

Cognitive Distortions as a Component and Treatment Focus of Pathological Gambling: A Review

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The literature on the role of cognitive distortions in the understanding and treatment of pathological gambling (PG) is reviewed, with sections focusing on (a) conceptual underpinnings of cognitive distortions, (b) cognitive distortions related to PG, (c) PG therapies that target cognitive distortions, (d) methodological factors and outcome variations, and (e) conclusions and prescriptive recommendations. The conceptual background for distortions related to PG lies in the program of heuristics and biases (Kahneman & Tversky, 1974) as well as other errors identified in basic psychology. The literature has focused on distortions arising from the representativeness heuristic (gambler's fallacy, overconfidence, and trends in number picking), the availability heuristic (illusory correlation, other individuals' wins, and inherent memory bias), and other sources (the illusion of control and double switching). Some therapies have incorporated cognitive restructuring within broader cognitive-behavioral therapies, with success. Other therapies have focused more narrowly on correcting distorted beliefs, more often with limited success. It is concluded that the literature establishes the role of cognitive distortions in PG and suggests therapies with particularly good promise, but is in need of further enrichment.

Keywords: pathological gambling, cognitive distortions, cognition, heuristics and biases, cognitive behavioral therapy

Gambling-related pathology has been the focus of rigorous scientific investigation for approximately 30 years, a briefer span than the comparable history relating to other addictive disorders. The cognitive distortions associated with pathological gambling (PG)¹ have been a significant research focus during that entire history. The cognitive approach to PG was held as separate from other approaches during the early years (e.g., Ladouceur, Mayrand, Dussault, Letarte, & Tremblay, 1984), and more recently combined with other approaches, such as cognitive-behavioral models (Sharpe & Tarrier, 1993), biopsychosocial models (Sharpe, 2002), and integrated models (Blaszczynski & Nower, 2002). One useful definition of cognitive distortions is a state wherein "habitual ways of thinking function to support core beliefs and assumptions by generalizing, deleting, and/or distorting internal and external stimuli" (Yurica & DiTomasso, 2005, p. 118), and there is widespread agreement that cognitive distortions work to maintain the persistence of gambling despite negative outcomes (Jacobsen, Knudsen, Krogh, Pallesen, & Molde, 2007).

In the first section of this article we discuss conceptual underpinnings of the field, including Kahneman and Tversky's program of heuristics and biases. In the section following, we review the

state of the literature on the role of cognitive distortions in PG, including its relationship to the study of basic or "normal" cognition. Next we review current PG therapies that target cognitive distortions, with the aim of identifying the effectiveness of these treatments in relation to broader forms of cognitive-behavioral therapy. In the subsequent section on methodological factors and outcome variations, we discuss sample differences (i.e., sample size, gender, and age) and treatment differences (i.e., group vs. individual therapy and hours in therapy) that may account for outcome variations between studies. In the final section we draw conclusions regarding the current state of the literature and make prescriptive suggestions for future research directions.

The Conceptual Underpinnings of Cognitive Distortions

History and Background

The research tradition of *judgment and decision making* (JDM) has profoundly informed the study of cognitive distortions in PG. JDM is a hybrid subdiscipline of cognitive psychology, social psychology, economics and business. Judgment refers to a cognitive belief, often about a probability, such as *I believe there is a heightened probability the ball of this roulette wheel will land in a black slot*. Decision making is the process of determining choice behaviors, largely but not entirely on the basis of probability judgments. For example, a gambler who forms the judgment that

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¹ We use "PGs" to refer to pathological gamblers, "NPG" to refer to "nonpathological gambling" and "NPGs" to refer to "nonpathological gamblers."

a black slot is more likely may, therefore, make the decision to bet on black.

The literature of cognitive distortions in PG is particularly influenced by the JDM theories of the psychologists Daniel Kahneman and Amos Tversky, whose *prospect theory* (Kahneman & Tversky, 1979) and extensive research program on *heuristics and biases* (e.g., Kahneman, Slovic, & Tversky, 1982) remain cornerstones of the field, and were the basis of Kahneman's being awarded the Nobel Prize in economics in 2002. Prospect theory is a comprehensive theory of decision making, which rests on pillars that have upheld decision theory for centuries: that decisions made under uncertainty can lead to more than one possible outcome, and that the overall value of a decision is a function of the value of each possible outcome (how good or how bad it is) and the likelihood (or probability) of each possible outcome. As an example of these concepts interacting, it is an acceptable risk to eat a tuna sandwich that might give you food poisoning, if the likelihood of food poisoning seems low enough, and the likelihood that you'll simply enjoy the sandwich seems high enough. Similarly, it is worthwhile to buy a lottery ticket that will probably cost a dollar and win nothing, if the amount to be won, while unlikely to arrive, is high enough. In resting on these basic concepts, prospect theory follows the tradition of its predecessors, the classical expected value theorem of Bernoulli (1738/1954), and the expected utility theory of von Neumann and Morgenstern (1944).

The program of heuristics and biases began earlier in Kahneman and Tversky's output (e.g., Kahneman & Tversky, 1974) and addresses itself to the portion of the decision process that involves probability judgment, or how people arrive at their assessments of uncertain probabilities. Occasionally one is told precisely the likelihood of success, for example on the back of a lottery ticket, but in many situations one must infer relevant probabilities from other information, and heuristics and biases address the process of arriving at such judgments. Probability assessment is also the part of the decision process whose pitfalls dominate the literature of cognitive distortions in PG, and many of the errors claimed in pathological gambling come directly from the program of heuristics and biases.

Assessing the probability of an uncertain event when the probability isn't simply provided is often sufficiently complex, that in the view of most theorists from a variety of perspectives, perfect performance should not be expected from human minds. Which pieces of information to use and which model to use in integrating them are complex decisions in themselves, and the optimal solution depends on the availability of information, the extent to which various models' assumptions are met, the content domain of the question, and so on. It has long been clear to psychologists and philosophers that optimal probability assessment is not feasible for humans (Simon, 1957), and may not even be possible in principle, on the grounds that the problem to be solved may sometimes be infinitely complex (Cohen, 1981; Goodie, Ortmann, Davis, Bullcock, & Werner, 1999). The principle of bounded rationality, a term coined by Herbert Simon (1957, also a Nobel Prize winner in economics), asserts that humans lack the ability to perform the complex computations that certain problems require.

As such, people have developed strategies for making decisions that maximally utilize the cognitive resources and abilities that they have, and act in an "intendedly rational" way (Simon, 1957). Oaksford and Chater (1992) supported this concept by arguing,

"Our rationality could be questioned only if we were capable of using the optimal strategy but failed to do so. Thinking otherwise is akin to condemning us because we do not fly even though we do not possess wings" (pp. 226–227). The biological underpinnings of decision processes remain largely unknown (Fellows, 2004), although processes have been posited that locate "cold" rational processing largely in cortical regions such as ventromedial frontal cortex (e.g., Fellows, 2006), and "hot" emotional processes in limbic structures such as the amygdala (e.g., Muramatsu & Hanoch, 2005). The evolutionary imperative of maximizing behavioral fitness within biological constraints has long been recognized (Cosmides & Tooby, 1994), and evolutionary approaches to decision making have made major advances in elucidating these processes (e.g., Camerer, 1999; Kenrick, Li, & Butner, 2003).

The Program of Heuristics and Biases

In their model of human judgment, Kahneman and Tversky (1973) proposed that people use *heuristics*, or cognitive shortcuts, which return probability estimates that come close to the correct answer much of the time, and do so in an amount of time that is compatible with the demands of real life. There are two basic disadvantages of using a heuristic instead of an optimal solution. First, there may be no heuristic-based assessments that are precisely correct, even if returned values are typically close to the correct value. Second, the errors might sometimes be severe. Furthermore, the relatively severe errors can be systematic, occurring in regular patterns, and these patterns of errors are dubbed the *biases* of the program. Systematic errors are predictable if the heuristics from which they arise are well understood, and might, therefore, be open to exploitation. When compared with the infeasibility of optimal models, however, the shortcomings of heuristics appear acceptable, and a heuristic that gets close to the right answer most of the time, and does so quickly, is a useful tool.

