software is designed to run on a particular operating system, it is not at all clear that there is with the human mind where such a neat division between the operator and that which is being operated upon has likely never existed.

Second, even if the hypothetical objectors' first assumption is true, and the information processing systems of the mind can one day be cleanly distinguished from the information being processed, it seems clear that we are far from being able to do so today. In the meantime, to ignore values, beliefs, the environment, and learning, or to abstract them down to numerical terms, is to limit ourselves from considering many of the factors that, given our present-day understanding of behavior, are the most relevant to and predictive of the processes and outcomes of decisions. It is well and good that some group of decision researchers (and some group of psychologists more generally) is committed to a project of trying to identify information processing mechanisms common to the human mind and independent of the infinite variety of values and beliefs that can be processed, just as it truly was well and good that some group of psychologists was (and still is) committed to studying the relationship between stimuli and responses common to the behaviorist tradition. But it is a serious mistake, given the "information processing" model's uncertain assumptions and its early (and imprecise) stage of development, to suggest that this should be the scope or primary focus of the study of mind and behavior.

Third, even if scientists were already able to cleanly distinguish between the information processing systems and the information being processed, it is not at all clear that the former, and not the latter, should be seen as the *proper* study of mind and behavior, any more than it would be clear that the study of a computer's operating system but not its application software would be the proper study of computer "psychology". Again, even when using the "mind as computer" metaphor, it seems clear that one cannot

describe, explain, or predict a computer's behavior without recourse to the specifics of the application software that is running on it.

There is a strong methodological commitment to reductionism within cognitive psychology (Gardner, 1985), a commitment that is particularly strong among decision theorists (Goldstein & Weber, 1995). The field is dominated by a focus on thinking, cognition, and information processing as it occurs at the individual level, largely distinct from context (Gigerenzer & Fiedler, 2003) and, in particular, the meaning-laden content of values and beliefs (Bruner, 1990; Shweder, 1984, 1990; Shweder & Sullivan, 1990). This is extremely useful in terms of adding control to studies and ruling out confounding variables, but it may be no wonder that much of what has been found to influence decisions depends on cognitive heuristics and biases that are largely divorced from context.

Does blackjack generalize to other domains?

At this point, the reader may reasonably wonder whether the current study generalizes beyond blackjack at all, or whether it even generalizes to blackjack in other locations. Indeed, one of the arguments of this study is that not only are other decisions not just like gambles, but not even gambling decisions are "just like gambles" since gambling choices depend significantly on a) the particular structure and dynamics of the gambling task, including its sociocultural and physical characteristics, b) the values and beliefs the gambler brings to the task, and c) experience and learning as it occurs within the domain. In this respect, I *would* argue that the psychology of casino blackjack is

multifaceted and its nature will vary from place to place, group to group, and individual to individual.

Indeed, this is largely the conclusion drawn by Wagenaar after his and Keren's study of casino gamblers. He writes: "The study of gambling behaviour has taught us that such rules [heuristics] should take into account individual notions, conceptions, and values, so that a separate network of heuristics can be specified for each individual" (Wagenaar, 1988:116). I would agree, while adding that it should also take into account subtle differences in the decision environment, and a separate network of heuristics would need to be specified for each individual-environment combination, including the environment of values, beliefs, and practices that are shared within one's culture.

It might (rightly) be argued that trying to understand decision processes at such a detailed and context specific level is not realistic. We do not have the resources or time to try to construct an individual model of blackjack playing for each individual and for each possible set of environments, nor would it be worthwhile if we could. General models are more useful and they have the added virtue that their construction is not beyond the scope of possibility. I would largely agree; but in coming to this conclusion it should be clearly recognized that the more-general models are created at the expense of understanding. This said, it is worth considering the degree to which the blackjack strategies and beliefs described here might generalize to other gambling activities as well as the degree to which the casino environment could be said to be "the real world".

Are blackjack players' strategies and beliefs like other casino gamblers' strategies and beliefs?

Many of the strategies and beliefs common to blackjack players are common to casino gamblers of other types. Thus, there are more general structural features largely unique to gambling but common to most casino gambles that contribute to the illusion that past hot and cold streaks in luck can be used to predict future probabilities of success. Similarly, the subjective devaluation of money seems to be common to the experience of winning across many domains. At the same time, even these beliefs are quite idiosyncratic from gambler to gambler and from game to game. For example, lottery players, who win much less often than blackjack players due in large part to the structure of the game, will likely not develop a belief that luck runs hot and cold. Slot machine players will, but their expectation of the pattern will be quite different in line with the different pattern in wins and losses. Roulette players can largely influence their subjective experience of streaks depending on how many numbers they choose to bet on, and how they vary their bets over time. I believe it would be well worth the effort to conduct intensive ethnographic and experimental studies of each casino activity in an attempt to identify the unique and shared structural features that attract different types of gamblers and that contribute to different sets (and degrees) of strategies and beliefs.

Are casinos "the real-world"?

One of the premises of this study is that it is important to examine decision processes in the "real world", using real decision problems, with substantive consequences, as they occur and develop in actual sociocultural communities. Yet one

might wonder whether casinos should be considered such environments at all. After all, it could be argued, casino games have been designed in much the same way that decision experiments have: with the express intention of creating an environment that will elicit biased perceptions and beliefs about the relationship between decisions and decision outcomes. As such, it is worthwhile considering the degree to which casino gambling is and is not equivalent to other kinds of real-world decision making.

Casino gambling is like other real-world decisions in the sense that the decision tasks have real consequences. Furthermore, although the sociocultural communities that develop around casino gambling activities may have more in common with one another than they do with the broader society from which their members are drawn, they are sociocultural communities all the same. Thus, unlike in experimental studies, it is possible to look at how the community itself participates in and contributes to the decision process, and it is possible to see whether the decision processes change over time as the culture develops around the decision tasks. For example, few if any of the strategies and beliefs endorsed by experienced casino blackjack players have significantly negative consequences. While increasing one's bets after losses is not uncommon among beginning players, and is endorsed by many (in the form of Martingale-type betting systems, chasing one's losses, or expression of some type of gambler's fallacy), experienced players almost never endorse such strategies, and most see them as the sign of a poor gambler. This is a consequence both of individual experience and of the development of community-wide values and beliefs that can be transmitted quickly to beginning gamblers without them having to learn from personal experience. Thus, the

experience of learning within a sociocultural context with real consequences may be as much a part of casino gambling as it is a part of other complex social decisions.

At the same time, many features of casino gambling are in fact unlike most other real-word decisions. As far as I could tell, in the locations where I conducted my field research, the belief that luck runs hot and cold and that this can be used to predict future outcomes is relatively rare outside the gambling community, while it is standard among experienced gamblers. This belief seems particularly related to the structure of the gambling activities: nearly equivalent outcome probabilities and identically weighted outcome values for each possible outcome, and the possibility for rapidly repeated trials. What other activities exist where the difference in probability between success or failure given a choice is so close to zero and the choice is often repeated continuously tens, even hundreds of times per hour. The only two non-gambling activities I could think of that even come close are day trading in the stock market and certain professional sports with particularly high scoring such as basketball, and in both domains there is evidence of a similar cognitive illusion (Gilovich et al., 1985; Tversky & Gilovich, 1989a).

As compared to most real-world decisions, the “tradition” and “culture” surrounding casino blackjack has been developing for a relatively short period of time. This may have significant consequences with regard to the types of practices and beliefs commonly expressed by casino gamblers, and to the degree one might expect these practices to be adaptive. In addition, there is a selection bias in the casino environment quite different from broader cultural communities, where most members are born into the group rather than choosing it. Casino gamblers probably *are* more likely to have false

beliefs about their chances of winning and how best to do so, not just from their experiences in the casino but also because that was what drew them to the casino in the first place.

The comparison between casino gambling and experimental decision research made above is also not altogether inappropriate. Casino gambling choices involve a predefined and limited set of choices, a limited and known set of possible outcomes, known or knowable probabilities of success, and an associated dollar value for success. These are the features that make casino gambling more amenable to a rational choice analysis, and they are features common to many experimental gambling-type decision problems. But such features are quite distinct from most real-world decisions, where possible choices are often unknown and essentially unlimited, possible outcomes and their probabilities can only be guessed at, and the utility of these possible outcomes is less directly related to easily translatable monetary values and may be unknowable ahead of time. In these respects, I would expect casino gambling to share many of the features of experimental decision research that make many of its findings at once applicable to gambling decisions and of questionable relevance to most other real-world decision tasks.

At the same time, the fact that casino blackjack involves artificially constrained decision tasks makes the findings presented here in some ways more significant than they might otherwise be. One might acknowledge that the processes and quality of most complex social decisions would depend essentially on the sociocultural environment and on pre-existing values, practices, and beliefs of the decision maker. One might furthermore acknowledge that given such domains, the findings from experimental

research into basic decision processes are of questionable relevance. Yet even with such acknowledgements, one could reasonably expect that casino gambling decisions would be different from other real-world decisions, and could be sufficiently explained by the heuristics and biases research tradition. The variety of strategies and beliefs discussed here, and their complex and sensitive dependence on features in the sociocultural environment suggest otherwise.

Indeed, although casino blackjack is analyzable in terms of expected value, players make decisions in much the same way they make other complex social decisions: through the use of domain-specific heuristics learned from individual experience and the experience of the broader sociocultural community, and interdependent with the values, practices, and beliefs shared and widely available to the group, with little attempt to calculate probabilities, to assess utilities, or to (consciously) maximize expected utility. It is time to acknowledge that not even gambling decisions are context-free, nor are the processes involved in making these decisions "basic" processes. At the very least, they depend on characteristics of the sociocultural community; the values, beliefs, and practices of the individual decision maker; subtle features in the structure and dynamics of the decision task; and learning at both the individual and community level.

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APPENDIX A
GLOSSARY OF BLACKJACK TERMS

Basic strategy/playing by the book: For a detailed description, see *Appendix C*. The *basic strategy* indicates the best way to play each hand without using a counting system (or cheating), assuming the player's goal is to maximize expected return. It is often referred to as *playing by the book*. It depends on the make up of both the player's cards and the dealer's upcard, and it varies slightly depending on the particular blackjack rules in one casino or another.

Blackjack: In addition to being the name of the game, *blackjack* is a two-card twenty-one (i.e., any ten-value card with an ace). It beats all other types of twenty-one (i.e., all twenty-ones with three or more cards). If the player gets a blackjack the casino pays the player a bonus of an additional one-half the player's original bet.

Bust: *Busting* is the act of getting a point total higher than twenty-one, which results in an automatic loss. If both the player and the dealer bust, the player still loses, the only tie that the player loses and the source of the casino's advantage in blackjack.

Busting hand/bust hand: *Busting hands* or *bust hands* are hands lower than seventeen that will exceed twenty-one, and thus bust, if they are hit with a ten, that is hand totals from twelve to sixteen. When the dealer has a two through six showing, these hands are also commonly called busting hands, since it is often assumed that the dealer

has a ten-value hole card and these are in fact the upcards for which the dealer is most likely to bust.

Card counting/card counters: For a detailed description see *Appendix D. Card counting* is a method for keeping track of past cards removed from the deck in order to give the player an advantage. Card-counting systems usually require the player to 1) assign plus and minus values to low and high cards, respectively, 2) add these values as the cards are removed from play; 3) normalize this sum based on the number of cards remaining to be dealt, and 4) adjust playing and betting decisions according to the this normalized number. Under ideal circumstances using such systems can give the player an advantage over the casino.

Dealer: The *dealer* (or croupier) works for the casino. Players win or lose depending on how their cards perform against the dealer's cards. The dealer must play according to predetermined rules set by the casino that do not depend on the players' hands. Usually these rules require the dealer to *hit* with sixteen or less and to *stand* with seventeen or more, although hitting with a *soft* seventeen is also common.

Double down: Players who *double down* are required to double the size of their initial bet. In turn they get exactly one additional card. Players have the option to do this after the deal, but only with their initial two cards or with the new two-card hands created after *splitting*.

Even money: See *Insurance*.

Eye in the sky: Smoked plastic semicircles are situated on the ceiling throughout most casinos. Inside each one is a video camera and together they make up the main

component of the surveillance system used by casinos, informally referred to as the *eye in the sky*. Many are recording. Together every table and seat in the casino is potentially under observation.

First base/third base: *First base* refers to the first person to the dealer's left. This is the first person to play after the deal. *Third base* refers to the player closest to the dealer's right. This is the last person to play before the dealer. The terms use a baseball analogy and are not used in the Czech Republic.

Floor supervisor: See *pit*.

Hard hand/soft hand: Hands without an ace or hands for which the ace can only legally be used as a one are called *hard hands*. If the ace can be used as either an eleven or a one, this is called a *soft hand*. For example, if the player (or dealer) has an ace and a five this is referred to as a soft sixteen (not a soft six). The dealer often refers to it as "six, sixteen", to indicate the two different possible values. Players can hit this hand without the risk of busting, since even receiving a ten would only make the hand a hard sixteen.

Hit: *Hitting* is the act of taking an additional card. Players tap their fingers or move their hands toward themselves to indicate that they want to hit.

