CHARACTERISTICS OF GOOD AND POOR POKER PLAYERS

Carrie A. Leonard

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Dedication

Marcel, Rokelle, and Jaden - I dedicate this work to you. Marcel, I know you have sacrificed much, yet you continue to be my pillar. I am so grateful to you for your support and encouragement. Rokelle, you found the white box - and when you did - you inspired me to do the same. Jaden, you came home, jumped in to help in a pinch (in many pinches actually), and taught me that letting go is not giving up. All of these things and more, I thank each of you for.

Abstract

Existing research has demonstrated that poker is a game predominated by skill. Little is known about the specific characteristics of good poker players however, which is partly due the lack of a readily administered measure of poker skill. The first purpose of this study was to develop and validate such an instrument ('Poker Skill Measure'). Having accomplished this, the second purpose of this study was to identify the individual differences that differentiate good from poor poker players. It was found that good players are more likely to be male, to have lower susceptibility to gambling fallacies, a greater tolerance for financial risks, superior social information processing skills, and perhaps less openness to aesthetic and imaginative experience. Tentative evidence would also indicate that having sufficient levels of most of these attributes is more important for poker success rather than having exceptional strength in just one or two of these areas.

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CHAPTER ONE. INTRODUCTION

1.1 OVERVIEW

Poker refers to a family of card games in which both skill and chance are combined to determine the outcome. Since the original development of poker in the late 1700s - early 1800s, numerous variants of the game have been introduced. Poker variants differ with respect to the 1) number of cards dealt, 2) number of cards hidden versus shared (i.e., community cards), 3) number of card exchanges, 4) number of betting rounds, 5) how the pot is shared, and 6) the presence and identity of 'wild' cards. Possibly due to the skill element, poker - especially its no limit Texas Hold'em variant - is one of the most popular card games today (“Evolution of Poker,” n.d.). No Limit Texas Hold'em is the poker variant played in the annual World Series of Poker (WSOP) tournament held in Las Vegas every year and is the most common card game played online (Fiedler, 2011). The steady rise in the popularity of poker began when poker tournaments began being televised to fill the empty National Hockey League (NHL) time slots occurring because of the 2004-2005 NHL lock-out (Jouhki, 2011). Additional popularity growth is said to have stemmed from the online qualification – and subsequent winning of – the WSOP by an American accountant who had never before played a live game: Chris Moneymaker (McCormack & Griffiths, 2011).

1.2 TEXAS HOLD'EM

Because Texas Hold'em is the most popular form of poker, it is the specific type of poker used in the present study.

Texas Hold'em is played most typically with six to ten players utilizing a standard 52 card deck (Jokers removed). Each player is dealt two cards, face down, these cards being known as the players 'hole cards' (refer to Appendix A for glossary of terminology used herein). Cards are dealt clockwise, beginning with the position immediately to the left of the dealer (known as the 'button') (see Figure 1).

After the distribution of the hole cards, the first round of betting occurs beginning with the mandatory bets of the people occupying the 'small blind' and 'big blind' positions. The small and big blind positions are, respectively, the first and second positions to the left of the dealer/button. The big blind bet is double the amount of the small blind, with the amounts of these bets being set by the game stake structure. For example, in a 10-20 game stake structure, the small blind would be required to bet 10 (e.g., $10) and the big blind would be required to bet 20. These mandatory 'blind bets' are required to ensure that there is always a monetary prize ('pot') available for players to win. The person to the left of the big blind must then either match the amount of the big blind ('call'), put in an amount higher than the amount of the big blind ('raise), or opt not to play ('fold'). All other players are then required to make these same choices. If someone has put in an amount larger than the original big blind (i.e., raised), then the remaining players are required to match this amount to stay in the game (for the small and big blinds, their mandatory bets count toward the amount they have to match).

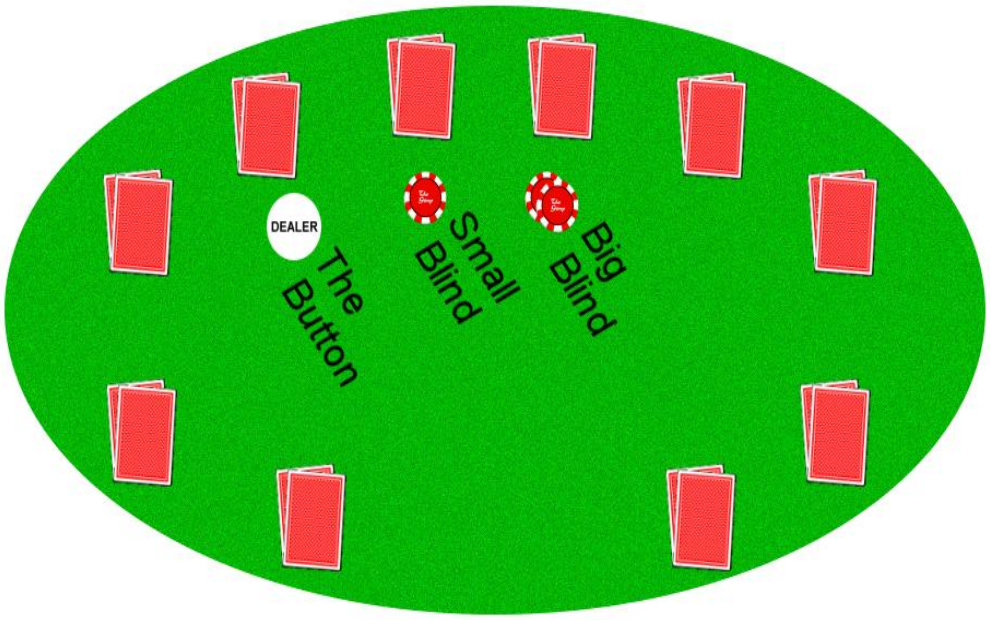

Figure 1: Texas Hold'em 10 Player Table Layout Example.
(“Holdem_Table.png ”,n.d.) Retrieved from: upload.wikimedia.org/wikipedia/commons

Following this first round of betting (known as the ‘pre-flop’), the dealer, after discarding (‘burning’) one card, deals the ‘flop’. The flop consists of three community cards turned face up in the center of the table. After the flop has been displayed, a second round of betting ensues beginning with the first person to the left of the dealer who is still in the game. This person has the option of either making a bet, or ‘checking’, which means that he/she passes the option of betting to the next person. If a bet is made by someone, then each person in the game is required to match the bet (‘call’), raise, or fold. Once betting has been completed, the dealer discards one more card, and then deals a fourth community card face-up (known as the ‘turn’ card). Another round of betting ensues. One final card, known as the ‘river card’, is then dealt face-up. This is followed by the final round of betting (see Figure 2).

Each player’s hand is comprised of any five card combination of community and/or hole cards. The pot is won by the player with the best hand. For hand rankings see Table 1.

1.3 LEGALITY OF POKER

Poker is identified as a 'mixed' game. A mixed game is one in which the outcomes are determined by a combination of skill and chance – regardless of the relative contribution of either skill or chance. Empirical attention devoted to the relative contribution of skill in poker is an important issue as it bears practical relevance to the legal standing of the game in relation to gambling and tax revenue laws.

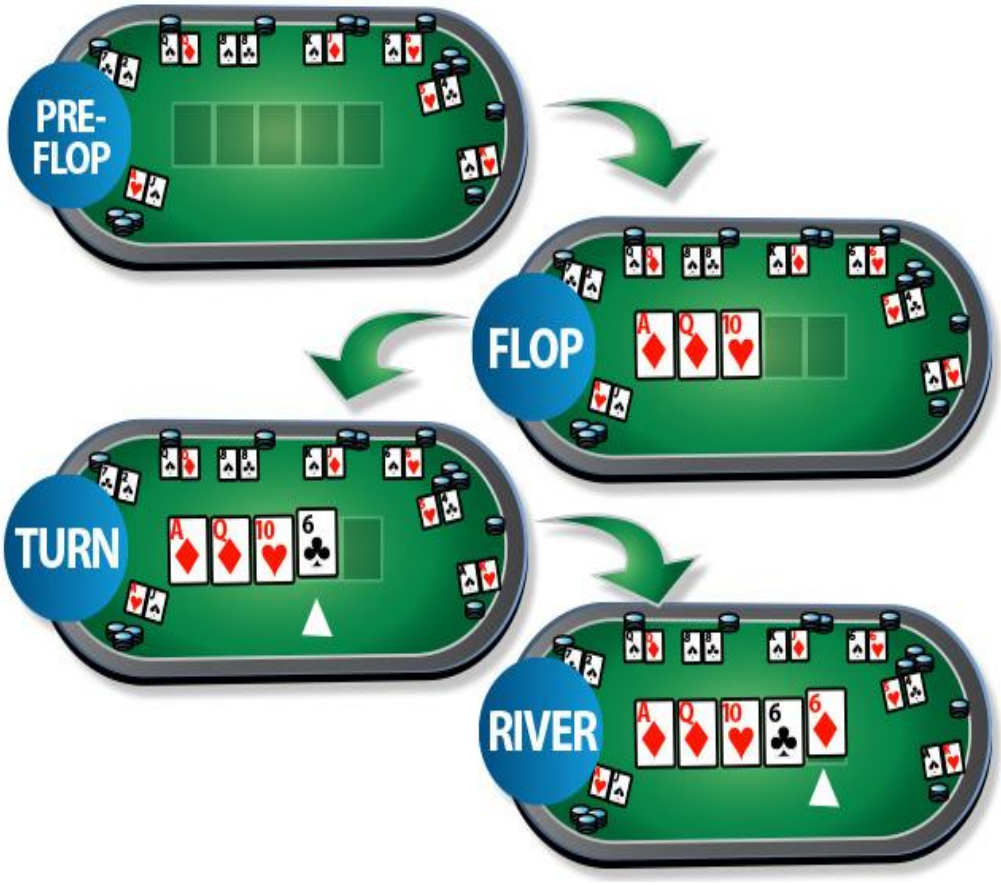

Figure 2. Texas Hold'em Rounds
Retrieved from: http://casinogames365.com/wp-content/
uploads/2013/07/texas-holdem-poker-rounds1.jpg

Table 1: Poker Hand Ranks

Hand Name	Example				
Royal Flush	A♡	K♡	Q♡	J♡	10♡
Straight Flush	10♡	9♡	8♡	7♡	6♡
Four of a Kind	A♡	A♠	A♣	A♢	3♣
Full House	K♢	K♣	9♢	9♡	9♣
Flush	A♣	Q♣	9♣	7♣	6♣
Straight	8♣	7♢	6♡	5♠	4♣
Three of a Kind	A♡	A♠	A♣	5♠	4♣
Two Pairs	K♢	K♣	9♢	9♡	6♣
One Pair	Q♣	Q♢	6♡	5♠	4♣
High Hand	A♢	8♣	6♠	3♣	2♡

Note: Name of poker hand (left column) with corresponding example (right column).Suits displayed in examples are for demonstrative purposes, not mandatory for the displayed hand. Ranking of poker hands is from highest valued to lowest.

In Canada, both online and brick and mortar establishments obtain licenses to provide gambling-related services (Criminal Code of Canada, 1985, ss. 206, 207), and no provision is made exempting mixed games from gambling legislation. In the United States, on the other hand, games for which the outcomes are *predominantly* determined by skill are not considered to be governed by gambling laws at all (Berzon, 2012; Goldstein, Egleson, & Eisenman, 2010). (Note that in the United States the *Wire Act* prohibits cross-state electronic activity (such as online poker), regardless of its skill/chance nature, Heitner, 2013, Schwartz, 2010).

In both Canada and the United States, the question of skill versus chance in poker is also relevant to taxation of winnings/earnings. In Canada, poker income would only be taxable if there is a 'reasonable expectation of profit'. When it is reasonable to expect profit from any pursuit, the profit becomes taxable income as the pursuit is then considered a business/commercial pursuit (Branch, 2012; Government of Canada, n.d.; Philander & Abarbanel, 2011). In the United States, money earned playing poker is considered income, and is taxable as such, regardless of whether it is considered skill or chance-based.

1.4 EVIDENCE THAT POKER IS PREDOMINATED BY SKILL

The ambiguous term 'predominantly' leaves considerable room for debate regarding the legal standing of poker in the United States. The Poker Players Alliance strongly advocates for poker being predominantly skill based (for discussion see: PPA, n.d.). Some recent legal decisions in the United States have agreed with this

characterization. For example, a New York federal judge recently declared that, as poker is predominantly a skill based game, poker should not be governed by U.S. gambling laws (Berzon, 2012).

The chance component in poker essentially rests in the randomness of the cards a player receives. What a player chooses to do with the cards he/she receives is where the skill component of poker begins. One source of evidence that poker is skill based is research by DeDonno and Detterman's (2008) and Dixon and Jackson (2008) who have found that poker training can influence decisions made and therefore increase poker performance. There are several other sources of evidence as well. Hannum and Cabot (2009) demonstrated via computer simulation that a skilled player wins 97% of hands played against an unskilled player. It has also been demonstrated that skilled players are better able to minimize profit losses (Meyer, von Meduna, Brosowski, & Hayer, 2012). Croson, Fishman, and Pope (2008) have shown that past performance in the World Series of Poker (WSOP) is predictive of future performance. They suggest that the differences among top WSOP contenders parallels skill differences seen among top performing professional golfers (p. 28). Also, reviewing the performance of WSOP players, it has been shown that highly skilled players had an average rate of return (on their financial investment) of 30%, compared to the 15% rate of return earned by all other WSOP players (Levitt & Miles, 2012).

The fact that past profit levels are predictive of future profit levels (and thus, implying poker is determined by skill) has also been demonstrated in several large scale

studies of online poker behaviour involving the analysis of hundreds of millions of hands (i.e., Cabot & Hannum, 2005; Hannum, Rutherford, & Dalton, 2012; Potter van Loon, van den Assem, & van Dolder, 2012; “The chart that proved poker is a game of skill,” n.d.). What these studies also illustrate is that skill determination by means of profit analysis may require an extremely large sample of hands for accurate analysis. Analysis of profitability with too few hands will lead to erroneous assumptions due to large variance found in profits. How many hands are actually required is not exactly clear. One poker forum recommends that analysis of profit should only be undertaken when data from at least 100,000 hands are available (“How many hands until you should analyse? - Poker Forums,” n.d., “Poker variance & online poker downswings,” n.d.).

Thus, evidence would tend to support the claim that poker is predominated by skill, but the methods available capable of reliably determining skill level (i.e., long-term profit) are impractical in the laboratory setting. There is in fact, at the time of this writing, no widely available and easily administered measurement of poker playing skill. Perhaps due to the lack of an easily administered poker playing skill measurement, there is a relative dearth of methodologically sound research identifying what characteristics are necessary and/or indicative of a skillful poker play. Popular culture often portrays good poker players as having the ability to 'read' other peoples body language and to conceal their own intentions (‘poker face’). Although social perceptual skills are may well be important to be a skilled poker player, there has never been any thorough empirical test of this hypothesis, let alone a more comprehensive study of the various other attributes that

may underlie poker playing ability (e.g., personality, intelligence, quantitative ability, working memory, playing experience, risk-taking propensity, demographic characteristics).

1.5 STUDY GOALS

The current research study has two goals. First, to create a standardized measure of poker playing skill that can be readily used in the laboratory setting. Second, to undertake a comprehensive analysis of the variables that differentiate good from poor poker players using this measure. Fulfilling these research goals will contribute to the literature by providing a poker skill measure that will allow other researchers to conduct sound scientific research on poker players. The findings of the present study will also inform the debate regarding the legal standing of poker as a game predominated by skill, the debate regarding the taxation of poker players' profits, and the legitimacy of training programs designed to improve poker skills. Finally, by identifying the individual differences that are characteristic of skilled poker players – a novel undertaking in and of itself – this research will address a significant gap in the scientific literature.

The remainder of this thesis is laid out as follows:

- Chapter Two will set forth the procedure and methodology used to meet both the goal of creating a valid measure of poker skill and the goal of determining which variables differentiate good from poor players. As the second goal of this study is contingent upon meeting the first goal, each study goal will be addressed individually as Study 1A (Development and Validation of the Poker Skills

Measure (PSM)) and Study 1B (Variables Differentiating Good from Poor Players), and discussed in separate chapters.

- Chapter Three will present pertinent literature regarding the methodologies employed to measure poker skill in the laboratory setting followed by Study 1A.
- Chapter Four will discuss existing literature pertaining to the characteristics of good versus poor poker players, followed by Study 1B.
- Chapter Five will present the overall study conclusions and suggestions for future research.

CHAPTER TWO. METHOD AND PROCEDURE

2.1 RECRUITMENT

The final study sample consisted of 100 participants recruited from both University of Lethbridge undergraduate students (82%) and Lethbridge community members (18%). To recruit the undergraduate participants, an advertisement was placed on the university's psychology participant pool soliciting participants familiar with Texas Hold'em to participate in a study investigating the factors that predict poker playing ability (see Appendix B). Participants recruited via this system received 2% course credit for their participation. Community member participants were recruited via word of mouth[1]. Word of mouth recruitment was engaged in to ensure a broader demographic sample (e.g., age, playing experience, education level, etc.), as well as a greater variation of skill level within the sample. In addition to course credit, the consent form (Appendix C) indicated that depending on their demonstrated poker skill, they would receive between $0 to $100 in the form of a Visa gift card[2]. This inducement was used to increase motivation and provide ecological validity for the task.

2.1.1. ETHICS

This study was reviewed and approved by the University of Lethbridge Human Subject Research Committee (Protocol #2013-001). In accordance with ethical principles and protocols, all participants read and then signed a written informed consent form.

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[1] Two word of mouth participants were not of the age of majority at the time of data collection. Written informed consent was received from these participants' parents and written informed assent was given by the participants. Word of mouth consent form can be viewed in Appendix D.

[2] Top poker performer received $100, people ranked 2 – 10 received $50 each; people ranked 11 – 40 received $30 each; people ranked 41 – 75 received $25 each; people ranked below 75 received $0.

Included in this form, was the explanation that consent to participate was voluntary and that the participant could withdraw consent at any time without explanation and without repercussion (i.e., loss of course credit). Signed consent forms were collected prior to data collection, and retained by the principal investigator in a locked cabinet separate from all data. Also, no identifying information was collected during data collection, instead participants' data was associated with a numeric identification number. Regardless, collected data was also secured in a locked cabinet in the principal investigators office.

One list however, a master list (an electronic copy only) of participant contact information and participant identification number was kept by the principal investigator for the purpose of participant contact. This contact was necessary for monetary remuneration post data collection. This master list was kept secured (i.e., on the private password protected computer of the principal investigator), and separate from collected data and was only accessible by the principal investigator.

Upon completion of participant remuneration, this list was destroyed (deleted). At the completion of testing sessions, participants were also provided a written debriefing. Within this debriefing form was information regarding relevant research as well as contact information for counseling services. It was hoped that if any participant, due to involvement in the current study or for any other reason, felt concerned about their level of involvement in gambling that they would seek out counseling services. Further information regarding the consent and debriefing process used is found in section 2.3.

2.2 MATERIALS

Each participant engaged in a total of 12 tasks including a detailed collection of demographic information, a virtual Poker Playing Assessment, our experimental Poker Skills Measure, and a series of individual difference measures. Table 2 itemizes all experimental tasks undertaken, task orders by condition (an attempt was made to counter-balance presentation of some of the tasks), and approximate time to complete each task. All experimental tasks and measures are described below.

