

Erroneous Beliefs Verbalized While Playing Online Poker

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Abstract

The objective of this study was to compare erroneous beliefs of online Texas Hold'em poker players with different level of severity of problems, in situations that could cause negative emotions. Verbalizations of three groups of gamblers (low-risk, $n=10$; at-risk, $n=10$ and problem, $n=10$) while playing an online poker tournament in a laboratory setting. Participants were not aware that they played against research assistants and that all cards received were predetermined and the same for all participants. Beliefs related to the illusion of control were found in the three groups of gamblers. At-risk and problem gamblers' perceptions denote a greater influence given to their ability on the game results, with even a denial of the part played by chance. Poker-specific beliefs, different from those usually held by game-of-chance gamblers, were also found. These results are discussed to provide ideas in how to adapt erroneous perceptions questionnaires for online poker players.

Keywords: poker, erroneous beliefs, emotions, online gambling

Introduction

The outcome of most gambling activities is essentially based on chance, with no skill involved. Poker, on the other hand, commands an element of skill, which sets it apart from other gambling activities (Bonneau & Turgeon, 2010; Schoenberg, 2018). According to poker players, three types of skills are required in this game: (1) *technical*, related to the knowledge of the game rules and odds, (2) *psychological*,

such as decoding opponents' behaviour and controlling attention spans, impulsivity and negative emotions provoked by the game, and (3) *financial*, involving balance between risk-taking and minimizing losses (Bouju et al., 2013). Empirical studies have shown that chance influences game outcomes more than skill in the short term (Meyer et al., 2013). In the long term, skill then tends to gain a little influence on game outcomes (Bjerg, 2010; Turner & Fritz, 2001), particularly for players who devote a considerable number of hours to the game (Fiedler & Rock, 2009). But even with an extensive skillset and a considerable game experience, chance tends to dominate up to 75% of the course of the game (Duersch et al., 2017).

Erroneous beliefs

A misunderstanding of the influence of skill on the game outcome can contribute to the development of gambling problems (Barrault & Varescon, 2012; Lévesque et al., 2018). According to the cognitive theory of gambling problems, the quantity of erroneous beliefs and the strength of the gambler's conviction about those same beliefs contribute to the persistence of gambling behaviours and eventually to the development of a gambling disorder (Barrault & Varescon, 2012; Jacobsen et al., 2007; Lévesque et al., 2018; Raylu & Oei, 2004). The primary erroneous beliefs observed in gamblers are related to a distorted understanding of the aspect of chance and that game events must "even out." A common example of erroneous beliefs is the illusion of control, where an individual believes that it is possible to influence or predict the outcome of a game more than realistically possible based on one's knowledge, skills, or personal characteristics (Lambos & Delfabbro, 2007; Smith & Giroux, 2019). The illusion of control has many variants, such as the belief that it is possible to predict upcoming results by finding patterns and links among past results (*illusory correlation*), selective attribution of gains to personal skill and losses to chance (*self-serving bias*), and attributing more importance to gains than losses (*availability bias*; Barrault & Varescon, 2012; Fortune & Goodie, 2012).

Erroneous beliefs in poker

Erroneous beliefs have been studied in poker players using questionnaires based on the beliefs of gamblers who practice mainly gambling activities relying on pure chance (Lévesque, 2017), an approach which, in turn, has led to interpretation problems. While erroneous beliefs usually distinguish pathological from non-pathological gamblers in gambling activities based on chance (Goodie & Fortune, 2013), Mitrovic and Brown's results (2009) showed that there no correlation existed between the erroneous beliefs score on the Gambler's Belief Questionnaire ([GBQ]; Steenberg et al., 2002) and gambling problems in a sample of poker players when controlling for participation in gambling activities that did not involve skill. Conversely, the results of other studies suggested that erroneous beliefs, particularly the illusion of control assessed using the Gambling Related Cognition Scale ([GRCS]; Raylu & Oei, 2004), were related to the presence of gambling problems in poker (Barrault, 2012; Barrault & Varescon, 2013). In the latter study, a questionnaire specific to poker was used to better encapsulate the mutual influence of chance and skill of this gambling activity. Contrary to most gambling activities, it is not erroneous nor illusory for poker players to believe

that it is possible to influence the outcome of the game with knowledge or the use of strategy (Barrault & Varescon, 2012; 2015; Bjerg, 2010).

Brochu and colleagues (2015) used a qualitative method to evaluate beliefs related to chance and skill for three groups of Texas Hold'em online poker players presenting different levels of gambling problem severity: *non-problem*, *at-risk* and *problem gambling*. The results of the at-risk and problem poker players focus groups suggested players believe that their skill has a major influence on the outcome of the game. In the at-risk and problem groups, verbalizations related to the importance of practice and learning from losses were observed. Other verbalizations in the at-risk and problem groups suggested that these players overestimate their respective skill levels. For example, in the at-risk group, the idea that it is possible to chase losses easily because of players' skill, as well as a previous belief that it was possible for the players to become professional poker players (before being confronted with evidence of their true skill level), were both mentioned. Losses are attributed to external sources such as cheating opponents and non-randomly generated online cards in the at-risk and problem groups, which could reflect those gamblers' tendency to protect beliefs about their own skill levels.

Erroneous beliefs expressed while gambling

Previous qualitative studies were mostly focused on the beliefs of poker players outside of a game and collected data via individual interviews or focus groups. Bjerg (2010) noted that, because of the skill involved in poker, it was not possible to determine whether beliefs were erroneous or correct without analyzing the context of the game within which they occurred. Research in this domain has also shown that gamblers' erroneous perceptions are mostly observable when they are active in a game. Sévigny and Ladouceur (2003) introduced the "double switching" cognitive concept to explain the incoherence between gamblers' beliefs and behaviours during a game, compared to outside of a game session. Many factors may explain the phenomenon of "double switching." Certain structural characteristics of gambling activities that promote the impression of control over the outcome, such as stopping devices on video lottery terminals, may have an influence on the emergence of erroneous beliefs and behaviours in gamblers during a game session (Ladouceur & Sévigny, 2003). Andrade and Iyer (2007) showed that outside of a game session, gamblers tend to underestimate the impact of negative emotions related to losses on their subsequent behaviour. These negative emotions strongly motivate them to recuperate their losses and re-establish their emotional equilibrium, thus facilitating risky gambling behaviours motivated by specific erroneous beliefs.