One of Kahneman and Tversky's principal tactics in the program of heuristics and biases was to use the biases to infer the heuristics. It is difficult to directly ascertain the thought processes that people use, but if their judgments produce systematic errors, these can be the basic data to inform theories of the heuristics that lead to them. Using this approach, Kahneman and Tversky (1974) elucidated three heuristics. One is *representativeness*, according to which an event is judged likely to be drawn from a particular class, to the extent it resembles (or is representative of) a typical member of that class. An example of the representativeness heuristic involves individuals guessing the occupation of a hypothetical character after receiving information about that person's personality traits and interests. When making this type of judgment, an individual is likely to rely on the degree to which the stated personality traits and interests align with certain occupations, and to ignore how common or rare those occupations are in the population, even though both are relevant considerations. For example, there are more public school teachers than professional football players who are thrill seekers, even though thrill-seeking is more typical of football players, simply because there are so many more teachers than NFL players. As the common advice to medical students has it, "When you hear hoofbeats, think horses, not zebras." In other words, when a patient has symptoms that are consistent with either of two diagnoses, one more common than the other, the doctor should be predisposed to make the more common diagnosis, per-

haps even if the symptoms are slightly more representative of the rarer disease. Yet many individuals attend primarily to the representativeness of the description to a class, neglecting to consider how common or rare the class is.

Kahneman and Tversky (1973) explored this phenomenon with three experimental groups, including a base-rate group, similarity group, and prediction group, who made judgments regarding a list of nine graduate school fields of study. Participants in the base-rate group assessed how common each of nine fields was among first year graduate students, without relating the rates to any individual. The similarity group was given a personality description of an individual named Tom W., and asked how similar his personality was to the typical personality for the same nine fields. Finally, the prediction group was asked how likely it was that Tom W. was in each of the nine fields. The results suggested that the perceived likelihood of being in a field was virtually indistinguishable from the perceived typicality for the field, reflected in correlations between the similarity and prediction assessments of .97. Indeed, the prediction group's responses correlated negatively with both objective base-rates and the average responses of the base-rate group.

The second heuristic is *availability*, according to which an event is deemed more likely to occur if it is easier to recall from memory, or in other words is more available in memory. For example, when judging the frequency of causes of death, individuals have been shown to inflate frequencies for causes to which they have had more exposure, such as through the direct exposure to the death of an acquaintance or the indirect exposure through media coverage (Lichtenstein, Slovic, Fischhoff, Layman, & Combs, 1978). In a study by Combs and Slovic (1979), participants' estimates of death due to particular causes were biased to exaggerate causes that are frequently covered in newspapers. For example, stomach cancer was underestimated, and catastrophic events like tornadoes were overestimated, as causes of death. Applying the availability heuristic to a gambling context, if each instance of winning a lottery is easier to recall than each instance of buying a losing ticket, either in one's own experience or in media accounts of other players' patterns, then the probability of winning will be overestimated.

The third heuristic is *anchoring and adjustment*, according to which an assessment is set to an initial value (which might be well-founded, or might rest on the flimsiest of evidence), and then adjusted in response to additional information. The adjustment is typically less than is warranted by the strength of the new information, which is especially problematic when the original estimate (the "anchor") is faulty or based on weak evidence. This heuristic is invoked in gambling-related contexts considerably less than either representativeness or availability.

Importantly, there is an implied balance between positive and negative aspects of the heuristics and biases program. The heuristics are conceived as adaptive and useful tools, which purchase the ability to make effective decisions in real time, albeit at the expense of frequent minor errors, as well as more severe and systematic biases occasionally. The biases constitute the negative aspect of the program, pointing out systematic errors that most people make. The research and rhetoric that emerged over time from the program did not succeed in maintaining its intended balance, as the focus turned decidedly to exploring the negative aspects of the biases. This may have occurred because the errors

constituted the primary data in support of the heuristics, which were taken to be latent, or because the errors and biases proved appealing to researchers, who went about exploring the known errors and adding to their catalog at an intensive pace. The appeal of the biases for researchers extended to many domains beyond basic JDM, including its application to PG.

As the program of heuristics and biases took on a negative cast, it drew criticism on these grounds from many quarters, including social psychology (Gigerenzer, 1991), cognitive psychology (Oaksford & Chater, 1992), philosophy (Cohen, 1981), and evolutionary psychology (Cosmides & Tooby, 1992). Criticism has also been raised on the grounds that the heuristics are drawn broadly enough to postdict any pattern of data that might emerge. For example, representativeness might lead one to believe black is more likely than red following red-red-red-red, as the 80% red of the sequence red-red-red-red-black is closer to the representative figure of 50% than is the 100% red of the sequence red-red-red-red-red; but availability could equally lead one to predict red following red-red-red-red, because more examples of red are available in recent memory. And in fact both patterns have been observed and named. The former is commonly called the *gambler's fallacy* (described in further detail below); the latter is termed the *hot hand* phenomenon (Gilovich, Vallone, & Tversky, 1985). One analysis (Ayton & Fischer, 2004) posits that individuals attribute positive recency to human performance, resulting in the hot hand fallacy in human-made domains, and attribute negative recency to natural events, resulting in gambler's fallacy in natural domains. As another example, if new information is given too little weight when integrated with an existing belief, this is a primary example of anchoring and adjustment, but if new information is given too much weight, this is referred to as base rate neglect (Bar-Hillel, 1981; Case, Fantino, & Goodie, 1999; Goodie & Fantino, 1996), an error that is thought to result from representativeness.

Cognitive Distortions Related to Pathological Gambling

The cognitive distortions that have been implicated as relevant for understanding the etiology and treatment of PG rest to a considerable degree on the biases that were identified by Kahneman and Tversky, and by those who followed them, and also on other probability judgment errors in the literature. In this section we describe the most prominent of these distortions and the evidence from basic psychology supporting them. We divide this section into three parts: distortions based on the representativeness heuristic, distortions based on the availability heuristic, and distortions not based on the heuristics and biases program. This organization is also reflected in Table 1, which summarizes the distortions under discussion. We aim to review the literature of cognitive distortions thoroughly, but we do not claim that these biases are the only relevant ones. Additional biases, which remain undiscovered or whose relevance to PG remains unheralded, may well exist. Indeed, one of our prescriptive conclusions is that further research should be devoted to discovering additional relevant biases.

Table 1
Common Heuristics and Associated Cognitive Distortions

Common heuristics	Distortions derived from heuristics
<p>Representativeness: An event is judged likely to be drawn from a particular class, to the extent it resembles (or is representative of) a typical member of that class.</p>	<p><i>Gambler's Fallacy:</i> When events generated by a random process have deviated from the population average in a short run (for example, when a roulette ball has fallen on a red slot four consecutive times), individuals may erroneously believe that the opposite deviation (in the example, a black winner) becomes more likely (Tversky & Kahneman, 1971).</p> <p><i>Overconfidence:</i> Phenomenon wherein individuals express a degree of confidence in their knowledge or ability that is not warranted by objective reality (Koriat, Lichtenstein, & Fischhoff, 1980).</p> <p><i>Trends in Number Picking:</i> Lottery players commonly try to apply long-run random patterns to short strings in their picks, for example, avoiding duplicate numbers and adjacent digits in number strings (Rogers & Webley, 2001; Haigh, 1997; Holtgraves & Skeel, 1992).</p>
<p>Availability: An event is deemed more likely to occur if it is easier to recall from memory, or in other words is more available in memory.</p>	<p><i>Illusory Correlations:</i> Individuals believe that events they expect to be correlated, due to previous experience or perceptions, have been correlated in current experience, even when they have not been (Chapman & Chapman, 1967; Ladouceur, Mayrand, Dussalut, Letarte, & Tremblay, 1984).</p> <p><i>Availability of Others' Wins:</i> When individuals see and hear fellow gamblers winning, it fosters a belief that winning is a regular occurrence and reinforces the belief that they will win if they continue to play (Griffiths, 1994).</p> <p><i>Inherent Memory Bias:</i> Individuals' memory is biased to recollect wins with greater ease than losses. This interpretive bias allows gamblers to reframe their memories regarding gambling experiences in a way that focuses on positive experiences (wins) and disregards negative experiences (losses), facilitating the rationalization of a decision to maintain their gambling behaviors (Walker, Skowronski, & Thompson, 2003; Wagenaar, 1988).</p>
<p>Anchoring and Adjustment: An assessment is set to an initial value and then adjusted in response to additional information.</p>	<p><i>No associated gambling distortions discussed</i></p>
<p>Additional distortions not derived from heuristics</p>	<p><i>Illusion of control:</i> An expectancy of a personal success probability that is higher than the objective probability should warrant (Langer, 1975; Goodie, 2005).</p> <p><i>Switching and Double Switching:</i> Individuals recognize errors and process gambling related situations in a rational way when they are not actively participating, but that they abandon rational thought when they personally take part in a gambling game (Sévigny & Ladouceur, 2003).</p>

Distortions Derived From the Representativeness Heuristic

Gambler's fallacy. When events generated by a random process have deviated from the population average in a short run (e.g., when a roulette ball has fallen on a red slot four consecutive times), individuals may erroneously believe that the opposite deviation (in the example, a black winner) becomes more likely. This false belief is called the *gambler's fallacy*, and common expressions of it include that black "is due" or that the odds must "even themselves out." This effect was first noted by Tversky and Kahneman (1971), and interpreted in terms of the representativeness heuristic (Kahneman & Tversky, 1973). According to this account, people expect all randomly generated sequences, even very short sequences, to reflect the long-run characteristics of the random process that generated them. For example, even short sequences of coin flips might be expected to land half heads and half tails. Short sequences that meet this criterion are deemed as more representative and hence more likely. For example, the sequence red-red-red-red-black is closer to half red than the sequence red-red-red-red-red, so that following four consecutive red rolls, a black roll is falsely deemed to be more likely than a red roll.