2.2.1. DEMOGRAPHICS AND POKER PLAYING SURVEY

The Demographics and Poker Playing Survey was designed specifically for this study (see Appendix E). Information was collected on age, sex, ethnicity, years of education, and university major. In addition, years of poker playing experience, typical poker playing habits (i.e., online versus live play; with friends/family versus strangers), and self-rating of playing ability were collected (the latter assessed by making a vertical mark along a horizontal line with anchoring endpoints described as *novice* and *expert*, and the mark converted to a score from 0 to 100).

2.2.2. POKER SKILL MEASURE

The Poker Skill Measure (PSM), created for this experiment (Appendix F), was modeled after many available poker training programs commercially available for Texas Hold'em (for example see: *Dead Solid Poker*, 2010). All questions on this measure were created in collaboration with a professional poker player, and then vetted by two of his professional

Table 2: Experimental Tasks, Tasks Times, and Task Orders by Condition

Task	Time	Condition 1 (*n*= 24)	Condition 2 (*n*= 24)	Condition 3 (*n*= 27)	Condition 4 (*n*= 25)
Consent	3	S1-1	S1-1	S1-1	S1-1
Demographics	3	S1-2	S1-9	S2-1	S2-8
Stanford Binet Matrices	15	S1-3	S1-8	S2-2	S2-7
Digit Span	3	S1-4	S1-7	S2-3	S2-6
Stanford Binet Equation Building	15	S1-5	S1-6	S2-4	S2-5
Poker Quantitative[3]	5	S1-6	S1-5	S2-5	S2-4
Gambling Fallacies Measure	5	S1-7	S1-4	S2-6	S2-3
Tromso Social Intelligence	5	S1-8	S1-3	S2-7	S2-2
PSM1	22	S1-9	S1-2	S2-8	S2-1
PSM2†		S2-1	S2-5	S1-2	S1-6
PPGM††	4	S2-2	S2-4	S1-3	S2-5
DOSPERT†††	7	S2-3	S2-3	S1-4	S2-4
NEO-Personality Inventory	25	S2-4	S2-2	S1-5	S2-3
Poker Playing Assessment	15	S2-5	S2-1	S1-6	S2-2

Note: Time = approximate time, in minutes, to complete each experimental task. Condition 1 through 4 present task orders, *n* = number of participants included in final sample by condition. Condition task orders are represented by S = Session number (1 or 2), and task number (e.g., S2-3 = session 2, 3rd task completed). Tasks marked with an asterisk were timed tasks, thus the time to complete is the maximum allotted time, rather than an approximate time.

† PSM2 was administered for test-retest purposes, and was included only for 50 participants, not the whole sample

†† Problem and Pathological Gambling Measure

††† Domain Specific Risk Taking Scale

[3] This 10 item paper and pencil test of poker quantitative skill is not used or mentioned in the subsequent analyses as it was thought to be too closely related to the Poker Skill Measure.

poker playing colleagues as well as calculation of the actual statistical odds for each response option.

For each of the 35 items in this measure, respondents are presented with a poker scenario for which the respondent must decide which playing action is most appropriate. The scenarios presented tend to increase in complexity from Scenario 1 to Scenario 35. The scenarios vary in terms of which stage of the game is occurring (pre-flop, flop, turn, river), the documented actions or inactions of the other players at the table, the number of other players remaining in the hand (2 to 6), the amount that has been bet, and the described playing style of the opponents (tight/loose; aggressive/passive). Each question is presented on a single page with a color pictorial and text. Participants also are provided with a glossary of Texas Hold'em terminology[4] as well as a tutorial page that itemizes each pictorial component (e.g., folded cards, cards in play, pot and stack sizes, etc.)[5]. Respondents are provided with three response actions for each scenario. As mentioned, the best answer for each item was determined by 100% consensus of three professional poker players as well as pre-flop statistical probabilities. Scores on the PSM consist of the sum of correct answers, with a range of possible scores being 0 to 35, with higher scores indicating higher skill. This is an untimed test and the score is not communicated to the participant.

[4] The glossary of terminology provided with the PSM is the same as can be seen in Appendix A.
[5] The final version of the PSM can be seen in Appendix F. The PSM originally contained 40 items, revisions to the measure to produce the current instrument are described in Chapter 3.

2.2.3. POKER PLAYING ASSESSMENT

For this assessment, participants were asked to play 30 hands in a virtual game of no limit Texas Hold'em against artificial intelligence (AI) players (maximum five AI players) on a laptop computer. *No-Limit Hold'em Cash Game V1* (Wilson Software, 2011) was utilized as this program 1) employs a random number generator (RGM) to determine cards dealt, 2) allows for automatic buy ins (e.g., if a player loses all their money, their account is automatically replenished so that they can continue playing), and 3) allows for the manipulation of both the skill level and the style of play of the AI players. It was statistically determined that playing 30 hands reduced the overall pre-flop equity[6][7] variance between players to 4%. With a maximum of 4% pre-flop equity variance, it was thought that no participant would be unduly advantaged or disadvantaged by playing so few hands. (Note: this program did not permit pre-determined selection of cards dealt so as to altogether eliminate variability in the pre-flop and/or post-flop equity between players).

The five AI opponents had a wide range of skill levels and playing styles to simulate what often happens in social games of poker. More specifically, there were two tight/aggressive players, two loose/aggressive players, and one loose/weak player. 'Loose' players are defined as people who play more hands and tend to continue with weaker hands, hence they do not often fold. 'Tight' players play fewer hands and tend not to

[6] i.e., The probability of winning the pot given the relative strength of the two 'hole cards'.
[7] Pre-flop variance assessment was conducted at the conclusion of the pilot study. Total pre-flop equity for each pilot study participant was determined. The largest pre-flop equity value noted less the lowest pre-flop equity value equalled 4%.

continue with weaker hands, hence they often fold. An 'aggressive' player is someone who is more likely to bet and raise, compared to a 'passive' player who is more likely to check and call. A 'loose/weak' player differs from a loose/passive player in that 1) they often will not fold prior to all community cards being dealt, and 2) they tend not to adjust their playing style (e.g., play more aggressively when holding a good hand).

After 30 hands, participants' net profit, number of hands folded pre-flop, percentage of hands won, percentage of hands raised pre-flop, and percentage of hands bet on the flop were recorded. For the purpose of participant remuneration, a composite score for the Poker Playing Assessment was derived by averaging the rank earned on four variables: net profit, hands won[8], aggression (bets) at pre-flop, aggression (bets) at the flop. (Note: betting aggression is generally correlated with skill level because increasing the price to stay in a round 1) has a tendency to induce players with stronger cards to fold, and/or 2) increases the payoff from players who remain in the round with weaker cards (Potter van Loon, van den Assem, & van Dolder, 2012; Siler, 2010). Skilled poker players also have been documented to play fewer hands ('playing tight') compared to poorer players, reflective of their better understanding that only a minority of hands have a good chance of winning (Siler, 2010). (Note: participant remuneration was based on this above-described composite ranking averaged with their ranking on the PSM).

[8] In general, better players have been shown to play fewer hands than poorer players. So as not to penalize better players for this tendency, percentage of hands won was calculated as: (Total number of hands won divided by total number of hands played) multiplied by 100.

2.2.4. DOMAIN-SPECIFIC RISK-TAKING (ADULT) SCALE (DOSPERT), RISK PERCEPTION SUBSCALE

The Domain-Specific Risk (DOSPERT) Scale (Blais & Weber, 2006) is a 30 item psychometric scale that assesses risk taking in five domains: financial decisions (separate subscales for investing versus gambling), health/safety, recreational, ethical, and social decisions. Respondents rate the likelihood that they would engage in domain-specific activities (Part I). Part II assesses respondents' perceptions of the magnitude of the risks of the activities judged in Part I. Participants in the current study responded only to Part II, the Risk Perception Subscale of the DOSPERT. The reported internal consistency for these domains is adequate, .74, .83, .74, .79, and .83 respectively (Blais & Weber, 2006). The DOSPERT Part II Scale used herein, is the short version of the original DOSPERT for which convergent and discriminant validity were established, and internal consistency values similar to those reported for the long version were obtained (Weber, Blais, & Betz, 2002).

2.2.5. GAMBLING FALLACIES MEASURE

The Gambling Fallacies Measure (Williams, 2003) is a 10 item questionnaire developed to assess erroneous beliefs associated with gambling. By assessing respondents' ability to take statistical probabilities and the random nature of most gambling games, this measure assesses respondents' tendency to succumb to (or to resist) gambling fallacies including: the illusion of control, perception of personal luck, the gambler's fallacy, etc.. Internal reliability is low (Cronbach alpha = .51), which reflects

the fact these 10 questions are assessing a wide range of different fallacies. However, one month test-retest reliability of this measure is relatively good (r = .70). Its validity is established by its significant correlation with problem gambling status, gambling frequency, number of gambling activities engaged in, and paranormal beliefs.

2.2.6. PROBLEM AND PATHOLOGICAL GAMBLING MEASURE (PPGM)

The PPGM measures the respondents self-reported gambling behaviour over the past 12 months. This instrument contains questions pertaining to all areas of potential harm related to gambling and has been shown to be better able to detect problem gamblers who are in denial compared to other commonly used measures (Williams & Volberg, 2010, 2013). The PPGM yields high classification accuracy, minimizing both false positives and false negatives, which is confirmed by high agreement (κ = .93) between instrument and clinical assessment (Williams & Volberg, 2010, 2013).

2.2.7. NEO PERSONALITY INVENTORY REVISED EDITION (NEO-PI-R)

The NEO-PI-R provides a measure of the five personality domains: Neuroticism, Extraversion, Openness, Agreeableness, and Conscientiousness as well as the six subfacets associated with each of the five domains[9] (Costa & McCrae, 1992b). It is currently the dominant instrument in the assessment of personality. Its validity, concurrent and discriminant, has been well established in both normal and clinical populations (Costa & McCrae, 1992). Internal reliability of the domain scores are high,

[9] Six facets comprise each of the five personality domains, thus 30 facets in all. Scores for each domain are the summation of relevant/related facet scores.

ranging from .86 to .92, and the internal reliabilities of the facets range from .58 to .82 (Costa & McCrae, 1992a). A description of facets can be found in Appendix G.

2.2.8. TROMSO SOCIAL INTELLIGENCE SCALE (TSIS)

The TSIS measures three components of social intelligence: Social Information Processing (SP), Social Skills (SK), and Social Awareness (SA) (Silvera, Martinussen, & Dahl, 2001). Silvera, Martinussen, and Dahl (2001, Study 3) report internal reliabilities for each subscale (SP, SK, and SA) to be α = .79, .85, and .72 respectively. The criterion and construct validity of this scale has also been established (Silvera et al., 2001 Study 1; Tayfun, 2009). The TSIS consists of 21 items and yields three scores for each component of social intelligence: Social Information Processing, Social Skills, and Social Awareness. A social intelligence composite score is also derived.

2.2.9. GENERAL INTELLIGENCE

Participants completed the Matrices subtest of the Stanford-Binet Intelligence Test 4th Edition (Thorndike, Hagen, & Sattler, 1986). The 26 items in this subscale from the Abstract/Visual Reasoning Area of the Stanford-Binet provide a pictorial matrix of either four or nine items with one of the cells blank. The person uses their reasoning ability to determine the pattern or principle contained in the matrix so as to determine which of the four options provided best fits the missing cell. The Matrices subtest is normally untimed, but participants in the present study were given 15 minutes to complete it. The Matrices subtest is modeled after the Raven Progressive Matrices, which is intended to be a culture-free measure of general intelligence (‘g’). Factor analytic

studies have confirmed that the Stanford-Binet Matrices is a good measure of *g* (accounting for 55% of the variance), as well as having a Pearson correlation of .78 with the overall Stanford-Binet Composite IQ (Sattler, 1988).

2.2.10. QUANTITATIVE ABILITY

The 18 item Equation Building subtest is from the Quantitative Reasoning Area of the Stanford-Binet 4th Edition. This subtest requires respondents to utilize given numbers and numerical operators to create a mathematical equation. For example, given the following information: "2 3 5 = +", respondents would create the true mathematical statement: "2 + 3 = 5". Although this test is normally untimed, participants were again given 15 minutes to complete it. This measure assesses respondents working understanding of numerical operations and is intended to be a measure of crystallized quantitative ability (Sattler, 1988). The Equation Building subtest has a test-retest reliability of .91 and is reported to have ample specificity (Sattler, 1988).

2.2.11. DIGIT SPAN TASK

This Digit Span Task (Della Sala, Foley, Beschin, Allerhand, and Logie, 2010), is intended to be a measure of working memory capacity. For this task, the experimenter reads a list of numbers with a one second delay between each number. Participants are then required to repeat the list back. Six lists per digit span length are used, and testing ends when a participant repeats less than five of the six lists correctly. Participants' scores are recorded as the greatest span that the person was able to accurately reproduce.

2.3 PROCEDURE

Each participant was tested individually, in two one-hour sessions, spaced one week apart. Written informed consent was obtained prior to the commencement of Session One, and verbal indication of continued consent was sought before engaging in Session Two. As indicated earlier, as part of the informed written consent, it was expressed to participants that in addition to 2% course credit[10,11], they could potentially be eligible for financial remuneration. It was explained that their eligibility for receiving monetary compensation would be based on their ranking, compared to the rest of the participants, on a composite score of both poker playing measures (the PSM and the Poker Playing Assessment). They were reminded of this same fact when introducing the PSM and Poker Playing Assessment measures.

After informed consent was obtained, participants were assigned to one of four test order conditions. Four different experimental task orders were employed so as to reduce order effects such as fatigue while also preventing potential priming effects which could occur (if, for example, the PSM and Poker Playing Assessments were completed in succession). Instructions preceded each experimental task and were delivered either verbally by the experimenter, or were included in the written instructions provided with the task. The Consent Form as well as all measurements were completed in a paper and pencil format with the exception of the Poker Playing Assessment which was conducted on a 17 inch Acer laptop computer in full screen mode.

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[10] Word of mouth participants received a written informed consent form that did not discuss course credit.
[11] The written consent form for both undergraduate participants and word of mouth participants can be seen in Appendix E and F, respectively.

Upon completion of the Second Session, participants were thanked and debriefed, and told that remuneration would follow at the end of all data collection completion[12].

[12] The Debriefing Form can be seen in Appendix H.

CHAPTER THREE. STUDY 1A: DEVELOPMENT AND VALIDATION OF THE POKER SKILLS MEASURE (PSM)

3.1 RELEVANT LITERATURE

No easily administered standardized measure of poker playing skill currently exists. Consequently, laboratory experiments examining poker players have utilized different techniques for identifying skill levels. Three studies have used play/don't play decision tasks to established participant skill level, whereby decision choices reflective of greater statistical probabilities of winning were deemed to be indicative of greater skill (Linnet et al., 2012; Linnet, Gebauer, Shaffer, Mouridsen, & Møller, 2010; Palomäki, Laakasuo, & Salmela, 2012). In these play/don't play decision tasks, participants are provided with their hole cards alone, or their hole cards plus the flop cards. Participants then indicated whether they would fold the hand (don't play) or continue on with the hand (play). Participants in these studies did not actually play out the hands given, rather they merely made a number of play/don't play decisions.

Self or third party report of skill level has been another strategy to assess skill. Meyer et al. (2012) utilized self-reports of playing frequency, perceived personal success, and self-reported poker playing profits to create a composite score by which participants were categorized as either average players or probable experts. Another study asked for self-reported experience and used this as an indication of participant familiarity and ability in poker (Slepian, Young, Rutchick, & Ambady, 2013). Other studies have relied

on peer-reports to identify participants' skill levels (Bina, Chen, & Milgram, 2008; St. Germain & Tenenbaum, 2011).

A few studies have asked subjects to participate in a computerized poker game against AI opponent(s). Participants in McKay's (2012) study played 75 hands of Texas Hold'em against a University of Alberta computer bot through a web based interface. Skill level for each participant was calculated based on attained profit versus expected profit (expected profit being the net value expected given the mathematical probabilities of winning each poker hand). Although this more objective measure seems promising, similar to other previously mentioned objective measures of playing skill, this task is fairly time consuming (75 hands taking on average 1 hour to complete) and difficult to administer (McKay, 2012). Also, it only assesses performance against a single opponent. A similar methodology was used by St. Germain & Tenenbaum (2011) who used 60 hands of No-Limit Texas Hold'em and were able to demonstrate significant differences in playing performance between expert and novice players, with these differences being most evident in later stages of play (i.e., flop, turn, river versus pre-flop) and in untimed conditions. However, it should be pointed out that the ability to obtain these differences in just 60 hands was facilitated by the considerable difference in skill levels between the novice and expert players. Expert players were recruited from the population of poker players that were nominated as experts by their professional peers. They averaged 13 years of play, and 39,200 hours of poker-playing experience. By comparison, the novice players averaged just 2.4 years and 23.9 hours of poker-playing experience.

There are several theoretical reasons to believe that many of the above-described methods used for poker skill assessment may be inadequate. For one, there are many more decisions that need to be made during a real hand (online or at the table) than can be fully accounted for by the static play/don't play decision tasks used in some of these previous studies. In addition to statistical assessment about the cards in play, the successful poker player also is required to make appropriate decisions regarding opponent modeling, self represented behaviours, and especially in No Limit Texas Hold'em, betting strategy (Bina et al., 2008; DeDonno & Detterman, 2008; Siler, 2010; St. Germain & Tenenbaum, 2011). The reliability of self-reported ability is also questionable as individuals often report higher ability for themselves than can be demonstrated objectively (for discussion see: Dunning, 2011; Hoorens, 1993). Peer-reports of other players ability very much depend on the accuracy and reference group used by the rater. Of final note, the ecological validity of these tasks was not optimal because of the lack of playing skill being related to level of participant remuneration (i.e., none of these studies reported providing financial remuneration for performance).

All the aforementioned studies do point to the importance of appropriate decision making being central to poker skill. The aim of Study 1A was to create and validate an objective, efficient, reliable, and valid paper and pencil measure of poker playing skill that assessed decision making in a variety of more complex and dynamic situations. Self-rated skill, years of playing experience, and objective performance on a short 15 minute

virtual game of Texas Hold'em (i.e., Poker Playing Assessment) were all used to help validate this paper and pencil measure.

3.2 PILOT STUDY

3.2.1. PARTICIPANTS

The Pilot Study sample consisted of n = 18 undergraduate student volunteers from the University of Lethbridge Psychology participant pool. Participants were required to know how to play the Texas Hold'em variant of poker. Each participant received course credit for their participation (2% towards course grade). In addition, dependent on their skill score ranking (as previously described), they were eligible to receive a prepaid Visa gift card. The study was conducted with the approval of the University of Lethbridge Research Ethics Committee. The sample consisted of 8 females and 10 males with a mean reported age of 22.89 (SD = 5.45). See Table 3 for additional participant information.