In poker, emotions related to the players' interpretations of the game situation concerning chance and skill have a considerable influence on their subsequent behaviours (Barrault, 2012; Bjerg, 2010; Lévesque, 2017; Moreau et al., 2020a). A poor decision made under the influence of strong negative emotions is a phenomenon called "tilt," and is often caused by an unexpected loss (Moreau et al., 2016; 2020b; Palomäki et al., 2014). With tilt, players end up feeling frustrated because they believe that they have experienced

an injustice because of chance and can seek a rapid recovery of their losses (Moreau et al., 2016; 2020a; Palomäki et al., 2013). Since such a comeback is not always possible, players end up accumulating losses instead of gains (Griffiths et al., 2010; Moreau et al., 2020a). Tilt is said to share certain features with problematic gambling since players experience losses of control, negative feelings and chasing (Moreau et al., 2016; 2020a). In Bjerg's study (2010), poker players in treatment or who have previously been treated for their gambling problem reported how their incapacity to self-assess their true skill level and the factors that influence it (e.g., emotional upsets) were important aspects in their transition to problematic gambling. Acquiring further knowledge about erroneous beliefs during game sessions that are likely to trigger negative emotions would allow for a better understanding of problem gambling in poker players (Moreau et al., 2016).

To our knowledge, the Bouju and colleagues' (2013) study is the only one thus far published that has focused on the beliefs that arose in the context of a poker game session. In this inquiry, sixteen poker players took part in face-to-face, semi-structured interviews and were observed during either an online or offline poker game session. The interview classified poker players by level of problem according to the number of satisfied *DSM-IV* criteria (American Psychiatric Association, 2000). Two criteria or less refer to social gamblers and the satisfaction of at least three criteria to problem gamblers. In this study, qualitative analysis results revealed that, compared to social gamblers, problem gamblers perceived that skill had an increased impact on the game, which led them to believe they could control chance and quickly make considerable gains. However, the two groups were not exposed to the same game context during the experimentation phase (one group was exposed to a mix of online games at the participant's home, while the other was exposed to offline games in live poker rooms; all players did not receive the same cards). This decision made the comparison of both groups' beliefs dependant, in part, to the game events to which they were exposed.

The role of online poker

Online poker, similar in nature to offline poker, can also be exceptionally different in terms of structural characteristics and potential consequences. Since online and offline poker are different gambling modalities, the limits of online poker, such as the potential for fraud (poker bots, cheats-at-play schemes, etc.) and dubious player practices (computer viruses, hacking, etc.), could also contribute to the reinforcement of erroneous beliefs, since players often believe they are being cheated when they lose in online poker games (McMullan, 2012). Participation in online poker is associated with high rates of gambling problems (Sirola et al., 2018). In recent years, research on poker has addressed the characteristics of the game in terms of chance and skill (Duerst et al., 2020; Palomäki et al., 2020). Since erroneous beliefs related to chance and skill are recognized for their involvement in the development and persistence of gambling problems (Lévesque et al., 2018), it is important to document those erroneous beliefs in relation to the practice of online poker.

Instruments measuring erroneous beliefs should consider the different structural characteristics of the games played by gamblers. It is possible that the erroneous

beliefs of poker players are different than the false beliefs of those gamblers who play games based mainly on chance (Barrault & Varescon, 2012; 2015). It is also necessary to study poker players' erroneous beliefs to adapt eventually assessment tools to poker compared to other gambling activities. A qualitative research design is appropriate for this task, as it has been applied during the developmental phase of the current cognitive theory on gambling problems (Goodie & Fortune, 2013). Qualitative research also allows access to the beliefs of poker players as verbalized within the dialect of the game (Baribeau, 2010).¹

Study design, aim and objectives

The present study consisted of a poker tournament where participants were asked to verbalize their thoughts while playing. The aim of this study was to compare the erroneous beliefs of three groups of online poker players with different levels of gambling problem severity. Players were compared in situations that were likely to evoke negative emotions and tilt during an online tournament of Texas Hold'em poker (i.e., situations where unexpected losses have more chance of occurring). This game was chosen because of its high popularity at the time of the study (Griffiths & Barnes, 2008). Since erroneous beliefs are generally related to problem gambling, the three groups were expected to differ with respect to particular erroneous beliefs. The three-group design also allows for a better documentation and comparison of erroneous beliefs, as verbalized by players at three different problem levels. This documentation will then provide a basis for future adaptation of cognitive interventions and existing assessment tools for players with gambling problems related to this game.

Method

Participants

Participants were invited to play in an online poker tournament. The inclusion criteria were as follows. Each participant was required to be (1) 18 years of age or older; (2) a man;² (3) someone who had played online poker for money at least once a month over the past six months; and (4) someone who had never have been treated previously for a gambling problem (since therapies for problem gamblers are mostly of a cognitive-behavioural nature and aim to restructure erroneous beliefs related to chance, the inclusion of gamblers who have previously been treated for a gambling problem would have biased the beliefs under study). Recruitment methods included a list of volunteers available at the Centre québécois d'excellence pour la prévention et le traitement du jeu research center

¹The dialect of the game refers to the specific terms and expressions used by poker players to communicate about certain aspects of poker (i.e., pocket cards, playing the rush, rabbit hunting, etc.).

²One study conducted on 180 online poker players described them as young single men, sensation seekers, persons working full-time, and persons playing approximately five times per week (Barrault & Varescon, 2013; Bonnaire & Barrault, 2018; Kairouz et al., 2016; Moreau et al., 2016).

($n=3$); the publication of advertisements in local newspapers ($n=6$), on the radio ($n=3$), and on a poker forum ($n=1$); solicitations on the local sport network website (rds.ca; $n=1$); e-mails to the community of students and employees at Université Laval ($n=6$), and word of mouth ($n=10$). The recruitment period took place between February 10 and September 8, 2010.

Thirty participants were selected to participate in the study according to their score on the National Opinion Research Center's DSM Screen (NODS; Gerstein et al., 1999). They were placed into one of the following three groups: non-problem gamblers (score of 0; $n=10$), at-risk gamblers (score of 1 or 2; $n=10$), and problem gamblers (score of 3 or 4; $n=10$).