Hole card: The *hole card* is the face down card in the dealer's hand. Player's do not get to see this card until after they have finished making their play choices. In the U.S., if the dealer has a 10 or ace showing, he or she usually checks the hole card for a blackjack before players commence play. If the dealer has a blackjack, the dealer takes all losing bets except double down or split bets. Dealer's in the Czech Republic (and throughout most of Europe) do not receive a hole card, but rather take their second and

all additional cards after the players have finished their turns. Unlike in the U.S., Czech players lose their double down and split bets. This rule difference leads to changes in the basic strategy, different expected costs against all dealer 10s and aces, and it contributes to different playing strategies across the two locations.

Insurance/even money: If the dealer has an ace showing, players have the option to place half their initial bet onto a special spot to take *insurance*. The dealer then looks at his or her hole card and if there is a 10-value card—giving the dealer a blackjack—the insurance bet pays two to one, thus paying the amount the initial bet. If the player has a blackjack when the dealer has an ace up, players have the option to take *even money*—that is, to win exactly the amount of their original bet—before the dealer checks his or her hole card for a blackjack (as compared to not taking even money and either winning three to two for the blackjack or pushing and winning nothing if the dealer ends up having a blackjack). Taking even money turns out to be monetarily identical to taking insurance with the same hand. Both plays have a negative expected return that all insurance decisions have.

Pit/pit boss/floor supervisor: Table games are arranged in an oval so that all of the players are on the outside facing dealers who are inside. The inside of this oval is known as the *pit*. *Pit bosses* are the highest level of manager within a pit. *Floor supervisors* are similar to pit bosses except that their domain is smaller. They are responsible for supervising anywhere from one to four tables depending on the game and the time of day, whereas the pit boss is responsible for the entire pit.

Push: When the player and the dealer tie (have the same point total) this is called a *push*. The player neither wins nor loses. There are two exceptions. When the player busts, the dealer takes the bet right away. If the dealer ends up busting also, the player still loses. This is therefore not a push. A blackjack (two-card 21) and a three or more card 21 is not considered a push. The blackjack (a.k.a. natural) always wins, whether it is the player's or the dealer's. If both the dealer and the player have a blackjack this is considered a push, unless the player opted for even money.

Shoe: The *shoe* is a plastic box that holds the decks of cards after they have been shuffled. The dealer draws cards from the shoe to deal to the players. Blackjack games use from one to eight decks. One or two deck games do not use a shoe; four, six, and eight deck games do. In all locations where I conducted my fieldwork, six-deck shoes were the most common. In the Czech Republic, all games use six-deck shoes. In the two casinos in Indiana, all games used six- or eight-deck shoes, although there was a high-limit room with a hand-dealt two-deck game. In the casino near Las Vegas where I worked, I always dealt six-deck games, although one- and two-deck games were available. Throughout Las Vegas, one, two, six, and eight deck games were offered at the various casinos available where I was a participant-observer.

Soft hand: See *hard hand*.

Split: If the first two cards dealt to a player are the same (including any two ten-value cards), the player has the option to double his or her bet, split the two cards and play them as two separate hands, a choice known as *splitting*. Players can split the same card up to three times in a single hand (thus playing up to four separate hands). Players

can only split aces once, and they are not allowed to hit after each ace is made into a two-card hand. If either or both of the split aces get tens, they are not treated as blackjacks but instead as standard twenty-ones; that is, they lose to a dealer blackjack, push to a dealer twenty-one, and only payout one to one, rather than three to two. The most common rules in all locations where I conducted fieldwork allow players to double down after splitting their hands, although many casinos in Las Vegas do not allow this option.

Stand: Players *stand* when they have finished making all play choices (except when they bust). In other words, standing involves the choice to stop taking additional cards and end one's turn. Players signal this by holding their (flesh and blood) hand horizontally above their cards and moving it side to side.

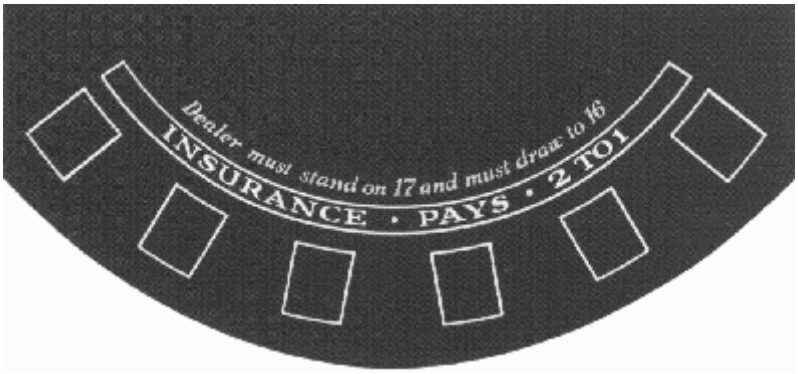
Third base: See *first base*.

APPENDIX B
BLACKJACK RULES

Blackjack rules vary to some degree from location to location. The rules discussed here refer to those offered in Las Vegas at the tables where I dealt cards and in the casino where I conducted interviews, in the northwestern Indiana casinos, and in Prague. The end of this section will consider some common rule variations, including those that are offered in many areas of Las Vegas where I conducted fieldwork.

The goal of blackjack is to get a higher point total than the dealer without *busting* (getting more than twenty-one points). All cards are worth their face value with two exceptions: face cards (jacks, queens, and kings) are each worth ten points, and aces are worth either one or eleven, depending on which makes a better hand. Blackjack is played on a felt-top table with six or seven places for players who sit around a crescent shaped table facing the dealer, an employee of the casino. As few as one person can play, and each person can use more than one betting spot (assuming it is available), although in the U.S., the minimum bet per hand is higher for players who wish to play more than one hand per round. Each player competes only against the dealer, not against the other players.

Figure 3. Common blackjack layout



Before the cards are dealt, players place their bets onto a circumscribed space in front of them on the felt. Players have the option to bet as much as they would like constrained by a minimum and maximum bet which is indicated at each table.[1] Bets are made in the form of casino chips that have various monetary values signified by both a color and a printed value. These may be purchased from the dealer at the table. Once all bets have been placed, two cards are dealt face up to each player and, in Las Vegas and Indiana, two cards to the dealer, one face up and the other face down (the latter known as the *hole card*). In the Czech Republic, no hole card is dealt to the dealer. Players are not

[1] In Las Vegas minimums go as low as $1 per hand, although in most Las Vegas Strip casinos the lowest minimums are between five and ten dollars. Fancier casinos have certain tables with minimums as high as $100 or higher. Maximums tend to be around one thousand times the minimum bet at the table, with a cap at around $10,000. In Indiana, minimums ranged from as low as five dollars (though usually ten dollars) to as high as one hundred dollars; maximums from as low as $1,000 to as high as $10,000. In Prague casinos tend to have tables with minimums that range from one or two hundred crowns (approximately $3.70-7.40) at the lowest tables and 500 crowns (approximately $18.60) at the highest tables. Maximums are only ten to thirty times the minimum at the tables, ranging from 3,000 to 10,000 crowns (approximately $111 to $370).

allowed to touch their cards; instead they signal their play choices using hand motions or by placing additional chips on the table.[2]

Cards are dealt from a plastic box called a *shoe*, which holds four, six, or eight normal decks of cards which have been shuffled together (the total number depending on the region, the particular casino, and even the location within the casino).[3] After the cards have been dealt, the dealer hands a blank plastic card to one of the players at the table, which the player inserts into the stack of cards, marking the place where the dealer will cut (separating and inverting the top and bottom halves of the stack of cards). Subsequently, this card is inserted into the shuffled cards, usually about two-thirds of the way down, before placing the cards in the shoe and beginning to deal. When the plastic card is reached (after several rounds of dealing), that particular round of play continues until it is finished, then all of the cards are again shuffled together before beginning the next round.

The payout system in blackjack works as follows: If the player busts or if the dealer does not bust and the player gets a lower point total, the player loses and the dealer takes the player's bet. If the player and the dealer have the same amount, called a *push*, no money is won or lost, and the player may take his or her original bet back, leave it out for the next round, or add to it. If the player has a higher point total than the dealer, or if

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[2] Hand motions are generally required so that the video surveillance can record the player's choice in order to settle potential subsequent disputes.

[3] In the locations where I conducted my fieldwork, four-deck shoes were not used.

the player does not bust and the dealer does, then the player wins the amount of their original bet.

If the first two cards are an ace and a ten-value card, the player (or dealer) has a *blackjack*. Blackjack is the most powerful hand in the game, winning against all other hands, including other hands worth twenty-one points that are not blackjacks. The player also receives a bonus for blackjack of an additional one half of the original bet (assuming the dealer does not also have a blackjack, in which case the player and dealer push).

Once the hands have been dealt, play proceeds with the first player to the dealer's left, who must make all of his or her play choices before the next player's turn. Players have as many as six different choices in blackjack: *hitting, standing, doubling down, splitting,* and *taking insurance* or *even money*. The two most common choices are between *hitting* and *standing* which involve, respectively, either taking additional cards or not taking additional cards and ending the turn.

Doubling down is an option on the player's first two cards. This requires doubling the original bet at which point the player receives exactly one additional card, no more, no less. If players would like to *double down* for less than the amount of their original bet, they may.

Splitting is an option if the player's first two cards have the same value, including any two ten-value cards, such as a ten and a king. Splitting requires the player to match his or her original bet, as with doubling down. The dealer then usually asks whether the player wishes to double or split, and once "split" is indicated, separates the two cards placing one of the bets in front of each card, and dealing a second card to each original,

so that the two cards make two new hands which are then played separately. If the split cards are aces, the player can only receive one card to each ace, and if this new card is a 10-value card, the hand only counts as a normal twenty-one, not as a blackjack. With all other split hands, the player may hit, stand, and double down as though playing a new hand.

If the dealer's upcard is an ace, players are given the option to take *insurance* before they begin play. The insurance bet is a side bet that the dealer will have a blackjack. The standard insurance bet is half the amount of the player's original bet, although players are allowed to insure for less than half if they wish. If the dealer has a blackjack, the insurance bet pays the player two to one, covering the amount of the player's original bet (assuming the player insures for the maximum amount), thus the name. If the dealer does not have a blackjack, the insurance bet is lost, and play commences as normal.

If one of the players has a blackjack given the insurance choice, this player has the option to take either *even money* or insurance*,* or just even money, depending on the rules in a particular location. If the player takes even money, the dealer pays out the amount of the player's original bet before checking the hole card for a blackjack, thus guaranteeing the player a win. If the player does not take even money, play commences as usual, such that the player either wins 1.5 times his or her original bet if the dealer does not also have a blackjack, or pushes, neither winning nor losing, if the dealer does have a blackjack. Taking even money results in an identical outcome to taking insurance for the full amount, although many players (and many casino employees) do not realize

this. In both cases, a player with blackjack will win exactly the amount of their original bet, whether or not the dealer ends up having a blackjack.

In Las Vegas and Indiana, before participants commence play, the dealer checks for a blackjack (assuming he or she has either a ten-value or ace upcard) using a mirror built into the table. If the dealer has a blackjack, all losing bets and the corresponding cards are removed from the table. Double-down or split bets are not lost since they have not yet been placed. If the dealer does not have a blackjack, play commences as usual. In the Czech Republic, the dealer does not have a hole card, and thus does not check for a blackjack before play commences. If any players have blackjacks, they are also paid immediately (assuming the dealer does not also have a blackjack) and their hands are removed from the table. During a player's turn, if they bust, their bet is immediately removed and their cards taken away, such that even if the dealer subsequently busts, the player still loses.

When all the players have finished with their turns, the dealer either turns over his or her hole card (in Las Vegas and Indiana) or takes a second card from the shoe (in the Czech Republic). The dealer must then hit or stand by a set of predetermined rules that do not depend on the players' cards. If the dealer's total is sixteen or less, the dealer must hit. If the total is seventeen or more, the dealer must stand. Thus, even if every player at the table has an eighteen and the dealer only has a seventeen, the dealer must stand, losing to all players at the table. If the dealer receives a blackjack in the Czech Republic, the casino takes the players' split and double-down bets along with the original bets.

The player has the following advantages over the casino: they can see previous cards dealt out of the shoe, the dealer's upcard, and their own cards, and then choose how to play their hands accordingly, while dealers must play their hands uniformly regardless of what the players have or what has been removed from the deck; they can choose to double their bets by doubling down or splitting after they have seen their own hand and the dealers' upcard, selectively increasing the amount they can win based on their initial cards; and blackjacks pay an additional one-half the player's original bet, even though a dealer blackjack only wins the amount the player risks. The casino advantage comes from the fact that the most common type of tie, when both the player and the dealer get more than twenty-one, goes to the casino since the casino takes the players' money the moment the player busts, even if the dealer subsequently busts as well. Under normal circumstances this advantage overwhelms all of the player advantages.