3.2.2. PILOT STUDY RESULTS

Participants in the pilot study (n = 18), reported having an average of 3.64 years of poker playing experience (SD = 1.7), and a mean self-rated poker playing ability of 37.44 (SD = 18.56) (on a scale ranging from 0 to 100). Participants attained a mean score on the PSM of 19.5 (SD = 6.36) on the first assessment (out of a total maximum score of

Table 3: Pilot Study Participant Demographics

	N	*M(SD)*	*Min*	*Max*	*Mdn*
Age	18	22.89 (5.45)	19	42	22
Gender					
Male	10				
Female	8				
Ethnicity					
Caucasian	13				
Asian	3				
African	1				
Mixed Ethnicity	1				
Years of Education		14.78 (2.07)	12	20	15
Playing Experience (Years)		3.64 (1.7)	1.17	8	3.38
Self-rated Playing Ability		37.44 (18.56)	0	68	36
Normal playing opponents (%)					
Family, live game	50				
Friends, online	11				
Strangers, online	50				
Friends, live game	72.22				
Strangers, live game (casino)	11				
Computer game, virtual players	27.80				
Poker Playing Assessment scores					
Profit (in Dollars)	18	-38.94 (98.32)	-270.00	125.00	-53.50
Hands Played (Max = 30)	18	21.78 (4.63)	13	29	22
Hands Won (%)	18	37.78 (11.11)	19	57	41.88
Aggression pre-flop (% raised)	18	10.12 (12.05)	0	41.70	7.40
Aggression flop (% bet)	18	27.82 (19.71)	0	27.35	31.55

Note: n = sample size; *M(SD)* = Mean with standard deviation in parentheses; *Min* = Minimum; *Max* = Maximum; *Mdn* = median.
† PSM scores are post-revision.

40). The internal consistency of the measure was α = .82. Neither ceiling nor floor effects were evidenced. The average score of 19.5 was low (considering chance accuracy would be 13.3), but this is consistent with a fairly low level of self-rated skill and relatively weak performance on the Poker Playing Assessment. All participants in the pilot study were re-tested on the PSM during their second testing session, exactly one week after the first assessment. On re-test, participants achieved a mean PSM score of 19.56 (*SD* =6.66), and the internal consistency of the re-test was α = .83. The one week test-retest reliability of the PSM was r = .81.

3.2.3. PSM ITEM ANALYSIS AND REVISION

Item analysis of the PSM pilot data revealed three items of low reliability and low discrimination. These items were eliminated. Two additional items were eliminated as the answers, despite receiving 100% consensus from three professional poker players, were not supported by pre-flop statistics. That is to say, statistical analysis would suggest the pre-flop decision should have been to fold the hand, yet the professional players each believed that the appropriate response would be to call rather than fold. These two items also had both low reliabilities and discrimination.

Two further changes were made. It was noted that 1) the item scenarios largely utilized language that was specific to the Texas Hold'em poker variant, and 2) each item contained one impossible answer (i.e., ‘checking’ when it would only be possible to ‘call’). Although a glossary of terminology was provided to participants, it was our intention to create a measurement of generic poker skill – not solely Texas Hold'em skill.

It was also a concern that the language utilized may create a barrier for individuals who, regardless of skill level, may simply not be familiar with Texas Hold'em terminology. To minimize these problems, each item was reworded to reduce unnecessary jargon. Impossible answers were also eliminated. Thus, the revised PSM consisted of 35 items, each with three possible answers.

3.2.4. PILOT STUDY RESULTS POST PSM REVISION

Removal of the five items from the PSM led to a new mean = 18.28 (*SD* = 5.49)[13]. The difference in PSM scores however, was not significant ($t = 0.76$, $df = 17$, $p = .46$). The internal consistency of the revised PSM remained high ($\alpha = .79$), as did the test-retest reliability post-revision, $r = .80$. See Table 3 for all pilot study results.

3.2.4.1. VALIDATION OF PSM PILOT RESULTS

Participants did not play every hand dealt in the virtual Poker Playing Assessment, playing an average of 21.78 (*SD* = 4.36) of the 30 hands. Most participants also lost money in this task (partly due to playing too many hands) (*M* = -$38.94, *SD* = 98.32; *Mdn* = -53.50). The relationship between PSM score and net profit was found to be $\tau = .30$ ($z = 1.71$, $p = .09$). (Note: Kendall *tau-b* is used in preference to Pearson *r* due to significant skewness in net profit. Although skewness is less of a problem with the other variables, Kendall *tau-b* was used throughout to facilitate comparisons). A similar relationship was detected between the PSM and percentage of hands won ($\tau = .26$, $z =$

[13] It was fortuitous that the 5 items removed tended to be harder items, making the overall scale somewhat easier.

1.49, $p = .13$)[14]. As aggression (e.g., betting, raising) has also been found to be a determiner of poker success, the relationship between PSM and measures of player aggression were also evaluated. PSM scores and pre-flop betting propensity were positively related, $\tau = .29$ ($z = 1.57$, $p = .12$). PSM scores were even more strongly related to propensity to bet and raise at the flop, with the relationship between PSM scores and bets laid being $\tau = .43$ ($z = 2.41$, $p = .02$) and the PSM scores and raised pots being $\tau = .39$ ($z = 2.01$, $p = .04$).

The relationship between PSM scores and participants self-rated playing ability and total playing experience (time in years), was also evaluated. Participants' rating of their own playing ability, indicated as a number between 0 and 100, was strongly and positively related to their scores on the PSM ($\tau = .39$, $z = 2.21$ $p = .03$). Total playing experience however, although positively related, was only weakly associated with PSM scores ($\tau = .12$, $z = 0.69$, $p = .49$).

3.2.5. PILOT STUDY DISCUSSION

The sample size of the pilot study is too small to make anything other than tentative statements about the reliability, validity, and psychometric characteristics of the revised PSM. Nonetheless, some observations are warranted. First, the internal consistency of the measure appears to be good ($\alpha = .79$), and the one week test-retest reliability appears strong ($r = .80$). The distribution of PSM scores appears to suggest that poker playing skill, as evaluated by the PSM, falls along a continuum and that poker playing skill may be normally distributed. This fact also illustrates that the obtained

[14] Note: The ability to achieve statistical significance in the Pilot Study is limited by the small sample size.

scores on the measure are sufficiently variable so as to be able to capture a range of skill levels in the general population, including players with superior skills to those in the current sample. None of the pilot study participants scored 100% on the PSM, although there were some individuals who did score below chance levels (consistent with the apparently relatively low levels of poker skill apparent in this sample).

The face validity of the instrument is established by the fact that the content was initially created from professional poker players. The concurrent validity is evidenced by the positive and significant relationships with a range of other measures that should theoretically bear a positive relationship. The low to moderate positive relationship between PSM scores and Poker Playing Assessment net profit and hands won was anticipated because of the relatively few hands of virtual poker played; the fact that some variability still existed in the strength of the cards dealt between participants; and because of the very high variability in the size of monetary wins and losses. There was also a strong relationship between participants' self-rated playing ability and their PSM scores (τ = .39) and a weak relationship with years of playing experience. This latter result may be attributed to the fact that many weak/casual players still enjoy the game and have engaged in it for many years (potentially similar to a weak relationship between years of golfing experience and golfing ability). Perhaps a better measure would have been frequency of playing, rather than years of playing.

3.3 STUDY 1A

Study 1A utilized the methodology and procedures as reported in Chapter Two. That being the case, the reader is referred to Chapter Two for discussion of materials and procedures used.

3.3.1. STUDY 1A RESULTS

The final sample consisted of n = 100 participants. They were predominantly Caucasian (80%), consisting of 54 males and 46 females, with a mean age of 23.28 years (SD = 6.45). Additional participant demographic information can be seen in Table 4. In addition to demographics reported in Table 4, information regarding current educational pursuits was collected. Of all student participants (e.g., participant pool and word of mouth), 24% indicated that they were majoring in Psychology, 15% were Kinesiology majors, 13% Neuroscience majors, and 8% were either Business and/or Management students. The remaining students indicated a diverse array of study majors: Sociology, Native American Studies, Dentistry, Mathematics, Addictions Counseling, Political Science, Philosophy, Modern Languages, History, Exercise Science, Environmental Science, English, Economics, Dramatic Arts, Biochemistry, and Biological Science.

No data were missing on the PSM and Poker Playing Assessment measures, enabling the use of all data collected[15]. One large outlier was evidenced in participants

[15] After data was collected from n = 46 participants in the primary study (e.g., Study 1A), a comparison was conducted between pilot (post-revision scores) and primary sample scores. No significant difference was found between groups on PSM scores (t = .078, df = 62, p = .44, 95% CI [-1.68, 3.81]). As such, data from the pilot study were incorporated into Study 1A data.

Table 4: Study 1A Participant Demographics

	n	*M(SD)*	*Min*	*Max*
Age		23.28 (6.45)	17	57
Gender				
Male	54			
Female	46			
Ethnicity†				
Caucasian	80			
Asian	11			
Metis	2			
First Nation	1			
African	2			
Mixed Ethnicity	4			
Inuit	1			
Other	1			
Years of Education		14.66 (2.01)	11	20
G.P.A.††	88	3.14 (0.55)	1.5	4.0
Playing Experience (Years)		4.68 (5.13)	.00	40
Self-rated Playing Ability		33.42 (21.15)	0	87
Normal playing opponents (%)†††				
Family, live game	45			
Friends, online	5			
Strangers, online	41			
Friends, live game	70			
Strangers, live game (casino)	15			
Computer game, virtual players	19			

Note: n = sample size; *M(SD)* = Mean with standard deviation in parentheses; *Min* = Minimum; *Max* = Maximum; G.P.A. = Grade point average on a 4.0 scale.
† Two participants self-identified as more than one ethnicity, thus the sample size calculated via ethnicity appears larger than the total sample size (*n* = 100).
†† Some word of mouth participants indicated their G.P.A. from when they were last in school, others were students at the time of data collection allowing them to provide a current G.P.A.
††† Participants were asked to check off all answers that applied.

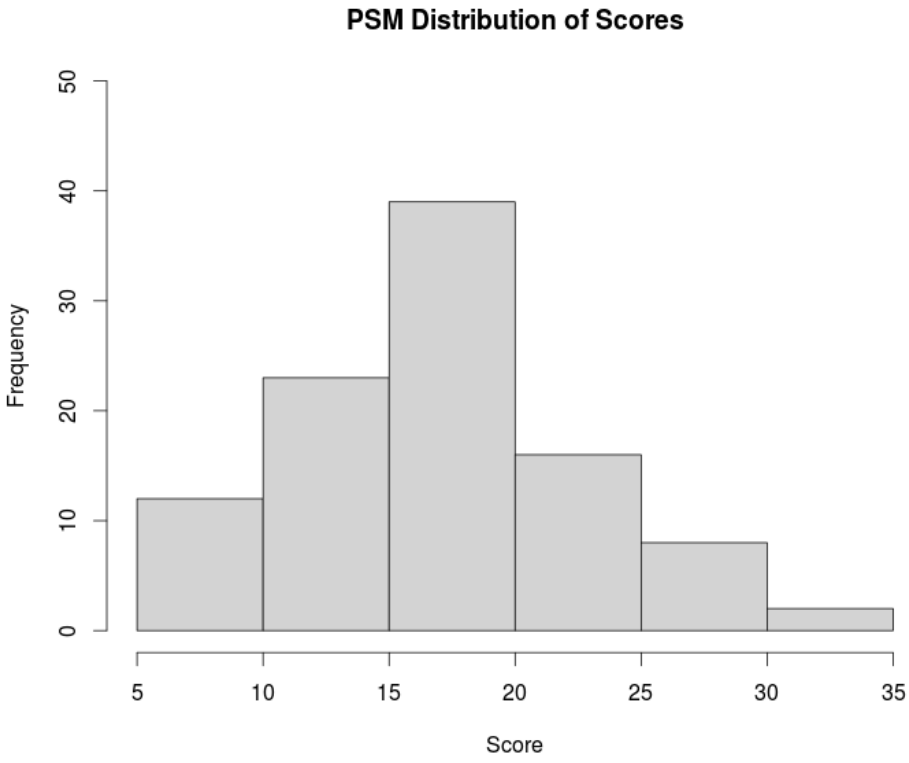

Figure 3. PSM Score Distribution

net profit, however (net loss for this participant was -$891.00), replacing this value with an outlier cap was deemed unnecessary as the analyses used a Kendall's τ correlation rank coefficient which negates any effect an outlier would otherwise have on the data.

A mean score of 17.63 was achieved on the PSM with a standard deviation of 5.57. The internal consistency of the PSM was $\alpha = .78$. As can be seen in Figure 3 the distribution of scores on the PSM had a mild positive skew, but was otherwise relatively normally distributed. Skew and kurtosis were 0.4 and -0.33, respectively. A subset of sample participants ($n = 50$) were re-tested on the PSM one week after the first assessment (i.e., during their second testing session) so as to establish test-retest reliability, which was found to be $r = .82$.

Results from the PSM were checked for both ceiling and floor effects. Ceiling effects occur when all, or nearly all, participants score near the maximum possible score on a measure. Ceiling effects were evaluated using the formula:

$$\frac{\text{Maximum Score} - \text{Mean Score}}{\text{Sample Standard Deviation}}$$

If ceiling effects were present in the data, the resultant quotient will be 1 or less. Scores on the PSM resulted in a quotient equal to 3.12. The PSM results were also checked for floor effects. Floor effects occur when nearly all, or all, participants score very low on a measure. Floor effects were evaluated using the formula:

$$\frac{\text{Mean Score} - \text{Minimum Score}}{\text{Sample Standard Deviation}}$$

Similar to ceiling effects, floor effects are evidenced when the resulting quotient from the above formula is at or below 1. The PSM results yield a floor effect quotient of 3.17. Thus, neither ceiling nor floor effects were evidenced in the PSM.

3.3.1.1. VALIDATION OF THE PSM

A significant positive relationship was found between PSM scores and percentage of hands won on the Poker Playing Assessment (τ = .26, z = 3.76, p < .001). On average, participants played 22.98 (*SD* = 4.5) of the 30 virtual hands allotted during the Poker Playing Assessment (see Table 5). A significant, and expected, negative relationship was found between PSM scores and hands played (τ = -.25, z = -3.57, p < .001). Participants earned a mean net profit of -$84.00 (*SD* = 199.76) on the Poker Playing Assessment. Unlike the Pilot Study, the relationship between PSM score and net profit with the full sample was essentially zero (τ = -.01, z = -0.21, p = .83).

As was found in the Pilot Study, PSM scores and pre-flop betting propensity were significantly and positively related, τ = .30 (z = 4.05, p < .001), as were PSM scores and increased betting propensity at the flop (τ = .31, z = 4.44, p < .001).

Participants reported an average of 4.68 years of poker playing experience (*SD* = 5.13), and a mean self-rated poker playing ability of 33.42 (*SD* = 21.15) (out of 100). Participants' rating of their own playing ability was significantly and positively related to their scores on the PSM (τ = .24, z = 3.37, p < .001). Similar to the Pilot Study, total playing experience was weakly associated with PSM scores, but statistically significant in the present case because of a much larger sample size (τ = .17, z = 2.35, p = .02).

Table 5: Final Sample Results

	n	*M(SD)*	*Min*	*Max*
Playing Experience (Years)	100	4.68 (5.13)	.00	40
Self-rated Playing Ability	100	33.42 (21.15)	0	87
PSM	100	17.63 (5.57)	8	32
Poker Playing Assessment scores				
Profit (in Dollars)	100	-84.00 (199.76)	-891.00	287.00
Hands Played (Max = 30)	100	22.98 (4.5)	12	30
Hands Won (%)	100	46.06 (14.15)	19.05	83.33
Aggression pre-flop (% raised)	100	11.63 (16.36)	0	69.2
Aggression flop (% bet)	100	36.25 (22.66)	0	100

Note: n = sample size; *M(SD)* = Mean with standard deviation in parentheses; *Min* = Minimum; *Max* = Maximum

3.3.2. STUDY 1A DISCUSSION

The evidence would suggest that the PSM provides an objective, efficient, reliable, and valid measure of poker playing skill. This untimed instrument takes an average of 22 minutes to complete, which is considerably less time than has historically been used to determine skill level from online play performance. It requires decision-making in a wide range of scenarios that better capture the complex and dynamic situations that typically occur in poker. It captures a wide range of skill levels (including skill levels higher than evidenced in the present sample), without any ceiling or floor effects.

Reliability is evidenced by good internal consistency (α = .77) as well as 1 week test-retest reliability (r = .82). The face validity of the instrument is established by the fact that the content was initially created from professional poker players. The concurrent validity is evidenced by the positive and significant relationships with a range of other measures that should theoretically bear a positive relationship. This includes self-rated playing ability, years of playing experience, and various indices on the Poker Playing Assessment test (i.e., % of hands won, % of hands played, pre and post-flop betting propensity). Of final note, it should be pointed out that there were no known professional poker players in the sample. If there were, all of these relationships may well have been even stronger as it was evident that the three professional poker players who helped design the PSM would have scored extremely high on this instrument even if they had been naïve to its content.

Some potential limitations of the PSM should be noted. The first limitation pertains to the content validity of the measure. Although the overall content validity of the measure is high, 'bluffing' is one element of player skill that is not assessed by this measure. There are three reasons for this intentional omission. First, both the choice to engage in a bluff - as well as determining when it is appropriate to bluff - is quite subjective. Gaining consensus from our three professional poker player raters for an item scenario where bluffing would be the 'most appropriate' action was therefore highly unlikely. Second, while acknowledging that bluffing when used wisely can aid in a players success (Goldstein et al., 2010), bluffing among good players is used far less than popular culture would suggest ("Poker myths: The best poker players continuously bluff.," 2007). Third, a hand with which bluffing might be a good course of action could not be validated by pre-flop statistics, which do not factor into account the non-optimal decision making of other players who might be influenced by a bluff. It was determined during the creation of the PSM that the 'correct answer' for all items should be as uncontestable as possible. As such, all items in the PSM were required to be supported by pre-flop statistics in addition to support from all three professional poker player raters.

A related issue is the fact that the PSM is an abstract decision-making task decontextualized from the conditions of an actual live game. There is no opportunity to attend to or be influenced by the interpersonal cues of other players (e.g., intimidation, 'behavioural tells', etc.). The implicit time pressure to make decisions in a short period of time is also not present. However, these differences may not be that important

considering the easy transition successful online players have made to high level live tournaments. Also, the evidence thus far would suggest that bluffing and ‘reading’ other players seems much less important than careful regulation and management of one's own play.

A final issue that could be perceived as a limitation is the near zero relationship noted between PSM scores and profit during the virtual Poker Playing Assessment. However, based on the reviewed literature, a weak or absent relationship between net profit and PSM scores was actually anticipated (e.g., Cabot & Hannum, 2005; Hannum & Cabot, 2009; Potter van Loon et al., 2012; “The chart that proved poker is a game of skill,” n.d.). Simply put, participants played too few hands to have net profit reliably represent their skill level.

All things considered, the PSM has been demonstrated to be a reliable and valid tool for the measurement and identification of poker playing skill level. Consequently, PSM scores will be utilized in Study 1B to as the dependent variable to investigate the attributes that differentiate good from poor players.

CHAPTER FOUR. STUDY 1B: VARIABLES DIFFERENTIATING GOOD FROM POOR POKER PLAYERS

4.1 RELEVANT LITERATURE

The position that poker is a game predominated by skill leads to the query: What individual differences (IDs) are characteristic of skilled poker players? No previous study has sought to evaluate the full scope of characteristics presupposed to contribute to playing skill. However, some previous empirical investigations have shed some light on the nature of poker players more generally.