Because of the small sample size, only a visual inspection of the sociodemographic and gambling habits variables was carried to verify if groups differed. The subjects were from Quebec city (90%) and others regions (10%) and spoke French as a first language, except for one participant who spoke French fluently as a second language. The mean age of the sample was 26.33 years ($SD = 7.23$). The majority of the sample was single (73.33%) and without children (76.67%). Fifty percent of participants held a college degree and 23.33% held a university degree. The participants were mostly students (46.67%) or worked full-time (36.67%). Over half of the subjects (56.67%) earned a personal annual income of \$20,000 or less. Participants had played online poker for an average of 3.62 years ($SD = 2.29$). The subjects had played approximately three times a week over the previous six months for an average of 26.11 hours ($SD = 31.92$) per month over the last year and spent a mean of \$398.99 per month ($SD = \$1,124.10$). The median largest sums lost was much higher for the problem gamblers (\$1,150) than the non-problem gamblers (\$175) and the at-risk gamblers (\$100). Surprisingly, the mean hours played, frequency of gambling, and amount spent in the last 12 months by non-problematic gamblers (NPG) for online poker represent higher amounts quantitatively than for at-risk gamblers or problem gamblers. On the other hand, the gambling habits for NPG are less frequent and the amount spent is lower than the other groups for the other two gambling forms. The mean amount spent by at-risk gamblers in the last 12 months on casino games (\$655.56) and sports betting (\$402.75) is also surprisingly high compared to the other two groups (NPG: casino games = \$1.00, sports betting = \$8.00; PG: casino games = \$0.00, sports betting = \$17.78). This finding could be explained by a higher mean annual income in the at-risk group (\$31,000 to \$40,000) in comparison to the other two groups (\$11,000 to \$20,000). We provide further details concerning the gambling habits of the three groups of poker players at poker and at other games in Tables 1 and 2, respectively.

Questionnaires

Sociodemographic and poker habits questionnaire

This questionnaire, formulated specifically for the present study, includes 28 open-ended and multiple-choice questions on gender, place of birth, first language, marital status, education, main occupation, religion, personal annual income, preferred poker

Table 1
Gambling Habits in Poker

Habits by game modality	NPG (<i>n</i> =10)		ARG (<i>n</i> =10)		PG (<i>n</i> =10)	
	<i>M</i>	(<i>SD</i>)	<i>M</i>	(<i>SD</i>)	<i>M</i>	(<i>SD</i>)
Online poker						
Years of experience	3.25	(3.14)	3.50	(2.04)	4.10	(1.58)
Frequency (past 6 months)	55.50	(50.38)	78.00	(69.86)	87.80	(61.26)
Frequency (last month)	7.45	(8.41)	12.22	(10.28)	26.60	(38.30)
Money spent (per month)	47.87	(65.42)	979.25	(1,989.43)	250.80	(348.24)
Hours played (per month)	26.00	(34.04)	37.95	(32.01)	44.20	(30.24)
Largest sum won	1,013.33	(1,456.39)	14,174.80	(42,454.81)	2,853.20	(3,894.30)
Largest sum lost	481.67	(806.39)	6,396.25	(17,618.96)	1,283.33	(788.46)
Poker at the (identified gambling site)						
Frequency (past 12 months)	2.54	(7.01)	0.70	(1.89)	0.850	(1.76)
Money spent (past 12 months)	2,544.00	(7,765.52)	20.00	(63.25)	327.50	(778.39)
Hours played	17.40	(52.95)	1.80	(4.73)	4.15	(10.30)
Poker at the casino						
Frequency (past 12 months)	0.20	(0.42)	0.30	(0.48)	0.95	(1.42)
Money spent (past 12 months)	300.70	(948.44)	125.00	(313.80)	347.50	(770.14)
Hours played (past 12 months)	1.55	(4.73)	1.10	(1.79)	5.40	(11.32)
Poker with friends						
Frequency (past 12 months)	23.40	(29.35)	22.15	(22.14)	30.00	(27.75)
Money spent (past 12 months)	255.00	(323.68)	667.00	(1072.24)	979.60	(1625.42)
Hours played (past 12 months)	63.63	(33.30)	92.39	(102.81)	94.65	(75.83)

Note. NPG = non-problem gamblers; ARG = at-risk gamblers; PG = problem gamblers.

websites and gambling establishments, types and variants of poker played, amount of money spent, time spent playing, and the number of years of experience at the game.

National Opinion Research Center's DSM Screen (NODS)

The translation and French adaptation (Jacques, 2000) of the NODS (Gerstein et al., 1999) was used to screen for pathological gambling³ over the past year in the sample of online poker players. The 17 diagnostic questions are based on the 10 diagnostic criteria of the fourth edition of the *DSM-IV* (APA, 2000). The items are dichotomous (i.e., yes or no questions) such as, “Over the past 12 months, have

³Since the NODS was created with the *DSM-IV* in mind, it has been used to screen pathological gambling, a term used in the *DSM-IV*. Subsequent to the publication of the *DSM-5* in 2013, pathological gambling is now referred to as “gambling disorder.” The two terms, even when considering this change in nomenclature, are conceptually similar. Pathological gambling refers to a persistent and recurrent maladaptive gambling behaviour (American Psychiatric Association, 2000). *Gambling disorder* is defined as a persistent and recurrent problematic gambling behaviour leading to significant impairment or distress, as indicated by different factors (i.e., needing to gamble with increasing amounts of money to achieve excitement, restlessness or irritability when attempting to stop gambling, etc.) (American Psychiatric Association, 2013).

