ACADEMY OF PROFESSIONAL DEVELOPMENT

Integrative Learning Student Artifact

Final Research Assignment: Logic In Poker

Anyone can play poker, however, not just anyone can play poker well. Poker is a game of luck and strategy, and in order to master it one must understand logic. Logic is a system of reasoning, a way to make reliable inferences. Logic can be applied to several areas of thought, including science, math, philosophy, and many more. When it comes to poker, a huge part of the foundation of skillful playing is working through the logic of what possible hands your opponent might have. One must then also work through a process of elimination to reduce the range of possibilities based on their actions as the hand plays out. Poker involves a lot of quick thinking and strategic decision making, all based on principles of logic.

I will be examining logic in poker and through my research. My goal is to understand exactly what is involved in making logical decisions during gameplay. To me, it is honestly shocking that players are able to illustrate different logical gameboards in their head that accurately predict the possible hands of their opponent. I am currently studying for the LSAT, which is a logic-based exam. I am often tasked with different scenarios and fact patterns that I must make inferences about in order to correctly reason possible outcomes. This process is very similar to what pokers players do when trying to decide which possible hands their opponent may have.

I have spent a large amount of my time over this last year trying to become comfortable understanding the language of formal logic. Formal logic is a set of rules for making deductions that seem self-evident ("Intro to the LSAT Exam"). On the LSAT there are two 35-minute sections that are based solely on logic. In the context of the LSAT, logic primarily relates to conditional logic and logic games. Each premise was constructed in an IF-THEN statement, which is a form of a necessary and sufficient conditional statement ("Intro to the LSAT Exam"). The logic games were designed as complex logic statements that I had to diagram out in a methodical fashion to arrive at

logical deduction ("Intro to the LSAT Exam"). I learned to express these statements symbolically while also understanding the underlying theory. I was then able to understand the statement quickly and effortlessly before I went on to answer the accompanying question. As I became more comfortable with taking the exam, I was then able to use my diagrams to come up with my own general idea of an answer. I am able to approach the question with an idea of the answer before I even look at the answer choices.

In order to understand logic in poker, one must first understand what logic is. Logic is a system of reasoning, simply it is a way to make reliable inferences. Logic can be applied to several different disciplines. These areas of thought include science, math, philosophy, and many more. I am a political science major with a minor in legal studies. Much of what I have learned throughout the last four years relates to logic, as it is the foundation of legal analysis. Logic helps to easily and clearly work through a number of scenarios, which relates directly to what occurs at the poker table.

Throughout the semester we have been learning about the game of poker, specifically the theory, practice and culture. Poker is not only a card game, but it is also a social opportunity to interact with other players around the table. The game of poker involves both skill and luck which presents players with numerous challenging strategic decisions. In poker, the objective of the player is to determine the winning probability of the hand against the opponent. The player must decide whether to play the hand or to fold. All these decisions made during the game are based on principles of formal logic. A player's skill is based on a number of components. The components closely mirror the several different disciplines that logic can be applied to. These include mathematics, psychology, deceptiveness, bluffing, assessing competition, reading hands, recognizing tells, exploiting position, and money management (Knight). Each hand is played based on strategy. How well a player strategizes is based on their level of comfort with logically reasoning the situation before them. This strategy helps a player determine whether to fold or bet and how much to bet. This is a skill that can improve with practice, as it is a decision made of a player's own free will (Knight).

One of the books we read during the semester actually relates quite perfectly to my topic of logic in poker. Self-Actualized by Poker written by Roman Gelperin. The author introduces the concept of free-thinking, which unlocks the mind's fullest potential (Gelperin). Once the mind is able to think freely, they no longer think about the hands before them in a categorical way, rather in a way that allows them to have a

clear understanding of the game (Gelperin). This connects to logic because the way that a player thinks at the table directly affects how they will logically interpret the situation before them.