While this set of rules is standard for the casinos where I conducted my fieldwork, there are a number of blackjack rule variations that frequently occur around the U.S. and around the world (and often even within the same casino from table to table). The common rule variations include 1) the number of decks used, which commonly include one-, two-, four-, six-, and eight-deck games; 2) whether or not the player may double down after splitting; 3) whether or not the player may double down on any two cards, or only a subset, usually limited to ten and eleven, or nine, ten, and eleven; 4) whether the dealer hits or stands with a *soft seventeen*; whether the dealer waits until after play choices have been made to check for a blackjack and then keeps or returns double-down and split bets; and whether or not players may *surrender* their hands, which involves

giving up half of one's bet after the cards have been dealt but before any play choices have been made, and throwing in one's cards. In Las Vegas, when this latter rule is allowed, it is only permitted after it has been determined that the dealer does not have a blackjack. In the Czech Republic, it is not permitted against the dealer's ace. These rule differences all have repercussions for how people in fact play their hands, for how they ought to play their hands given the goal of maximizing expected value, and for the casino's advantage assuming optimal play. A number of conventions also vary from casino to casino, such as whether the cards are dealt face up or down and whether the player can touch the cards (they are dealt face down and the player can touch the cards in single- and double-deck games), whether the player can take insurance with a blackjack or just even money, whether the player can insure or double down for less, and whether gamblers can place bets on the outcome of other players' hands (they can in the Czech Republic, but not in Las Vegas or Indiana).

APPENDIX C
THE BASIC STRATEGY

The *basic strategy* indicates the statistically best way to play each hand without using a card-counting system (or cheating), assuming one's goal is to maximize expected value. The basic strategy depends on two cues: the value of the dealer's upcard and the player's hand. A correct basic strategy for a particular set of blackjack rules was not calculated until 1956 (Baldwin, Cantey, Maisel, & McDermott) when a team of statisticians worked it out. The correct basic strategy, however, varies from casino to casino, and sometimes from table to table depending on a variety of common rule variations, including the number of decks being used. The specific basic strategies for various rule changes were not determined until the 1960s when high speed computers were programmed to simulate all of the different hand combinations millions of times in order to determine the true odds for a particular play choice given a particular set of rules (Revere, 1980; Thorp, 1966).

Today the various basic strategies for common rule variations are widely available. They are printed in most books on blackjack, often for sale in U.S. casino gift shops, and many casinos in Las Vegas sell credit-card-sized plastic laminated cards with

some version of the strategy that can be used by players at the table (see *Figure 4*).[1] When the strategy was first developed, blackjack rules were favorable enough for the player that perfect play often gave the player a positive expected return. Today's casinos have changed their rules so that they retains a slight advantage over the perfect basic-strategy player, usually between about 0.2% and 0.5%, depending on the blackjack rules offered at the particular casino (if the casino has a 0.5% expected return, then for every $100 a gambler risks, the casino will retain fifty cents, on average over the long term). The expected cost to the player for perfect basic strategy at the casinos where I conducted my field research is 0.43% and 0.53% (Janecek & Tesinsky, 2003), respectively, depending on whether or not the casino returns (United States) or keeps (most of Europe including the Czech Republic) double down or split bets when the dealer receives a blackjack.[2]

Table 16 indicates the basic-strategy chart that applies to the most common blackjack rules offered in the Las-Vegas-area casino where I dealt cards, the Las-Vegas-Strip casino where I conducted most blackjack strategy interviews, and the Las Vegas, Indiana, and Czech casinos where I engaged in participant observation as a gambler. The strategy is for six decks (Las Vegas, Prague, and Indiana) or eight decks (Indiana and Las Vegas), where doubling down after splitting one's cards is allowed, doubling down on

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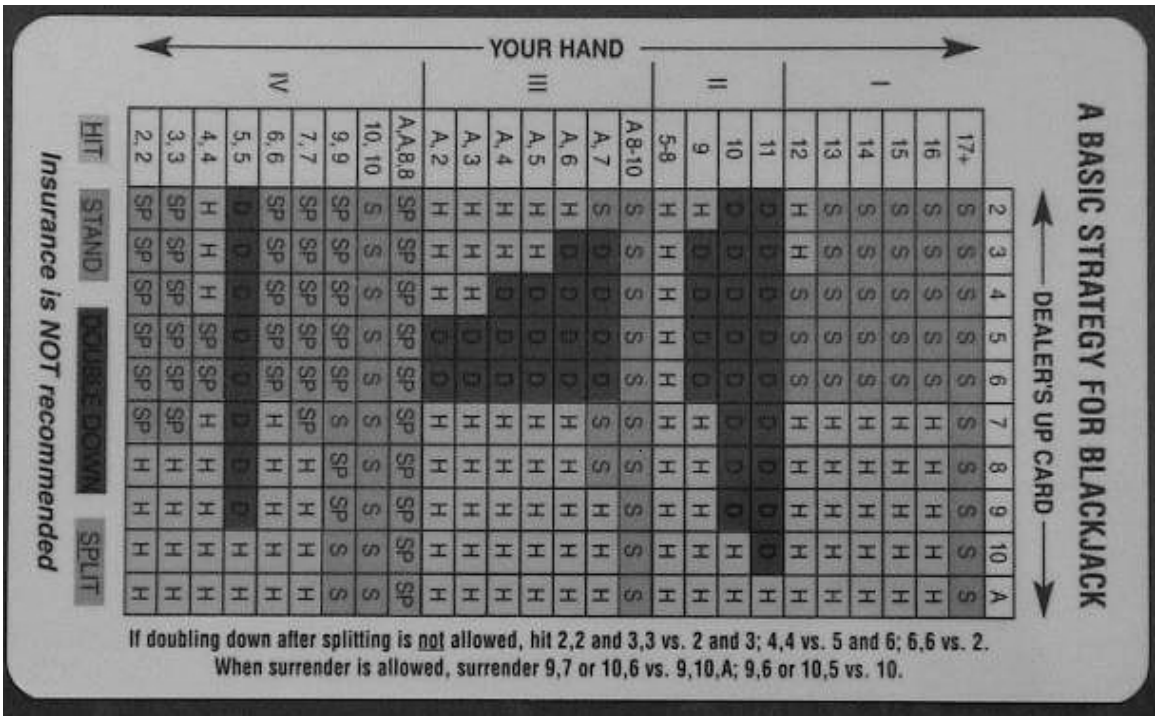
[1] It should be noted, however, that basic strategy charts given away by casinos or printed in books are often not optimal for the particular casino rules, and in many cases the charts are gross simplifications of optimal basic strategy.

[2] These returns are based on the initial bet amount (i.e., not including bets made after the hand has begun for splitting and doubling down), the more common convention in blackjack for calculating expected return. The expected values based on the total bet amount are 0.38% and 0.48% respectively.

any first two cards is allowed, and the dealer stands on soft-seventeen (a hand worth either seven or seventeen because of the ace).

Figure 4: Credit-card-sized basic-strategy chart (Instructional Services, 2000)



The one common rule difference in Prague casinos is that the dealer there does not take a face down (*hole*) card. Dealers in Las Vegas and Indiana check for a blackjack before the players have made their decisions, and do not allow the players the option to double down or split in cases where the dealer does have a blackjack (good news for the player, since they do not lose these additional bets in cases where the dealer has a blackjack). Czech dealers do not take a hole card, and thus have no way to determine whether or not they have a blackjack until after all players have finished their turns, at which point—in the event the dealer does have a blackjack—the dealer takes both the players' original bets and their double down and split bets (bad news for the players,

Table 16. The basic strategy (Janecek & Tesinsky, 2003; Wong, 1994)

KEY	
Sp	SPLIT
V	VARIES: Sp/Db in US; do not Sp/Db in CR
Db	DOUBLE
	NEXT CHART
H	HIT
S	STAND

Decisions should be made sequentially,
beginning with Chart 1,
and concluding with Chart 4.

1) NEVER TAKE INSURANCE

3) DOUBLE vs. DO NOT DOUBLE

Player's 2-card total	Dealer's up-card 2	3	4	5	6	7	8	9	X	A
8										
9		Db	Db	Db	Db					
10	Db	Db	Db	Db	Db	Db	Db	Db		
11	Db	Db	Db	Db	Db	Db	Db	Db	V	
12										
AA										
A2				Db	Db					
A3				Db	Db					
A4			Db	Db	Db					
A5			Db	Db	Db					
A6		Db	Db	Db	Db					
A7		Db	Db	Db	Db					
A8										

2) SPLIT vs. DO NOT SPLIT

Player's 2-card total	Dealer's up-card 2	3	4	5	6	7	8	9	X	A
22	Sp	Sp	Sp	Sp	Sp	Sp				
33	Sp	Sp	Sp	Sp	Sp	Sp				
44				Sp	Sp					
55										
66	Sp	Sp	Sp	Sp	Sp					
77	Sp	Sp	Sp	Sp	Sp	Sp				
88	Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp	V	V
99	Sp	Sp	Sp	Sp	Sp		Sp	Sp		
XX										
AA	Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp	V

4) HIT vs. STAND

Player's 2-card total	Dealer's up-card 2	3	4	5	6	7	8	9	X	A
11	H	H	H	H	H	H	H	H	H	H
12	H	H	S	S	S	H	H	H	H	H
13	S	S	S	S	S	H	H	H	H	H
14	S	S	S	S	S	H	H	H	H	H
15	S	S	S	S	S	H	H	H	H	H
16	S	S	S	S	S	H	H	H	H	H
17	S	S	S	S	S	S	S	S	S	S
A6	H	H	H	H	H	H	H	H	H	H
A7	S	S	S	S	S	S	S	H	H	H
A8	S	S	S	S	S	S	S	S	S	S

since they lose these additional bets). This leads to four changes to the basic strategy in the Czech Republic, changes that have been indicated with *V* in the table.

The basic strategy is a binary system, in the sense that there is a simple yes no choice between whether or not to take insurance, whether or not to split, whether or not to double down, and whether to hit or to stand, but in fact each violation of basic strategy in the previous chart has a different cost to the player. Some violations are very costly (e.g., splitting two 10s against a dealer's 9, which has a net expected cost of 105% as compared to the best play—standing), others are essentially arbitrary (e.g., standing with a 16 against a dealer's 10, which has a net expected cost of 0% as compared to the best play—hitting). As such, when assessing the normativity of an actual blackjack players' strategy, the cost of their particular violations is an important factor.

Tables 17a through *17c* indicate these costs (these tables were constructed using simulation data provided by Cacarulo, 1998). Costs are rounded to the nearest percentage point. Cells across the top row indicate the dealer's upcard. Cells down the left column indicate the player's hand. Soft hands are indicated by an "s". Aces are indicated by "A" and 10-value cards are indicated by "T". A second version of the dealer's 10-value and ace upcards has been provided assuming the rules in the Czech Republic, where the player does not yet know whether the dealer will get a blackjack when making play choices (as opposed to the Las Vegas and Indiana, where the dealer knows the dealer does not have a blackjack). Cells for which the correct basic strategy is to split, double, or hit, respectively, are in bold and are outlined with a thick border. The percentages given in these cells indicate the cost of violating basic strategy by making the next best play.

Table 17a. Expected cost for violating basic given cues: Split vs. do not split

Sp	2	3	4	5	6	7	8	9	T	A	T	A
22	4%	8%	12%	18%	23%	10%	2%	15%	21%	18%	27%	44%
33	1%	6%	12%	18%	23%	10%	1%	14%	21%	17%	27%	43%
44	17%	11%	4%	3%	4%	26%	27%	30%	37%	36%	42%	56%
55	65%	62%	58%	53%	54%	70%	75%	79%	76%	76%	78%	83%
66	6%	13%	21%	27%	31%	3%	14%	25%	33%	30%	38%	52%
77	17%	22%	28%	33%	41%	28%	1%	14%	18%	20%	24%	45%
88	37%	40%	44%	47%	56%	73%	42%	12%	6%	15%	2%	21%
99	7%	11%	15%	19%	18%	4%	13%	10%	14%	3%	21%	33%
TT	56%	49%	41%	33%	28%	52%	80%	105%	100%	100%	100%	100%
AA	40%	43%	45%	47%	49%	31%	27%	24%	25%	15%	16%	21%

Table 17b. Expected cost for violating basic given cues: Double vs. do not double

Db	2	3	4	5	6	7	8	9	T	A	T	A
7	32%	28%	23%	18%	16%	51%	64%	67%	63%	81%	66%	87%
8	18%	14%	10%	6%	2%	26%	39%	50%	50%	61%	54%	73%
9	1%	3%	6%	10%	13%	6%	12%	25%	31%	36%	36%	56%
10	18%	21%	24%	27%	29%	14%	9%	3%	3%	9%	11%	37%
11	24%	26%	29%	32%	34%	17%	12%	7%	6%	2%	2%	33%
12	25%	23%	21%	22%	19%	29%	35%	40%	41%	48%	46%	64%
s13	11%	7%	4%	0%	3%	30%	37%	41%	41%	56%	45%	70%
s14	9%	5%	1%	2%	5%	26%	32%	37%	37%	52%	42%	67%
s15	7%	3%	0%	4%	6%	21%	29%	34%	34%	49%	39%	65%
s16	5%	2%	2%	5%	8%	18%	25%	30%	31%	46%	36%	63%
s17	0%	3%	6%	10%	13%	6%	18%	24%	26%	35%	31%	55%
s18	0%	3%	7%	10%	10%	18%	14%	19%	20%	27%	26%	49%
s19	15%	10%	7%	3%	1%	30%	40%	36%	30%	47%	35%	63%
s20	28%	24%	20%	16%	13%	39%	51%	62%	57%	68%	60%	78%