A similar conclusion is reached by using the Gestalt principle of "grouping" (Roney & Trick, 2003): any grouping that is subjectively salient to an individual is deemed likely to the extent that it reflects the long-run characteristics of the random process. It is also clearly reflected in the classic Zenith Radio Experiments

(Goodfellow, 1938), in which participants generated random sequences that alternated more frequently than would occur by chance, a bias that generates more short sequences that reflect the probabilities that are expected over the long run.

Although the gambler's fallacy can be observed in many contexts, not just those related to gambling, its applicability to gambling contexts is obvious. For example, it is a clear catalyst for "chasing losses," which is one of the 10 diagnostic criteria for pathological gambling and involves returning to try to retrieve past losses in subsequent wins by gambling with greater stakes, duration, or frequency.

Overconfidence. Overconfidence is a phenomenon wherein participants express a degree of confidence in their knowledge or ability that is not warranted by objective reality. For example, participants may answer many trivia questions, assessing their degree of confidence in each answer, typically in percentage terms. At the end of the study, it may be found that the average expressed confidence exceeded the proportion of questions that were answered correctly (Koriat, Lichtenstein, & Fischhoff, 1980). Individuals have been found to be particularly overconfident when expressing very high confidence. In one study (Fischhoff, Slovic, & Lichtenstein, 1977, Experiment 1), participants expressed certainty, or 100% confidence, in 20% of their answers, but achieved only 83% accuracy on those items. In other studies in the same article, when participants thought they were 100 times more likely to be right than wrong (100:1 odds), they were right only four

times as often as they were wrong. When they thought they were a million times more likely to be right than wrong, they were only 20 times more likely to be right. Overconfidence has been demonstrated to be positively correlated with PG (Goodie, 2005; Lakey, Goodie, Lance, Stinchfield, & Winters, 2007; Walker, 1992), and also with sensation seeking in financial trading (Grinblatt & Keloharju, 2009).

Trends in number picking. Lottery players commonly try to apply long-run random patterns to short strings in their picks. Individuals are less likely to play the lottery with numbers that were previously matched winners (Rogers & Webley, 2001), and avoid lottery choices that include duplicate numbers (Holtgraves & Skeel, 1992), evidently because both of these would lead to short-run violations of long-run expectations. It has been argued that people prefer to choose number strings that do not contain adjacent digits, but rather contain separation between digits. This hypothesis is supported by data from the U.K. national lottery: when the separation between winning lottery number strings was greater than the average value, the number of winners splitting a jackpot far exceeded the predicted number of winners. Conversely, when the amount of separation between lottery number strings was less than the expected value, the number of winners splitting the jackpot was less than the predicted number of winners (Haigh, 1997).

Cognitive Distortions Derived From the Availability Heuristic

Illusory correlation. In illusory correlation, participants believe that events they expected to be correlated, due to previous experience or perceptions, actually have been correlated in recent experience, even when they were not. For example, when participants view many pairs of words in random combinations, they believe that “bacon” was paired most often with “eggs,” and “lion” was paired most often with “tiger,” even though these pairs were not presented any more often than, for example, “eggs” and “tiger” (Chapman & Chapman, 1967). Similarly, psychiatrists believed that particular preconceived responses to Rorschach inkblot tests were positively associated with male homosexuality, even though no such correlation existed (Chapman & Chapman, 1969).

Relating this phenomenon to PG, the common belief among PGs that personal luck can impact chance outcomes represents an illusory correlation, in which individuals create unjustified associations between two unrelated variables (Petry, 2004). Gamblers may have behavioral superstitions in which they associate certain habits with positive gambling results, cognitive superstitions in which they associate specific thought processes with winning, or talismanic superstitions in which they associate good luck charms with winning (Toneatto, 1999a). Indeed, money and time spent gambling correlate with gamblers’ perceptions about luck and superstition, and PGs have been shown to endorse such superstitious beliefs to a greater degree than nonpathological gamblers (Joukhador, Blaszczyński, & MacCallum, 2004). Furthermore, gamblers have distinct and separable concepts of chance, skill, and luck, finding luck to be of the greatest importance, followed by skill, and then by chance (Wagenaar & Keren, 1988). Gamblers may see luck as an internal, personal trait that can alter “chance” outcomes in a positive way (Keren, 1994; Ladouceur et al., 1984; Wagenaar & Keren, 1988; Wohl & Enzle, 2002).

The availability of other people’s wins. Casinos typically place slot machines in close proximity of each other, which may merely reflect a design of convenience, but which also taps into gamblers’ use of availability. When individuals see and hear fellow gamblers winning on nearby slot machines, it allows them to believe that winning is a frequent occurrence and reinforces the belief that they will win if they continue to play (Griffiths, 1994).

Additionally, media coverage is clearly slanted to highlight gambling winners. In the arena of the lottery, winners receive considerable attention, whereas the typical loser receives no media coverage at all (Griffiths, 1994; Wagenaar, 1988). The same may be speculated with regard to the more recent phenomenon of televised poker. Coverage invariably emphasizes the late rounds of play, or the early round play of those few who advance very far in the tournament, to a greater extent than the vastly larger population of entrants who fail to advance to the late stages.

Inherent memory bias. There is evidence that individuals’ memory is biased to recollect wins with greater ease than losses. For example, people are generally more likely to remember pleasant experiences than unpleasant ones (Walker, Skowronski, & Thompson, 2003), and it has been posited that this may contribute to individuals more easily recalling their winning gambling experiences than their losing gambling experiences (Wagenaar, 1988). Relatedly, the degree of a gambler’s optimism is positively related to the degree to which the gambler overestimates the success of past gambling experiences (Gibson & Sanbonmatsu, 2004). According to Rachlin (1990), gamblers may remember a greater proportion of their wins than their losses because of the way in which they store their memories of gambling experiences. Rachlin proposes that gamblers store the combination of wins and losses in a string, and then assess the string after a win occurs, at which point the system is reset. Using this approach, a string of numerous losses followed by one win may be viewed more as a success than it otherwise would because it appears as vague string of losses, followed by a vivid win that remains salient partly because it is the most recent element of the string.

In the gambling literature, erroneous conclusions related to remembering wins better than losses have been referred to as *interpretive control*. Interpretive control, which includes both attributional and memory biases, is one of five categories of cognitive distortions that have been identified in association with heavy gambling (Toneatto, Blitz-Miller, Calderwood, Dragonetti, & Tsanos, 1997), and which have been shown to account for a moderate amount of variance (18%) in measures of pathological gambling (Raylu & Oei, 2004). Interpretive bias allows gamblers to reframe their memories regarding gambling experiences in a way that focuses on positive experiences (wins) and disregards negative experiences (losses), facilitating the rationalization of a decision to maintain gambling behaviors.