4.1.1. DEMOGRAPHICS

It is well established that poker players are predominantly comprised of young adult males who report higher rates of alcohol use than other (non poker playing) gambling populations (Dannewitz & Weatherly, 2007; Meinz et al., 2012; Oliveira & Silva, 2001; Shead, Hodgins, & Scharf, 2008). However, beyond these general demographic characteristics, there is no research regarding whether certain demographic characteristics are associated with superior poker skill.

4.1.2. QUANTITATIVE/STATISTICAL SKILL

As would be expected, it has been found that better players make more statistically optimal poker-related decisions. For example, St. Germain and Tenenbaum (2011) found that better decision-making processes leading to higher expected value were consistently demonstrated by more expert players and that these players incorporated more situation-relevant cues during decision-making than did novice players.

4.1.3. EXPERIENCE

Palomäki, Laakasuo, and Salmela (2013) concluded that more experienced players make more mathematically justified poker decisions. Similarly, two studies by Linnet showed that in more experienced players, probability estimation (i.e., relating to potentiality of hands winning) was superior to that of inexperienced players (Linnet et al., 2010, 2012).

While it may well be the case that ability tends to increases with experience, there are some situations where it does not. One study found that in their sample of experienced players, those who were also classified as pathological gamblers had comparable decision-making skill to the inexperienced players (Linnet et al., 2012). It should be pointed out that a potential gender confound exists in the aforementioned studies. Most notably, Linnet et al.'s (2010) experienced sample was comprised solely of males, while the inexperienced sample consisted solely of females. Palomäki, Laakasuo, and Salmela's (2013) study analyzed predominantly males, with females comprising only 16% of their sample.

4.1.4. SOCIAL SKILLS/INTELLIGENCE

Social intelligence is another area that would seem likely to play a role in poker playing skill. It certainly is the ability most endorsed in popular culture as being necessary for successful poker playing. Social intelligence includes one's tendency to attend to social information, process information observed in the social environment, as well as being capable of controlling the social information delivered via one's own

behaviour (Silvera, Martinussen, & Dahl, 2001). In the literature, studies of poker players have provided support for the necessity of social intelligence in successful poker playing. Bellin (2002) for example, notes that players often introduce fake ‘tells’ in attempts to fool opponents (e.g., feigned excitement suggesting a good hand, when the hand is actually weak). On a somewhat related note, one study has shown that the best 'poker face' may be one that conveys trustworthiness rather than neutrality (Schlicht et al., 2010). Schlicht et al. (2010) showed that players more often folded to a bluffer demonstrating facial characteristics associated with trustworthiness than to a bluffer demonstrating a neutral facial expression.

Wilson (2003) states that both the ability to deceive and the ability to recognize deception are crucial skills that aid in successful poker playing. Opponent modeling is the act of perceiving and interpreting opponent behaviours, and adjusting one's own strategy based on this information (McCormack & Griffiths, 2011). McCormack and Griffiths (2011), in a qualitative study of four professional and five recreational poker players, found that the professional players were more adept at accurate opponent modeling. Castaldo (2007), in an interview with a professional female player, found that she would change playing strategies (e.g., choosing to bluff more or less) dependent upon her perception of her opponents attitudes towards her – as a female player. Slepian et al. (2013) found that experienced players were able to accurately rate players' hand strength at above chance levels, based merely on arm movements used when the player was placing bets (i.e., chips) into the center of the table. Abilities captured under the umbrella

of social intelligence then, such as those used for opponent modeling, also appear to contribute to the skill set of a successful poker player.

4.1.5. PERSONALITY AND RISK-TAKING

Personality traits may also differentiate good from poor players. Palomäki, Laakasuo, and Salmela (2013) found that greater self-evaluation, less rumination, and greater emotional control occurred more frequently in their sample of experienced players. This finding also implies lower levels of neuroticism. Browne (1989) also concluded, via an observational study, that better players demonstrate greater emotional stability - evidenced by staying 'off tilt'. To be 'on tilt' is to lose one's temper and begin to make playing decisions based on emotion. Another observational study found that winners were more gregarious than losers (Martinez & Lafranchi, 1969). Another study found that aggressive players are more likely to be extraverted (Brown & Mitchell, 2010).

Barrault and Varescon (2013) noted high sensation seeking among online poker players. McCormack & Griffiths (2011), via a qualitative study of four professional and five recreational players, identified lower risk-taking and more self-discipline (i.e., professional players expressed that they were less likely to chase losses) in the professional players as compared to the recreational players. In a similar way, Siler (2010) noted greater 'risk neutrality' associated with successful play. Risk neutrality is evidenced when players consistently bet when their cards suggest a positive expected value, without consideration of opponents hand strengths and the overall win/loss

potential. It is possible that simply attending to their own cards facilitates greater risk taking (i.e., aggression), which is empirically associated with more successful play. The risk-taking demonstrated by better players then, may be best seen as *calculated* rather than reckless risk-taking.

Findings relating to personality must be seen with healthy skepticism as some of the methodologies used are less than sound. For example, Brown and Mitchell (2010) simply defined aggressive players as those individuals who played three or more out of ten hands observed. Other studies (e.g., Palomäki, et al., 2013), provide results that implicate personality differences but do not contain methodologies that objectively assessed personality. Rather, conclusions regarding individual differences in self-control for example, stem from qualitative judgements.

4.1.6. OTHER DIFFERENCES

Three other studies have examined characteristics of poker players. One study identified higher working memory capacity in their sample of better players (Meinz et al., 2012). The other two studies have reported a significant association between gambling fallacies and problem gambling among poker players (McKay, 2012; Mitrovic & Brown, 2009).

4.1.7. INDIVIDUAL DIFFERENCES SUMMARY

There is relatively little research on the characteristics differentiating good from poor poker players. Existing findings tentatively indicate that in addition to better

statistical knowledge about poker, the successful poker player tends to have more playing experience, as well as higher social intelligence, emotional control, and working memory.

4.2 STUDY 1B GOALS

The goal of the current study is to begin to fill the above noted void by attempting to more comprehensively and rigorously examine the individual characteristics that differentiate good from poor poker players. Specifically, the current study seeks to ascertain whether good players are significantly different from poor players in terms of: 1) demographic characteristics (age, gender, race/ethnicity, educational level); 2) educational achievement (i.e., grade point average); 3) general intelligence; 4) general quantitative ability; 5) resistance to gambling fallacies; 6) social intelligence; 7) working memory; 8) risk perception and tolerance, 9) personality and 10) problem gambling status.

To accomplish the goals of Study 1B, poker skill was assessed with the PSM, and individual differences in the above-mentioned variables were assessed with the instruments described in Chapter 2.

4.3 STUDY 1B RESULTS

4.3.1. DATA SCREENING AND CLEANING

Less than 0.005% of data were missing. Of these, the majority of missing data points were missing from the NEO personality questionnaire. Missing values from the NEO were replaced with the individuals' mean score for the personality facet from which the data point was missing. Two participants each left one answer blank on the Gambling

Fallacies Measure. Scores for these participants were calculated out of nine, rather than 10. Twelve percent of data was missing from G.P.A., due either to participants not being students or not knowing/reporting their G.P.A. This variable was omitted from the multivariate analysis due to the large proportion of missing data.

For the purposes of regression analysis, all variables were assessed for skew above or below 0.4, and outliers, with outliers defined as having a standard score of ± 3.29. Outliers were detected in age, total playing experience, the PPGM composite, NEO domains Neuroticism and Agreeableness, NEO facets of Activity-level (Extraversion domain) and Tendermindedness (Agreeableness domain), and the Social skills subsection of the Tromso Social Intelligence Scale. Outliers accounted for less than 0.9% of all data, and all outliers were determined to be accurate data points thus, original values were retained (and reported) for the descriptive statistics. An inverse transformation corrected for outliers and non-normality of the PPGM composite variable. As no transformation adequately corrected for skew and outliers in the other aforementioned variables these variables were winsorized. Winsorization significantly reduced the skew of Agreeableness, Activity-level, and Social Skills. Winsorization removed the outliers and attenuated the skew of Neuroticism, Tendermindedness, age, and total playing experience).Of final note, a point biserial correlation was conducted for the dichotomous variables of gender (Male; Female) and ethnicity (Caucasian; nonCaucasian).

4.3.2. STUDY 1B UNIVARIATE RESULTS

Pearson's *r* correlations were calculated between PSM scores and all the individual difference measures. As can be seen in Table 6, surprisingly few variables were significantly associated with PSM scores, and the magnitude of the correlation was low for the few that were.

The relationship between poker skill and all five NEO personality domains (Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness) was near zero. Similarly, there was no significant correlation with general intelligence (SB Matrices), working memory capacity (Digit Span), quantitative skills (SB Equation Building), GPA, age, or years of education.

However, PSM had a significant negative relationship with two personality facets from the Openness domain:(Aesthetics r = -.20, t = 2.06, df = 98, p = .04, Fantasy: r = -.23, t = -2.30, df = 98, p = .02). What this reflects is that appreciation of art and beauty as well as having a rich fantasy life and imagination are both negatively related to poker skill.

Poker skill was also significantly related to lower levels of gambling fallacies (r = .26, t = 2.70, df = 98, p < .01) (higher scores on the GFM indicate greater resistance to gambling fallacies). What this implies is that the behaviour of good poker players is more strongly guided by the statistical probabilities involved rather than hunches, beliefs, and other erroneous notions.

Poker skill was also negatively related to a perception that engaging in gambling (r = -.21, t = -2.14, df = 98, p = .04), or financial investment (r = -.19, t = -1.89, df = 98,

Table 6: Full Sample Assessment Scores and Correlation with PSM

	Scores (n= 100)				Correlation	
Assessment	*M*	*SD*	*Min*	*Max*	*r*	*p*
Gender	.54		0	1	.38	< .001*
Ethnicity	.80		0	1	.007	.94
Age	23.28	6.45	17	57	.17	.10
Grade Point Average	3.14	0.55	1.50	4.00	-.01	.91
Years of Education	14.58	2.07	10.64	20	-.04	.67
Poker Experience	4.68	5.13	0	40	.26	.01*
Digit Span	5.6	1.02	4	8	.16	.12
SB Matrices	55.19	7.29	41	68	.13	.20
SB Equation Building	57.65	10.45	35	76	.04	.70
Gambling Fallacies	7.36	1.52	3	10	.26	< .01*
Risk Perception						
Ethical	30.00	4.96	15	40	.06	.54
Monetary	29.34	5.11	16	40	-.25	.01*
Gambling Only	17.05	3.41	7	21	-.21	.04*
Investing Only	12.29	3.09	6	21	-.19	.06
Health/Safety	27.11	6.09	11	39	-.05	.59
Recreational	23.14	6.76	8	38	.09	.35
Social	16.42	4.92	7	26	-.001	.99
Social IQ						
Information Processing	5.21	0.69	3.29	7	.27	< .01*
Social Skills	4.81	.07	2.43	6.14	.12	.24
Social Awareness	5.12	.82	3	7	.10	.34
Social IQ Composite	105.94	12.41	78	137	.20	.05*
PPGM Total Score[†]	.045	1.06	0	5	-.24	.02*
Personality Domains & Facets						
Extraversion	3.56	0.44	2.58	4.58	-.05	.60
Assertiveness	3.25	0.64	1.75	4.75	-.006	.96
Activity Level	3.27	0.56	1.38	4.50	-.02	.86
Excitement-seeking	3.81	0.54	2.5	5.00	-.05	.65
Gregariousness	3.36	0.72	1.62	5.00	.03	.74
Positive Emotions	3.79	0.67	1.88	5.00	-.06	.55
Warmth	3.88	0.57	2.62	5.00	-.06	.56
Agreeableness	3.37	0.45	1.58	4.29	-.05	.64
Trust	3.27	0.71	1.38	5.00	.06	.57
Straightforwardness	3.21	0.59	1.62	4.50	-.15	.14
Altruism	4.00	0.56	2.25	5.00	-.09	.39

	Scores (n= 100)				Correlation	
Assessment	*M*	*SD*	*Min*	*Max*	*r*	*p*
Meekness	2.96	0.67	1.12	4.50	.08	.44
Modesty	3.23	0.73	1.00	4.88	-.15	.14
Tendermindedness	3.56	0.56	1.62	4.75	.06	.53
Conscientiousness	3.48	0.41	2.54	4.60	-.06	.57
Competence	3.55	0.42	2.62	4.5	.10	.31
Achievement	3.50	0.55	2.12	4.75	-.12	.25
Discipline	3.53	0.71	2.00	5.00	-.08	.44
Order	3.36	0.56	2.12	4.50	-.07	.52
Dutifulness	3.74	0.51	2.62	5.00	-.05	.63
Deliberation	3.21	0.68	1.62	4.50	-.01	.90
Neuroticism	2.79	0.45	1.29	3.65	-.02	.87
Anxiety	3.01	0.66	1.12	4.50	-.07	.49
Hostility	2.71	0.63	1.25	4.62	-.08	.49
Depression	2.68	0.69	1.12	4.25	.02	.82
Self-consciousness	2.77	0.67	1.00	4.38	.05	.63
Impulsivity	3.33	0.56	2.00	4.50	.05	.63
Vulnerability	2.25	0.52	1.00	3.62	-.07	.49
Openness	3.54	0.43	2.56	4.54	-.11	.28
Aesthetics	3.22	0.82	1.38	5.00	-.20	.04*
Fantasy	3.44	0.70	1.50	5.00	-.23	.02*
Feelings	3.64	0.64	2.25	5.00	-.07	.51
Ideas	3.72	0.68	2.00	5.00	.11	.27
Actions	3.31	0.42	2.38	4.25	-.09	.36
Values	3.88	0.53	2.25	5.00	.09	.35

Note: *M* = mean, *SD* = standard deviation,
Min = lowest score detected, *Max* = highest score in sample. .
* $p \leq .05$
† Correlation calculated with inverse transformation of PPGM scores.

p = .06) constituted a significant risk (overall correlation with the Monetary scale was also significant (r = -.25, t = -2.60, df = 98, p < .01).

A significant positive relationship was obtained between poker skill and the Information Processing section of the TROMSO (r = .27, t = 2.76, df = 98, p < .01), indicating higher levels of social information processing among skilled players.

Of final note, a significant relationship was established between poker skill and an inverse transformation of the Problem and Pathological Gambling Measure Composite score (r = -.24, t = -2.37, df = 98, p = .02). What this indicates is that problem gambling symptomatology is higher among more skilled poker players.

4.3.3. STUDY 1B MULTIVARIATE RESULTS

Multiple univariate capitalize on chance occurrence of significance. They also do not indicate the unique contribution of each variable to poker skill. Thus, a multiple regression was also undertaken. Univariate outliers and skew were corrected as previously explained. A number of variables were excluded so as to eliminate singularity and/or multicollinearity, and to reduce the overall number of independent variables in light of the relatively small sample size of 100. More specifically, the following variables were not included in the multiple regression: Social Intelligence composite score, all subfacets of each of the personality domains, the Extraversion domain, and the two subareas of the Monetary section of the DOSPERT. GPA was also excluded due to the fact that 12% of the data was missing. The PPGM was also not included, as its statistical association with poker skill almost certainly reflects the fact that people who are heavily

involved in poker are more likely to experience gambling-related problems (i.e., rather than gambling problems facilitating poker skill). All other variables were included. No multivariate outliers were found as assessed by Mahalanobis distance ($\chi^2 \geq 48.3$). All other variables were entered simultaneously. The poker skill index (PSM score) was significantly related to the combination of individual difference measures, $F_{(21,78)} = 2.63$, $p = .001$. The Adjusted[16] R-squared value was .26, indicating that in this sample, 26% of the variance in the poker skill scores can be accounted for by the combination of these individual differences. Table 7 displays the unstandardized and standardized regression coefficients as well as the semi-partial squared correlations. Variables are listed in order of largest standardized regression coefficient to lowest. Only 2 variables contributed significantly to prediction of higher PSM scores: Social Information Processing and Gender. However, three additional variables approached significance: Gambling Fallacies Scores ($p = .06$), Age ($p = .09$), and the Ethical subscale of the DOSPERT ($p = .09$).

[16] Unadjusted R-squared was.414. Normality of residuals was also confirmed by non-significant Shapiro Wilks test, and non-significant Breusch-Pagan test indicates homoscedasticity.

Table 7: Multiple Regression Results

	Regression Coefficients (B)	Standardized Regression Coefficients (β)	Squared Semi-Partial Correlations (sr_i^2)
*Social Information Processing	2.446	0.304	0.046
*Gender	2.772	0.249	0.039
Gambling Fallacies Score	0.694	0.198	0.027
Age	0.236	0.198	0.023
Risk - Ethical	0.214	0.190	0.022
Risk - Health/Safety	-0.161	-0.176	0.014
Risk - Financial	-0.170	-0.157	0.017
Neuroticism	1.796	0.144	0.009
Openness	-1.824	-0.140	0.011
Years of Education	-0.374	-0.139	0.013
Conscientiousness	-1.844	-0.137	0.009
Playing experience (Years)	0.205	0.101	0.006
Digit Span	0.438	0.080	0.005
Risk - Recreational	0.061	0.074	0.003
Stanford Binet Matrices	0.055	0.072	0.004
Agreeableness	-0.701	-0.053	0.002
Social Awareness	0.331	0.049	0.001
Ethnicity	-0.595	-0.043	0.001
Stanford Binet Equation Building	0.020	0.037	0.001
Risk - Social	0.036	0.032	0.001
Social Skills	0.248	0.030	0.000
Constant	-0.386		

Note: * $p \leq 0.05$

4.3.4. HIGHEST SKILL CASES

The multiple regression identified several variables that are generally associated with skill levels, but they do not indicate whether having strength in all of these attributes is required for individual poker success, or whether having strength in any one or more would be sufficient. Thus, a final analysis examined the consistency of individual attributes among the highest skilled players in the sample. These four people had PSM scores greater than two standard deviations above the mean, scoring 32, 32, 29, and 29.

The scores of each case participant, as well as the mean scores of the whole sample, can be seen in Table 8. Variables where all four players scored above or all scored below the average are bolded.