Table 17c. Expected cost for violating basic given cues: Hit vs. Stand

H-S	2	3	4	5	6	7	8	9	T	A	T	A
12	4%	2%	0%	3%	2%	26%	24%	20%	16%	31%	15%	22%
13	2%	4%	7%	9%	8%	20%	19%	16%	12%	27%	11%	19%
14	7%	10%	13%	16%	15%	15%	14%	11%	8%	23%	7%	16%
15	13%	16%	19%	22%	21%	11%	10%	7%	4%	18%	3%	13%
16	18%	21%	25%	29%	27%	7%	6%	4%	1%	15%	0%	10%
17	38%	41%	45%	47%	51%	37%	12%	13%	16%	8%	15%	6%
s17	15%	14%	14%	14%	12%	16%	31%	27%	22%	30%	21%	20%
s18	6%	6%	6%	5%	9%	23%	7%	8%	4%	0%	3%	0%
s19	27%	25%	24%	24%	25%	39%	44%	28%	15%	29%	14%	20%
s20	46%	44%	43%	41%	42%	52%	60%	65%	53%	58%	49%	40%

The percentages given in other cells indicate the cost of violating basic strategy by splitting, doubling, or hitting, respectively, depending on the chart. For easy reference, cells for which the expected cost of violating basic strategy is 35% or greater are highlighted in dark grey, cells for which the expected cost is from 15% up to 35% are highlighted in light grey, and no highlighting is used for cells where the expected cost of violating basic strategy is less than 15%. It should be stressed that these figures do not indicate the expected cost for making the particular play choice, but rather the cost of violating basic strategy. Thus, going back to an earlier example, if the player has a total of 12, and the dealer has a 6, the basic strategy calls for standing, which has an expected cost of 15.38%. If, in the Hit vs. Stand Chart, the player violated basic strategy by hitting, this would have an expected cost of 17.05%. The difference in expected cost is 1.67% which is rounded up to 2% and entered in the table. If, in the Double vs. not-double Chart, the player indicated they would double down given this same hand, it would have an expected cost of 34.10% over the correct basic-strategy play, standing. The difference in expected cost is 18.72%, which has been rounded up to 19% and entered in the Double vs. not-double chart.

A second consideration again related to the player's expected value is the frequency with which a particular choice must be made. Certain combinations of hands occur more frequently than others. Since players see these hands more often, and thus receive more frequent outcome feedback, one might expect the more commonly occurring hands to be played better. Similarly, by misplaying the more frequently occurring hands, there is a higher expected cost than by misplaying rarely occurring

hands that have the same expected cost on any given occurrence. *Tables 18a* to *18c* indicate the frequency with which each set of basic-strategy cues occurs. The previous set of charts for expected costs provide a description of the chart layout. There are two changes in this layout. First, frequencies are rounded to the nearest hundredth of a percent. Second, the cells have been highlighted according to different rules. Cells for which the set of basic-strategy cues occur with a frequency of 0.3% or higher are highlighted in black; cells for which the frequency is from 0.1% to 0.3% are highlighted in dark grey; cells for which the frequency is from 0.05% to 0.1% are highlighted in light grey; and cells for which the expected cost of violating basic strategy is less than 0.01% are not highlighted at all. Notice that the relative frequency is quite low for split choices and quite high for hard hit-stand choices.

The product of these two sets of charts, that is, the product of the expected cost given a particular set of basic-strategy cues and the frequency of occurrence of that set of cues, equals the total expected cost for that particular basic-strategy violation. If a player violated basic strategy on every possible set of cues, their expected loss would be the sum of all these numbers, plus the expected loss for playing perfect basic strategy. If a person only violated basic strategy on two cells, their expected loss would be the sum of those two cells plus the expected loss for perfect basic-strategy play. This set of numbers can be found in *Tables 19a* through *19c*. In these charts, percentages are rounded to the nearest thousandth. Black highlighting indicates cells for which the expected cost exceeds basic-strategy expectation by 0.1% or greater; dark-grey highlighting, cells for which the expected cost is from 0.03% to 0.1%; light-grey highlighting, cells for which the xpected

cost is from 0.01% to 0.03%; and no highlighting, cells for which the expected cost is less than 0.01%.

Should we expect players to be equally attuned to frequency and cost? In some sense, this is like comparing apples and oranges. How many units of frequency should be compared to how many units of lowered expected value? At the same time, we can empirically examine the influence of both frequency and expected value on player's conformity to basic strategy. Perhaps there are cases where players are not well attuned to either due to other factors in the decision-making process, a consideration that will be given in this study.

Table 18a: Split vs. do not split basic-strategy-cue frequencies

Split		DEALER'S UPCARD										
		2	3	4	5	6	7	8	9	T	A	Total
PLAYER'S TOTAL	22	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	0.04%	0.04%	0.18%	0.04%	0.57%
	33	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	0.04%	0.04%	0.18%	0.04%	0.57%
	44	0.04%	0.04%	0.04%	**0.04%**	**0.04%**	0.04%	0.04%	0.04%	0.18%	0.04%	0.57%
	55	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.04%	0.18%	0.04%	0.57%
	66	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	0.04%	0.04%	0.04%	0.18%	0.04%	0.57%
	77	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	0.04%	0.04%	0.18%	0.04%	0.57%
	88	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.18%**	**0.04%**	0.57%
	99	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	0.04%	**0.04%**	**0.04%**	0.18%	0.04%	0.57%
	TT	0.73%	0.73%	0.73%	0.73%	0.73%	0.73%	0.73%	0.73%	2.85%	0.73%	9.40%
	AA	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.04%**	**0.18%**	**0.04%**	0.57%
	Tot	1.12%	1.12%	1.12%	1.12%	1.12%	1.12%	1.12%	1.12%	4.44%	1.12%	14.52%

Table 18b: Double vs. do not double basic-strategy-cue frequencies

Double		DEALER'S UPCARD										
		2	3	4	5	6	7	8	9	T	A	Total
PLAYER'S TOTAL	7	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.74%	0.18%	2.37%
	8	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.18%	0.74%	0.18%	2.37%
	9	0.27%	**0.27%**	**0.27%**	**0.27%**	**0.27%**	0.27%	0.28%	0.28%	1.10%	0.28%	3.56%
	10	**0.27%**	**0.27%**	**0.27%**	**0.28%**	**0.27%**	**0.27%**	**0.27%**	**0.28%**	1.10%	0.28%	3.56%
	11	**0.36%**	**0.36%**	**0.36%**	**0.36%**	**0.36%**	**0.36%**	**0.36%**	**0.36%**	**1.47%**	0.37%	4.75%
	12	0.63%	0.64%	0.64%	0.64%	0.64%	0.64%	0.64%	0.64%	2.56%	0.64%	8.31%
	s13	0.09%	0.09%	0.09%	**0.09%**	**0.09%**	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	s14	0.09%	0.09%	0.09%	**0.09%**	**0.09%**	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	s15	0.09%	0.09%	**0.09%**	**0.09%**	**0.09%**	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	s16	0.09%	0.09%	**0.09%**	**0.09%**	**0.09%**	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	s17	0.09%	**0.09%**	**0.09%**	**0.09%**	**0.09%**	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	s18	0.09%	**0.09%**	**0.09%**	**0.09%**	**0.09%**	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	s19	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	s20	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	Tot	2.63%	2.64%	2.64%	2.64%	2.65%	2.65%	2.65%	2.65%	10.65%	2.63%	34.43%

Table 18c: Hit vs. Stand basic-strategy-cue frequencies

Hit-Stand		DEALER'S UPCARD										
		2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**T**	**A**	**Total**
PLAYER'S TOTAL	**12**	**0.63%**	**0.64%**	0.64%	0.64%	0.64%	**0.64%**	**0.64%**	**0.64%**	**2.56%**	**0.64%**	8.31%
	13	0.64%	0.63%	0.64%	0.64%	0.64%	**0.64%**	**0.64%**	**0.64%**	**2.56%**	**0.64%**	8.31%
	14	0.55%	0.55%	0.54%	0.55%	0.55%	**0.55%**	**0.55%**	**0.55%**	**2.19%**	**0.55%**	7.12%
	15	0.55%	0.55%	0.55%	0.54%	0.55%	**0.55%**	**0.55%**	**0.55%**	**2.19%**	**0.55%**	7.12%
	16	0.46%	0.46%	0.46%	0.46%	0.44%	**0.46%**	**0.46%**	**0.46%**	**1.82%**	**0.46%**	5.94%
	17	0.46%	0.46%	0.46%	0.46%	0.46%	0.44%	0.46%	0.46%	1.82%	0.46%	5.94%
	s17	**0.09%**	**0.09%**	**0.09%**	**0.09%**	**0.09%**	**0.09%**	**0.09%**	**0.09%**	**0.37%**	**0.09%**	1.19%
	s18	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	**0.09%**	**0.37%**	**0.09%**	1.19%
	s19	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	s20	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.37%	0.09%	1.19%
	Tot	3.66%	3.66%	3.65%	3.65%	3.65%	3.64%	3.65%	3.65%	14.62%	3.66%	47.49%

Table 19a: Expected total cost for violating basic strategy: Split vs. do not split

Split		DEALER'S UPCARD										European rules		US	Europe
		2	3	4	5	6	7	8	9	T	A	T	A	Total	Total
PLAYER'S TOTAL	22	**0.002%**	**0.003%**	**0.005%**	**0.008%**	**0.010%**	**0.004%**	0.001%	0.006%	0.038%	0.008%	0.048%	0.019%	0.09%	0.11%
	33	**0.000%**	**0.002%**	**0.005%**	**0.008%**	**0.010%**	**0.005%**	0.001%	0.006%	0.037%	0.008%	0.047%	0.019%	0.08%	0.10%
	44	0.007%	0.005%	0.002%	**0.001%**	**0.002%**	0.011%	0.012%	0.013%	0.065%	0.016%	0.074%	0.025%	0.13%	0.15%
	55	0.029%	0.027%	0.025%	0.021%	0.024%	0.031%	0.033%	0.035%	0.133%	0.033%	0.137%	0.037%	0.39%	0.40%
	66	**0.002%**	**0.006%**	**0.009%**	**0.012%**	**0.013%**	0.001%	0.006%	0.011%	0.057%	0.013%	0.067%	0.023%	0.13%	0.15%
	77	**0.007%**	**0.010%**	**0.012%**	**0.014%**	**0.018%**	**0.011%**	0.001%	0.006%	0.031%	0.009%	0.043%	0.020%	0.12%	0.14%
	88	**0.016%**	**0.018%**	**0.019%**	**0.021%**	**0.025%**	**0.032%**	**0.017%**	**0.005%**	**0.011%**	**0.007%**	0.004%	0.009%	0.17%	0.17%
	99	**0.003%**	**0.005%**	**0.006%**	**0.009%**	**0.008%**	0.002%	**0.006%**	**0.004%**	0.024%	0.001%	0.036%	0.015%	0.07%	0.09%
	TT	0.410%	0.355%	0.298%	0.237%	0.201%	0.381%	0.579%	0.765%	2.838%	0.726%	2.839%	0.727%	6.79%	6.79%
	AA	**0.018%**	**0.019%**	**0.020%**	**0.021%**	**0.022%**	**0.014%**	**0.012%**	**0.010%**	**0.044%**	**0.006%**	**0.028%**	0.008%	0.18%	0.17%
	Tot	0.50%	0.45%	0.40%	0.35%	0.33%	0.49%	0.67%	0.86%	3.28%	0.83%	3.32%	0.90%	8.16%	8.28%

Table 19b: Expected total cost for violating basic strategy: Double vs. do not double