Logic can be applied to poker and game play in several different ways. First, one can use logical systems to help them analyze the game before them (Pacuit). Players can use logical proofs to help them analyze the hands before them and establish a pattern of reasoning on how to react to the situation (Pacuit, 743). Logic can also be used for reasoning with the game of poker, specifically when it comes to strategizing (Pacuit, 743). Logical system can be used to reason about the compositional structure of the strategies a player uses during a hand (Pacuit, 743). When using logic, a strategy is not simply telling the players what to do at each move, instead a strategy is a complex entity with a logical structure of its own that can be analyzed (Pacuit, 743). Finally, formal logic can also be used with the game, to analyze how people behave (Pacuit, 743). A player can logically use a mathematic logical model of a game situation while including a description of what the players know and believe about the hand before them and the other people at the table, known as the bottom-up approach (Pacuit, 744). However, it is important to note that these approaches are not totally reliable when it comes to all of the complex phenomena that arise when rational and not-so-rational agents interact with one another at the poker table (Pacuit, 744). Although these models are useful to help a player understand complex situations, they are often limited because they are narrow hypothetical constructs that do not mirror real world situations (Pacuit, 750).

From personal experience, I use formal logic to create different logical gameboards in order to accurately predict several outcomes. In poker, game theory is the framework for envisioning different situations among competing players. Game theory is the process of modeling the strategic interaction between the players, similar to the gameboards that I create while completing formal logic games ("Game Theory Optimal Solutions and Poker"). In fact, logicians have often used game-theoretic notions in their logical analysis because game theory provides a generative testing ground for a variety of logical systems. Game theory optimal, also known as GTO, is thinking about the game in terms of ranges and probabilities instead of being strictly result oriented ("Game Theory Optimal Solutions and Poker"). GTO allows you to predict possible outcomes, which then helps the player formulates strategies ("Game Theory Optimal Solutions and Poker"). Game theory uses a strong definition of optimal

play, this assists a player in considering every play they would ever make with any hand ("Game Theory Optimal Solutions and Poker"). Various logical frameworks can be used to make precise the important notions that can be applied to the game theoretical analysis used in poker ("Game Theory Optimal Solutions and Poker"). They players are basically using formal logic to visualize different possible outcomes.

Since a large part of good play in poker is based on logic, this then begs the question of whether poker is a game of skill or a game of luck. Just as I suspected, skill plays a substantial role in good logical game play (Levitt and Miles). An empirical study done by Levitt and Miles examined the performance of skilled vs non-skilled players in the 2010 World Series of Poker (32). Their study found that the high-skill players earn an average return of over $1,200 per tournament in (Levitt and Miles 34). Whereas the other plays, which was anyone who was not considered high-skilled, experienced an average loss of $400 per tournament (Levitt and Miles 34). After examining a variety of additional empirical evidence, Levitt and Miles found that players who are considered highly skilled outperform other competitors (41). Based on this study, it therefore can be determined that skill does in fact play a substantial role in the success of poker game play (Levitt and Miles).

A player makes logical decisions about how to act based upon the information that that they have available to them. Because the game is played around the concept of uncertainty, with all the opponents' cards facing down, people are more apt to make poor decisions (Badger).

However, sometimes a player's failure to make correct poker decisions does not stem from the lack of information, but rather from the inability to correctly identify and act upon information they do have access to (Badger). The way in which a player processes information can help to improve decision making (Badger). In order to improve decision making, a player has to do a better job of extracting the fragments of information from the existing mass that are strategically relevant to their or their opponents' decision making (Badger). Therefore, one must first do a better job of evaluating how the relevant information affects logical decision making (Badger). The game theory principles I previously discussed can be used as a logical framework for a player's strategic decision making. With this, a player can improve both their ability to recognize the information that is relevant, as well as the logical process used to evaluate it.

A large part of logic is the psychological component. A player's ability to solve

problems quickly and effectively is a large part of good practical game play. Reasoning, which is the ability to solve problems, relies on multiple cognitive processes including relational thinking. Research has demonstrated that reasoning can improve with practice and increased task-specific expertise (Guerra-Carrillo and Bunge). In a scientific behavioral study, Guerra-Carrillo and Bunge researched and tested which cognitive processes are honed with experience (1). They hypothesized that practicing solving word-based logic problems would lead to improved performance on tests of reasoning, as well as improved efficiency of relational thinking, as measured via gaze metrics (Guerra-Carrillo and Bunge 1). The research combined the use of eye tracking with neuroimaging methods to provide unique insights into the brain mechanisms that support cognitive functioning and learning and sources of individual differences within (Guerra- Carrillo and Bunge 6). Guerra-Carrillo and Bunge analyzed the patterns of eye movements, which helped them to conclude that reasoning instruction and practice led to improved performance on a composite of four measures of reasoning (7). I believe this study can therefore be applied to poker. If a player wants to improve their game play, they must first improve their reasoning skills. By practicing simple real-world logic when they are not playing, a poker player can improve their ability to solve problems at the poker table.