Table 2
*Gambling Habits Outside of Poker**

Habits per gambling activity	NPG (<i>n</i> =10)		ARG (<i>n</i> =10)		PG (<i>n</i> =10)	
	<i>M</i>	(<i>SD</i>)	<i>M</i>	(<i>SD</i>)	<i>M</i>	(<i>SD</i>)
Lottery						
Frequency (past 12 months)	7.30	(9.84)	9.45	(15.63)	33.85	(50.28)
Money spent (past month)	3.85	(6.62)	2.70	(4.67)	24.00	(53.89)
Casino games						
Frequency (past 12 months)	0.50	(0.71)	1.70	(3.68)	12.55	(37.77)
Money spent (past month)	1.00	(3.16)	655.56	(1650.08)	0.00	0.00
Video lottery terminals						
Frequency (past 12 months)	0.95	(0.90)	2.60	(5.50)	32.50	(76.91)
Money spent (past month)	0.56	(1.67)	3.10	(6.87)	8.00	(13.98)
Skill games						
Frequency (past 12 months)	0.60	(1.07)	5.40	(15.05)	21.30	(47.72)
Money spent (past month)	6.11	(13.64)	50.00	(158.11)	31.11	(68.64)
Sports betting						
Frequency (past 12 months)	2.70	(7.85)	4.35	(7.88)	16.30	(37.24)
Money spent (past month)	8.00	(16.19)	402.75	(1263.95)	17.78	(33.83)

Note. NPG = non-problem gamblers; ARG = at-risk gamblers; PG = problem gamblers.

* Bingo, animal race and stock market participation were not included in Table 2 as their rates were either non-existent or nearly non-existent.

you needed to gamble with larger amounts of money to get the same feeling of excitement?" The total score on the NODS can vary between 0 and 10, where a score of 0 indicates the absence of a gambling problem. Scores between 1 and 2 indicate a risk of developing a gambling problem, scores of 3 or 4 suggest the presence of a gambling problem, and scores of 5 or above signal the probable presence of pathological gambling. The original English instrument possesses high internal consistency and reliability for prevalence over life ($r = 0.99$) and over the past 12 months ($r = 0.98$; Gerstein et al., 1999). The French adaptation of the instrument, administered to a sample of 865 people, shows an internal consistency of 0.91 (Jacques, 2000).

Procedure

Individuals who were interested in participating in the study gave their contact information to the research center via voicemail. When they were contacted, participants responded to the sociodemographic and poker habits questionnaire and the NODS. Eligible participants then received an invitation to participate in an online poker tournament at Université Laval. Upon their arrival in the laboratory, participants were instructed to be seated in front of a computer equipped with the online poker software. They were joined by an interviewer, a doctorate-level graduate student in psychology. Participants were informed that the other participants in the tournament were in rooms on other stories of the building to assure their anonymity. They read and signed the consent form in which the tournament procedure was explained.

Before signing the consent, participants were informed that they would receive a \$40 gift certificate for a local shopping center as compensation for their participation in the tournament and \$10 in cash to cover their parking fees at the university. To create a context that is similar to the reality of a poker tournament and to recreate the lure of gains that players seek, we informed the participants that they had a chance to receive an additional gift certificate depending on their position in the tournament: \$100 for first place, \$50 for second, \$30 third, and \$10 fourth. After the experiment, for ethical reasons, the participants who did not finish the tournament in first place received a gift certificate in the amount of the difference between the gift certificate received and the gift certificate that was given to the first-place winner in the tournament. All the participants therefore received the same amount in compensation for their participation in the study (\$140 in gift certificates and \$10 in cash for parking fees). Once the consent form was read and signed, the interviewer explained the instructions for the verbalizing technique to be used during the tournament (inspired by Ladouceur et al., 1988): (1) say all the thoughts that come to mind aloud, even those that do not seem relevant, (2) speak as much as possible and continuously, (3) talk loudly enough to be heard, and (4) situate self as a poker instructor. Each participant had an opportunity to practice this technique while playing solitaire for about five minutes.

Prior to the study, a software created for this study randomly generated a sequence of cards for participants and for their opponents (research assistants) until the 30th hand. During the tournament, for these first 30 hands, each participant received the same series of cards as the other participants, and each opponent (from the same table position) received the same cards for each participant they played against. On the 31st hand, participants and opponents received different cards that were randomly dealt by the software so that the outcome of the tournament was not biased by the experiment. The tournament was programmed so that the value of the small and big blind bets increased every 15 minutes according to the following structure: 15–30, 30–60, 50–100, 100–200 and 200–400. Two research assistants assumed the role of opponents (there were four opponents altogether) by following an opponent game protocol indicating the decisions to be made (*wait, fold, call, or raise*) at each round (*preflop, flop, turn, and river*) for the first 30 hands of the tournament. Each protocol considered the cards and decisions made by the participants. No mistakes in the following of the protocol were made by any of the research assistants at any moment. The protocols insured that no participant would be evicted from the tournament before the 31st hand of the game. Throughout the tournament, the interviewer encouraged the participants to verbalize their beliefs and questioned them on those beliefs if necessary. After the 30th hand, the research assistant opponents played for the rest of the tournament without knowing which cards the participants had and without following a game protocol.

Once the experimentation phase with the tournament was completed for all participants, they were contacted by telephone or e-mail to reveal the actual context of the tournament, which was that they had played against research assistants who were following a pre-established game protocol for the first 30 hands of the game. The participants were free to agree or refuse to allow their data to be used for the

Table 3
Tournament Hands Selected for Analysis

Hand	Cards	Common cards	Final hand
2	K♥7♣	9♥3♥8♥K♣A♦	Pairs of K
3	K♥A♠	7♦2♣9♦5♣Q♠	Ace and a King
4	8♦5♠	6♠Q♠3♠3♦J♦	Pair of three with Queen kicker
5	A♥4♦	4♣10♥K♠10♦9♦	Two pairs (10 and 4) with Ace kicker
6	4♦3♠	10♥7♠Q♣6♣5♠	Straight (3 to 7)
7	3♣10♥	5♣2♣2♠Q♦8♠	Pair of two with 10 kicker

study; none of the participants refused. This study received the approval of the Comité d'éthique à la recherche sur des êtres humains de l'Université Laval (2009-032 A-1 / 26-01-2010).

Qualitative analysis procedure

In the Texas Hold'em poker tournament, hands 2 through 7 were selected for analysis. According to the probability calculator available on the Poker News website,⁴ hands 2 through 7 involved unexpected loss situations (small probability of loss; to see the sequence of hands, refer to Table 3). For example, during the third hand (participants received the king of hearts and ace of spades), the probability of gains was relatively strong at the beginning (27% at the preflop) but was considerably reduced (11% at the flop and 6% at the turn) and reached zero at the river. Unexpected losses are known to generate negative emotions in poker players, including tilt (Griffiths et al., 2010; Moreau et al., 2016; Palomäki et al., 2014).