Cognitive Distortions Not Derived From Heuristics and Biases

Illusion of control. The illusion of control was first characterized by Langer (1975), who described the phenomenon as “an expectancy of a personal success probability inappropriately higher than the objective probability should warrant” (p. 311). In one of the five original experiments, workers in an office could buy a \$1 lottery ticket for a chance to win \$50. After agreeing to

play in the lottery, in one condition participants were allowed to choose their own ticket; in the other condition the experimenter handed the participants a ticket. Later, when asked to sell their ticket to another person in the office, those who were assigned a ticket were willing to sell it for approximately \$2, but those who choose their own ticket demanded almost \$9 on average. In fact, this value was obtained only after participants were forced by the experimenter to assign a value to the ticket; at first, most participants in this condition indicated that they simply would not sell their ticket. In a more recent study (Rudski, 2004), participants were again less willing to part with lottery tickets on which they chose the numbers, rather than those with randomly generated numbers or tickets that had been found. These results suggest that people assign greater value to their own choices than the choices of others or random events, even when the probability of success clearly is not affected by the opportunity to choose.

The role of perceived control has been demonstrated to bear significantly on PG, as PGs distinguish less between situations with and without control than do NPGs (Goodie, 2005), showing maladaptive betting patterns under both conditions whereas NPGs show more adaptive betting patterns when control is transparently absent. This decisional bias may mediate the positive association of PG with the personality trait of narcissism (Lakey, Rose, Campbell, & Goodie, 2008), and its negative association with mindfulness (Lakey, Campbell, Brown, & Goodie, 2007). This relationship between the impact of control and gambling pathology has been shown to hold among poker and other card players in particular (Lakey, Goodie, & Campbell, 2007), but not among lottery players (Goodie & Lakey, 2007).

Switching and double switching. Some research suggests that gamblers are able to recognize errors and process gambling related situations in a rational way when they are not actively participating, but that they abandon rational thought when they personally take part in a gambling game (Benhsain, Taillefer, & Ladouceur, 2004). Sévigny and Ladouceur (2003) refer to this as “double switching.”

In double switching, gamblers switch “. . . from a rational perception of gambling events (switch on) to a behavioral manifestation of irrational cognitions (switch off), and back on to a rational perception” (Sévigny & Ladouceur, 2003, p. 164). To investigate this concept, Sévigny and Ladouceur measured rational and irrational cognitions and behaviors that accompanied game play in 20 participants who played a modified video lottery terminal (VLT) game. They measured the rationality of cognitions with three questions that focused on feelings of control, strategic play, and chance versus skill. Irrational behavior was identified when participants sought superstitious strategies for winning, such as varying the location where they touched the VLT screen or the amount of time between touches. Seventeen of the 20 participants were rational thinkers prior to participating in the VLT game, 14 of those 17 then exhibited irrational thinking during game play, and four of those 14 returned to rational thinking strategies after game play.

Thus, most participants had rational thinking patterns prior to game play, and then moved toward more irrational thinking patterns during game play, and some even switched back to rational thought following game play. It should be noted, however, that the sample consisted of “occasional gamblers,” who generally had low South Oaks Gambling Screen (SOGS; Lesieur & Blume, 1987)

scores ($M = 0.2$), reflecting little gambling-related pathology. Given the positive relationship between cognitive distortions and gambling severity, it would be interesting to see whether these results would obtain in a PG sample.

Switching and double switching might arguably be viewed not as cognitive distortions, but as metacognitive information processing biases. That is, they may relate less to relatively lower-order processes of arriving at probability assessments, and more to higher-order processes of deciding whether those probabilities should be applied equally to the individual him- or herself as they should by a generalized other. For example, a gambler may know that a particular probability of winning is very low, and yet accept a bet with the belief that they will be lucky. The distinction is a significant one: individuals may have markedly different perspectives on their own behavior from an “inside” perspective than they have about others’ behavior from an “outside” perspective (Kahneman & Lovallo, 1993).

Pathological Gambling Therapies That Target Cognitive Distortions

Cognitive distortions have clear relevance for the treatment of PG: if pathological gamblers have fewer of the irrational beliefs that sustain disordered gambling, then they might reasonably be expected to have fewer gambling-related problems. For example, Gamblers Anonymous (GA) members with higher scores on the Gambling Related Cognitions Scale (GRCS; Raylu & Oei, 2004) are significantly more likely to relapse than those with low GRCS scores, and erroneous cognitions are a moderate predictor of whether a GA member would belong to a relapse or abstinent group (Oei & Gordon, 2008).

Clinical studies that focus on the correction of cognitive distortions often utilize a strategy referred to as cognitive restructuring (CR). In the CR method, therapists seek to help their clients realize that their gambling-related verbalizations may be based on irrational thoughts. This process can incorporate the thinking-aloud method (Gaboury & Ladouceur, 1989), alone or in combination with elements like problem solving training and relapse prevention (e.g., Bujold, Ladouceur, Sylvain, & Boisvert, 1994; Sylvain, Ladouceur, & Boisvert, 1997), and education on the concepts of randomness and the independence of chance events (e.g., Gaboury & Ladouceur, 1990; Ladouceur, Sylvain, Letarte, Giroux, & Jacques, 1998). Here we review several studies of the effectiveness of therapies that incorporate challenges to cognitive distortions, first those that are embedded in broader-based cognitive-behavioral therapies (CBT), then those that take challenging cognitive distortions as their central focus. Examining differences in therapeutic success between studies that utilize CR in CBT, those that use it in combination with other educational elements, and those that do not use CR at all, contributes to a fuller understanding of the significance of correcting cognitive distortions in PG therapies.

As is often the case when comparing several studies, multiple methodological differences are evident between studies, making it a challenge to determine which methodological differences are responsible for outcome differences that are observed. Following our overview of the studies, therefore, we will consider which of several methodological variables might be implicated in treatment effectiveness, including the size, gender, and age composition of

samples, group versus individual therapy, and total hours spent in therapy.

Approaches Based on Broad Cognitive–Behavioral Therapy

CBT is a widely used and much-researched treatment approach for PG that has frequently met with success, which in some cases has explicitly targeted cognitive distortions. A recent meta-analysis of CBT's effectiveness in treating PG concludes that the CBT is often successful, and that the positive effects of CBT can be seen as much as two years following treatment (Gooding & Tarrier, 2009). Specific therapies varied from study to study, a full listing of which can be found in the *Content of Treatment* section in Gooding and Tarrier (2009), but outcome measures such as gambling abstinence, frequency, and SOGS scores showed significant effect sizes at the 0- to 3-month follow-up, and collectively the 20 cited studies showed significant impact at that follow-up time. Additionally, when assessing pre- and posttherapy differences for treatment groups, there was an overall significant effect for the 13 studies that included a 6-month follow up assessment, for the six studies that provided a 12-month follow up, and for the three studies that included a 24-month or more follow up (Hedge's g 's of -0.58 , -0.40 , and -0.81 , respectively). The authors attempt to compare the significance of the various therapy techniques for the 0–3 month and 6-month follow ups, but the small number of studies using the same techniques gives pause in drawing firm conclusion. Gooding and Tarrier (2009) do not specifically address the impact of therapies that utilize the CR technique. In light of the small number of studies incorporating CR, this was appropriate.

When utilizing a thinking-aloud approach in a therapy setting, the irrational verbalizations of the patient or of a character in a vignette are discussed, analyzed, and corrected by either the patient or the therapist. In some cases, the patients are responsible for distinguishing between their own rational and irrational verbalizations and then correcting a minimum percentage of the irrational verbalizations before the treatment can be terminated. For example, Bujold et al. (1994) required that their clients correctly identify and modify 80% of irrational verbalizations. In other cases, the therapist simply points out which of a patient's verbalizations are erroneous or inadequate (e.g., Ladouceur et al., 1998; Sylvain et al., 1997). These methods have resulted in some success, at least on a small scale over short periods of time. After completing these types of therapy, patients have reported having greater control over their gambling and less severe gambling behavior (Bujold et al., 1994; Ladouceur et al., 1998; Sylvain et al., 1997), as well as a decreased urge or desire to gamble, and a coinciding reduction in the number of DSM criteria met (Ladouceur et al., 1998; Sylvain et al., 1997). For these studies, the benefits from treatment were still present during follow-up evaluations from 6 to 9 months posttreatment. However, it is difficult to judge the specific impact of cognitive restructuring in these treatments, as it was used in combination with other therapy elements such as problem solving training and relapse prevention.

Echeburúa, Báez, and Fernández-Montalvo (1996) investigated the success rates of treatment-seeking PGs who were assigned to four groups: individual treatment focusing on stimulus control and response prevention, Group CR, a combination of both the indi-

vidual and group treatment, and a wait-listed control group. The group therapy condition is of particular interest because those individuals received education about cognitive distortions, including the illusion of control and gamblers' memory bias for wins, which makes them distinct from both the individual treatment group, who received no such education, as well as the combined treatment group, who received the cognitive distortion education in addition to the individual treatment protocol. The combined success rate across the three treatment conditions (59%) was significantly better than that of the control (25%) at the 6-month follow up period.