What this table illustrates is that, as expected, the four skilled players all had higher than average self-rated poker ability, played fewer hands, and had higher flop aggression. The other variables where all four players were consistently different from average were: male gender, higher intelligence, greater resistance to gambling fallacies, lower perception of risk involved in gambling and investing, better social information processing, better social skills, lower modesty, lower openness, and lower aesthetic appreciation. It must be recognized that the fact that the highest skilled players all consistently scored higher or consistently scored lower than most people on these variables contributed to these variables being identified as statistically important in both the univariate and multivariate analyses. Despite this obvious confound, however, the a) consistency in these attributes across the four players, b) the fact that virtually all of these

Table 8: Highest Skill Participant Scores vs. Total Sample Scores

	Sample Scores (n= 100)		Case Scores			
			1	2	3	4
Assessment	*M*	*SD*				
PSM	17.63	5.57	29	29	32	32
Age	23.28	6.45	23	23	20	22
Gender[†]			**M**	**M**	**M**	**M**
Ethnicity[††]			**C**	**C**	**C**	**C**
Self-rated poker ability	33.42	21.15	**68**	**87**	**65**	**67**
Playing Experience (Years)	4.68	5.13	2.5	10	7	3
Profit	-84.00	199.76	-7	217	-131	11
Hands Played (Max=30)	22.98	4.5	**14**	**12**	**15**	**16**
Hands Won (%)	45.94	14.15	42.86	83.33	60	56
Pre-flop Aggression (%)	11.63	16.36	0	46.2	53.8	69.2
Flop Aggression (%)	36.25	22.66	**50**	**50**	**62.50**	**55.60**
Digit Span	5.6	1.02	4	6	7	7
Stanford Binet Equation Building	57.65	10.45	70	46	56	72
Stanford Binet Matrices	55.19	7.29	**60**	**64**	**60**	**60**
GFM	7.36	1.52	**8**	**8**	**9**	**10**
Risk Perception						
Ethical	30.00	4.96	28	31	30	33
Monetary	29.34	5.11	**22**	**19**	**26**	**20**
Gambling only	17.05	3.41	**10**	**10**	**16**	**13**
Financial only	12.29	3.09	**12**	**9**	**10**	**7**
Health/Safety	27.11	6.09	25	27	31	16
Recreational	23.14	6.76	26	35	21	17
Social	16.42	4.92	18	9	15	23
Social IQ						
Information Processing	5.21	0.69	**5.43**	**7.00**	**6.57**	**5.71**
Social skills	4.81	.07	**4.86**	**6.14**	**5.86**	**5.29**
Social Awareness	5.12	.82	3.71	6.43	5.86	5.29
Composite SIQ	15.14	1.78	13.90	19.57	18.29	16.29
Composite PPGM	.045	1.06	2	3	0	3
Personality Domains & Facets						
Extraversion	3.56	0.44	3.21	3.56	3.71	3.88
Assertiveness	3.25	0.64	3.25	3.13	4.38	3.13
Activity Level	3.27	0.56	2.13	3.25	4.25	3.5

	Sample Scores (n= 100)		Case Scores			
			1	2	3	4
Assessment	*M*	*SD*				
Excitement-seeking	3.81	0.54	3.88	2.88	3.63	4.38
Gregariousness	3.36	0.72	3.00	3.63	3.38	3.89
Positive Emotions	3.79	0.67	3.38	4.00	3.25	4.63
Warmth	3.88	0.57	3.63	4.50	3.38	3.75
Agreeableness	3.37	0.45	2.50	3.92	2.83	3.63
Trust	3.27	0.71	2.50	4.75	3.25	3.38
Straightforwardness	3.21	0.59	2.00	3.63	2.38	3.13
Altruism	4.00	0.56	2.50	4.88	3.00	4.50
Meekness	2.96	0.67	2.13	3.38	2.38	3.50
Modesty	3.23	0.73	**2.50**	**3.13**	**2.13**	**2.88**
Tendermindedness	3.56	0.56	3.38	3.75	3.88	3.38
Conscientiousness	3.48	0.41	2.58	3.71	4.21	2.88
Competence	3.55	0.42	3.25	3.63	4.38	3.63
Achievement	3.50	0.55	2.63	3.75	4.25	2.75
Discipline	3.53	0.71	2.00	3.75	4.88	3.00
Order	3.36	0.56	2.38	3.50	4.25	2.63
Dutifulness	3.74	0.51	2.75	4.13	4.25	3.13
Deliberation	3.21	0.68	2.50	3.50	3.25	2.13
Neuroticism	2.79	0.45	2.89	2.65	2.60	2.60
Anxiety	3.01	0.66	3.00	3.13	2.63	2.25
Hostility	2.71	0.63	3.00	1.63	3.13	2.13
Depression	2.68	0.69	2.50	2.75	2.25	2.00
Self-consciousness	2.77	0.67	3.25	2.38	2.75	2.63
Impulsivity	3.33	0.56	3.50	4.00	3.25	4.38
Vulnerability	2.25	0.52	2.13	2.00	1.63	2.25
Openness	3.54	0.43	**3.52**	**3.48**	**3.15**	**3.48**
Aesthetics	3.22	0.82	**3.13**	**2.63**	**2.13**	**2.88**
Fantasy	3.44	0.70	3.50	3.75	2.13	3.50
Feelings	3.64	0.64	3.50	4.38	3.50	2.75
Ideas	3.72	0.68	4.63	2.00	4.13	4.25
Actions	3.31	0.42	3.13	3.75	2.88	3.38
Values	3.88	0.53	3.25	4.38	4.13	4.13

Note. Total sample scores compared to Case scores which are scores of the four participants who scored at least two standard deviations above the group mean on the PSM.

† Total sample included 54 males and 46 females.

†† C = Caucasian. Total sample included 80 Caucasian.

attributes were previously identified in either the multivariate and/or univariate analysis, and c) the low magnitude of these univariate and multivariate correlations would suggest that having *sufficient levels* of most of these attributes is more important for poker success rather than having exceptional strength in just one or two of these areas.

4.4 STUDY 1B DISCUSSION

The current study was conducted to comprehensively examine the individual characteristics that differentiate good from poor poker players. First, it was found that age, race/ethnicity, educational level, and educational achievement were not significantly correlated with poker playing skill. None of these variables had a strong theoretical basis for expecting them to be associated with poker skill, so the failure to find a relationship was not unexpected.

More surprising is the fact that being male was significantly and consistently related to poker skill. Although most professional poker players are male, the presumption was that attributes associated with being male, rather than 'maleness' itself, facilitated success. Being female certainly does not preclude one from being an excellent player, as there are several well known professional female poker players. Nonetheless, as poker remains a male dominated game, it is also possible that females - despite knowing how to play, and even playing well - tend to devote less time/attention to the game to hone their skill and perhaps have a less competitive drive to win.

General intelligence was also found to have little or no relationship to poker skill level and/or poker skill attainment. Higher intelligence was never postulated as a

necessary attribute (and certainly does not appear to be a pre-eminent feature among the world's best poker players). Thus, it was not surprising that it was not strongly related to poker skill, although it is still quite possible that at least average or above average levels are required.

More surprising is the failure to find a relationship between quantitative ability and poker skill. As poker is recognized to be a game in which mathematical ability is necessary, this finding may seem counter intuitive. There are two possible explanations for this finding. First, when one reviews the types of calculations required in the game of poker it becomes evident that much of the math is relatively simple. Much of what a poker player does in determining his likelihood of winning is a) simply adding up the number of remaining cards in the undealt deck that could complete the hand they are creating, b) judging the likelihood that they will appear in the five community cards, and c) being familiar with the strength of that particular hand if it did appear.

The second possible explanation relates to the fact that poker skill was consistently associated with low levels of gambling fallacies. Many gambling fallacies hinge on the misunderstanding of statistics. The fact that better poker players are more resistant to fallacies suggests that they do understand the basic tenets of statistics. Understanding statistics however, is both a specific and a learned ability. Thus, it is possible that better poker players have attained a greater understanding of the specific mathematical calculations and statistics necessary for successful poker playing, without necessarily increasing their general quantitative skills. Put another way, although

exceptional quantitative skills may not be necessary to poker success, basic quantitative ability and adherence to poker-specific statistical probabilities is essential.

One component of Social Intelligence was consistently found to be significantly related to PSM scores: Social Information Processing. High scores on this component of Social Intelligence speak to an individual's ability to accurately interpret the behaviour of others. This finding supports previous research that indicates that better players make mental models of opponents (Castaldo, 2007; McCormack & Griffiths, 2011; Wilson, 2003), and at least, in part, use this information to direct their own playing strategy. That the relationship detected between PSM scores and this component of Social Intelligence was only moderate, and that no other component of Social Intelligence was found to significantly relate to poker skill, indicates however that high Social Intelligence is not essential, nor sufficient in the making of a skilled poker player.

Working memory capacity was a significant predictor of poker performance in one prior study (Meinz et al., 2012). The current study findings did not indicate any relationship between working memory, evaluated by a digit span task, and poker skill. Nor was there a consistent trend, higher or lower, in the working memory capacity of the four high PSM scorers in comparison to the whole sample. Thus, it does not appear that working memory capacity has any important bearing on poker skill level or poker skill attainment, although it is always possible that working memory evaluated by different means would reveal results similar to those of previous research (e.g., Meinz et al., 2012 used one verbal and one spatial complex span task).

Previous research regarding risk perception/tolerance found that better poker players have a greater tolerance for poker specific risk taking (i.e., betting/raising) (Siler, 2010). In the current study, risk perception was assessed across five domains: Health/Safety, Recreational, Social, Ethical, and Financial. Findings from the current study add support for, and extend, previous findings. Better poker players demonstrated greater tolerance for all financial risk, rather than only for gambling specific financial risk. Importantly, no other significant relationships were detected between poker skill and risk perception/tolerance. This indicates that despite the greater tolerance for financial risk, better poker players are not more tolerant of risk in general.

Previous studies indicated that better players had traits indicative of extraversion such as gregariousness (Martinez & Lafranchi, 1969), and sensation seeking (Barrault & Varescon, 2013), and that better players were lower in traits presumably associated with neuroticism such as rumination (Palomäki et al., 2013). In the current study however, no relationships between PSM scores and personality domains or facets were found that would support previous research claims. In fact, with two exceptions, there was virtually no association between any aspect of personality and poker skill. The two exceptions to this finding were the significant negative relationships detected between poker skill and two personality facets of the Openness domain, Aesthetics and Fantasy. Low scores for the Fantasy personality facet are indicative of individuals who prefer practicality/realism. Individuals who score low on the personality facet Aesthetics are not swayed by art/beauty. It could be that better players tendency towards realism, both in the avoidance

of fantasy and art/beauty, aids their poker playing by reducing susceptibility to distraction (e.g., maintain focus on the game rather than slipping off into a spell of daydreaming).

The final individual characteristic of interest in the current study was susceptibility to problem gambling behaviours. Susceptibility to problematic gambling behaviour did increase significantly in association with higher skill. Specifically, higher skilled players reported a greater tendency to spend more time and money gambling than planned, as well as problems with family/spouse due to the time spent gambling. These findings suggest that better players tend towards over-involvement with the game of poker. It may well be the case that the time spent playing poker however, is at least in part, a facilitator of poker skill attainment. This possibility was supported by the significant univariate correlation between years playing poker and poker skill.

A final observation concerns the fact that the four most skilled players had very similar profiles, with above average (but not exceptionally high) levels of virtually all of the above statistically important variables. This, combined with the observation that the magnitude of all of the statistically significant variables was quite low, suggests that the profile of a successful poker player is someone who has requisite levels of all of these attributes, rather than exceptional strength in just one or two of these areas.

Study limitations and future directions will be discussed in Chapter Five.

CHAPTER 5: CONCLUSION

5.1 SUMMARY

Past literature has indicated that more experienced poker players make better playing decisions, where better decisions are statistically optimal decisions (Linnett et al., 2012, 2010; St. Germain & Tenenbaum, 2011). The PSM developed and used herein required participants to evaluate various poker scenarios and choose the most appropriate 'playing action' given the information available. The appropriate choice for each scenario, in addition to 100% agreement of three professional players, was verified statistically. Scores on this measure therefore, increase as a function of statistically appropriate decisions. In the current study a moderate relationship between poker skill and years of playing experience was detected however, years of playing experience does not appear to be sufficient to increase skill levels as two of the four highest skill cases reported below average playing experience. Findings from the current study do lend support to the notion that *more skilled* players make better poker related decisions however.

Literatures in both the scientific and popular culture communities have suggested that social abilities such as perceiving and interpreting others' behaviours (i.e., social intelligence) contributes to successful poker playing. The current study provides some, albeit limited, support for this position. Although a moderate association, a significant positive relationship was found between poker skill and Social Information Processing. Social information processing is the component of social intelligence that aids in the interpretation of socially derived stimuli (Silvera et al., 2001). An example of this can be

found in Slepian et al.'s (2013) study where it was found that more experienced players were able to estimate the strength of a players' hand based on arm movements during bet placement. It would be of interest to further examine, rather than general social intelligence, whether players with greater skill are significantly better at identifying poker specific social information as compared to general social information. Identifying bluffs versus relational deceit for example. Would highly skilled players be good 'lie detectors' in general? Or are they merely more adept at identifying deception in relation to poker playing (e.g., identifying bluffers)? It is possible that a stronger relationship would be identified between poker playing skill and poker specific social skills were assessed, as compared to that found between poker skill and general social intelligence.

Only two studies were found to have discussed risk-taking specifically in association with poker players. First, McCormack and Griffiths (2011) found lower risk-taking in their sample (n = 4) of professional poker players. Siler (2010) noted greater risk neutrality in better poker players. The results of the current study shed light on the seemingly contradictory findings. As supposed, greater tolerance for financial risk was demonstrated in association with higher poker skill. So was aggression during the Poker Playing Assessment however. In this sample higher skilled players did demonstrate both: greater risk neutrality (i.e., tolerance for financial risk) and greater calculated risk-taking (i.e., betting). It remains possible that the mention of risk-taking from McCormack and Griffiths's (2011) participants pertained to reckless risk (e.g., bluffing without the bank roll to support the bluff).

The results of this study do not provide support for past findings and/or conclusions asserted in the literature regarding personality traits associated with good poker players. It is possible that experimenter bias played a role in identification of personality in these studies (e.g., Martinez & Lafranchi, 1969), or that the players interviewed/observed were poorer players than researchers believed them to be. This is especially possible due to the fact that no objective measure of skill was used to establish player ability in previous studies, rather skill was determined through observation. The one possible exception to this line of reasoning is the players observed by Browne (1989). Browne (1989) noted that better players demonstrated greater emotional stability - they stayed 'off tilt'. This finding, in relation to personality, could be evidence of lower neuroticism scores. The current sample exhibited no relationship between skill and neuroticism and did find an association with a very practical/realistic orientation, thus it is possible that Browne's (1989) conclusions may be valid.

Three additional areas of focus, brought to attention in past literature, were also evaluated for potential differential relationships to poker skill: working memory, problematic gambling behaviours and susceptibility to gambling fallacies. Meinz et al. (2012) concluded that working memory capacity was a significant predictor of performance. The current study results do not provide support for this conclusion. That being said, it is also important to recognize that Meinz et al. (2012) used one verbal and one spatial span task to assess working memory capacity. Both of these tasks were presented visually, rather than aurally as was the case in the current study. It is possible

that the different tasks used or the method of task delivery - rather than working memory capacity per se - are the reason for the differing results obtained. Further investigation may therefore be required to more thoroughly evaluate the relationship between working memory capacity and poker skill.

In previous literature, relationships have been found between poker players who demonstrate problem gambling behaviours and susceptibility to (or the demonstration of) gambling related errors in thinking. The current study found a different association. High skill in the current study was associated with both less susceptibility to gambling fallacies, and more problem gambling behaviours. It is possible that the current sample was, due to their education attainment, more statistically savvy. That is to say, it is possible that the current sample, comprised predominantly of university students, understands that chance is not self righting for example[17]. But also that the current sample, despite having a more correct understanding of gambling related principles (e.g., odds), engages in risky/problematic gambling behaviours none-the-less. It is also possible, that gambling related cognitive errors are not in fact associated with increases in problem gambling behaviours.

5.2 STUDY LIMITATIONS

A number of study limitations require acknowledgement. First, gender was not evenly distributed across the identified range of skill. This study did avoid the level of gender bias seen in previous studies (e.g., Linnet et al.,2010: all male experienced players

[17] The Gambler's Fallacy is the idea that chance is self righting, this belief negates the role of statistical independence.

versus all female inexperienced players), in that nearly half of the sample was female and the PSM scores of females ranged from 9 to 22 (out of 35) indicating that the higher PSM scores were not solely attained by males. Regardless, that the distribution of skill level did differ between males and females is an acknowledged limitation, and future studies should attempt to avoid this confound.

Second, participants in the current study were asked to indicate all of their normal playing experiences/environments (e.g., live games with family/friends, live games with strangers at a casino, online games with strangers, online games with friends, etc.). This being the case, no analyses could be conducted comparing online versus live/face-to-face players. Previous studies have found differences in self-rated ability and problem gambling behaviours between online and offline poker players (e.g., McKay, 2012). Not having established more stringently the most consistent/dominant playing habits (i.e., online vs. offline) of the participants in the current study may have introduced a potential confound.

Third, it could be seen as a limitation that the vast majority of participants were recruited from the psychology participant pool. However, as previously discussed, students reported a wide variety of study majors. As such, the participants are more diverse than one may originally suspect. Due to this diversity, it is posited that utilization of the psychology participant pool was not in reality a study limitation.

Fourth, evaluating playing experience by years and months may have been inadequate. A more reasonable evaluation would probably have also included questions

pertaining to the frequency of play. For example, one person may have 10 years of experience - playing twice a year. In contrast, another may have only begun playing three years ago, but has accumulated greater experience due to weekly poker game attendance. It is possible, if not likely, that actual playing experience (measured more precisely) may in reality bear a greater relationship to skill level than was evidenced in the current study.

Lastly, it could be seen as a limitation to the PSM specifically and/or the current study more generally, that individual differences presupposed to be 'required' of a good poker player were found to account for less variability in skill scores than expected. It is possibly the case however, first that individual differences measured via standardized tests are not capturing the specific abilities required of a good poker player. Second, as was demonstrated with the comparison between high skill cases and the whole sample, it is likely - how ever counter intuitive - that higher intelligence (social and general), greater general quantitative ability and/or differences in personality alone are simply not sufficient to become a skilled poker playing. Rather, as previously mentioned, it appears that a good poker player is someone who has requisite levels of all of these attributes in combination.

5.3 FUTURE DIRECTIONS

Future directions for this line of research include first, the establishment and evaluation of both: a computerized version, and a short form of PSM. Both undertakings would increase the ease of use of the PSM, and also make the measure more widely available for research and potentially public use.

Second, as previously mentioned, evaluation of the relative contribution of poker specific social abilities to skilled poker playing requires further investigation. Social information processing was significantly and positively related to poker skill in the current study; however, the relationship was not strong. It remains a query then, as to whether or not skilled poker players demonstrate greater social perception in poker specific contexts as compared to general social contexts. As well as whether, or not, social perception in poker specific contexts contributes significantly to the explanation of skill variability.

Third, as some of the individual differences found to differentiate good from poor poker players could feasibly be learned, it would be worthwhile to investigate the impact of training. Poker specific statistical training for example, may lend to a significant decrease in gambling related cognitive errors, and increases in calculated risk taking during poker playing.

Finally, an examination of gender and individual differences associated with poker ability. It was beyond the capabilities of the current study, given the sample composition, to evaluate the individual differences of male and female players matched by skill level. Gender differences/similarities in player attributes therefore, remain unknown. This line of research could/should also take into account online versus offline play, where differing amounts and types of social information is available.

5.4 IMPLICATIONS

The current study findings lends to two important practical implications. First, findings from this study contribute to the ongoing policy debates regarding poker: the legal standing of poker and the relevant taxation of poker profits. Herein it was found that in addition to individual characteristics (i.e., risk tolerance) that are associated with/aid poker ability, player style such as aggression also contributes to skill level. As for the argument regarding whether skill predominates in the game of poker then, findings from this study suggest yes - skill does predominate as 1) skill is measurable, and 2) player actions (e.g., aggression) and attributes (e.g., social information processing) influence game outcomes. Therefore, in jurisdictions (i.e., in the United States) where games predominated by skill are not considered gambling, the legal standing of poker requires re-evaluation.