Double		DEALER'S UPCARD										European rules		US	Europe
		2	3	4	5	6	7	8	9	T	A	T	A	Total	Total
PLAYER'S TOTAL	7	0.058%	0.050%	0.041%	0.033%	0.030%	0.095%	0.117%	0.123%	0.464%	0.150%	0.485%	0.160%	1.16%	1.19%
	8	0.032%	0.025%	0.018%	0.010%	0.004%	0.048%	0.072%	0.093%	0.365%	0.112%	0.394%	0.134%	0.78%	0.83%
	9	0.002%	**0.007%**	**0.017%**	**0.026%**	**0.035%**	0.016%	0.033%	0.068%	0.343%	0.099%	0.402%	0.154%	0.65%	0.76%
	10	**0.050%**	**0.057%**	**0.065%**	**0.073%**	**0.080%**	**0.038%**	**0.025%**	**0.008%**	0.035%	0.024%	0.118%	0.102%	0.46%	0.62%
	11	**0.087%**	**0.096%**	**0.105%**	**0.115%**	**0.123%**	**0.063%**	**0.044%**	**0.026%**	**0.087%**	0.008%	0.034%	0.120%	0.75%	0.81%
	12	0.159%	0.149%	0.137%	0.139%	0.120%	0.189%	0.223%	0.256%	1.059%	0.307%	1.176%	0.411%	2.74%	2.96%
	s13	0.010%	0.007%	0.003%	**0.000%**	**0.002%**	0.028%	0.034%	0.038%	0.149%	0.049%	0.166%	0.061%	0.32%	0.35%
	s14	0.008%	0.005%	0.001%	**0.002%**	**0.004%**	0.024%	0.030%	0.034%	0.137%	0.046%	0.154%	0.059%	0.29%	0.32%
	s15	0.006%	0.003%	**0.000%**	**0.004%**	**0.006%**	0.020%	0.026%	0.031%	0.124%	0.043%	0.142%	0.057%	0.26%	0.30%
	s16	0.005%	0.001%	**0.002%**	**0.005%**	**0.008%**	0.016%	0.023%	0.028%	0.113%	0.040%	0.132%	0.055%	0.24%	0.27%
	s17	0.000%	**0.003%**	**0.006%**	**0.009%**	**0.011%**	0.006%	0.017%	0.023%	0.095%	0.031%	0.116%	0.049%	0.20%	0.24%
	s18	0.000%	**0.003%**	**0.006%**	**0.009%**	**0.009%**	0.016%	0.013%	0.017%	0.073%	0.024%	0.095%	0.044%	0.17%	0.21%
	s19	0.014%	0.009%	0.006%	0.003%	0.001%	0.027%	0.035%	0.033%	0.109%	0.041%	0.128%	0.056%	0.28%	0.31%
	s20	0.026%	0.022%	0.018%	0.014%	0.012%	0.036%	0.047%	0.055%	0.210%	0.060%	0.221%	0.069%	0.50%	0.52%
	Tot	0.456%	0.436%	0.426%	0.443%	0.445%	0.621%	0.737%	0.832%	3.364%	1.034%	3.763%	1.531%	8.794%	9.690%

Table 19c: Expected total cost for violating basic strategy: Hit vs. Stand

Hit-Stand		DEALER'S UPCARD										European rules		US	Europe
		2	3	4	5	6	7	8	9	T	A	T	A	Total	Total
PLAYER'S TOTAL	12	**0.025%**	**0.013%**	0.002%	0.018%	0.011%	**0.167%**	**0.152%**	**0.126%**	**0.413%**	**0.202%**	**0.381%**	**0.140%**	1.13%	1.03%
	13	0.010%	0.025%	0.042%	0.059%	0.053%	**0.131%**	**0.118%**	**0.100%**	**0.299%**	**0.172%**	**0.276%**	**0.119%**	1.01%	0.93%
	14	0.038%	0.054%	0.068%	0.087%	0.081%	**0.083%**	**0.078%**	**0.062%**	**0.167%**	**0.124%**	**0.154%**	**0.086%**	0.84%	0.79%
	15	0.070%	0.087%	0.105%	0.120%	0.117%	**0.060%**	**0.053%**	**0.039%**	**0.079%**	**0.101%**	**0.073%**	**0.070%**	0.83%	0.79%
	16	0.081%	0.097%	0.114%	0.131%	0.119%	**0.031%**	**0.028%**	**0.017%**	**0.010%**	**0.069%**	**0.009%**	**0.047%**	0.70%	0.67%
	17	0.176%	0.191%	0.207%	0.218%	0.236%	0.164%	0.053%	0.058%	0.296%	0.037%	0.273%	0.026%	1.64%	1.60%
	s17	**0.014%**	**0.013%**	**0.012%**	**0.013%**	**0.010%**	**0.015%**	**0.029%**	**0.025%**	**0.082%**	**0.026%**	**0.076%**	**0.018%**	0.24%	0.22%
	s18	0.006%	0.006%	0.005%	0.005%	0.008%	0.020%	0.006%	**0.008%**	**0.013%**	**0.000%**	**0.012%**	**0.000%**	0.08%	0.08%
	s19	0.024%	0.023%	0.022%	0.022%	0.023%	0.036%	0.039%	0.026%	0.056%	0.025%	0.051%	0.017%	0.30%	0.29%
	s20	0.042%	0.041%	0.039%	0.038%	0.038%	0.048%	0.055%	0.057%	0.196%	0.051%	0.181%	0.035%	0.60%	0.57%
	Tot	0.49%	0.55%	0.62%	0.71%	0.70%	0.75%	0.61%	0.52%	1.61%	0.81%	1.49%	0.56%	7.36%	6.99%

APPENDIX D
CARD COUNTING

Card-counting systems are used by players to reduce the casino's advantage further and, under certain conditions, to give the player an advantage. Unlike roulette and many other casino games, events are not independent in blackjack because cards are removed from play without being replaced for several rounds, changing the statistical makeup of remaining cards as well as the optimal playing strategy and the odds of winning subsequent hands. Thus, a true optimal strategy will incorporate past cards played out of the shoe and vary both betting and playing strategies accordingly. Systems that do so are called card-counting systems.

It should be noted that even these systems do not involve *optimal* strategies in terms of expected value. To keep track of the exact make up of all the cards in the deck, to calculate their ratio to one another, and then to determine the exact best playing strategy and the player's consequent expected value based on this information is not reasonable for even the most gifted card counters because it is cognitively too difficult for the unaided human mind. It is possible to do so with the aid of a computer, but that is illegal. Instead card-counting systems rely on *heuristics* based on the recognition that when the remaining cards are relatively rich in nines through aces, the player has an advantage, and when the remaining cards are relatively rich in twos through sevens, the

casino has an advantage. Although these systems are not optimal when one assumes unlimited processing power, given human cognitive limitations card-counting heuristics are widely accepted as the optimal realistic strategies for blackjack play.

For nearly all card-counting systems, the counter assigns positive values to low cards that have been removed from the shoe (usually from +1 to +3, depending on the particular card value and its effect on player advantage), and negative values to high cards (usually from –1 to –3), and adds these values together to obtain a *running count*. Since the statistical significance of a particular count depends on the number of cards remaining to be dealt, advanced systems usually require that the count be normalized by dividing this number by some fraction of the number of decks remaining to determine the *true count*. When card-counters determine that they have an advantage, they bet as much as they can get away with and that their bankroll allows.[1]

The count also affects the playing strategy. For most hands, there is a particular count at which the player varies from the basic strategy, whether this involves choosing to hit, stand, split, double or take insurance in violation of the basic strategy. When the count is low, there is a lower relative frequency of high cards remaining in the deck. Both the player and the dealer are thus less likely to receive high cards, and the player will therefore both hit more often and double down and split less often than the basic strategy

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[1] The size of the player's bankroll turns out to be a very important factor for card-counters. With an advantage of one or two percent even skilled card-counters will usually end up significantly down at some point during their playing period just due to normal random variation. Among mathematicians interested in gambling (and investing), the study of risk management, or the proportion of one's bankroll that should be risked given a particular advantage and a particular variance is something of a sub-field in its own right.

would prescribe. When the count is high, there is a higher relative frequency of high cards remaining to be dealt, and thus the player will hit less often and double down and split more often than usual.

Even skilled card counters will have a difficult time gaining an advantage over the casino. The reason for this is that casinos take several precautions in order to foil proficient card counters. Dealers, pit bosses, and casino-surveillance systems all look out for potential card counters. Knowing what to look for, most card counting-systems are relatively easy to spot. If the casino determines the counter is sufficiently skilled to warrant interference, they have the option to either bar the player entrance to the casino, to instruct the dealer to shuffle the cards every time the player increases his or her bet, or to use one of various other options that make successful card counting more difficult or impossible. Thus, while card-counting strategies can give the player a slight statistical advantage over the casino, it is probably no more than one percent given the best realistic casino conditions (Uston, 1981). The exact advantage depends largely on particular casino norms, on the casino's system for handling card counting, on the range of techniques used by the card counter, and on the card-counter's ability to employ these techniques without error.

Table 20 indicates one of the more effective and easy to use card-counting systems, the Hi-Lo Lite a slightly simplified version of the most widely used system, Hi-Lo. The layout is identical to the basic-strategy charts displayed earlier. Numbers in cells for which basic strategy normally requires players to split, to double down, or to stand indicate the true count at or *below* which players should violate basic strategy by not

splitting, not doubling down, or hitting, respectively, depending on the section of the chart. Numbers in cells for which basic strategy normally requires players not to split, not to double down, or to hit indicate the true count at or *above* which players should violate the basic strategy by splitting, doubling down, or standing, respectively. In this system 2s through 6s count as plus one, 7s through 9s count as zero, and tens and aces count as minus one. So, for example, if a player were to see the cards 6, 4, A, A, 10, 7, 3, 10, 10, their running count would be minus two (1+1-1-1-1+0+1-1-1 = -2). To determine the true count using this system, players must divide the running count by the number of half-decks remaining to be dealt. With practice, a skilled card counter using this system can learn to carry on a conversation while counting the cards as quickly as they are dealt, adjusting for the true count, and determining how to play and bet.

Table 20. The Hi-Lo Lite (modified from Snyder, 1998)

KEY	
Sp/Db/H	SPLIT, DOUBLE, OR HIT
#	Strike # at which to violate basic strateg
	NEXT CHART
S	STAND

Decisions should be made sequentially, beginning with Chart 1, and concluding with Chart 4.

1) TAKE INSURANCE +2 OR MORE

3) DOUBLE vs. DO NOT DOUBLE

Player's 2-card total	Dealer's up-card 2	3	4	5	6	7	8	9	T	A
7			6	4	4					
8	6	4	2	2	0					
9	0	0	0	-2	-2	2	4			
10	Db	Db	Db	Db	Db	-2	-2	0	2	2
11	Db	Db	Db	Db	Db	Db	-2	-2	-2	0
12										
AA										
A2			2	0	0					
A3			0	0	-2					
A4			0	-2	-4					
A5	8	2	-2	-2	Db					
A6	0	-2	-4	-4	Db					
A7	0	0	-2	-4	-6					
A8	4	2	2	0	0					
A9	6	4	4	2	2					

2) SPLIT vs. DO NOT SPLIT

Player's 2-card total	Dealer's up-card 2	3	4	5	6	7	8	9	T	A
22	0	-2	Sp	Sp	Sp	Sp	2			
33	0	-2	Sp	Sp	Sp	Sp	2			
44		4	0	0	-2					
55										
66	Sp	Sp	Sp	Sp	Sp					
77	Sp	Sp	Sp	Sp	Sp	Sp	2			
88	Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp	4	0
99	0	-2	-2	Sp	Sp	2	Sp	Sp		0
TT		4	4	2	2					
AA	Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp	Sp	-2

4) HIT vs. STAND

Player's 2-card total	Dealer's up-card 2	3	4	5	6	7	8	9	T	A
11	H	H	H	H	H	H	H	H	H	H
12	2	0	0	0	0	H	H	H	H	H
13	0	0	-2	-2	-2	H	H	H	H	H
14	-2	-2	-2	S	S	H	H	H	H	H
15	-2	S	S	S	S	H	H	4	2	H
16	S	S	S	S	S	4	4	2	0	4
17	S	S	S	S	S	S	S	S	S	S
A6	H	H	H	H	H	H	H	H	H	H
A7	S	S	S	S	S	S	S	H	H	H
A8	S	S	S	S	S	S	S	S	S	S

APPENDIX E

DEMOGRAPHIC SECTION: ALL INTERVIEWS

1. Year of Birth: **19___**

2. Gender: **F** **M**

3. What is your country of residence?_____
   [If not U.S., skip to question 7]
4. What is your city of residence?_____

5. In what country were you born? _____

6. [If not U.S.] How old were you when you came to the U.S.?

7. Which one of the following best describes the racial/ethnic group with which you identify? (circle one)
   a. Black/African-American b. Asian or Pacific Islander c. White/Caucasian
   d. Hispanic/Latino e. Native American f. Other:_____

8. If you choose, please further specify your cultural heritage (e.g., Vietnamese, Ukrainian, etc.)_____

9. Please circle a letter corresponding to the highest year of schooling you have completed?
   a. 8th grade or less
   b. Some high school
   c. High school diploma or equivalent
   d. Vocational/trade/business school degree
   e. Some college
   f. Finished college, 4 or 5 year degree
   g. Master's degree or equivalent
   h. Ph.D. or other advanced degree

10. What is your profession?_____

11. Please circle the amount that best describes your total household or family income, before taxes, from all sources last year? [If you are uncertain, please make your best guess.]

a……	**Under $10,000**	**e……**	**$40,000-59,999**
b……	**$10,000-19,999**	**f……**	**$60,000-79,999**
c……	**$20,000-29,999**	**g……**	**$80,000-99,999**
d……	**$30,000-39,999**	**h……**	**$100,000 or more**

12. Indicate the three gambling activities you engage in most often in order of frequency:
    a._____ b._____ c._____

13. What is your level of experience playing **[name of game]**? [1 = very experienced/expert; 6 = just learning the game/complete beginner]

    1 2 3 4 5 6

14. Which of the following factors have been important to how you play **[name of game]**? [Answer all that apply according to its importance to your playing strategy, where 1 = "extremely important" and 6 = "not at all important".]

a)	**Instruction offered by the casino**	**1 2 3 4 5 6**
b)	**Books, strategy cards, or other types of media**	**1 2 3 4 5 6**
c)	**Experience playing/observation**	**1 2 3 4 5 6**
d)	**Advice from other gamblers**	**1 2 3 4 5 6**
e)	**Advice from casino personnel**	**1 2 3 4 5 6**
f)	**Common sense or logical reasoning**	**1 2 3 4 5 6**
g)	**Intuition or gut feeling**	**1 2 3 4 5 6**
h)	**Playing on the computer/Internet**	**1 2 3 4 5 6**
i)	**Playing cards or gambling growing up**	**1 2 3 4 5 6**
j)	**Other_____**	**1 2 3 4 5 6**

15. Approximately how many hours, total *in your lifetime*, have you spent playing **[name of game]**?
    a) up to 10 hours
    b) from 11 to 30 hours
    c) from 31 to 60 hours
    d) from 61 to 100 hours
    e) from 101 to 300 hours
    f) from 301 to 600 hours
    g) from 601 to 1000 hours
    h) more than 1000 hours

16. What percentage of this time has been spent playing at casinos on the Las Vegas Strip?
    a) 81-100%
    b) 61-80%
    c) 41-60%
    d) 21-40%
    e) 0-20%
    [If the response is more than 60% skip the next two questions.]