Interestingly, the outcome of the individual treatment was superior to that of all the other groups, as indicated by greater success rates at the 6- and 12-month follow-ups. Although the group treatment condition showed 6-month success that is fairly comparable to that of individual treatment (62.5% and 75%, respectively), the individual treatment condition showed a greater advantage over the group treatment condition at 12 months (68.8% compared to 37.5%). While the individual therapy condition received 6.5 hours of treatment and the group therapy condition received 6 hours of treatment, the combined treatment condition received 12.5 hours over the same 6-week period. The authors suggest that when using a complex treatment plan, like the combined therapy, a simple extension of the number of treatment hours may not be sufficient to produce the desired results.

We note the authors of this study used a rather strict and nonstandard definition of therapeutic success, which was gambling abstinence that could include no more than two incidents of gambling during the entire 12-month follow-up period, combined with gambling expenditure that could not exceed the weekly amount spent by the individual pretreatment. While the authors use both the SOGS and the *DSM-III-R* scores as part of the participant inclusion criteria, and even note that the SOGS was the "central measurement of the seriousness of gambling pretreatment" (p. 59), the posttreatment SOGS and *DSM-III-R* scores are not reported. Posttreatment DSM scores would have provided a more concrete measure of therapeutic success, although as SOGS reflects the lifetime severity of gambling, the exclusion of these scores is understandable. Additionally, the ability to assess the effectiveness of CR that focuses on education about cognitive distortions is confounded by the fact that CR was included only in a group therapy setting, which may be less effective, as we shall argue at greater length.

Correcting Distortions Outside a CBT Context

In a study by Ladouceur et al. (2001), the only intervention provided was treatment to correct erroneous cognitions and informing individuals of relapse prevention techniques. The cognitive intervention involved skilled therapists administering individual sessions wherein participants were educated about the inability to control random events and the inability to predict the outcome of independent events. In essence, they taught participants to avoid falling victim to the gambler's fallacy and the illusion of control. During these sessions, the therapists also taught the participants the difference between rational and irrational thoughts pertaining to gambling, and how irrational thoughts may be identified and corrected. Those in the treatment group attended up to 20 weekly sessions of 60-min duration ($M = 11.03$ hours of treatment), at the

end of which 86% of the individuals were no longer classified as PGs, as based upon the *DSM-IV* criteria. In comparison, only 14% of the individuals in the control group were no longer classified as PG at the end of the term. The treatment group also displayed significant posttreatment improvement on three other gambling-related dependent variables including the perception of control, the desire to gamble, and self-efficacy perception. These therapeutic benefits remained apparent at both a 6- and 12-month follow-up assessments, with 100% of the 6-month follow-up sample ($n = 31$) still maintaining NPG status and 89.2% of the 12-month follow-up sample ($n = 28$) maintaining NPG status.

Another study by Ladouceur and colleagues (2003) used the same methodology as Ladouceur et al. (2001) with the exception of administering the treatment in a group therapy setting as opposed to individual sessions. Those receiving group therapy participated in 10 2-hr sessions, at the end of which 88% of the individuals were no longer classified as PGs. In comparison, only 20% of individuals in a control group were no longer classified as PGs at the end of the term. The beneficial effects of treatment remained apparent at follow-up sessions of 6, 12, and 24 months, with more than two thirds of patients not returning to PG status at all three intervals. Of concern, and in contrast to the earlier (2001) Ladouceur et al. study, the treatment group in the Ladouceur et al. (2003) study did not significantly differ from the control group at the end of treatment in desire to gamble or frequency of gambling, even as those receiving treatment showed higher levels of perception of control and self-efficacy. The similarity in gambling frequency between the treatment and control groups despite the large discrepancy in percentage of PG identified within each group posttreatment (12% vs. 80%, respectively) is somewhat perplexing, but it is important to realize that gambling pathology is not based primarily on gambling frequency but on the degree to which gambling behaviors are maladaptive. If being educated on statistical concepts did not cause those in the treatment group to have a lesser desire to gamble or to gamble less frequently, and indeed led to a greater perception of control and self-efficacy in relation to gambling, then it may be reasonable to fear later relapse, although results were good at 24 months.

Other studies have reported less successful outcomes. In order to compare the effects of CR with other types of therapy, Toneatto and Gunaratne (2009) investigated treatment outcomes of four types of therapy: Cognitive therapy (CT) with the goal of correcting irrational beliefs such as the illusion of control, behavior therapy (BT) in which the patient is expected to make lifestyle changes to avoid gambling behaviors and develop constructive ways of handling urges, motivational therapy (MT) that fosters changes in gambling behaviors by enhancing a patient's motivational state, and minimal intervention (MI) in which patients received only a brief 90-min therapy session and a guidance booklet. The more intensive types of therapy—CT, BT and MT—included six individual sessions over an 8- to 10-week period. No significant group differences emerged among the treatment groups in outcome measures, with all of the treatments resulting in marginal effects, including a 50% reduction in gambling frequency from pre- to posttreatment and a 38% decrease (from 81% to 43%) in the number of participants meeting the *DSM-IV* diagnostic criteria for PG.

Surprisingly, even though CT was focused on correcting cognitive distortions in gamblers, the group receiving CT performed

no better than the other treatment groups on the Gambling Cognition Questionnaire (GCQ; Toneatto, 1999b) during posttreatment or 12-month follow-up assessments. Of the eight items measured on the GCQ, the CT group showed marked improvement only in the categories of chasing losses and gut instincts, and in fact, the group receiving the MI showed the greatest score change on the GCQ, with marked improvement in seven categories. However, because the GCQ is only one of many instruments used to measure cognitive distortions, and one with relatively slender published validation, we believe it would be injudicious to rely too heavily on it as a measure of therapeutic success. While the CT group did not exhibit results on the GCQ that were superior to those in the other treatment groups, the CT group did exhibit a decrease in gambling frequency and severity that was equivalent to the other treatment groups. Toneatto and Gunaratne conclude that CT focused solely on correcting cognitive distortions may not be an adequate means of treatment for pathological gamblers, but because of its reasonable success in the primary goal of reducing PG symptoms, we find that CT focused solely on correcting cognitive distortions offers benefits, even as these may be fruitfully augmented by treatment components that address other aspects of PG.

One final treatment approach to consider is math-based interventions. Because cognitive distortions are rooted in inaccurate beliefs about statistics and how statistical concepts apply to gambling, Williams and Connolly (2006) investigated the effectiveness of an intervention composed purely of mathematical education, without any other therapeutic elements. They compared a group of students that received specialized gambling-specific statistics education, with groups of students in other math or nonmath classes. Students are a robust population for distortion intervention, as 50% of students in an Introductory Statistics course endorsed the gambler's fallacy in a task of picking football games' winning teams (Riniolo & Schmidt, 1999).

Those in the intervention group received statistics lectures and additional class materials that focused more on gambling probabilities, as well as common fallacies associated with gambling. At the conclusion of the semester, the intervention group demonstrated superior understanding of gambling-related probabilities and was less likely to endorse gambling-related fallacies. However, this statistical knowledge did not transfer to gambling behaviors, as those in the intervention group did not show a change in their attitude toward gambling, the amount of time and money spent gambling, or degree of gambling severity, assessed pre- and postintervention using the Canadian Problem Gambling Index (CPGI; Ferris & Wynne, 2001). These results may be explained by Sévigny and Ladouceur's (2003) concept of double switching, in which individuals do not extend their rational thoughts about gambling in the abstract to their actual gambling behaviors. Interestingly, Lambos and Delfabbro (2007) show that neither general numerical reasoning ability nor the understanding of gambling-related odds is related to the severity of gambling behavior. General mathematical ability is also not related to several cognitive distortions, including the illusion of control, predictive control, and personification of machines. Thus, the usefulness of simple math education within PG therapies focused on correcting cognitive distortions is unsubstantiated.

Methodological Factors and Outcome Variations

Demographic and methodological variability across studies forms the foundation for generalizing underlying concepts to broader populations. At the same time, differences in samples across studies can pose a challenge in addressing the overall therapeutic effects. Here we discuss some methodological and demographic differences that may contribute to the mixed results of the studies we have discussed.