Findings from the current research also speak to the legal issue pertaining to profits earned from poker playing. In Canada, if there is a reasonable expectation for profit from any pursuit, then that pursuit is considered a business pursuit (Branch, 2012; Government of Canada, n.d.; Philander & Abarbanel, 2011). Results of the current study suggest that monies earned playing poker should be regarded as income and subject to revenue taxation for some players. It should be emphasized that it is not reasonable to expect all poker players to profit from poker playing. However, as evidenced herein, there are poker players for whom it would be reasonable to expect to earn a profit during poker play. For players who demonstrate sufficient poker playing skill, profit would seem

the likely result of poker playing. It would be prudent to establish precisely what level of skill would lend to the expectation of profit, and establish taxation policies accordingly.

The second important implication that stems from the current research speaks to the utility of poker training programs. As individual differences (e.g., working memory capacity, social perception, etc.) were found to contribute less than previous studies (and popular culture) suggest, player skill level appears to be largely malleable. That is to say, no specific individual difference was found to be sufficient for greater poker skill level. Rather, having a profile of statistically important individual differences (i.e., greater financial risk tolerance, greater social information processing skills, etc.) appears necessary to provide the foundation on which poker players can build skill. Moreover, to a large extent, individual differences that were found to relate to skill level were differences that could be developed/learned (e.g., reducing gambling related cognitive errors through statistical education). Addressing both players who desire to improve their poker playing ability/skill level, and business/individuals seeking to aid player(s) in game improvement: skill increases are attainable, and as such players with the goal to increase ability should be successful in their pursuits given the appropriate training.

5.5 CONCLUSION

Both the established psychometric properties and the significant moderate correlations - hypothesized and found - between skill scores and actual playing measures (i.e., aggression) are indications that the PSM is both a reliable and valid tool in the assessment of poker skill. It is also reasonable to claim that the PSM developed and

evaluated in this study provides for greater ecological validity than the subjective measures used in previous studies (e.g., self- or peer-report). All things considered, it is asserted that findings based on the PSM as an indication of skill are valid.

The findings of the current study reveal that some individual differences do in fact delineate good and poor players. Better players tend to have superior social information processing skills, a greater tolerance for financial risks, lower susceptibility to gambling fallacies, and are perhaps less openness to aesthetic and imaginative experience. Counter intuitively however, individual differences in general intellect, social intellect, risk tolerance, general quantitative ability, resistance to gambling fallacies, and personality appear to influence poker playing ability to a far lesser extent than was presupposed. Our findings indicate that having sufficient levels of most or all of these attributes is more important for poker success rather than having exceptional strength in just one or two of these areas. Further study is required to establish if stronger relationships exist between poker skill and poker context specific abilities (e.g., deception perception for bluffing versus general social intelligence; poker specific mathematics versus general mathematical/quantitative ability). Further study is also required to assess the effectiveness of training on poker skill acquisition.

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APPENDIX A: POKER TERMINOLOGY

6max	A poker table seating a maximum of six players.
Bet	To make the first wager, when there is not a set price for continuing in the hand. A bet does not apply pre-flop because the blinds are considered as being a set price even though they are required/forced.
Big Blind	The individual in the big blind position, seated immediately left of the small blind position, is required to put into the pot the biggest of the blinds that serves as the price to play. The big blind position is the last to act pre-flop and the second to act post-flop.
Big Blinds	Also known as BB. Unit of measurement based on the size of the big blind (see Blind). In a $1/$2 game, 100 Big blinds would equal $200.
Blind	A fee for playing a hand. Usually the blind is structured (e.g., 1 / 2 or 10 / 20), with the big blind being twice the size of the small blind.
Board	Community cards, including the flop, turn and river cards.
Burning a card	The dealer discards one card from the deck before dealing cards.
Button	The button indicates a position at the table where cards will begin being dealt. Cards are dealt beginning with player seated left of the button. When the dealer is also a player, the button indicates the dealers position.
Call	To match the current bet amount, to put the same amount into the pot.
Check	To pass, or to not bet when additional money is not required to remain in the hand.
Come(s) down	Term referring to the dealing of cards. For example, the flop came down means the flop cards are dealt.
Community Cards	Cards which are dealt, face up, that each player can use in the creation of their own best five card hand.
Cutoff	Also known as third to act at a 6max table. The person in this position has third option (to act) pre-flop and is seated directly left of the Hijack position.
First to act	The person that makes the first decision pre-flop. This person sits directly left of the individual with the button.
Flop (The Flop)	Refers both to the first three community cards dealt and to the action which follows the dealing of these cards until the turn.
Fold	To discard your hand, to remove yourself from play during the current hand.

Hand	Refers to both a round of play and to the five cards used by a player.
Hijack	Also known as second to act at a 6max table. The individual in has the second option (to act) pre-flop and sits directly left of 'under the gun'.
Hole Card(s)	Private card(s), two are dealt to each player (face down) at the beginning of each hand.
On the button	Individual 'on the button' has fourth option (to act) pre-flop at a 6max table. Individual in this position also is last to act post-flop since betting begins with the small blind after the flop.
Post-flop	The betting rounds which follow the flop being dealt. Includes three rounds of betting, one after the flop, one after the turn, and one after the river.
Pot (The pot)	The pool of money players are playing to win.
Pre-flop	Indicates the period of play, round of betting, after hole cards are dealt but before the flop comes down.
Raise	To put more into the pot than required to stay in the hand.
River (The River)	One additional community card that is dealt after the turn card and betting round following the dealing of the turn card. One round of betting follows the dealing of the river card. Also known as 5th street card.
Small Blind	The individual in the small blind position has the fifth option (to act) pre-flop, and first option post-flop. This position is seated directly left of the button. The individual in the small blind position is normally required to (pre-flop) put in a blind bet that is typically one half the value of the big blind.
Tilt	The emotional/mental state when a player, in frustration, diverges from optimal strategy (e.g., bets out of anger/frustration)
Turn (The Turn)	One additional community card that is dealt after the flop cards and betting round. One round of betting follows the dealing of the turn card. Also known as 4th street card.
Under The Gun (UTG)	Player that is in the first to act position.

APPENDIX B: SONA RECRUITMENT

Do you know how to play Texas Hold 'em? If so, you are eligible to participate in a study investigating the factors that predict poker playing ability. We are interested in poker players of all skill levels. You do not need to be an expert poker player to participate in this study however, you should have a good understanding of how to play the game. In this study, you will be asked to complete a number of questionnaires including measures of risk perception, fluid intelligence, personality, etc. You will also be asked to play a computerized poker game. The study will require approximately 2 hours of your time (one hour per session) and for your participation, you will receive 2% credit. Upon completion of the study, you will also be eligible to win a Visa gift card for your participation. Your identity and any other information gathered will be kept strictly confidential. [You must not have participated in this study from previous semesters].

APPENDIX C: PSYCHOLOGY PARTICIPANT POOL CONSENT FORM

CONSENT FORM
Individual characteristics of good and poor poker players

Investigators:
Carrie A. Leonard
M.Sc. Candidate, Psychology, UofL
Phone: 403-382-7128
Email: carrie.leonard@uleth.ca

Supervisor: Dr. R. Williams
Professor, Faculty of Health Sciences, UofL
Phone: 403-382-7128
Email: robert.williams@uleth.ca

Study Overview. You are invited to participate in a study on individual differences associated with good and poor poker players supervised by Dr. Robert Williams. Poker is considered one of the most popular card games today and Texas Hold 'em is potentially the most commonly played variant of the game of Poker. In this experiment, you will be asked to participate in a number of tasks including measures of personality, memory, and mathematical ability. You will also be asked to participate in two measures of poker playing skill. The overall aim of the study is to understand how individual differences aid in poker playing ability.

Risks, Benefits, Costs, & Compensation. It is expected that you will not face any risks by participating in the study. It is possible however, that you may experience some emotional discomfort when filling out the questionnaires included in this study. Please be aware that you can choose not to answer any question you encounter. Should you feel emotional discomfort in association with the questions included in this study contact information for Counseling Services at the University of Lethbridge will be provided.
This study will take about 2 hours of your time to complete the study. In appreciation for your participation, you will receive 2% in research credits (1% per session) towards your grade in your Psychology class and gain experience with how psychology research is conducted. You will also be eligible to receive a gift card based on your percentile ranking of skill (see below). Your percentile rank will be calculated by averaging your scores on two poker skill measures. Gift cards will be given out once all data for this study has been collected.

percentile rank	$
100	100
90-99	50
80-89	30
70-79	30
60-69	30
50-59	25
40-49	25
30-39	25
25-29	25
0-24	0

Consent & Withdrawal. Your participation in this study is entirely voluntary. If at any time during the study you wish to withdraw and terminate your participation, you are free to do so (e.g., tell the experimenter). Your withdrawal will not be reported to anyone, will be kept in strict confidence, and you will not be penalized in any way. In any case, you will receive 1% for the current session in research credits toward your grade in your Psychology class for your participation. If you

choose to withdraw from the study your data will be excluded from the analyses and destroyed. Note: If prior to withdraw, you were eligible to receive a gift card (see Risks, Benefits, Costs, & Compensation section for details) and you choose to consent to the use of data you have already contributed (e.g., data necessary to calculate percentile ranking for gift card eligibility) you will still be eligible to receive the gift card.

Contact information. If you have any questions about this study or its implications, please ask now or contact Carrie A. Leonard or Dr. Williams (see contact info above). Questions regarding your rights as a participant in this research may be addressed to the Office of Research Ethics, University of Lethbridge (Phone: 403-329-2747 or Email: research.services@uleth.ca).

Confidentiality. Your results in this study are treated in strict confidence. For this purpose, demographic information and all test forms will not contain any information that would allow anyone to link the results with you. This consent form will be stored separately from your data in locked cabinets in the office of the Principal Investigator. Your results will be used to write scientific reports about individual differences of poker players.

Although you will participate as an individual, your individual results will not be published in any form; they will be combined with those of a large group of other participants. If you would like to participate in the present study, please sign this form to indicate that you have read this form and would like to participate. Your signature on this form indicates that you have understood to your satisfaction the information regarding your participation in the research project and that you agree to participate.

_____	_____
Name of Participant	Signature of Participant & Date
_____	_____
Name of Witness	Signature of Witness

If you wish a copy of this form, please ask experimenter.

If you wish to receive the final group results of the study, please provide your email address.

Email address: _____

APPENDIX D: WORD OF MOUTH CONSENT FORM

CONSENT FORM
Individual characteristics of good and poor poker players

Investigators:
Carrie A. Leonard
M.Sc. Candidate, Psychology, UofL
Phone: 403-382-7128
Email: carrie.leonard@uleth.ca

Supervisor: Dr. R. Williams
Professor, Faculty of Health Sciences, UofL
Phone: 403-382-7128
Email: robert.williams@uleth.ca

Study Overview. You are invited to participate in a study on individual differences associated with good and poor poker players supervised by Dr. Robert Williams. Poker is considered one of the most popular card games today and Texas Hold 'em is potentially the most commonly played variant of the game of Poker. In this experiment, you will be asked to participate in a number of tasks including measures of personality, memory, and mathematical ability. You will also be asked to participate in two measures of poker playing skill. The overall aim of the study is to understand how individual differences aid in poker playing ability.

Risks, Benefits, Costs, & Compensation. It is expected that you will not face any risks by participating in the study. It is possible however, that you may experience some emotional discomfort when filling out the questionnaires included in this study. Please be aware that you can choose not to answer any question you encounter. Should you feel emotional discomfort in association with the questions included in this study contact information for Counseling Services at the University of Lethbridge will be provided.
This study will take about 2 hours of your time to complete the study. In appreciation for your participation, you be eligible to receive a gift card based on your percentile ranking of skill (see below). Your percentile rank will be calculated by averaging your scores on two poker skill measures. Gift cards will be given out once all data for this study has been collected.

percentile rank	$
100	100
90-99	50
80-89	30
70-79	30
60-69	30
50-59	25
40-49	25
30-39	25
25-29	25
0-24	0

Consent & Withdrawal. Your participation in this study is entirely voluntary. If at any time during the study you wish to withdraw and terminate your participation, you are free to do so (e.g., tell the experimenter). Your withdrawal will not be reported to anyone, will be kept in strict confidence, and you will not be penalized in any way. If you choose to withdraw from the study your data will be excluded from the analyses and destroyed.
Note: If prior to withdraw, you were eligible to receive a gift card (see Risks, Benefits, Costs, & Compensation section for details) and you choose to consent to the use of data you have already

contributed (e.g., data necessary to calculate percentile ranking for gift card eligibility) you will still be eligible to receive the gift card.

Contact information. If you have any questions about this study or its implications, please ask now or contact Carrie A. Leonard or Dr. Williams (see contact info above). Questions regarding your rights as a participant in this research may be addressed to the Office of Research Ethics, University of Lethbridge (Phone: 403-329-2747 or Email: research.services@uleth.ca).

Confidentiality. Your results in this study are treated in strict confidence. For this purpose, demographic information and all test forms will not contain any information that would allow anyone to link the results with you. This consent form will be stored separately from your data in locked cabinets in the office of the Principal Investigator. Your results will be used to write scientific reports about individual differences of poker players.

Although you will participate as an individual, your individual results will not be published in any form; they will be combined with those of a large group of other participants. If you would like to participate in the present study, please sign this form to indicate that you have read this form and would like to participate. Your signature on this form indicates that you have understood to your satisfaction the information regarding your participation in the research project and that you agree to participate.

_____	_____
Name of Participant	Signature of Participant & Date
_____	_____
Name of Witness	Signature of Witness

If you wish a copy of this form, please ask experimenter.

If you wish to receive the final group results of the study, please provide your email address.

Email address: _____

APPENDIX E: DEMOGRAPHIC QUESTIONNAIRE

Please indicate your answer by writing in blanks provided and/or filling in appropriate bubbles.

Age: _____

Sex:

M❍ F○

Ethnicity:

○ Caucasian ○ First Nation
○ Metis ○ African
○ Asian ○ Inuit
○ Mixed Ethnicity ○ Other

G.P.A. _____
(on 4.0 scale)

Years of Education Completed: _____ (Include grade one but not Kindergarten)

Study Major (select appropriate by filling in bubble):

○ Agricultural Biotechnology	○ Geographical Information Science	○ Modern Languages
○ Agricultural Studies	○ Dramatic Arts	○ Music
○ Anthropology	○ Economics	○ Native Amer. Studies
○ Archaeology / Geography	○ English	○ Neuroscience
○ Biochemistry	○ Environmental Science	○ Nursing
○ Biological Science	○ Exercise Science	○ Philosophy
○ Business	○ History	○ Physical Education
○ Canadian Studies	○ Kinesiology	○ Physics
○ Chemistry	○ Management	○ Political Science
○ Computer Science	○ Multidisciplinary	○ Psychology
○ Religious Studies	○ Social Work	○ Sociology
○ Dentistry	○ Mathematics	○ Women & Gender Studies
○ Law	○ Medicine	○ Addictions Counseling
○ Undeclared		

Years/Months of playing experience: Years: _____ Months: _____

Who poker is normally played with (Select all that apply):

- ○ Family (live game)
- ○ Online with regular group of friends
- ○ Online with strangers
- ○ Regular group of friends (live game)
- ○ Casino with strangers (live game
- ○ Against a computer (e.g., PS3, xbox)

Please rate your playing ability? Draw a vertical line along the continuum below to indicate your answer.

Novice _____ Expert

APPENDIX F: POKER SKILL MEASURE (PSM) – FINAL VERSION

PSM

PLEASE DO NOT WRITE IN THIS BOOKLET

This measure presents you with 35 scenarios. There is one scenario per page, presented in both pictorial and text versions.

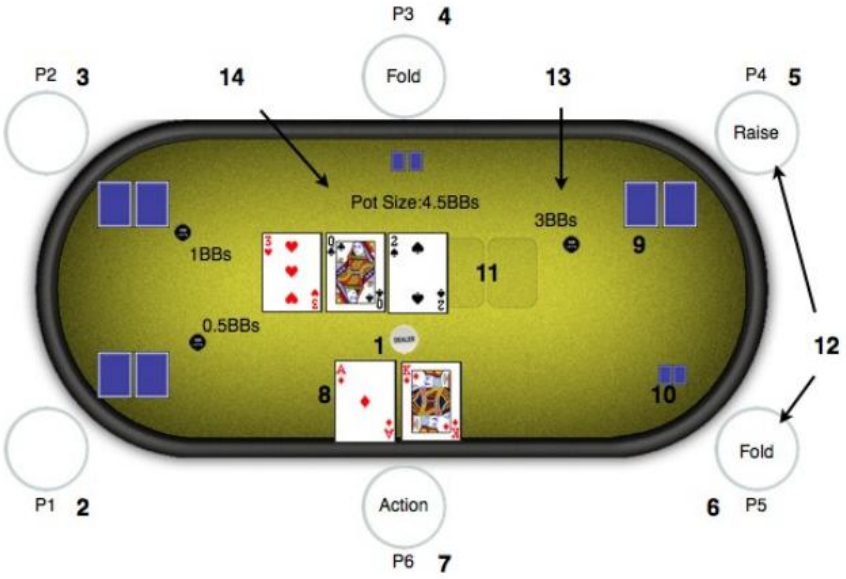
The first pictorial you will see, is a tutorial. This tutorial identifies the components of the pictorial representations that you will encounter in this test (e.g., what folded cards look like, the dealer button, etc.).

There is a glossary of terminology and phrases to aid you in understanding the scenarios.

You are to choose **one**, and only one, of the multiple choice options provided. Indicate your answer by filling in the appropriate bubble on the answer sheet provided.