The research assistants, who were undergraduate psychology students, transcribed the participants' verbalizations verbatim for hands 2 through 7 of the tournaments using Microsoft Word. They transferred the transcription into the qualitative analysis software QDA Miner version 3.2.9. Thematic analysis was performed according to the six-step procedure described by Braun and Clarke (2006): (1) familiarization with the data, (2) development of codes (subthemes), (3) search for themes, (4) definition and description of themes, and (5) presentation of themes and subthemes and their analysis with quotations that support the findings. An inter-rater agreement procedure was carried out on 35% of the verbatim content. The raters then applied the codes (subthemes) to each relevant text segment. To be considered an agreement, the application of a theme to a given text segment had to overlap at least 50% between raters. The reliability statistic chosen was Krippendorff's alpha because of the complexity of the themes and subthemes that arose from the thematic analysis (Hayes & Krippendorff, 2007). The values of this criterion varied between 0 (total disagreement) to 1 (perfect agreement). Disagreements were resolved by discussion and reaching a consensus on the re-definition, fusion, separation, or

⁴<http://fr.pokernews.com/poker-tools/poker-odds-calculator.htm>

Table 4*Themes and Subthemes Related to Beliefs of Chance and Skill*

Themes	Subthemes
Decision	Bad decision / mistake / regret Good decision Call / raise Verbal contradictions Fold / check
Decision-related elements	Number of people in the hand Opponents' cards Participants' hand Opponents' bets Position around the table Probabilities Structure / moment in the tournament Difficult reading of opponents Bet or pot amount Available <i>stack</i> States / emotions Other elements
Strategies	Bet / raise / reraise <i>Bluff</i> Cognitive reassurance Control Other strategies
Luck / chance / skill	Luck / chance Rigged game Believing oneself to be more skillful than opponents Skill / experience Not skillful
Playing style	Aggressive / risk-taking Careful / patient / tight

suppression of themes or subthemes until their final Krippendorff's alpha criterion had a value of 0.70 or more. This cut-off is suggested for exploratory studies (Neuendorf, 2002). The final themes and subthemes are presented in Table 4. The final inter-rater agreement statistic was 97.40% (Krippendorff's alpha = 0.79). The groups of players were compared based on the presence or absence of subthemes indicating the presence of erroneous beliefs in their verbalizations. The groups were considered similar when a theme was evoked in all three groups and considered different when a theme was evoked in only one or two of the three groups.

Results and discussion

Erroneous beliefs

Erroneous beliefs were identified in each of the three groups (non-problem gamblers, at-risk gamblers, and problem gamblers). Each erroneous belief was described

according to the game context, the group within which it was verbalized, or both. Erroneous beliefs found in this study were linked to existing literature on erroneous beliefs in gambling.

The lucky hand

In the non-problem group, the idea that the starting, non-assorted hand of King-7 is a “lucky hand” was evoked. This is a medium-strength hand, as its probability of winning is 28.14% at a table of four players.⁵ The perception of a lucky hand is an attempt to predict the results of the game based on previous winning experiences. Unfortunately, the predicted results did not materialize, and this failure led to a loss associated with negative emotions,⁶

O.K. I have King-7 [king of hearts and 7 of clubs]. This is a hand that I usually like. [Interviewer (I): Do you?]} Yes, even if it is not forcibly a good hand. [I: Why do you like that hand?] I don't know, having played many games, they have been lucky hands. [I: Oh, O.K.] So, in this case, I will bet more [...] I have the pair of kings, but if he was lucky [one of the opponents, Player 5], he will be saved by the ace in the end. And there you go! [Player 5 forms a second pair at the river (a pair of aces) while he only had a pair of 3s before the last round of the game.] What is kind of a shame is when you have a pair of kings, not knowing whether the pair of aces will come out. It's a shame because I would lose a big hand. It wouldn't be fun. (Player #37 from the non-problem group)

The lucky hand reported in the non-problem group is an example of an erroneous belief known as an illusory correlation, which is the establishment of a link between independent events in a game (Jacobsen et al., 2007; Labrador et al., 2020). In this case, players believe that they will be able to predict the outcome of the game based on their past experiences, although the result of the game depends on winning odds and one's way of playing the game (number of bets made, use of skill). The lucky hand is a form of illusion of control known as predictive control, which is the erroneous belief that it is possible to predict the results of a game based on one's intuition, emotions, or hypotheses (Mathieu et al., 2018; Toneatto et al., 1997). It is possible that this erroneous belief also relates to the concept of availability bias or interpretive control, which is when players remember certain events of a game more readily, such as their wins, rather than having an overall perspective including both their wins and losses (Lambos & Delfabbro, 2007; Mathieu et al., 2018; Toneatto et al., 1997).

Losses because of the opponent's lack of skill

In the three groups, there were many situations in which the players attributed their loss to the opponent's lack of skill. The players reported that their opponents made

⁵<http://www.poker-regle-strategie.com/probabilites/probabilites-Texas-holdem-4-joueurs.php>

⁶Verbalizations are free translations from French.

bets that were too low or that were not proportional to the size of the pot, which made it difficult to detect whether they had a good or a bad hand and made a good decision as a result (call, raise, or fold). In the problem gambler group, the opponent's lack of skill appeared to create frustration and anger, but this was not observed in the non-problem and at-risk gambler groups.

8-5 [8 of clubs and 5 of spades; hand 4], I'll never play that. Everyone is in the hand except me. They keep making strange bets. [I: Which players?] Mostly everyone. I get worked up against people with whom I usually play poker. They don't realize the value of each hand. They'll have an ace-5 and put all their chips on it. They also don't realize the value of the bets. They put 30 in a pot of 500 when they have the best hand, but also when they have nothing. You can't really... I have trouble playing with players like that. I would rather play against good players. You know what to expect. (Player #251 from the problem gamblers group)

Anger associated with the lack of skill in an opponent relates to the concept of flexible attribution (interpretive control) described previously. One player from the problem gamblers group said, "I can be skillful, but due to the style of the table, I am not playing the way I usually would," emphasizing the belief that his loss was because of the opponent's lack of skill rather than his own. The opponents' level of skill and strategy constitutes a large part of the chance aspect that is involved in poker and influences the players' odds of winning. However, in the problem gamblers group, the opponent's lack of skill and the uncertainty it generated in the players' decision-making was interpreted as an injustice rather than a fact of the game.