Sample Size, Gender, and Age

Treatment groups ranged in size from three (Bujold et al., 1994) to 35 (Ladouceur et al., 2001). The largest total N was 99 (Toneatto & Gunaratne, 2009), which was disbursed among four treatment groups containing 22 to 28 participants. Studies using both the smallest and largest treatment samples report good therapeutic results, and as such, sample size does not appear to have noticeable influential effects on treatment success.

The reviewed studies have similar demographic profiles in terms of gender and age. As is often the case in gambling research samples, all but one of the reviewed studies included more men than women, with samples ranging from 73% (Ladouceur et al., 2003) to 100% (Bujold et al., 1994) male. Echeburúa et al. (1996) is the exception with a majority (56%) of female participants. We do not detect a pattern of impact of gender composition on results of the studies we have reviewed, but we reiterate the comment made by many that more studies with robust female subsamples would have a salutary impact on the field. The included studies also appear to use a fairly homogeneous age group, with the mean age of samples being between 35 and 47.5. These similarities leave little room for interpretation regarding any influence of these demographic characteristics on therapeutic outcomes.

Group Versus Individual Therapy

Dowling, Smith, and Thomas (2007) found that participants receiving individual treatment had greater therapeutic success than those receiving group treatment, in a CBT therapy that did not have a CR component. Specifically, both individual and Group CBT participants showed significant differences from the wait-listed control group on the gambling behavior variables, but those in group therapy did not differ from the control group in depression, anxiety, or self-esteem, whereas those in individual CBT did show significant improvement in these areas. Furthermore, only 8% of the individual therapy sample categorized as PGs based on *DSM-IV-TR* criteria posttreatment, compared to 35% of the group therapy sample. Improvements remained stable for the individual therapy sample at 6-month follow-up; improvement declined by 5% for the group therapy sample.

Does this conclusion extend specifically to therapies focused on correcting cognitive distortions? We believe that both individual and group therapies have benefit, but that individual therapy may have greater benefit. In reaching this conclusion we are especially struck by the findings of Echeburúa et al. (1996), in which, uniquely among the studies we reviewed, correcting cognitive distortions was found inferior to other methods, but in which, also uniquely, therapy based on cognitive distortions was confounded with therapy presented in a group setting. The results of the

Ladouceur et al. (2001) form an especially notable contrast with those of Echeburúa et al. (1996), which were substantially different despite providing similar educational content. The most salient difference between the two appears to be that Ladouceur et al. (2001) utilized an individual therapy format for cognitive correction regarding gambling misconceptions while Echeburúa et al. (1996), used a group therapy format. Importantly, when Ladouceur et al. (2003) replicated a similar study in a group setting, they observed a high degree of initial success, but scores obtained at three subsequent follow-up periods between 6 and 24 months were not as impressive as the follow-up data from the earlier Ladouceur et al. (2001) study that utilized individual therapy.

We emphasize that group-based therapies do appear to have beneficial effects. Indeed, other studies focusing on the effectiveness of group-based CBT for PG have also found positive therapeutic outcomes (Jiménez-Murcia et al., 2007; Myrseth, Litréré, Stoylen, & Pallesen, 2009), although these studies did not include an individual therapy condition for comparison. Even in the Echeburúa et al. (1996) study, while the individual therapy yielded the best overall results at 12 months' follow-up, the group therapy condition demonstrated results that were significantly better than the control group and similar to the individual therapy at 6-month follow-up. In general, although group therapy based on correcting cognitive distortions appears to have positive impact, this impact appears to be less robust than that of individual therapy.

Hours in Therapy

Most treatments reported in the literature were administered on a weekly or biweekly schedule and lasted from 1 to 2 hours. Some treatments were as brief as 90 total minutes (the MI condition from Toneatto & Gunaratne, 2009) while other therapies had a maximum of 30 treatment hours (Sylvain et al., 1997). Variations in sheer quantity of therapy do not appear to specifically correspond with outcome success, as highlighted by Echeburúa et al. (1996) who found the 6.5-hr individual treatment to have more positive outcomes than the 12.5-hr combined group and individual treatment as well as Toneatto and Gunaratne (2009) who found the 90-min MI intervention to have greater positive influence on cognitive distortions than more time-intensive therapies.

Summary

Cognitive-behavioral therapy (CBT) as a whole has shown good effectiveness in treating PG, including applications that incorporated cognitive restructuring (CR). Studies combining CR with problem solving and/or relapse prevention (Bujold et al., 1994; Ladouceur et al., 1998; Sylvain et al., 1997) obtained therapeutic success, exhibited by decreases in gambling severity and increases in the perception of gambling control. Although the literature examining the specific role of CR may be too small to draw firm conclusions, there is evidence to suggest it may be an effective component of treatment.

Although the literature does not speak with a single voice, treatment approaches that challenge cognitive distortions and provide educational corrections to them as their primary focus have showed relatively good success with fewer participants meeting diagnostic criteria for PG posttreatment (Ladouceur et al., 2001; Ladouceur et al., 2003), when conducted within particular bounds.

Individual treatment plans have demonstrated comparatively greater success than group treatment, but increased time in therapy sessions does not show a similar enhancement of outcomes. Simple math education does not seem adequate as a treatment, perhaps because of issues of switching. We detect no systematic impact of other study variations, such as sample size, gender, and age on therapeutic success. The similarity of the cited samples may indicate that the aggregated findings are only generalizable to groups that are primarily male and middle-aged.

Conclusions and Prescriptive Recommendations

The contribution of cognitive distortions to the development and maintenance of pathological gambling behavior is not a new area of research interest, yet questions remain surrounding the definition and measurement of cognitive distortions, the relationship of cognitive distortions to gambling severity, and the incorporation of cognitive distortion-related therapies for PGs. In our view, there is compelling evidence that cognitive distortions are a fundamental element of gambling pathology, but our understanding of these and other areas remains incomplete, and further research would aid both in theoretical and applied domains of gambling studies.

There is not a generally agreed upon catalog of cognitive distortions that gamblers possess, nor general agreement about how such a catalog would be organized or developed. Also, although it can be beneficial to have a variety of questionnaires and other methods to assess a psychological phenomenon, there is little literature to compare the existing instruments for assessing cognitive distortions in PG, which is a significant gap to be addressed (Fortune, 2010). There is little consensus on whether distortions might be fruitfully considered separately for the various gambling modalities that lead to pathology, or whether it is more useful to collapse across modalities.

Another area of limitation in the literature is agreed standards for assessing the impact of pathological gamblers' cognitive distortions when these same distortions are acknowledged to exist in abundance among nonpathological gamblers and nongamblers as well. Recall that distortions are thought to stem from heuristics, which are regarded as working well in general. The idea of bounded rationality suggests that even healthy humans lack the tools to solve problems perfectly. However, it remains irrational and destructive for gamblers to assume that they can apply long-run probabilities to relatively short runs of independent games of chance. Delfabbro (2004) recognizes this when he asserts that educational effort should be less focused on actually "correcting" cognitive distortions, and more focused on informing gamblers when it is and is not appropriate to utilize them. Gamblers are not the only individuals who fall victim to erroneous beliefs like the gambler's fallacy, but such abstract errors have greater practical impact when dealing frequently with games of chance.

Approaches based simply on factual mathematical information do not appear adequate as a treatment for PG. Even when individuals have been taught the proper use of statistics and situations in which they may be applied, they have generally failed to apply this knowledge to their gambling behaviors. Furthermore, gamblers do not have inferior mathematical knowledge in comparison to nongamblers, and their level of cognitive distortions was not related to level of math skill. However, the presence of cognitive distortions has been shown to have a positive relationship with gambling

severity, and as such, broader-based methods such as CR appear to be a more promising approach to PG treatment. The shortcomings in simple mathematical education as a treatment approach may spring from causes related to switching. Pure mathematics relate to gambling in the abstract or among others, whereas successful therapies may need to emphasize that their impact is not intended for an abstract gambler but for the client in particular.

Thinking-aloud has been a useful component of treatment, with patients endorsing fewer PG criteria at posttreatment and follow-up assessments. The interactive element of the thinking-aloud approach, in which patients actively identify and correct erroneous gambling-related cognitions, may be a key factor in treatment success. Other types of CR that use strictly educational approaches (i.e., the counselor educating individuals about cognitive distortions without an interactive element) have had more mixed results, but individual treatment settings seem to lend themselves more appropriately to the correction of cognitive distortions than group settings.