17. Other than on the Strip, where have you spent the most time, during your lifetime playing **[name of game]** ["The Internet" is an acceptable answer]?

    _____

18. What percentage of this time has been spent playing there?
    a) **81-100%**
    b) **61-80%**
    c) **41-60%**
    d) **21-40%**
    e) **0-20%**

19. [Blackjack players only] What is your average bet in blackjack?
    a) **more than $100**
    b) **between $51 and $100**
    c) **between $26 and $50**
    d) **between $11 & $25**
    e) **between $5 & $10**
    f) **less than $5**

SLOT MACHINE SECTION

20. What denomination slot machine do you usually play?
    a) **$5**
    b) **$1**
    c) **25¢**
    d) **5¢**
    e) **Other_____**

21. How many coins do you bet per spin?

22. When choosing a machine, what do you look for in terms of features? [Answer all that apply according to their importance to you, where 1 = "extremely important", 2 = "somewhat important", 3 = "I avoid games with that feature".]

a)	**progressive jackpot**	**1 2 3**
b)	**bonus for max coins bet**	**1 2 3**
c)	**multi-line play features**	**1 2 3**
d)	**bonus screens**	**1 2 3**
e)	**video screen**	**1 2 3**
f)	**older-style machine**	**1 2 3**
g)	**Other_____**	**1 2 3**

23. What are your three (3) favorite slot machines, beginning with your favorite (if you do not have favorites, you may leave one or more of these lines empty)?

	Name	**Denomination**
1.	_____	_____
2.	_____	_____
3.	_____	_____

ROULETTE SECTION

24. What is your average bet in roulette per spot?
    a) **more than $10**
    b) **from $5 to $10**
    c) **from $3 to $4**
    d) **from $1 to $2**
    e) **less than $1**

25. How many spots, total, do you prefer to play?
    a) **more than 20**
    b) **from 16 to 20**
    c) **from 11 to 15**
    d) **from 6 to 10**
    e) **from 3 to 5**
    f) **1 or 2**

ALL GAMES

26. Why do you like to play **[name of game]**? [Indicate importance of reason where 1 = "extremely important" and 6 = "not at all important". You may select more than one answer.]

a) **in the hope of winning money**	**1 2 3 4 5 6**
b) **for the excitement/thrill of winning**	**1 2 3 4 5 6**
c) **for entertainment/fun**	**1 2 3 4 5 6**
d) **to "get away from it all"**	**1 2 3 4 5 6**
e) **for the social interaction**	**1 2 3 4 5 6**
f) **other_____**	**1 2 3 4 5 6**

27. Do you believe it is possible for players to win more than they lose in **[name of game]**, over the long run, if the correct strategy is used? **Yes No I am not sure**

28. [If you answered "Yes" to #20] Are *YOU* able to implement this strategy well enough to win more than you lose over the long run? **Yes No I am not sure**

29. If you had to give a percentage to skill versus luck in **[name of game]**, so that the total added up to 100%, what percentage would you give to each?

30. If you had to give a percentage to intuition vs. reason, as factors in how you make your playing decisions, what percentage would you give to each?

Czech version

1. Rok narození: 19.....

2. Pohlaví: M - Ž

3. Ve které zemi žijete? .....
[If not Czech or Slovak Republics, skip to question 8]

4. Ve kterém městě? .....

5. V jaké zemi jste se narodil? .....

6. (pokud dotazovaný není původem Čech) Kolik let Vám bylo, když jste do Čech přišel?

9. Prosím, vyberte možnost, která označuje Vaše nejvyšší dosažené vzdělání:
   a. základní vzdělání (i neukončené)
   b. střední škola (student nebo neukončená)
   c. maturita
   d. vyšší škola, nástavba
   e. vysoká škola, univerzita (student nebo neukončená)
   f. ukončená VŠ - titul Bc. nebo ekvivalent
   g. ukončená VŠ - titul Mgr. nebo ekvivalent
   h. ukončená VŠ - titul Dr. nebo jiná vyšší akademická hodnost

10. Jaká je Vaše profese? .....

11. Prosím, označte Váš průměrný měsíční příjem:

a. méně než 5500 Kč	e. 20 000 - 29 999 Kč
b. 5500 - 9 999 Kč	f. 30 000 - 49 000 Kč
c. 10 000 - 14 999 Kč	g. 50 000 - 100 000 Kč
d. 15 000 -19 999 Kč	h. více než 100 000 Kč

12. Označte tři sázkové hry (příp. výherní automaty), kterým se nejčastěji věnujete:
a. ..... b. ..... c. .....

13. Jaká je úroveň Vašich zkušeností v této hře (jméno hry)?
(Oznámkujte jako ve škole na škále 1 – 6, 1= velmi zkušený/expert; 6= začátečník/učím se ji hrát):

1 2 3 4 5 6

14. Nakolik následující faktory ovlivnily to, jak jste se naučil hrát? (Ukaždého faktoru označte jeho důležitost, známkujte jako ve škole na škále 1 – 6, kdy 1= ”velmi důležitý” a 6= vůbec ne důležitý”)?

a) [US sample only]
b) Knihy, instrukce na kartičkách, jiná média 1 2 3 4 5 6
c) Zkušenosti z hry/pozorování 1 2 3 4 5 6
d) Rady od jiných hráčů 1 2 3 4 5 6
e) Rady od personálu kasina 1 2 3 4 5 6
f) Zdravý rozum nebo logické uvažování 1 2 3 4 5 6
g) Intuice, předvídavost, ”šestý smysl” 1 2 3 4 5 6
h) Hra na počítači/Internetu 1 2 3 4 5 6
i) Hra v karty nebo hráčská zkušenost z mládí 1 2 3 4 5 6
j) Jiné 1 2 3 4 5 6

15. Kolik hodin přibližně jste za celý svůj život věnoval (jméno hry)?

a) méně než 10 hodin
b) 11 - 30 hodin
c) 31 - 60 hodin
d) 61 - 100 hodin
e) 101 - 300 hodin
f) 301 - 600 hodin
g) 601 - 1000 hodin
h) více než 1000 hodin

16. Kolik asi procent tohoto času jste strávil v kasinech v Praze?

a) 81 - 100% b) 61 - 80% c) 41 - 60% d) 21 - 40% e) 0 - 20%

(Pokud je odpověď více než 60%, další dvě otázky přeskočte.)

17. Ve kterém kasinu (kasinech) mimo Prahu jste nejčastěji hrál (jméno hry)? (”Na Internetu” je přijatelná odpověď)

18. Kolik procent svého celkového času, věnovaného hře, jste tam asi strávil?

a) 81 - 100% b) 61 - 80% c) 41 - 60% d) 21 - 40% e) 0 - 20%

SEKCE BLACKJACK:

19. Jaký je Váš průměrný vklad v Blackjacku?

a) více než 5 000 Kč
b) 3 001 - 5 000 Kč
c) 1 001 - 3 000 Kč
d) 501 - 1 000 Kč
e) 201 - 500 Kč
f) 50 - 200 Kč

SEKCE VÝHERNÍ AUTOMATY:

20. Když si vybíráte výherní automat, jaké vlastnosti u her pokládáte za nejdůležitější?

(U každé vlastnosti označte její důležitost, známkujte jako ve škole na škále 1 – 6, přičemž 1= ”velmi důležitá”, 2= ”do jisté míry důležitá”, 3= ”takovým hrám se vyhýbám”.)

a) narůstající jackpot	1 2 3
b) bonus za maximální vklad	1 2 3
c) multi - line automaty	1 2 3
d) extra obrazovka s bonusem	1 2 3
e) video obrazovka	1 2 3
f) automaty staršího typu	1 2 3
g) Jiné	1 2 3

SEKCE RULETA:

21. Jaký je Váš průměrný vklad v ruletě na jedno políčko (číslo, černé-červené, sudé-liché...)?

22. Na kolik políček obvykle sázíte?

a) více než 20
b) 16 - 20
c) 11 - 15
d) 6 - 10
e) 3 - 5
f) 1 nebo 2

VŠECHNY HRY:

23. Proč rád hrajete (jméno hry)?_____

(Označte důvody podle důležitosti, známkujte jako ve škole na škále 1 – 6, 1= „velmi důležitý", 6= „vůbec ne důležitý". Můžete označit více než jednu možnost.)

a) naděje na výhru peněz	1 2 3 4 5 6
b) vzrušení z hry/napětí z možnosti výhry	1 2 3 4 5 6
c) zábava	1 2 3 4 5 6
d) "únik od starostí"	1 2 3 4 5 6
e) příjemná společnost	1 2 3 4 5 6
f) jiné	1 2 3 4 5 6

24. Věříte, že při dlouhodobém hraní může hráč ve (jméno hry) více vyhrát než prohrát (získat výhodu nad kasinem), když použije správnou strategii?

Ano Ne Nejsem si jist

25. (Jestli je odpověď "ano") Dokážete Vy dlouhodobě užívat tuto správnou strategii a získat výhodu nad kasinem?

26. Určete poměr hráčské šikovnosti a štěstí při hře v procentech. (součet je 100 procent)

27. Určete poměr Vaší hráčské intuice a rozumu při hře v procentech? (součet je 100 procent)

APPENDIX F

SEMI-STRUCTURED INTERVIEW

1. What strategies or other factors influence your likelihood of winning at *[name of game]*?

2. *[Probe for justification and clarification with regard to: what terms mean, how the player decides when particular strategy or influence is important, how exactly the strategy works or is influenced, why the strategy works, or how the player knows that it works?]*

3. *[Probe for other influences (WRITE THEM DOWN): including timing; features, rules of the particular game; when bet is increased or decreased; casino employees; (IN ROULETTE ONLY) where chips are played on the layout; (IN SLOTS ONLY) which machine is played; (IN BLACKJACK ONLY) playing strategy, influences of other players, where you sit. For each additional influence, probe for justification and clarification as described in #2.]*

4. How did you first learn or find out about *[refer to the factors mentioned in previous question, one at a time]*?

5. What strategies or beliefs are typical of bad *[name of game]* players? *[Probe for additional answers (WRITE THEM DOWN).]*

6. Why does *[refer to the factors mentioned in previous question, one at a time, if the answer hasn't been provided]* indicate that the player is bad?

APPENDIX G

SSI—INFORMED CONSENT FORM

CONSENT FOR PARTICIPATION IN RESEARCH PROTOCOL

Research Project: "Culture and Rational Choice"
Research Protocol: Semi-structured interview
Principle investigator: Dr. William Goldstein

I, _____, agree to participate in the "Culture and Rational Choice" research project, conducted under the direction of Dr. William Goldstein from the University of Chicago. My consent is given voluntarily: I have not been pressured to participate in any way, and the following things have been explained:

1. NATURE AND DURATION OF PROCEDURES

This interview contains a number of questions about your gambling strategies and beliefs. It will take approximately 20 minutes depending on the length of your responses and will be **recorded on audio tape**. The information obtained during this interview will be used in the current project and may be published or used by other researchers in the future. **Your response will be completely confidential**: This confidentiality agreement will be separated immediately from the interview data and will be maintained in a secure filing cabinet. Information indicating your identity is not desired nor will it be intentionally requested during this interview. If identifying information is provided unintentionally, it will be removed during data entry. A research assistant or investigator other than the person conducting this interview may be involved in entering data from this interview, but they have agreed, in writing, to these same standards of confidentiality. After transcription, **the audio tape containing your responses will be erased**.

2. POTENTIAL RISKS AND BENEFITS

Your involvement in this study does not involve any known risks. Your participation will contribute to a better understanding of how people make decisions and form beliefs when gambling and in every day life.

I have had the opportunity to ask questions concerning all aspects of this project and my questions have been answered. I understand that participation is voluntary and that I may withdraw my consent at any time without penalty. A copy of this written consent has been given to me. I understand that if I have any questions concerning this research, I can contact the Investigator stated below.