In another excerpt of the transcript for the problem gamblers group, a participant expressed his frustration of unexpectedly losing a hand to an opponent who would not have called that hand if the opponent had been skilled.

Ace-3 [Ace of spades and 3 of diamonds: the opponent's cards at hand 2]. Damn that was ugly! He called my... damn that was ugly! What a donkey [bad poker player]! I put in as much money as there was in the pot, and he called 200 with his pair of 3s when he had three hearts [followed by his pair of 3s regardless of the possibility that an opponent could have a flush, as there were three heart cards on the board]. [I: Uh huh.] Now I have ace-king [participant's cards at hand 3] and I am angry. What a donkey! (Player #110 from the problem gambler group)

At this hand, the participant had the best hand at the turn—a pair of kings—and faced the possibility (a 19.6% chance) of completing a flush in hearts on the river. The probability that the opponent would complete a second pair on the river was only 7%. Despite the participant's correct interpretation of the game situation, his feeling of anger, which reflected his belief of injustice, appears erroneous. His belief of injustice concerning chance relates to the concept of "moral indignation" discussed by Palomäki and colleagues (2013) within a sample of online poker players. Moral indignation is expressed when players erroneously expect that chance will be on their side and favor a positive outcome of the game for them. According to

this study, this state of mind can create risky situations in which players seek to chase their losses and re-establish the expected balance between their wins and losses and thus, their emotional equilibrium.

Minimization of the consequences of loss or the player's role in his loss

After incurring an unexpected loss (because of the strength of the cards and the associated winning odds) at hand 3, a tendency to minimize the consequences of the loss or of the player's role in the loss was observed in the at-risk gamblers group. The participants had a rather strong starting hand (ace and king), but the cards on the board (flop, turn, and river) did not allow them to increase that strength.

But you know, even if I have the short stack right now [a small quantity of chips], at this point, I am not very worried. [I: No?] It's happened to me so often to get back up ... No that's not true, it has happened to me a few times to get back up and win. (Player from the at-risk gambler group)

I did not lose to a hand where the guy had 4-2 [an opponent won the hand by forming a flush on the river]. It's for sure that I am a little disappointed, but at the same time, I played what I had to play so it's not a big deal. (Player #229 from the at-risk gambler group)

Overestimating one's chances of recuperating losses as mentioned in the first of the two quotations above relates to the erroneous belief known as "chasing losses" (Jacobsen et al., 2007). Players' beliefs that they can make up for their losses constitutes an illusion of control known as probability control, which is based on a poor comprehension of odds (Labrador et al., 2020; Toneatto et al., 1997). The minimization of a loss in the second quotation above constitutes an attribution bias. In that hand, participants began with a seemingly strong combination (ace-king), but the cards that appeared on the board at each round of the game (14% on the flop, 11% on the turn, and 0% on the river) decreased the probability of winning. To continue betting regardless of the small probability of winning was not a proper strategy. In this case, this strategy was a way to attribute one's loss to chance (the opponent's good cards) rather than to the player's own lack of skill (the poor decision to continue the hand after the flop). This type of reasoning is called interpretive control, a form of illusion of control in which wins are attributed flexibly to skill while losses are attributed to chance or other dispositions (Baboushkin et al., 2001; Mathieu et al., 2018; Toneatto et al., 1997). Minimizing the consequences of losses or of the players' own role in the loss as observed in the at-risk gambler group appears to protect their belief of their own personal skill level. Players might convince themselves that their personal skill level appears high enough to tolerate their losses while modulating their negative emotions and the associated negative consequences.

The online game is rigged

In the at-risk and problem gambler groups, a belief that the online game was rigged was mentioned.

To me, online poker is just an occasional replacement for when I can't play in person ... because I don't trust the poker software on the Internet. I find that the odds are higher. While certain hands are rarely seen in person, we see them often when playing online. So that's why I never play large amounts, I occasionally play in small online tournaments at \$1, \$3 maximum. (Player #235 from the at-risk gambler group)

I never have the impression that the cards are already set in advance. I don't have the impression that the cards to come are always the same. [I: What do you mean?] When I am playing, I always have the impression [...] that if I push, my ace could come out, more than if I had played in small bets, like now, if I pushed all-in.... Anyway, on the big poker sites, on *Stars*, *Tilt*, that's the impression I developed over time, that aggressive players are rewarded, and players that wait do not get them [the cards that they want]. I have come to think that they probably just want their tournaments to roll faster.... If the all-in always win, they come back into the game and it never ends, whereas if they get them out, it is beneficial for the game. The losers can go to another table, start a new game. (Player #132 from the problem gambler group)

Beliefs that the online game was rigged (non-random distribution of cards) were verbalized in the at-risk and problem gambler groups, although in a slightly different manner. In the at-risk group, the reported belief was that the odds were higher of getting strong hands (for example getting a flush happens more often on the Internet than is normally expected with chance). This belief is erroneous because the players' cards were generated randomly during the online tournament, and the belief seems to correspond to an incoherence between the participant's own belief of chance and actual results because of chance. This belief is an example of *gambler's fallacy* (a form of probability control), which consists of an incorrect comprehension of the independence of game events. The players who demonstrated this belief expected that the odds during a short game sequence would correspond to the same odds in the long term over a long game sequence (Fortune & Goodie, 2012). Their belief of chance rendered patterns incoherent, such as a series of strong hands that are played close to each other in time. The belief of higher odds of obtaining strong hands in online poker seemed to produce a detachment from the consequences of the loss and from the associated emotions. By attributing the loss to an external factor such as the non-random generation of the cards, players minimized their responsibility in the loss. This interpretation may aim to protect the players' sense of personal skill. According to this hypothesis, the belief of higher odds of strong hands in online poker could be a manifestation of an illusion of interpretive control known as flexible attribution. As mentioned previously, this type of erroneous belief influences players to attribute their wins to their personal skill and their losses to external or contextual factors (Baboushkin et al., 2001; Mathieu et al., 2018; Toneatto et al., 1997).