Poker is also all about heuristics. A heuristic is like a mental map, it can aid you in problem-solving (Myers and Twenge). It serves as a shortcut in the brain to quickly solve problems, which can be incredibly beneficial in a high stakes fast pace game like poker (Myers and Twenge). Heuristics are often formed from past experiences (Myers and Twenge). These experiences can be mixed with the social understanding of the players at the table to create a mental blueprint (Myers and Twenge). This can then lead the player to easily develop a sound understanding of poker theory and the ability to react to hands in a quick mindless manor (Pedersen). The heuristics are incredibly crucial to the development of good, pragmatic play (Pedersen). This relates back to the topic of game theory I discussed on the previously, as heuristics are a simpler tool for players to use than the calculations required to find optimal range, which are too complex to memorize.

In Social Psychology I learned about stereotype threat, which I am now able to connect to the game of poker. Stereotyping can impact a way that an individual logically thinks and performs in the situation around them (Myers and Twenge). Stereotype threat is the fear that one might confirm the negative stereotypes about one's

group leads to poor performance on stereotype-relevant tasks (Myers and Twenge). This often occurs in any group about whom a generally known relevant stereotype exists (Myers and Twenge). For example, women at the poker table. The stereotype is that women are weaker less aggressive poker players. Although the women themselves do not internalize this stereotype and the game of poker is still important to them, they are still likely to fall prey to stereotype threat (Myers and Twenge). When women are aware their male collogues are judging them around the table, they often experience a fear that they might confirm the generally known negative stereotypes about their group, leading to their poor performance and bad decision making during the game (Myers and Twenge).
Stereotyping is just one example of a logical fallacy committed at the poker table that has a great effect on game play.

When it comes to using logical thinking there is a chance for error and these errors are also known as logical fallacies. Several of these flaws are often seen at the poker table and are common amongst poker players. You may recognize that you yourself have accidently committed some of these logical fallacies in everyday arguments. Personally, I have become very skilled at recognizing logic flaws as several questions on the LSAT exam involves this skill. The first flaw a poker play may commit is the association fallacy ("Poker Psychology"). This is when a person assigns properties of one person or thing to other 'similar' people or things ("Poker Psychology"). This flaw is simply stereotyping, as I described above. The next fallacy one is likely to commit is proof by example ("Poker Psychology"). This means that a person makes a general conclusion based on a single observation ("Poker Psychology"). Poker players may rely on their memory of a single situation where something especially good happened and then as a result will seek out similar situations in the future. A third fallacy often committed is assuming that correlation implies causation, when it in fact does not ("Poker Psychology"). Just because two things happen at similar times, does not mean one caused the other. Therefore, in poker, just because a player often wins at one location, does not mean that playing at that location causes them to win ("Poker Psychology"). The fourth common flaw is appeal to probability ("Poker Psychology"). This occurs when someone assumes that because something has the ability to happen, that it will happen ("Poker Psychology"). Some players often call with all kinds of strange draws holding out hope of hitting a single lucky card. The final common flaw that commonly occurs at the poker table is the appeal to tradition ("Poker Psychology").

This occurs when a person insists on doing something a certain way because they have always done it this way ("Poker Psychology"). It can be seen as a habit that is resistant to change. In poker, players play certain hands in certain situations in a set way, strictly because that is the way they have always played them.

Given its complex and social nature, decision making in poker almost always possesses some degree of subjectivity. The game involves a complex combination of skill and luck, rationality and intuition and mathematics and psychology. However, this is all burdened by uncertainty over outcomes, and affects each of these components' relationship to success. A player comes to a conclusion about their best course of action by using their ability and level of information about the situation before them. Implied odds often make chasing speculative and uncertain hands profitable, even if the chances of them succeeding are slim, leading people to make riskier decisions. In poker, many best strategies implicitly involve acting with greater risk and uncertainty. This is why logical decision making is vital.

I have examined a variety of different texts and studies in this research assignment. In addition, I have connected some of the information from this course to my research, as the theory and practice of poker relates directly to my topic of logic within the game. This research discussed in this paper has expand on the things I've learned in my general education classes, such as calculus, psychology and sociology. In addition, my research on logic in poker relates back to what I have learned in both my major and minor, as logic is a huge part of the thought process for both politics and the law. Through my research I have built on my current knowledge of logical thinking and strategic decision making while I also learned more about how logic drives some of the most successful hands in poker.

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