_____ _____
Signature of Participant Date

_____
Signature of Investigator

If you have further questions, you may contact:
Will Bennis, Committee on Human Development, 5730 S. Woodlawn Ave.
University of Chicago, Chicago, IL 60637, USA w-bennis@uchicago.edu
If your feel your rights have in any way been violated, you may contact:
Social and Behavioral IRB Office, +1-773-834-5805, 5848 S. University Ave.
University of Chicago, Chicago, IL 60637, USA kellyc@ura.uchicago.edu

APPENDIX H

BLACKJACK STRATEGY SURVEY

Protocol:

1) Do not give chart to participants.
2) Explain: "The following three charts ask you to indicate your normal blackjack playing strategy, given your two cards and the dealer's upcard. You are to indicate whether you *usually* SPLIT (Chart 1), DOUBLE DOWN (Chart 2), HIT or STAND (Chart 3), all other things being equal.
3) "I will tell you a particular two-card hand for the player, and you should tell me how you would *usually* play that hand for each dealer upcard.
4) "In many cases, your play may vary depending on other factors (such as how the cards have been falling or which cards have recently been played from the deck).
5) ***"Let me know when this is the case (i.e., when your play depends on context).***
6) **"At the same time, if you *usually* make one play choice more than another, please tell me the favored play choice.**
7) "For some of your two card combinations, given some dealer upcards, your choices may depend entirely on context, and you may not be able to tell me how you *usually* play. That's not a problem. Just tell me know when this is the case."
8) **If participants seem unclear about how to respond, re-word/repeat instructions from 3), and if necessary 7).**

Use the colored pens to mark the cells according the following key:
<u>GREEN</u> = SPLIT/DOUBLE DOWN/HIT
<u>RED</u> = DO NOT SPLIT/DOUBLE DOWN/HIT
<u>BLACK</u> = DEPENDS ON CONTEXT or NO FAVORED STRATEGY

CHART 1: WHEN DO YOU SPLIT YOUR CARDS?

SPLIT CHART										
YOUR CARDS	DEALER'S UP-CARD									
	2	3	4	5	6	7	8	9	10	Ace
2,2										
3,3										
4,4										
5,5										
6,6										
7,7										
8,8										
9,9										
10,10										
ace,ace										

CHART 2: WHEN DO YOU DOUBLE DOWN?

DOUBLE CHART										
YOUR CARDS	DEALER'S UP-CARD									
Hard	2	3	4	5	6	7	8	9	10	Ace
4 to 6										
7										
8										
9										
10										
11										
12										
13 to 14										
15 to 20										
Soft	2	3	4	5	6	7	8	9	10	Ace
A, A										
A, 2										
A, 3										
A, 4										
A, 5										
A, 6										
A, 7										
A, 8										
A, 9										
Blackjack										

CHART 3: WHEN DO YOU HIT?

HIT CHART										
YOUR CARDS	**DEALER'S UP-CARD**									
Hard	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Ace**
4 to 11										
12										
13										
14										
15										
16										
17										
18-21										
Soft	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**Ace**
A, 2 - A, 5										
A, 6										
A, 7										
A, 8										
A, 9										
Blackjack										

1. In the above three charts, if your choices sometimes vary due to context, how important are each of the following contextual factors? [Answer all that apply according to their importance to your playing strategy, where 1 = "extremely important" and 3 = "not at all important".]
   - **a. Hot or cold streaks/"How the cards have been falling" 1 2 3**
   - **b. Cards previously dealt out of the deck or shoe 1 2 3**
   - **c. The playing style of others at the table 1 2 3**
   - **d. Whether you are playing "1st" or "3rd base" 1 2 3**
   - **e. Intuition/Gut feeling 1 2 3**
   - **f. The amount of money you are wagering 1 2 3**
   - **g. How your choice will affect others at the table 1 2 3**
   - **h. How many decks are being used 1 2 3**
   - **i. Particular game rules or features where you are playing 1 2 3**
   - **j. Advice/expectations of others at the table 1 2 3**
   - **k. Other_____ 1 2 3**

2. Assuming you have a blackjack and the dealer has an ace showing, how often do you take even money (or insurance)?
   - **a. Never b. Rarely c. Always d. Usually e. Sometimes**

3. When do you take insurance, assuming you don't have a blackjack [Leave this question open ended, and circle all that apply. Probe for causes.]?

a. Never b. Rarely c. Always d. Usually e. Sometimes
f. When my hand is <u>good</u> enough g. When my hand is <u>bad</u> enough
h. When my bet is very large
i. When the <u>dealer</u> has been <u>hot</u> or has been <u>getting blackjacks</u>
j. When the <u>dealer</u> has been <u>cold</u> or has <u>not had a blackjack</u> for a while
k. When a 10-value card is "due"
l. When the proportion of 10s to non-10s remaining in the shoe or deck reaches a certain point
m. When my gut tells me the dealer will have a blackjack
n. Other_____

4. If you answered **f.** or **g.** in question 3., What hands do you consider [good/bad] enough for insurance?: _____

5. If a casino allows you to "surrender",* would you ever take this option?
Yes No I don't think so I never do, but I might I am not sure

6. If you answered, "Yes", in question 5., which hands, or other circumstances, would lead you to surrender? _____
_____

*-"Surrender" is allowed when the dealer does not have a blackjack. It allows players to keep half of their original bet and requires them to forfeit the other half of their bet, along with their cards, after seeing their first two cards and the dealer's upcard.

Czech version

Záznam rozhovoru při zkoumání strategií hry Blackjack:

1) Nedávejte tabulky účastníkům.

2) Vysvětlete: ”Pomocí těchto tří tabulek, prosím předveďte Vaši normální strategii (postup) při hře blackjack. Máte své dvě karty a vidíte kartu dealera. Naznačte, kdy obvykle split (”splitujete”) (Tabulka 1), dubl (”dublujete”)(Tabulka 2), táhnete nebo řeknete, že již stačí (Tabulka 3), všechno ostatní zůstává stejné.

3) ”Řeknu Vám určitou kombinace dvou karet, kterou hráč obdrží. Vy mi, prosím, řekněte, jak byste obvykle s těmito kartami hrál s kteroukoli kartou dealera”.

4) ”Mnohokrát může Vaše hra záviset na jiných vlivech (například jaké karty padají nebo které karty byly v předchozím průběhu hry odebrány ze stolu”.

5) Řekněte mi, kdy se to stává (například kdy Vaše hra závisí na okolnostech).

6) ”Zároveň, když obyčejně ve hře zvolíte určitou možnost více než jinou, řekněte mi, prosím, která je Vaše oblíbená možnost.”

7) ”Při některých kombinacích dvou karet a nějaké dealerovy vrchní karty, mohou Vaše rozhodnutí záviset úplně na okolnostech a nebude možno říci, jak obvykle hrajete. To nevadí. Jen mi řekněte, když tato situace nastane.”

8) Jestli Vám připadá, že účastník neví, jak odpovědět, přeformulujte nebo zopakujte instrukce z bodu 3), případně 7).

Na označení políček použijte barevné tužky. Označujte podle následujícího klíče:
ZELENÁ = split
ČERVENÁ = ne split/dubl/táhnu
ČERNÁ = záleží na okolnostech nebo žádná oblíbená strategie

TABULKA 1: KDY SPLIT VAŠE KARTY?

Vaše karty	**Krupierová karta**									
	2	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**eso**
2, 2										
3, 3										
4, 4										
5, 5										
6, 6										
7, 7										
8, 8										
9, 9										
10, 10										
eso, eso										

TABULKA 2: KDY DUBL VAŠE KARTY?

Vaše karty	Krupierová karta									
	2	3	4	5	6	7	8	9	10	eso
4 až 6										
7										
8										
9										
10										
11										
12										
13 až 14										
15 až 20										
eso, eso										
eso, 2										
eso, 3										
eso, 4										
eso, 5										
eso, 6										
eso, 7										
eso, 8										
eso, 9										
Black Jack										

TABULKA 3: KDY TÁHNETE KARTU?

Vaše karty	Krupierová karta									
	2	3	4	5	6	7	8	9	10	eso
4 až 11										
12										
13										
14										
15										
16										
17										
18 až 21										
e,2 až e,5										
eso, 6										
eso, 7										
eso, 8										
eso, 9										
Black Jack										

1. Pokud se Vaše volby nějak mění podle okolností, jak důležitý je v předchozích třech tabulkách vliv následujících okolností? (U každé položky označte, jak je důležitá pro strategii Vaší hry, známkujte jako ve škole na škále 1 – 6, přičemž 1 = ”velmi důležitá” a 3 = ”vůbec ne důležitá”).

a. Série výher nebo proher/”Jak karty padají” 1 2 3
b. Karty, předtím odebrány z boty 1 2 3
c. Styl hry ostatních hráčů 1 2 3
d. Hrajete-li na první nebo poslední pozici 1 2 3
e. Intuice/Předvídání 1 2 3
f. Výška vkladu, sázky 1 2 3
g. Jak má volba ovlivní ostatní hráče u stolu 1 2 3
h. Kolik balíčků se používá 1 2 3
i. Určitá pravidla nebo vlastnosti hry , kterou hrajete 1 2 3
j. Rady/očekávání ostatních u stolu 1 2 3
k. Jiné 1 2 3

2. Předpokládejme, že máte blackjack a dealer ukazuje eso. Jak často vezmete insurance? a. Nikdy b. Zřídka c. Vždy d. Často e. Někdy

3. Kdy vezmete insurance v případě, že nemáte blackjack? (Ponechejte tuto otázku otevřenou a označte vše, co se k ní vztahuje. Zkuste se zeptat na důvody.)
a. Nikdy b. Zřídka c. Vždy d. Často e. Někdy
f. Když mám hodně dobré karty
g. Když mám hodně špatné karty
h. Když je má sázka velmi vysoká
i. Když dealer hodně vyhrával nebo měl hodně blackjacků
j. Když dealer prohrával nebo delší dobu neměl blackjack
k. Když "má padnout" desítková karta
l. Když rozložení desítek a jiných karet v botě dosáhne určité hodnoty
m. Když mi intuice říká, že dealer bude mít blackjack
n. Jiné .....

4. Pokud jste odpověděl f. nebo g. v otázce č. 3. jaké kombinace karet pokládáte za hodně dobré či hodně špatné?

5) Pokud Vám kasino umožní "surrender"*, využijete někdy takovou možnost?
Ano Ne Nemyslím Nedělám to, ale možná bych mohl Nevím

6) Pokud jste odpověděl "Ano" v otázce č. 5., jaké kombinace karet nebo jiné okolnosti by vás vedly k surrender?.....

.....

* - Umožňuje hráčům ponechat si polovinu jejich původních vkladů; druhou polovinu vkladu ztrácejí společně s kartami po shlédnutí prvních dvou karet a karty, kterou ukazuje dealer.

APPENDIX I

BJS—INFORMED CONSENT FORM

CONSENT FOR PARTICIPATION IN RESEARCH PROTOCOL

Research Project: "Culture and Rational Choice"
Research Protocol: Blackjack Strategy Survey
Principle investigator: Dr. William Goldstein

I, _____, agree to participate in the "Culture and Rational Choice" research project, conducted under the direction of Dr. William Goldstein from the University of Chicago. My consent is given voluntarily: I have not been pressured to participate in any way, and the following things have been explained:

1. NATURE AND DURATION OF PROCEDURES

This interview contains a number of questions about your blackjack playing strategy. It will take approximately 10-15 minutes depending on the length of your responses. The information obtained during this interview will be used in the current project and may be published or used by other researchers in the future. **Your response will be completely confidential**: This confidentiality agreement will be separated immediately from the interview data and will be maintained in a secure filing cabinet. Other than this confidentiality agreement, no identifying information will be requested or recorded during this survey.

2. POTENTIAL RISKS AND BENEFITS

Your involvement in this study does not involve any known risks. Your participation will contribute to a better understanding of how people make decisions and form beliefs when gambling and in every day life.

I have had the opportunity to ask questions concerning all aspects of this project and my questions have been answered. I understand that participation is voluntary and that I may withdraw my consent at any time without penalty. A copy of this written consent has been given to me. I understand that if I have any questions concerning this research, I can contact the Investigator stated below.

_____ _____

Signature of Participant Date

_____
Signature of Student Investigator

If you have further questions, you may contact:
Will Bennis, Committee on Human Development, 5730 S. Woodlawn Ave.
University of Chicago, Chicago, IL 60637, USA w-bennis@uchicago.edu

If your feel your rights have in any way been violated, you may contact:
Social and Behavioral IRB Office, +1-773-834-5805, 5848 S. University Ave.
University of Chicago, Chicago, IL 60637, USA kellyc@ura.uchicago.edu

SOUHLAS S ÚČASTÍ VE VÝZKUMU [BJS]

Vedoucí výzkumu: Dr. William Goldstein

Já, ..., souhlasím s účastí na výzkumu prováděném Dr. Williamem Goldsteinem z Chicagské univerzity. Souhlasím dobrovolně, k účasti jsem nebyl nucen a byl jsem seznámen s následujícím:

1. Oblast výzkumu a trvání interview:

Tento rozhovor se týká Vašich strategií při hře Blackjack. Bude trvat přibližně 10-15 minut (podle délky Vašich odpovědí). Informace, získané z rozhovoru, budou použity pro tento výzkum a mohou být publikovány nebo využity pro jiné výzkumné účely v budoucnu.