In the problem gambler group, the belief related to rigged online poker refers to the belief that it is possible to influence chance with one's actions. In the cited example above, player #132 stated, "When I am playing, I always have the impression [...]"

that if I push, my ace could come out, more than if I had played in small bets.” He mentioned that the cards obtained can vary depending on the amount of the bet made; the higher the bet, the higher the odds of obtaining strong cards. This belief underlies an overestimation of one’s personal capacity to influence the events of a game (*active illusory control*; Lambos & Delfabbro, 2007; Mathieu et al., 2018; Toneatto et al., 1997).

It was interesting to note that beliefs of a rigged online game were indicated after the loss at hand 3, while an opponent was completing his flush in an unexpected way on the river. Situations of unexpected loss—“bad beat” in poker slang—may possibly generate these kinds of erroneous interpretations.

To summarize, the main erroneous belief themes observed during the game were related to: (1) decisions, (2) decision-related elements, (3) strategies, (4) luck, chance, or skill, and (5) playing styles (see Table 4). The beliefs observed in the non-problem and the problem group were mainly based on 2 and 4, while those in the at-risk group were mainly based on 1, 2 and 4. The main sub-themes observed in the non-problem group were related to the player’s past experiences playing poker, emotions, and the opponent’s lack of skill. The sub-themes observed in the at-risk group were mainly related to cognitive reassurance, the opponent’s luck, and the feeling of playing a rigged game because of gambler’s fallacy. Those observed in the problem group were related to the frustration and anger caused by the opponent’s lack of skill, and the feeling of playing a rigged game because of the manipulation of chance by the opponent.

It is interesting to note that certain of the same themes and subthemes tend to repeat themselves in the three groups. The main difference therefore lies in the player’s emotional reaction to the events of the game, which is better illustrated in the sub-themes (i.e., anger and injustice in the problem group, but not in the at-risk or the non-problem group).

General discussion

The aim of this paper was to compare the specific erroneous beliefs of three unique groups of Texas Hold’em online poker players (i.e., non-problem, at-risk, and problem) as verbalized during game situations likely to generate negative emotions. When observing the erroneous beliefs reported in the three groups of gamblers, it appears clear that they are all related to illusions of control in one form or another (predictive, interpretive, probability, or active).

Erroneous beliefs relating to illusions of control

While the whole sample of participants was dealt the same sequence of cards, certain forms of illusion of control were noted in specific groups. This was the case for the illusion of predictive control, which was only noted in the non-problem group. Interpretive and probability control were identified in the three groups of gamblers.

Active control (i.e., making higher bets leads to stronger cards) was only observed in the problem gambler group. Those illusions of control were identified through the erroneous beliefs verbalized by the players in each group. Other studies have previously shown that online poker players tend to rely on more erroneous beliefs than other types of poker players (Dufour et al., 2015). Since the chosen modality of the poker game was online, the erroneous beliefs observed in the context of this study are effectively specific to the experience of online poker players and the context of an online poker game.

The intensity of the players' denial of the role of chance in the game, or a lack of questions about the influence of one's own skill on the outcome of the game appears to distinguish the erroneous beliefs of the at-risk and problem gamblers from those of the non-problem gamblers. While the non-problem gamblers sometimes appeared to feel that they had more control over the game's outcome than they did (e.g., "lucky hand"), the belief of control in the at-risk gambler group appeared stronger because of their belief that they could make up for their losses, as well as their interpretation of their losses as caused by factors other than their personal skill. Beliefs of a rigged online game (higher probability of strong cards) and that losses were because of their opponent's lack of skill as observed in the at-risk and problem gambler groups emphasize their denial of the role of chance in poker.

The importance of the perception of control over the game's outcome, or not questioning one's skill level with respect to gambling problem severity were also emphasized in the results of focus groups conducted with online poker players (no problem, at-risk, and problem; Brochu et al., 2015). The beliefs verbalized in the at-risk and problem groups, such as the importance of practice, acquiring knowledge, and learning from one's losses showed that these gamblers consider skill to be more important than non-problem gamblers, as the latter did not display this type of belief. In the at-risk and problem gambler groups, personal levels of skill appeared to be overestimated when compared to the non-problem group because of the belief that they could make up for their losses or that they had believed at one time that they could become professional poker players until they were confronted with evidence that this is not an easy feat. Beliefs resulting from significant denial of one's own lack of skill or control on the outcome of the game (e.g., cheating opponents or non-random generation of cards) were noted in the at-risk and problem gambler groups, but not in the non-problem group.

Erroneous beliefs and the integrity of online poker

At-risk and problem gamblers' beliefs related to the lack of integrity of the online game (e.g., non-random generation of cards and cheating opponents) as observed in both this inquiry and Brochu and colleagues' study (2015) raise certain questions. Although these beliefs were reported in a context in which cards were generated randomly, this type of fraud has been confirmed on certain poker websites. For example, online robots—virtual opponents with an artificial intelligence that can extract gains from consumers—were used on reputed websites such as PokerStars

and Full Tilt (Dance, March 13, 2011). Gamblers' doubts regarding the integrity of the game are therefore sometimes justified. Although PokerStars and Full Tilt were the most-visited websites by all three groups of poker players in this study, doubts concerning game integrity were only verbalized in the at-risk and problem gambler groups. Could it be possible that the frequency and intensity of these doubts are related to the presence of a gambling problem?

Alternative explanations to fraud and cheating were mentioned in the at-risk gambler group studied by Brochu and colleagues (2015) but were not mentioned in the problem gambler group. For example, concerning the idea that the odds of obtaining strong hands online are higher than the odds of obtaining such hands offline (which allows website operators to earn higher amounts of money at each pot), it was mentioned in the at-risk gambler group that this finding can be explained by the speed of the online game and the higher volume of hands played compared to an offline game. Such a determination was also the case for the number of bad beats observed in an online poker game, which can be explained by the tendency to remember unexpected or less probable game events more easily, as reported by the at-risk gambler group.