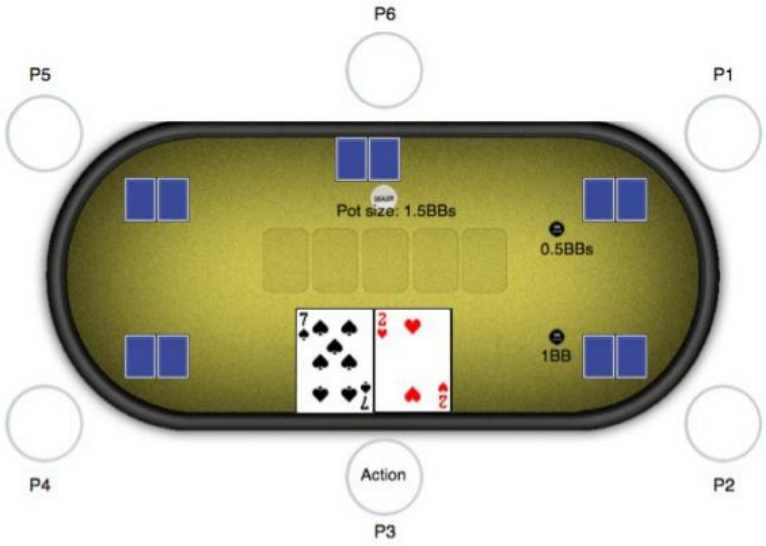
Your goal in this task is to make the one decision, given the information presented in the scenario, that would allow you to **maximize profits AND minimize losses.**

Pictorial Presentation Tutorial



1: Dealer button
2: P1 is player one (small blind)
3: P2 is player two (big blind)
4: P3 is player three
5: P4 is player four
6: P5 is player five
7: P6 is player six (button)
8. Hole cards
9. In play cards (big cards)
10. Folded cards (small cards)
11. Community cards
12. History of action
13. Bet size
14. Pot size

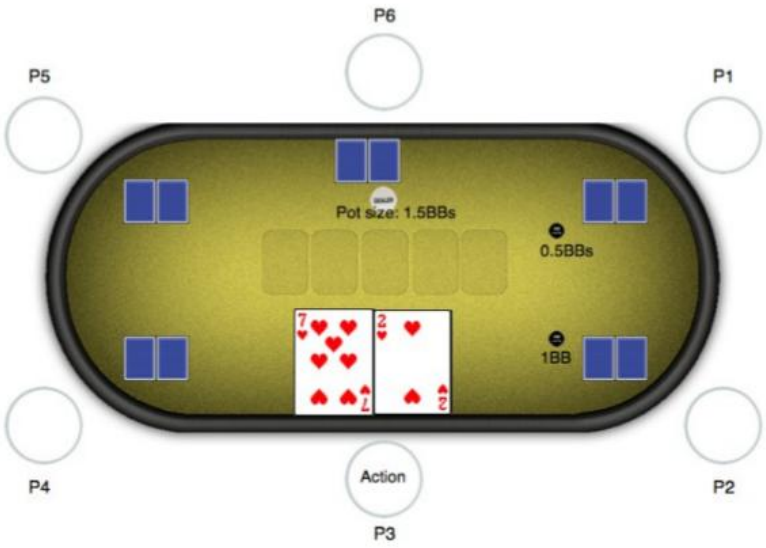
Scenario 1



You are player 3, the first to act after the player 1 and 2 have posted their blind bets preflop. With 7 of spades and 2 of hearts for hole cards, your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 2



You are player 3, the first to act after the player 1 and 2 have posted their blind bets preflop. With 7 of hearts and 2 of hearts for hole cards, your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 3

You are player 2, the big blind. Players 3, 4, and 5 have folded, the button (player 6) raises the pot to 3 times the big blind amount and player 1 (the small blind) folds. With Jack of clubs and 3 of clubs as hole cards, your decision should be to:

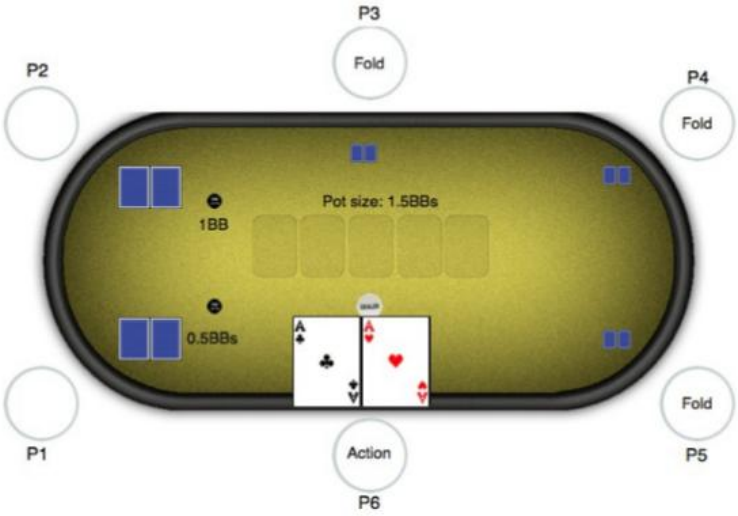
Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 4

You are player 2, the big blind. Players 3, 4, and 5 have folded. Player 6 (the button) raises the pot to 3 times the big blind amount and player 1 (the small blind) folds. With Jack of clubs and 3 of hearts for hole cards, your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 5



You are on the button (player 6). Players 3, 4, and 5 have folded preflop. With Ace of clubs and Ace of hearts for hole cards, your decision should be to:

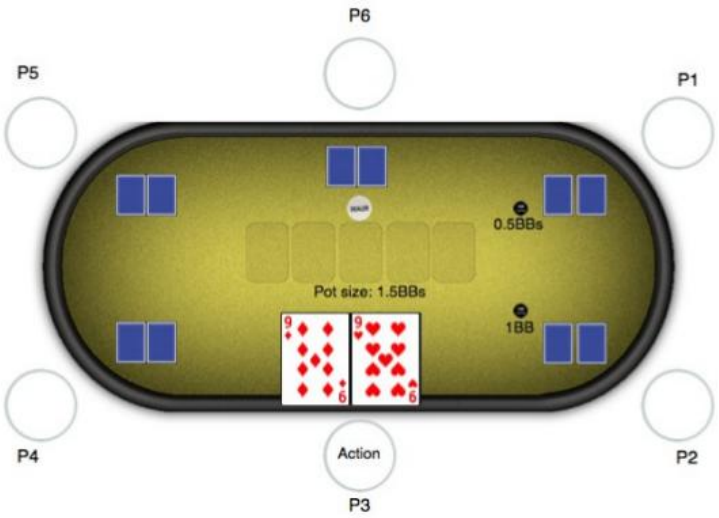
Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 6

You are player 5. Players 3, and 4 have folded preflop. With Queen of clubs and Queen of hearts for hole cards, your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

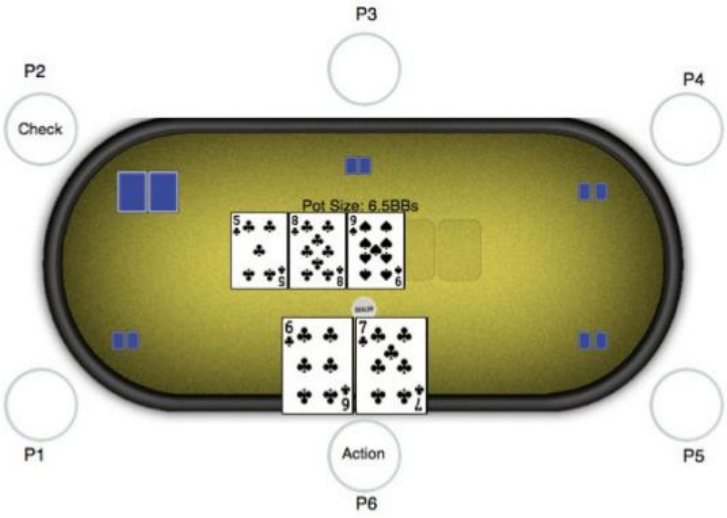
Scenario 7



You are player 3, the first to act after the player 1 and 2 have posted their blind bets preflop. With 9 of diamonds and 9 of hearts for hole cards, your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

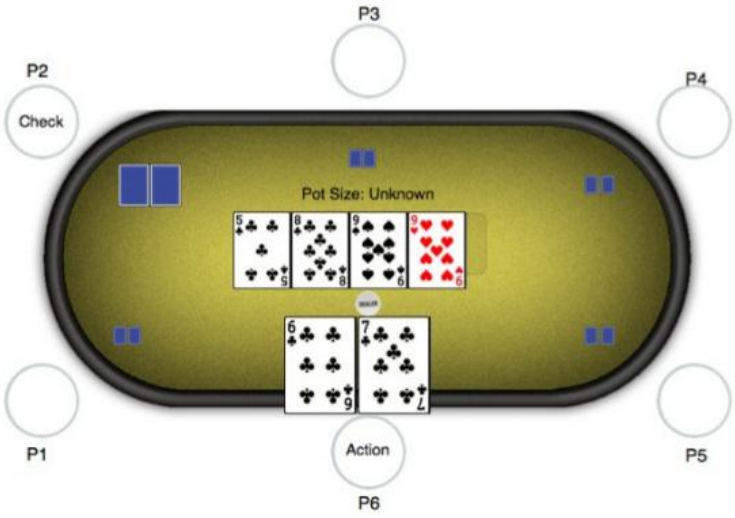
Scenario 8



After players 1 and 2 posted their blind bets, players 3, 4, and 5 folded preflop. With 6 of clubs and 7 of clubs for hole cards, you had raised preflop to 3 big blinds on the button (you are player 6). Player 1 folds. The big blind (player 2) calls and you see a flop. The big blind (player 2) checks. Your decision should be to:

Ⓐ Fold
Ⓑ Bet
Ⓒ Check

Scenario 9



After players 1 and 2 posted their blind bets, players 3, 4, and 5 folded preflop. With 6 of clubs and 7 of clubs for hole cards, you had raised preflop to 3 big blinds on the button (you are player 6). Player 1 folds. The big blind (player 2) calls and you see a flop. The big blind (player 2) checks. You bet, and then the big blind calls. After seeing the turn, the big blind checks again. Your decision should be to:

Ⓐ Fold
Ⓑ Bet
Ⓒ Check

Scenario 10

After players 1 and 2 posted their blind bets, players 3, 4, and 5 folded preflop. With 6 of clubs and 7 of clubs for hole cards, you had raised preflop to 3 big blinds on the button (you are player 6). Player 1 folds. The big blind (player 2) calls and you see a flop. The big blind (player 2) checks, you bet, and then the big blind calls. After seeing the turn, the big blind checks, you bet and the big blind calls. On seeing the final community card (the river), you bet and the big blind now raises the bet to around 4 times the original size, that is 2 times the size of the pot. Your decision should be to:

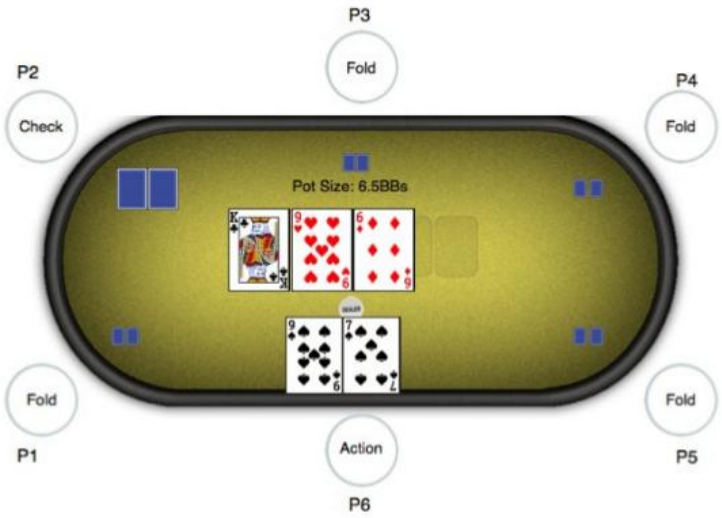
Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 11

You are player 6 (on the button) with Ace of spades and Ace of clubs for hole cards and all community cards visible. Players 1, 2, 3, and 4 have folded. Your opponent (player 5), bets. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 12



Players 3, 4, and 5 folded preflop. You (player 6), raise preflop to 3 times the big blind amount with 9 of spades and 7 of spades for hole cards. Player 1 (the small blind) folds and player 2 (the big blind) calls and you see the flop. Your opponent (player 2) checks to you. Your decision should be to:

Ⓐ Fold
Ⓑ Bet
Ⓒ Check

Scenario 13

Players 3, 4, and 5 folded preflop. You (player 6), raise preflop to 3 times the big blind amount with 9 of spades and 7 of spades for hole cards. Player 1 (the small blind) folds and player 2 (the big blind) calls and you see the flop. Your opponent (player 2) checks to you. Your decision should be to:

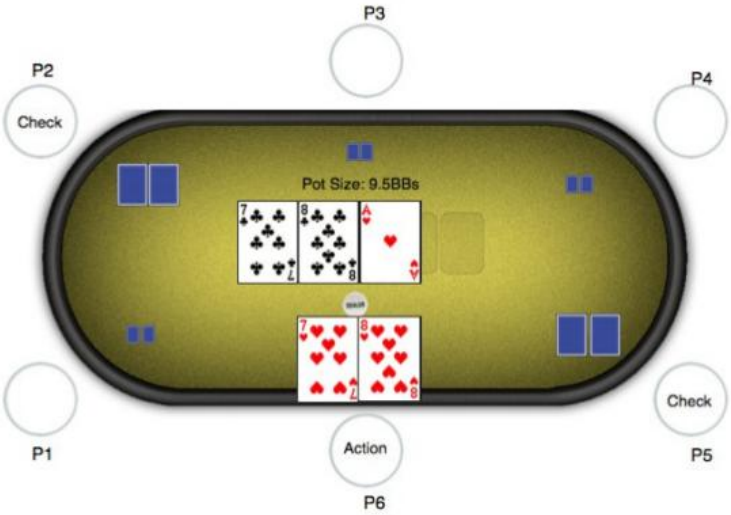
Ⓐ Fold
Ⓑ Bet
Ⓒ Check

Scenario 14

After players 1 and 2 have posted their blind bets, player 3 folds (preflop). With Ace of clubs and King of clubs for hole cards, your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 15



Preflop, players 3 and 4 folded. You (player 6), with 7 of hearts and 8 of hearts for hole cards, called after player 5 raised to 3 big blinds. Player 1 (the small blind) folded. Player 2 (the big blind) called as well. The flop comes. Player 2 (the big blind) checks, and player 5 also checks. Your decision should be to:

Ⓐ Fold
Ⓑ Bet
Ⓒ Check

Scenario 16

You (player 3) have 7 of clubs and 8 of hearts for hole cards. Players 1 and 2 have posted their blind bets preflop. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 17

You (player 3) have 5 of diamonds and 6 of diamonds for hole cards. Players 1 and 2 have anted up the blind bets preflop. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 18

You are player 2 (the big blind), with 6 of spades and 6 of diamonds for hole cards. Player 3 folds. Player 4 raises it to 3 big blinds, then player 5 raises to 11 big blinds. Player 6 (on the button) and player 1 (the small blind) fold. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 19

You are player 2 (the big blind), with 9 of hearts and 9 of diamonds for hole cards. Player 3 folds. Player 4 raises it to 3 big blinds, then player 5 raises to 11 big blinds. Player 6 (on the button) and player 1 (the small blind) fold. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 20

After the blind bets have posted their blind bets, players 3, 4, 5, and 6 fold preflop. You are player 1(the small blind) with Ace of diamonds and 8 of diamonds for hole cards. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 21

After the preflop blind bets have been posted, players 3, 4, 5, and 6 fold. Player 1 raises to 3 big blinds. You, player 2, have Ace of diamonds and 8 of clubs for hole cards. Your decision should be:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 22

The preflop blind bets have been posted. Player 3 raises to 3 big blinds. Player 4 folds. Player 5 then raises to 11 big blinds. You, player 6, have King of hearts and King of clubs for hole cards. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Re-raise

Scenario 23

After the blind bets have been posted, player 3 and 4 fold preflop. Player 5 bets only enough to remain in the hand (limps). Player 6 (on the button) folds. Player 1 calls. You, player 2, with King of hearts and 2 of hearts for hole cards, check. The flop comes down. You decide to bet the flop, and you get raised by player 5. Player 1 (the small blind) folds. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 24

After the blind bets have been posted, player 3 and 4 fold preflop. Player 5 bets only enough to remain in the hand (limps). Player 6 (on the button) folds. Player 1 calls. You, player 2, with King of hearts and 2 of hearts for hole cards, check. The flop comes down. You decide to check the flop, and then player 5 bets. Player 1 (the small blind) folds. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

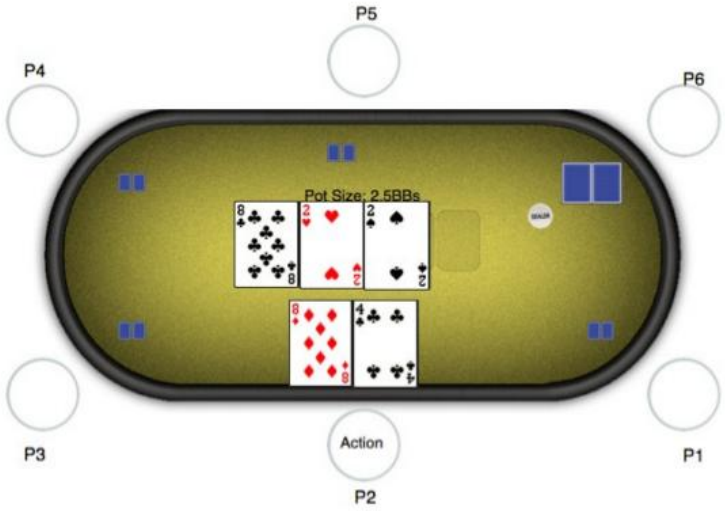
Scenario 25

Note: Positions are also unknown in this example. Cutoff and Big Blind are just used for ease of illustration.

You, player 5, with Ace of diamonds and Jack of diamonds for hole cards, have check/called both the flop and the turn. Players 1, 2, 3, and 4 have all folded. With all community cards displayed, you check and then your opponent (player 6) bets. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 26



You are Player 2 (the big blind) with 8 of diamonds, 4 of clubs. Player 6 (the button) decides to call. You decide to check and the flop comes down (first 3 community cards are dealt). Your decision should be to:

Ⓐ Fold
Ⓑ Bet
Ⓒ Check

Scenario 27

You are player 4 with Queen of diamonds and Queen of clubs for hole cards. You have 100BB available to bet with. Player 5, player 6 (button), and player 1 (small blind) all start the hand with 100BB, but player 2 (the big blind) has 18BB. Player 3 folds. Your decision should be to:

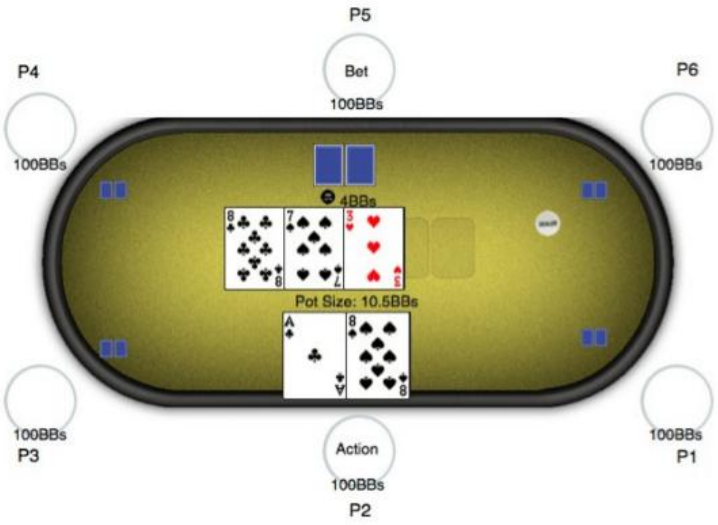
Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 28

You are on the button (player 6) with Jack of diamonds and Jack of clubs for hole cards and 30BB available to bet with. Player 1 (the small blind) and player 2 (the big blind) both have 30BB available to bet with. Players 3, 4, and 5 fold. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 29



Everyone at the table has 100BBs available to bet with. You are player 2 with Ace of clubs and 8 of spades for hole cards. Player 5 raises to 3 big blinds preflop. Player 5 has a preflop raise percentage of 45%. You decide to call player 5's raise and the flop is dealt: 8 of clubs, 7 of spades, and 3 of hearts. You check to Player 5 who decides to bet 4BBs into a pot of 6.5BBs. His continuation bet (betting on the flop after raising preflop) percentage is 93%. Your decision should be to:

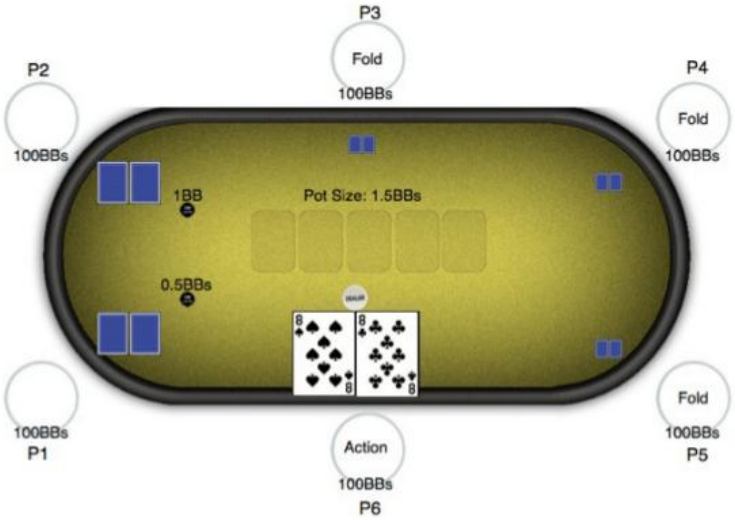
Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 30

You (player 2) have 17BBs to bet with and have 9 of hearts and 9 of spades as hole cards. Player 3 has been playing extremely tight, raising 7% of hands over 100 observed hands. The button (player 6) has also been playing tight, raising 12% of hands over 100 observed hands. Everyone except you have 100BBs available to bet with. Player 3 raises to 2.5BBs, it folds to the button (player 6) who calls. Player 1 folds. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

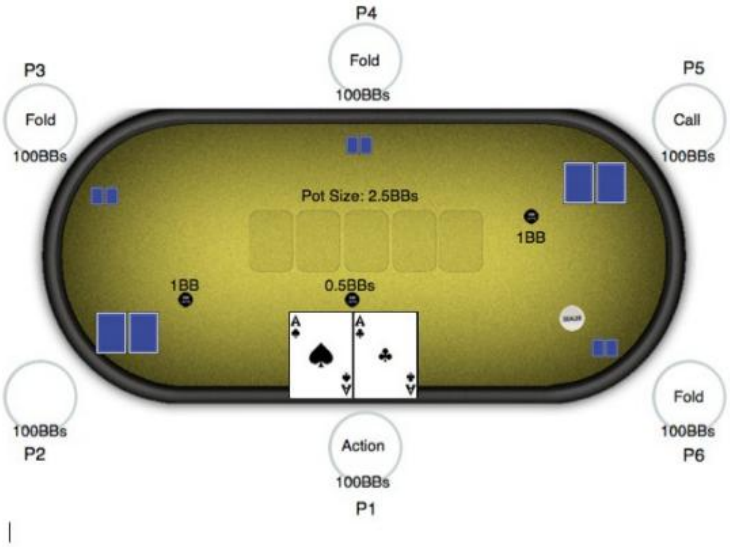
Scenario 31



Everyone starts the hand with 100BBs. You are the button (player 6) with 8 of spades and 8 of clubs as hole cards. After players 1 and 2 post their blind bets, players 3, 4, and 5 fold. The small blind (player 1) re-raises 9% of the time and the big blind (player 2) re-raises 15% of the time both over 300 observed hand samples. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

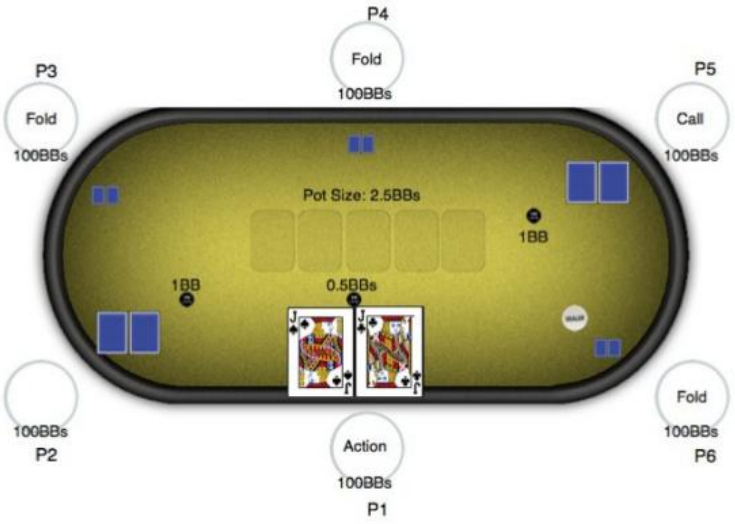
Scenario 32



You are in the small blind (player 1) with Ace of spades and Ace of clubs for hole cards. Everyone starts the hand with 100BBs available to bet with. Player 5 bets the minimum amount necessary to remain in the hand (limps). You have noticed that player 5 has a tendency to do this (limp) over the last 100 hands. Player 6 (the button) folds. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

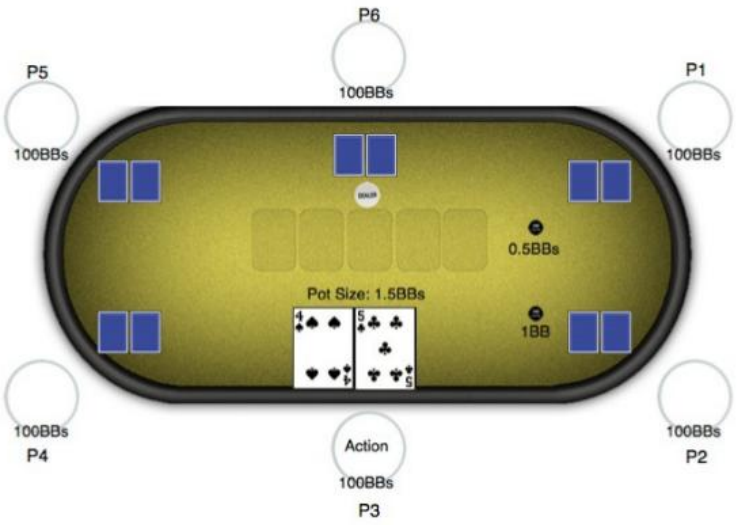
Scenario 33



You are in the small blind (player 1) with Jack of spades and Jack of clubs for hole cards. Everyone starts the hand with 100BBs available to bet with. Player 5 bets the minimum amount required to remain in the hand (limps). You have noticed that player 5 has a tendency to do this (limp) over the last 100 hands. Player 6 (the button) folds. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 34



You are player 3 with 4 of spades and 5 of clubs for hole cards. Everyone has 100BBs available to bet with. You have been really active over the past hour raising 22 hands out of 100. The rest of the table is playing pretty tight aggressive, raising approximately 15% of hands each. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

Scenario 35

You are player 3 with Ace of spades and 6 of clubs for hole cards. Everyone at the table has 100BBs available to bet with. You have been really active over the past hour raising 22 hands out of 100. The rest of the table is playing pretty tight aggressive, raising approximately 15% of hands each. Your decision should be to:

Ⓐ Call
Ⓑ Fold
Ⓒ Raise

APPENDIX G: NEO PI-R FACET DESCRIPTIONS

Facet Composition of the Big Five NEO-PI-R Domain Scales		
High Scorers		Low Scorers
	EXTRAVERSION	
Dominant, forceful, decisive	Assertiveness	Retiring, avoids speaking up
Energetic, fast-paced, vigorous	Activity-level	Slow, deliberate, unhurried
Seek strong stimulation, takes risks	Excitement-seeking	Avoids overstimulation, cautious
High-spirited, light-hearted, cheerful	Positive Emotions	Cheerless, serious, somber
Seeks social contacts, has many friends	Gregariousness	Avoids crowds, solitary
Friendly, talkative, affectionate	Warmth	Distant, aloof, impersonal
	AGGREEABLENESS	
Trusting, not suspicious	Trust	Cynical, distrustful
Not manipulative or deceptive	Straightforwardness	Crafty, cunning, sly
Sympathetic, caring, selfless	Altruism	Selfish, not concerned for others
Obliging, agreeable	Meekness	Stubborn, quarrelsome
Deferential, self-effacing	Modesty	Boastful, cocky
Softhearted, lenient, generous	Tendermindedness	Hardhearted, strict, punitive
	CONSCIENTIOUSNESS	
Ready, well prepared	Competence	Frequently ill prepared
Hardworking, industrious	Achievement	Lazy, carefree
Not distractible, concentrating	Discipline	Easily distracted, low focus
Organized, neat, tidy	Order	Disorganized, sloppy
Reliable, responsible	Dutifulness	Irresponsible, negligent
Cautious, planning, careful	Deliberation	Careless, spontaneous, impulsive
	NEUROTICISM	
Anxious, worrying, tense, edgy	Anxiety	Stable, calm, relaxed, at ease
Impatient, irritable, easily angered	Hostility	Placid, even-tempered, amiable
Despairing, down-hearted, blue, despairing	Depression	Hopeful, feels worthwhile, seldom sad
Shy, feels inferior, embarrasses easily	Self-consciousness	Poised, feels secure, socially apt
Easily yields to temptation/urges	Impulsivity	Self-controlled, resists temptation
Panicky, indecisive, easily overwhelmed	Vulnerability	Resilient, composed, cool-headed
	OPENNESS	
Values aesthetics, is moved by art	Aesthetics	Insensitive to aesthetics
Likes daydreaming, fantasy, imaginative	Fantasy	Practical, avoids daydreaming
Empathetic, emotionally sensitive	Feelings	Low empathy & emotional range
Reflective, intellectually curious	Ideas	Concrete, avoids abstract
Likes novelty, change, and variety	Actions	Favors routine, familiarity
Tolerant, liberal, broad-minded	Values	Intolerant, conservative, conforming

Note: Adapted from Costa, McCrae, and Dye (1992).

APPENDIX H: DEBRIEFING FORM

DEBRIEFING FORM

Individual characteristics of good and poor poker players

Investigators:

Carrie A. Leonard
M.Sc. Candidate, Psychology, UofL
Phone: 403-382-7128
Email: carrie.leonard@uleth.ca

Supervisor: Dr. R. Williams
Professor, Faculty of Health Sciences, UofL
Phone: 403-382-7128
Email: robert.williams@uleth.ca

It has been shown that skilled poker players make better decisions than less skilled players. For this study, better decision-making was defined as making choices that maximize profits while minimizing losses.

The study you have just taken part in has several goals. The first goal of the study is to create and validate a measurement of poker skill. For this purpose, all participants engaged in two poker tasks. The first being a paper and pencil measure designed to assess players decision-making. The second poker task required all participants to play virtual poker. During virtual play, players decision-making was assessed to establish whether players demonstrated the same level of decision-making capacity as was established during the paper and pencil measure.

The second goal is to advance our understanding of individual differences which contribute to skill in poker playing. To illustrate, do highly skilled players demonstrate higher quantitative and social intelligence? How is skill in poker playing related to measures of memory, risk perception, and personality?

The third goal of the study was to examine the characteristics of poker players who may be considered at risk for problem gambling.

The results of this study will be disseminated in both professional meetings/conferences and through peer-reviewed journals.

If you are interested in this area of research, you may wish to read the following:

Linnet, J., Frøslev, M., Ramsgaard, S., Gebauer, L., Mouridsen, K., & Wohlert, V. (2012). Impaired probability estimation and decision-making in pathological gambling poker players. *Journal of Gambling Studies*, *28*(1), 113–122. doi:10.1007/s10899-011-9244-2

St. Germain, J., & Tenenbaum, G. (2011). Decision-making and thought processes among poker players. *High Ability Studies*, *22*(1), 3–17. doi:10.1080/13598139.2011.576084

Williams, R. J. (2003). *Reliability and validity of four scales to assess gambling attitudes, gambling knowledge, gambling fallacies and ability to calculate gambling odds*. (Unpublished tecnical report). Lethbridge, Alberta: Available from author.

Williams, R. J., & Volberg, R. A. (2010). *Best practices in the populations assessment of problem gambling.* (pp. 1–97). Ontario Problem Gambling Research Center.

If you have any questions about this study or its implications, please ask the experimenter now or contact Carrie Leonard (see contact information above). Questions regarding your rights as a participant in this research may be addressed to the Office of Research Ethics, University of Lethbridge (Phone: 403-329-2747 or Email: research.services@uleth.ca).

If you are concerned about your level of involvement in gambling please contact the University of Lethbridge counselling services at: counselling.services@uleth.ca or 403-317-2845.

If you wish to receive the final group results of the study, please contact Carrie Leonard.

Thank you very much for your participation!!

APPENDIX I: MALE VS FEMALE PARTICIPANTS' SCORES

	Male (*n*= 54)		Female (*n*= 46)				
	M	*SD*	*M*	*SD*	*t*	*p*	*95% CI*
Age	23.33	6.81	23.22	6.06	0.09	0.93	-2.44, 2.67
Education (Years)	14.44	1.88	14.75	2.28	-0.75	0.46	-1.15, 0.52
Self-rated Playing Ability (%)	41.39	21.72	24.07	16.22	4.56	< .001	9.78, 24.87
Playing Experience (Years)	5.58	5.96	3.66	3.74	1.97	0.05	-0.02, 3.88
Hands Played (Max = 30)	22.56	4.6	23.48	4.39	-1.03	0.31	-2.71, 0.86
Hands Won (%)	48.93	12.43	42.68	15.40	2.21	0.03	0.62, 11.88
Net Profit	-118.00	230.91	-44.09	148.24	-1.93	0.06	-149.94, 2.11
Pre-flop Aggression (%)	15.33	18.57	7.29	12.13	2.56	0.01	1.89, 14.19
Flop Aggression (%)	40.26	17.57	31.54	26.90	1.88	0.06	-0.51, 17.94
Composite Aggression (%)	27.79	14.73	19.42	14.96	2.81	0.006	2.46, 14.30
Assessment scores							
PSM	19.59	5.67	15.33	4.51	4.19	<0.001	2.25, 6.29
Digit Span	5.63	0.98	5.57	1.07	0.31	0.76	-0.35, 0.47
Stanford Binet Matrices	55.72	6.94	54.57	7.70	0.78	0.44	-1.78, 4.09
Stanford Binet Equation Building	58.44	10.64	56.72	10.27	0.82	0.41	-2.43, 5.89
GFM	7.54	1.48	7.15	1.53	1.27	0.21	-0.22, 0.99
Risk Perception							
Ethical	29.30	5.39	30.83	4.32	-1.58	0.12	-3.46, 0.40
Monetary	28.61	5.65	30.11	4.36	-1.49	0.14	-3.49, 0.49
Gambling Only	16.50	3.65	17.61	3.07	-1.65	0.10	-2.44, 0.23
Financial only	12.11	3.45	12.50	2.63	-0.64	0.53	-1.60, 0.82
Health/Safety	26.00	5.96	28.35	6.02	-1.95	0.05	-4.74, 0.04
Recreational	22.94	7.24	23.37	6.21	-0.32	0.75	-3.09, 2.24
Social	16.35	4.95	16.35	5.01	0.004	0.99	-1.98, 1.99
Social IQ							
Information Processing	5.29	0.82	5.12	0.49	1.25	0.21	-0.09, 0.43
Social skills	4.91	0.74	4.69	0.65	1.61	0.11	-0.05, 0.50
Social Awareness	5.19	0.86	5.04	0.78	0.91	0.36	-0.18, 0.48
PPGM							
Impaired Control	0.37	0.71	0.17	0.53	1.58	0.12	-0.05, 0.44
Other issues	0.11	0.42	0.11	0.43	0.03	0.98	-0.17, 0.17
Problems	0.09	0.35	0.02	0.15	1.35	0.18	-0.03, 0.18
Composite PPGM	0.57	1.14	0.30	0.94	1.30	0.20	-0.14, 0.68

	Male (n= 54)		Female (n= 46)				
	M	*SD*	*M*	*SD*	*t*	*p*	*95% CI*
Personality Domains & Facets							
Extraversion	3.54	0.44	3.59	0.44	-0.62	0.54	-0.23, 0.12
Assertiveness	3.28	0.64	3.21	0.64	0.51	0.61	-0.19, 0.32
Activity-level	3.27	0.52	3.27	0.64	-0.08	0.94	-0.24, 0.22
Excitement-seeking	3.84	0.65	3.78	0.51	0.49	0.62	-0.16, 0.27
Gregariousness	3.30	0.73	3.43	0.72	-0.91	0.37	-0.42, 0.16
Positive Emotions	3.70	0.67	3.90	0.66	-1.50	0.14	-0.47, 0.06
Warmth	3.84	0.55	3.94	0.60	-0.93	0.36	-0.34, 0.12
Agreeableness	3.30	0.47	3.46	0.41	-1.77	0.08	-0.33, 0.02
Trust	3.24	0.76	3.30	0.66	-0.45	0.65	-0.34, 0.22
Straightforwardness	3.09	0.59	3.35	0.56	-2.28	0.03	-0.49, -0.03
Altruism	3.93	0.63	4.08	0.45	-1.34	0.18	-0.36, 0.07
Meekness	2.98	0.67	2.93	0.68	0.33	0.74	-0.22, 0.31
Modesty	3.12	0.73	3.37	0.71	-1.74	0.09	-0.54, 0.04
Tendermindedness	3.44	0.59	3.69	0.50	-2.34	0.02	-0.47, -0.04
Conscientiousness	3.51	0.43	3.46	0.41	0.61	0.54	-0.11, 0.21
Competence	3.60	0.40	3.50	0.45	1.16	0.25	-0.07, 0.27
Achievement	3.48	0.62	3.52	0.46	-0.35	0.73	-0.25, 0.18
Discipline	3.61	0.73	3.44	0.68	1.16	0.25	-0.12, 0.44
Order	3.40	0.56	3.30	0.56	0.88	0.38	-0.12, 0.32
Dutifulness	3.71	0.56	3.78	0.44	-0.71	0.48	-0.27, 0.13
Deliberation	3.24	0.68	3.19	0.68	0.37	0.71	-0.22, 0.32
Neuroticism	2.68	0.47	2.92	0.40	-2.72	0.008	-0.41, -0.06
Anxiety	2.82	0.65	3.23	0.61	-3.19	0.002	-0.65, -0.15
Hostility	2.69	0.61	2.72	0.66	-0.20	0.84	-0.28, 0.23
Depression	2.58	0.66	2.81	0.71	-1.64	0.11	-0.50, 0.05
Self-consciousness	2.63	0.65	2.94	0.71	-2.35	0.02	-0.57, -0.05
Impulsivity	3.28	0.59	3.39	0.53	-1.00	0.32	-0.33, 0.11
Vulnerability	3.28	0.58	3.39	0.53	-3.39	0.001	-0.53, -0.14
Openness	3.48	0.42	3.61	0.43	-1.54	0.13	-0.30, 0.04
Aesthetics	3.00	0.81	3.48	0.76	-3.10	0.003	-0.80, -0.18
Fantasy	3.38	0.71	3.52	0.68	-0.98	0.33	-0.41, 0.14
Feelings	3.51	0.62	3.80	0.64	-2.25	0.03	-0.54, -0.33
Ideas	3.80	0.67	3.62	0.68	1.36	0.18	-0.09, 0.45
Actions	3.33	0.38	3.30	0.47	0.22	0.82	-0.15, 0.19
Values	3.84	0.55	3.92	0.50	-0.74	0.46	-0.29, 0.13

Note: *M* = mean; *SD* = standard deviation, *t* = *t* obtained, *p* = probability of *t* obtained, *95% CI* = 95% confidence intervals for *t* obtained