It is clear that cognitive distortions play a significant role in pathological gambling. The program of heuristics and biases (Kahneman & Tversky, 1973), along with other concepts developed outside of psychopathology such as the illusion of control (Langer, 1975) form a strong conceptual basis for this approach. Two particular cognitive distortions, the illusion of control and the gambler's fallacy, are the focus of robust empirical support that transcends several methodologies and theoretical perspectives, and may fairly be considered to have positions of preeminence in the literature of cognitive distortions.

Prescriptive Recommendations

1. Keep heuristics, biases, normal (imperfect) behavior and PG-related behavior straight. It is important to remember that the use of heuristics, complete with sometimes falling into cognitive errors, is characteristic of individuals generally, including those who are not pathological gamblers and those with no psychopathology. It is acceptable, indeed it may be indispensable, for people to use heuristics to arrive at decisions. When gamblers utilize these same strategies and apply them to various games and gambles, they are prone to be identified as acting in an unacceptable and irrational way (Baboushkin et al., 2001; Hardoon, Baboushkin, Derevensky, & Gupta, 2001). The impact of cognitive distortions on gambling severity may come from two sources. PGs may display them to a greater extent than NPGs, or they may stumble into situations where normal human biases have outsized consequences. Heuristics result when people rely on applying past learning to new experiences, but pathological gamblers may fail to realize that while this is appropriate in many everyday situations, these same heuristics are not appropriate when dealing with chance events (Baboushkin et al., 2001).

2. Investigate additional errors. In our view, the emphasis in the literature on a handful of errors, especially the gambler's fallacy and the illusion of control, is a coincidence or an artifact of the relatively narrow focus of the empirical literature in this area, rather than the result of winnowing many candidates to those that best withstand theoretical and empirical examination. The gambler's fallacy, illusion of control and others have clear relevance and promise, but there may be others that could be explored to provide additional explanatory and treatment benefits. We believe

the continuing examination of additional cognitive biases would be a promising contribution to the field.

Two particular effects, which have been reliably related to gambling pathology but which have not been incorporated extensively in measures of cognitive distortions or in therapies, stand as likely candidates to contribute to such efforts. One is delay discounting, in which individuals pay a premium to receive gains earlier (or avoid losses longer). In other words, individuals may choose a smaller reward over a larger one, if the smaller one is available sooner. Delay discounting may affect gambling behavior in a variety of ways. For example, the possibility of an immediate win may overshadow what the gambler knows about the likelihood of long-term losses, or the immediate excitement of continuing to play may overwhelm long-term incentives to stop playing. Like engaging in heuristics, delay discounting is normal behavior (Mazur, 1987), but greater discounting is differentially associated with PG (MacKillop, Anderson, Castelda, Mattson, & Donovan, 2006; Rachlin, 1990). Second is the near-miss phenomenon, wherein outcomes that lose but are similar to potential winning outcomes (such as a lottery ticket that differs from a winning number only slightly) are found to be rewarding (Clark, Lawrence, Astley-Jones, & Gray, 2009). The strength of the reward response has been correlated with gambling severity both behaviorally (Clark, 2010) and neurally in dopaminergic midbrain activity (Chase & Clark, 2010).

3. Analyze covariation among judgmental errors, gambling modalities, and symptoms. Some research has focused on gambling in general, whereas other research has focused more specifically on particular gambling modalities, such as VLTs (Jefferson & Nicki, 2003), card playing (Lakey et al., 2007) and lottery playing (Goodie & Lakey, 2007). Analytical and empirical research on how particular biases might covary or interact with particular symptoms or particular modalities, would be of significant theoretical and clinical benefit. One example of this comes from Breen and Zuckerman (1999), who compared “chasers” and “nonchasers” in analyzing the Gambling Beliefs and Attitudes Survey, or GABS. More such analyses would be a welcome development. Categories of biases may also relate to symptoms and modalities. The classification system we use—representativeness-based (including gambler’s fallacy), availability-based, and other (including illusion of control)—may serve as one such classification system.

Wagenaar (1988) makes the following important observation:

Gamblers gamble, not because they have a bigger repertoire of heuristics, but because they select heuristics at the wrong occasions. The gambling situation is deliberately designed to be different from everyday life. Gamblers fail to appreciate how crucial the difference is (pp. 116–117).

The future study of cognitive distortions in PG should focus on how and under what circumstances pathological gamblers’ use of heuristics, and the cognitive biases that can ensue, lead to problems that are not encountered by other individuals who use the same heuristics and are plagued by the same biases.

References

- Ayton, P., & Fischer, I. (2004). The hot hand fallacy and the gambler’s fallacy: Two faces of subjective randomness? *Memory & Cognition*, *32*, 1369–1378.

- Baboushkin, H. R., Hardoon, K. K., Derevensky, J. L., & Gupta, R. (2001). Underlying cognitions in gambling behavior among university students. *Journal of Applied Social Psychology*, *31*, 1409–1430.
- Benhsain, K., Taillefer, A., & Ladouceur, R. (2004). Awareness of independence of events and erroneous perceptions while gambling. *Addictive Behaviors*, *29*, 399–404.
- Bar-Hillel, M. (1981). The base rate fallacy in probability judgments. *Acta Psychologica*, *44*, 211–233.
- Bernoulli, D. (1738/1954). Exposition of a new theory on the measurement of risk. *Econometrica*, *22*, 22–36.
- Blaszczynski, A., & Nower, L. (2002). A pathways model of problem and pathological gambling. *Addiction*, *97*, 487–499.
- Breen, R. B., & Zuckerman, M. (1999). “Chasing” in gambling behavior: Personality and cognitive determinants. *Personality and Individual Differences*, *27*, 1097–1111.
- Bujold, A., Ladouceur, R., Sylvain, C., & Boisvert, J. (1994). Treatment of pathological gamblers: An experimental study. *Journal of Behavior Therapy and Experimental Psychiatry*, *25*, 275–282.
- Camerer, C. (1999). Bounded rationality in individual decision making. *Experimental Economics*, *1*, 163–183.
- Case, D. A., Fantino, E., & Goodie, A. S. (1999). Base-rate training without case cues reduces base-rate neglect. *Psychonomic Bulletin and Review*, *6*, 319–327.
- Chapman, L. J., & Chapman, J. P. (1967). Genesis of popular but erroneous psychodiagnostic observations. *Journal of Abnormal Psychology*, *73*, 193–204.
- Chapman, L. J., & Chapman, J. P. (1969). Illusory correlations as an obstacle to the use of valid psychodiagnostic signs. *Journal of Abnormal Psychology*, *74*, 271–280.
- Chase, H. W., & Clark, L. (2010). Gambling severity predicts midbrain response to near-miss outcomes. *Journal of Neuroscience*, *30*, 6180–6187.
- Clark, L., Lawrence, A. J., Astley-Jones, F., & Gray, N. (2009). Gambling near-misses enhance motivation to gamble and recruit win-related brain circuitry. *Neuron*, *61*, 481–490.
- Clark, L. (2010). Decision-making during gambling: An integration of cognitive and psychobiological approaches. *Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences*, *365*, 319–330.
- Cohen, L. J. (1981). Can human irrationality be experimentally demonstrated? *Behavioral and Brain Sciences*, *4*, 317–370.
- Combs, B., & Slovic, P. (1979). Newspaper coverage of causes of death. *Journalism Quarterly*, *27*, 383–390.
- Cosmides, L., & Tooby, J. (1992). *The adapted mind: Evolutionary psychology and the generation of culture*. New York, NY: Oxford University Press.
- Cosmides, L., & Tooby, J. (1994). Beyond intuition and instinct blindness: Toward an evolutionarily rigorous cognitive science. *Cognition*, *50*, 41–77.
- Delfabbro, P. (2004). The stubborn logic of regular gamblers: Obstacles and dilemmas in cognitive gambling research. *Journal of Gambling Studies*, *20*, 1–21.
- Dowling, N., Smith, D., & Thomas, T. (2007). A comparison of individual and group cognitive-behavioural treatment for female pathological gambling. *Behaviour Research and Therapy*, *45*, 2192–2202.
- Echeburúa, E., Báez, C., & Fernández-Montalvo, J. (1996). Comparative effectiveness of three therapeutic modalities in the psychological treatment of pathological gambling: Long-term outcome. *Behavioural and Cognitive Psychotherapy*, *24*, 51–72.
- Fellows, L. K. (2004). The cognitive neuroscience, of human decision making: A review and conceptual framework. *Behavioral and cognitive neuroscience reviews*, *3*, 159–172.
- Fellows, L. K. (2006). Deciding how to decide: Ventromedial frontal lobe