VAŠE ODPOVĚDI JSOU ÚPLNĚ DŮVĚRNĚ: Tento formulář o Vašem souhlase s účastí bude oddělen od údajů z rozhovoru a bude bezpečně uložen. Informace, týkající se Vaší identity, nebudou v průběhu rozhovoru zjišťovány.

2. Možná rizika a výhody:

Vaše účast v tomto výzkumu nezahrnuje žádná známá rizika. Váš podíl na výzkumu přispěje k lepšímu pochopení způsobů, jakými se lidé rozhodují a řídí při hře a v běžném životě.

Měl jsem možnost se zeptat na cokoliv, týkající se výzkumu a mé otázky byly zodpovězeny. Potvrzuji, že má účast je dobrovolná a mohu ji kdykoli bez jakýchkoli následků ukončit. Obdržel jsem kopii formuláře Souhlas s účastí. V případě, že se chci dále informovat, mám možnost kontaktovat vedoucího výzkumu.

....
Podpis účastníka Datum

.....
Podpis studenta, provádějícího výzkum

V případě dalších otázek, kontaktujte:
Will Bennis, Committee on Human Development, 5730 S. Woodlawn Ave.
University of Chicago, Chicago, IL 60637, USA w-bennis@uchicago.edu

Pokud máte pocit, že Vaše práva nebyly respektovány, kontaktujte:
Social and Behavioral IRB Office, +1-773-834-5805, 5848 S.University Ave.
University of Chicago, Chicago, IL 60637, USA kellyc@ura.uchicago.edu

APPENDIX J

ETHNOGRAPHIC INTERVIEW

1) **[Background]** Original exposure to/interest in gambling?

2) Original exposure to/interest in **[name of game]**? [Where; wins-losses; approach to gambling; get story]

3) How the interest in **[name of game]** progressed.

4) If you've moved from one denomination of machine/table to another, could you describe what motivated this change?

5) How did you learn to play **[name of game]**?

6) Have you ever read a book on how to play **[name of game]**? Why/why not?

7) Why do you play **[name of game]**? [the hope of winning, fun, etc.?]

8) **[Skill]** Talk about the role of skill in **[name of game]**.

9) What percentage of **[name of game]** players do you think you're better than?

10) How do you identify a good/bad player?

11) How does that characteristic indicate a good/bad player?

12) **[Luck]** Talk about the role of luck in **[name of game]**.

13) Are some people luckier than others?

14) Is it possible to control luck?

15) Is it possible to tell when you are lucky and when you aren't lucky?

16) What do you do to bring yourself luck?

17) Do you believe these things work? Why/Why not?

18) What led you to use this technique?

19) If you had to give a percentage to skill versus luck in **[name of game]**, what percentage would you give to each?

20) **[Betting strategy]** Can you describe your betting system?

21) How do you choose how much to bet?

22) Does this change over time or based on previous outcomes? How?

23) What other money management techniques do you use?

24) **[Playing strategy]** What strategies do you use to improve your chances of winning?

25) Is there a way to get a long-term advantage in **[name of game]**? How?

26) Can you play the game well enough to get a long-term advantage?

27) What is your playing strategy?

[For roulette only]

28) How do you decide where to place your bet?

29) How do you decide which numbers? [Favorite numbers? Past outcomes? How? What other people are betting? When, why?]

[For blackjack only]

30) Is there some best way to play every hand in blackjack?

31) [If yes:] How would you describe this system?

32) Could you explain the system to me?

33) Do you adjust your playing or betting decisions based on the outcomes of previous hands?

34) Could you describe how you do this?

35) Does the general trend of the dealer or deck influence your decisions? How? Why?

36) Do you know how to count cards? Do you count cards?

37) Can you explain card counting?

38) What other factors besides basic strategy influence your chances of winning?

39) **[Choosing a game & proper order]** How do you choose a table or machine?

40) What rules or game features do you like (**blackjack**: # of decks, other rules; **slots**: bonus game, video, progressive, bonus for max coins played, double/triple/five/10 times play feature/location etc.)

41) When do you leave a table/game?

[Blackjack and roulette only]

42) Do you join an empty table? Why or why not?

43) Do you like to play with other players or alone

44) What kind of players do you like/not like to play with? Why?

45) What kind of dealer's do you like/not like to play with? Why?

46) Can the play of other people influence your chances of winning? How? Consistency? Strategy?

47) Does the play of others influence your own playing decisions? How?

48) Does the dealer influence your decision to play or how you play?

49) Do you care if someone joins/leaves the table at any particular time? When/why?

50) Does the position at the table matter in terms of your chances of winning or your influence on others' chances of winning? How?

51) Where do you like to play?

52) Do you care who plays third base? First base? Why?

53) Should 3rd base play differently? How? Why?

54) Do you ever adjust the number of hands you play? When? Why?

55) Assume I am a beginner, and you are going to tell me how to play all my hands, what would you tell me?

Czech version

1) **[<u>Obecné informace o hraní her</u>|]** První zájem o hry? O **(jméno hry)**? (Kde; výhry-prohry; přístup k hraní; chtějte ”příběh”)

2) Jak se zájem o **(jméno hry)** rozvíjel.

3) Jak jste se naučil hrát **(jméno hry)**?

4) **[<u>Hráčská strategie</u>|]** Jaké strategie využíváte, abyste zvýšil svou šanci na výhru? [Pro ruletu: Podle čeho se rozhodujete, kam umístíte svůj vklad?]

5) Přizpůsobujete strategii Vaší hry nebo Vašeho vkládání v závislosti na kartách, které padly v předchozích kolech? Můžete popsat, jak to děláte, jakým způsobem?

6) Můžete popsat Váš systém vkládání (sázení)? [Jak si určujete výšku vkladu? Jak se mění Váš systém vkládání v průběhu času nebo v závislosti na předchozích výsledcích?]

7) Jaké další způsoby (techniky) zacházení s penězi využíváte?

8) Jak poznáte dobrého/špatného hráče?

9) Jak tato vlastnost (popis) vypovídá o dobré/špatné hře hráče?

10) Kolik asi procent hráčů předčíte ve **(jméno hry)**?

11) Existuje nějaký nejlepší způsob, jak hrát s kterýmikoliv kartami v blackjacku?

12) [Pokud ano:] Jak byste tento způsob popsal nebo nazval?

13) Víte, jak se počítají karty? Počítáte je?

14) Můžete vysvětlit, jak se počítají karty?

15) Jak si vybíráte stůl nebo výherní automat?

16) Kdy skončíte hru/opustíte stůl?

17) Hrajete radši s dalšími hráči nebo sám?

18) Jaká pravidla nebo vlastnosti hry máte rád (**blackjack**: počet balíčků karet, další pravidla; **výherní automaty**: žolík(Joker) nebo jiný symbol bonusu…)

19) S jakým typem spoluhráčů rádi/neradi hrajete? Proč?

20) Má dealer vliv na to, zda se rozhodnete hrát či na způsob Vaší hry?

21) S jakým typem dealerů rádi/neradi hrajete? Proč?

22) Ovlivňuje všeobecný postup dealera nebo padání karet Vaše rozhodnutí? Jak? Proč?

23) Může způsob hry jiných hráčů ovlivnit Vaše šance na výhru? Jak? [Pokud je potřeba odpověď upřesnit, podrobnějšími otázkami zkoumejte, zda je zde důležitá strategie jiných hráčů nebo dodržování stejného postupu]

24) Zajímáte se o to, zda se někdo připojí ke stolu nebo odejde v nějaké konkrétní chvíli? Kdy/proč?

25) Hrajete někdy na více místech (pozicích) současně? (v jednom kole) Kdy? Proč?

26) Má pozice (místo) u stolu nějaký vliv na Vaši šanci na výhru? Umožňuje Vám nějak ovlivnit šance jiných hráčů na výhru? Jak?

27) Zajímáte se o to, kdo hraje na posledním místě (pozici)? Na prvním? Proč?

28) Měl by hráč na posledním místě (pozici) hrát jinak? Jak? Proč?

29) Kde (na kterém místě) rád hrajete?

30) **[<u>Štěstí</u>]** Co si myslíte o roli štěstí v **(jméno hry)**.

31) Mají někteří lidé více štěstí než jiní?

32) Můžeme štěstí nějak ovlivnit?

33) Lze říci, kdy máme štěstí a kdy ne?

34) Co děláte, aby Vám štěstí přálo?

35) Věříte, že to funguje? Proč/Proč ne?

36) Co Vás vedlo k používání tohoto způsobu?

APPENDIX K

EI—INFORMED CONSENT FORM

CONSENT FOR PARTICIPATION IN RESEARCH PROTOCOL

Research Protocol: Ethnographic interview

Principle investigator: Dr. William Goldstein

I, _____, agree to participate in the "Culture and Rational Choice" research project, conducted under the direction of Dr. William Goldstein from the University of Chicago. My consent is given voluntarily: I have not been pressured to participate in any way, and the following things have been explained:

1. NATURE AND DURATION OF PROCEDURES

This interview concerns your gambling behavior and gambling strategies. It will be open-ended, meaning that you are free to discuss any thoughts that come to mind. It will take from one to two hours **and will be recorded on audio tape**. The information obtained during this interview will be used in the current project and may be published or used by other researchers in the future. YOUR RESPONSE WILL BE COMPLETELY CONFIDENTIAL: This confidentiality agreement will be separated immediately from the interview data and will be maintained in a secure filing cabinet. Information indicating your identity is not desired nor will it be intentionally requested during this interview. If identifying information is provided unintentionally, it will be removed during transcription. A research assistant or investigator other than the person conducting this interview may be involved in transcribing, translating, or entering data from this interview, but they have agreed, in writing, to these same standards of confidentiality. After transcription, the audio tape containing your responses will be erased.

2. POTENTIAL RISKS AND BENEFITS

Your involvement in this study does not involve any known risks. Your participation will contribute to a better understanding of how people make decisions and form beliefs when gambling and in every day life.

I have had the opportunity to ask questions concerning all aspects of this project and my questions have been answered. I understand that participation is voluntary and that I may withdraw my consent at any time without penalty. A copy of this written consent has been given to me. I understand that if I have any questions concerning this research, I can contact the Investigator stated below.

_____ _____

Signature of Participant Date

_____

Signature of Student Investigator

If you have further questions, you may contact:
Will Bennis, Committee on Human Development, 5730 S. Woodlawn Ave.
University of Chicago, Chicago, IL 60637, USA w-bennis@uchicago.edu

If your feel your rights have in any way been violated, you may contact:
Social and Behavioral IRB Office, +1-773-834-5805, 5848 S. University Ave.
University of Chicago, Chicago, IL 60637, USA kellyc@ura.uchicago.edu

SOUHLAS S ÚČASTÍ VE VÝZKUMU [E]

Vedoucí výzkumu: Dr. William Goldstein

Já, ..., souhlasím s účastí na výzkumu prováděném Dr. Williamem Goldsteinem z Chicagské univerzity. Souhlasím dobrovolně, k účasti jsem nebyl nucen a byl jsem seznámen s následujícím:

1. Oblast výzkumu a trvání interview:

Tento rozhovor se týká chování hráče některých zábavných her a hráčských strategií. Je otevřený, t. j. můžete mluvit o všem, o čem budete chtít. Rozhovor bude trvat 1 - 2 hodiny **a bude zaznamenán na magnetofonovou kazetu**. Informace, získané z rozhovoru, budou použity pro tento výzkum a mohou být publikovány nebo využity pro jiné výzkumné účely v budoucnu.

VAŠE ODPOVĚDI JSOU ÚPLNĚ DŮVĚRNÉ: Tento formulář o Vašem souhlasu s účastí bude oddělen od údajů z rozhovoru a bude bezpečně uložen. Informace, týkající se Vaší identity, nebudou v průběhu rozhovoru záměrně zjišťovány. Pokud takové informace nezáměrně sdělíte, budou vymazány při přepisu rozhovoru. Osoby, které budou interview přepisovat, překládat či zadávat data do počítače, se rovněž zavazují zachovat důvěrnost údajů. Po přepisu budou všechny nahrávky vymazány.

2. Možná rizika a výhody:

Vaše účast v tomto výzkumu nezahrnuje žádná známá rizika. Váš podíl na výzkumu přispěje k lepšímu pochopení způsobů, jakými se lidé rozhodují a řídí při hře a v běžném životě.

Měl jsem možnost se zeptat na cokoliv, týkající se výzkumu a mé otázky byly zodpovězeny. Potvrzuji, že má účast je dobrovolná a mohu ji kdykoli bez jakýchkoli následků ukončit. Obdržel jsem kopii formuláře Souhlas s účastí. V případě, že se chci dále informovat, mám možnost kontaktovat vedoucího výzkumu.

....
Podpis účastníka Datum

.....
Podpis studenta, provádějícího výzkum

V případě dalších otázek, kontaktujte:
Will Bennis, Committee on Human Development, 5730 S. Woodlawn Ave.
University of Chicago, Chicago, IL 60637, USA w-bennis@uchicago.edu
Pokud máte pocit, že Vaše práva nebyly respektovány, kontaktujte:
Social and Behavioral IRB Office, +1-773-834-5805, 5848 S.University Ave.
University of Chicago, Chicago, IL 60637, USA kellyc@ura.uchicago.edu