Considering these results, it seems that at-risk gamblers manifest more cognitive flexibility when interpreting their losses compared to the problem gamblers. Moreover, it is possible that attributing losses to the online game's lack of integrity as seen in the problem gambler group makes it difficult for these gamblers to question their own level of skill or the limits of their influence on the outcome of the game, which encourages them to continue playing.

Erroneous beliefs in clinical practice

When examining certain questionnaires for erroneous beliefs in poker players, it appears relevant to test additional items that better reflect the beliefs reported by the gamblers in this study to determine whether these items would help discriminate between poker players with and without gambling problems. Since poker is a popular online gambling activity, it appears relevant to add items assessing flexible attribution that target dispositions or circumstances that occur in this online game. Items such as "I do not trust online poker websites" or "When I play poker online, I sometimes feel that the cards are not generated randomly" could be tested. Considering the multi-player context in poker, it could be interesting to add an item that evaluates flexible attribution, such as "I sometimes think that my losses are caused by my opponents' lack of skill." Certain items that evaluate active illusory control also do not appear to be adapted to the reality of poker players. An item such as "I have a particular way of betting that allows me to increase my chances of winning" could assess active illusory control more adequately in poker players.

Different items in gambling questionnaires measure illusory correlations (*predictive control*), but none assess the lucky hand concept reported in the non-problem gambler group of this study. Rather, there are general items that assess gamblers'

capacity to predict upcoming results rather than an example of *illusory correlation* that can occur at poker (i.e., GBQ: “I am pretty accurate at predicting when a ‘win’ will occur”). An item such as “In my experience, certain hands that are not necessarily associated with high odds of winning are favorable to me” could be tested.

Many questionnaire items assess the idea of chasing one’s losses in gambling (GBQ: “If I continue to gamble, it will eventually pay off and I will make money”; GABS: “If I lose, it is important to stick with it until I get even”). If the common language of poker players as observed in this study was used for questionnaires, an item such as “Even if I have a small stack, it is O.K. because I know that I can catch up” could be used specifically with poker players. All the aforementioned recommendations still hold relevancy at the time of publication, considering the fact that those questionnaires still hold a reasonable amount of use in clinical assessment to this day (Bücker et al., 2019; King & Whelan, 2020; Mestre-Bach et al., 2020).

Erroneous beliefs revealing a high degree of denial of chance were observed when gamblers faced unexpected losses. As stated by Griffiths and colleagues (2010) and Moreau (2016; 2020a), tilt (i.e., frustration associated with the impression of experiencing an injustice because of chance) often occurs after an unexpected loss. Research concerning negative emotions and perceptions in the context of unexpected losses could allow for further understanding of the erroneous beliefs of poker players.

Considering these results, prevention and treatment strategies aiming to help gamblers reflect on their level of skill, use of strategy, and the limits of their influence on the game’s outcome could be beneficial since poker, compared to other gambling activities, partly relies on skill, which can emphasize erroneous beliefs in players. In poker, beliefs related to the roles of skill and chance can be evaluated within the game session in which they manifest. In online poker, erroneous beliefs related to the integrity of the online poker game (other player’s practices, whether the website is rigged, etc.), which tend to be a motivator to chase losses and continue playing, should be explored in cognitive restructuring. Supporting gamblers in their interpretation of game situations could also be an interesting option for restructuring erroneous beliefs.

Study’s strengths and limitations

The main strength of the present study is that the erroneous beliefs were expressed in real time by the participants as they are playing. Those beliefs, because of this fact, can be considered “hot” beliefs. This term refers to the way players react to events in the context of a gambling activity (David et al., 2002; Smith et al., 1993; Simon et al., 2015).

The study also has several limitations that should be considered. Despite the depth of information gathered in this study, the intrusive nature of the thinking aloud method (Dickerson & O’Connor, 2006) could have influenced the results. Indeed, the findings

depended on participants' ease at verbalizing their thoughts and their capacity to do so while playing (Delfabbro & Winefeld, 2000). Certain verbalizations were limited to descriptions of behaviours during the game rather than explanations of the causes that preceded or justified them (Walker, 1992) and thus, were of little relevance for analysis. The administration of instruments via telephone is also a notable limitation to the study since it opened the possibility of bias in the answers reported by the participants. In addition, conclusions are limited by the challenge to establish a consistent gambling experience across participants. Indeed, the individual choices inevitably modified the experience and could have altered verbal reports. Moreover, the number of game situations analyzed was limited, and the hands selected for analysis occurred at the beginning of the tournament. It is possible that, as the tournament progressed and the related emotions intensified, the end of the tournament may have constituted a relevant game sequence to analyze for the presence of erroneous beliefs.

A thematic analysis method also involves the risk of missing potential nuances or misinterpreting data. As with the subjective and reflexive nature of this method, the analyzed data therefore relied on the authors' choices and interpretations, which is a potential limit given the influence it has on the outcomes of the study if not carried out properly. Nevertheless, this method was chosen given the flexibility it allows and its overall ease of use with large data sets.

Participants were recruited between February 10 and September 8, 2010. Since the recruitment took place more than 10 years ago, this limitation must be considered when interpreting the results. Even if the division of players in three distinct groups allowed comparison despite small numbers, the sample of participants recruited for each group ($n=10$), does not adequately allow generalization. Nevertheless, given the frequency of erroneous beliefs observed in the present study, there is still a high probability that similar cognitive distortions take place in many other Texas Hold'em online poker players. Finally, despite the variety of recruitment techniques used, an insufficient number of pathological gamblers (endorsing five or more criteria on the NODS) were recruited. The results of the present study therefore only apply to gamblers who present subclinical levels of gambling problems.

Conclusion

The results of this study support the significance of erroneous beliefs in gamblers who play online poker, whether they have a gambling problem or not. The findings showed that at-risk and/or problem gamblers who play online poker tend to believe that their personal skill largely influences the game's outcome, such that the role of chance is denied. Doubts about the integrity of the online game, a preoccupation that has been documented in previous studies, was one of the erroneous beliefs specific to online poker demonstrated by these groups. The results of the present study support the implementation of protection measures for poker players so that they can play on websites that they trust. Moreover, pairing the erroneous beliefs emphasized in this study with items in questionnaires designed to evaluate these cognitions in poker

players allowed us to suggest new items that consider chance and skill, online practice, and slang used by poker players.

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