- damage affects information acquisition in multi-attribute decision making. *Brain*, 129, 944–952.
- Ferris, J., & Wynne, H. (2001). *The Canadian Problem Gambling Index: Final report*. Ottawa, ON: Canadian Center on Substance Abuse.
- Fischhoff, B., Slovic, P., & Lichtenstein, S. (1977). Knowing with certainty: The appropriateness of extreme confidence. *Journal of Experimental Psychology: Human Perception and Performance*, 3, 552–564.
- Fortune, E. E. (2010). *Redefining heuristics: The identification and treatment of cognitive distortions in gamblers*. Unpublished manuscript, Department of Psychology, University of Georgia, Athens, Georgia.
- Gaboury, A., & Ladouceur, R. (1989). Erroneous perceptions and gambling. *Journal of Social Behavior and Personality*, 4, 411–420.
- Gaboury, A., & Ladouceur, R. (1990). Correction of irrational thinking during American roulette. *Canadian Journal of Behavioural Science*, 22, 417–423.
- Gibson, B., & Sanbonmatsu, D. M. (2004). Optimism, pessimism, and gambling: The downside of optimism. *Personality and Social Psychology Bulletin*, 30, 149–160.
- Gigerenzer, G. (1991). How to make cognitive illusions disappear: Beyond heuristics and biases. In W. Stroebe & M. Hewstone (Eds.), *European review of social psychology* (Vol. 2, pp. 83–115). Chichester, UK: Wiley.
- Gilovich, T., Vallone, R., & Tversky, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive Psychology*, 17, 295–314.
- Goodfellow, L. D. (1938). A psychological interpretation of the results of the Zenith radio experiment in telepathy. *Journal of Experimental Psychology*, 23, 601–632.
- Goodie, A. S., & Fantino, E. (1996). Learning to commit or avoid the base-rate error. *Nature*, 380, 247–249.
- Goodie, A. S., & Lakey, C. E. (2007). Lottery playing as a marker of and contributor to gambling-related problems in college students. *International Gambling Studies*, 7, 199–211.
- Goodie, A. S., Ortmann, A., Davis, J. N., Bullock, S., & Werner, G. M. (1999). Demons versus heuristics in artificial intelligence, behavioral ecology and economics. In G. Gigerenzer, P. M. Todd, & The ABC Research Group, *Simple heuristics that make us smart* (pp. 327–355). New York, NY: Oxford University Press.
- Goodie, A. S. (2005). The role of perceived control and overconfidence in pathological gambling. *Journal of Gambling Studies*, 21, 481–502.
- Gooding, P., & Tarrier, N. (2009). A systematic review and meta-analysis of cognitive-behavioural interventions to reduce problem gambling—Hedging our bets? *Behaviour Research and Therapy*, 47, 592–607.
- Griffiths, M. D. (1994). The role of cognitive bias and skill in fruit machine gambling. *British Journal of Psychology*, 85, 351–369.
- Grinblatt, M., & Keloharju, M. (2009). Sensation seeking, overconfidence, and trading activity. *The Journal of Finance*, 64, 549–578.
- Haigh, J. (1997). The statistics of the national lottery. *Journal of the Royal Statistical Society Series A-Statistics in Society*, 160, 187–206.
- Hardoon, K. K., Baboushkin, H. R., Derevensky, J. L., & Gupta, R. (2001). Underlying cognitions in the selection of lottery tickets. *Journal of Clinical Psychology*, 57, 749–763.
- Holtgraves, T., & Skeel, J. (1992). Cognitive biases in playing the lottery: Estimating the odds and choosing the numbers. *Journal of Applied Social Psychology*, 22, 934–952.
- Jacobsen, L. H., Knudsen, A. K., Krogh, E., Pallesen, S., & Molde, H. (2007). An overview of cognitive mechanisms in pathological gambling. *Nordic Psychology*, 59, 347–361.
- Jefferson, S., & Nicki, R. (2003). A new instrument to measure cognitive distortions in video lottery terminal users: The informational biases scale (IBS). *Journal of gambling studies*, 19, 387–403.
- Jiménez-Murcia, S., Alvarez-Moya, E. M., Granero, R., Aymami, M. N., Gomez-Pena, M., Jaurrieta, N., . . . Vallejo, J. (2007). Cognitive behavioural group treatment for pathological gambling: Analysis of effectiveness and predictors of therapy outcome. *Psychotherapy Research*, 17, 544–552.
- Joukhador, J., Blaszczynski, A., & MacCallum, F. (2004). Superstitious beliefs in gambling among problem and non-problem gamblers: Preliminary data. *Journal of Gambling Studies*, 20, 171–180.
- Kahneman, D., & Lovallo, D. (1993). Timid choices and bold forecasts: A cognitive perspective on risk taking. *Management Science*, 39, 17–31.
- Kahneman, D., Slovic, P., & Tversky, A. (1982). *Judgment under uncertainty: Heuristics and biases*. Cambridge, UK: Cambridge University Press.
- Kahneman, D., & Tversky, A. (1973). On the psychology of prediction. *Psychological Review*, 80, 237–251.
- Kahneman, D., & Tversky, A. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185, 1124–1131.
- Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47, 263–291.
- Kenrick, D. T., Li, N. P., & Butner, J. (2003). Dynamical evolutionary psychology: Individual decision rules and emergent social norms. *Psychological Review*, 110, 3–28.
- Keren, G. (1994). The rationality of gambling: Gamblers' conceptions of probability, chance and luck. In G. Wright & P. Ayton (Eds.), *Subjective probability* (pp. 485–499). Chichester, UK: Wiley.
- Koriat, A., Lichtenstein, S., & Fischhoff, B. (1980). Reasons for confidence. *Journal of Experimental Psychology: Human Learning and Memory*, 6, 107–118.
- Ladouceur, R., Mayrand, M., Dussault, R., Letarte, A., & Tremblay, J. (1984). Illusion of control: Effects of participation and involvement. *The Journal of Psychology*, 117, 47–52.
- Ladouceur, R., Sylvain, C., Boutin, C., Lachance, S., Doucet, C., Leblond, J., & Jacques, C. (2001). Cognitive treatment of pathological gambling. *The Journal of Nervous and Mental Disease*, 189, 774–780.
- Ladouceur, R., Sylvain, C., Boutin, C., Lachance, S., Doucet, C., & Leblond, J. (2003). Group therapy for pathological gamblers: A cognitive approach. *Behaviour Research and Therapy*, 41, 587–596.
- Ladouceur, R., Sylvain, C., Letarte, H., Giroux, I., & Jacques, C. (1998). Cognitive treatment of pathological gamblers. *Behaviour Research and Therapy*, 36, 1111–1119.
- Lakey, C. E., Campbell, W. K., Brown, K. W., & Goodie, A. S. (2007). Dispositional mindfulness as a predictor of the severity of gambling outcomes. *Personality and Individual Differences*, 43, 1698–1710.
- Lakey, C. E., Goodie, A. S., & Campbell, W. K. (2007). Frequent card playing and pathological gambling: The utility of the Georgia Gambling Task and Iowa Gambling Task for predicting pathology. *Journal of Gambling Studies*, 23, 285–297.
- Lakey, C. E., Goodie, A. S., Lance, C. E., Stinchfield, R., & Winters, K. C. (2007). Examining DSM-IV criteria in gambling pathology: Psychometric properties and evidence from cognitive biases. *Journal of Gambling Studies*, 23, 479–498.
- Lakey, C. E., Rose, P., Campbell, W. K., & Goodie, A. S. (2008). Probing the link between narcissism and gambling: The mediating role of judgment and decision-making biases. *Journal of Behavioral Decision Making*, 21, 113–137.
- Lambos, C., & Delfabbro, P. (2007). Numerical reasoning ability and irrational beliefs in problem gambling. *International Gambling Studies*, 7, 157–171.
- Langer, E. J. (1975). The illusion of control. *Journal of Personality and Social Psychology*, 32, 311–328.
- Lesieur, H. R., & Blume, S. B. (1987). The South Oaks Gambling Screen (SOGS): A new instrument for the identification of problem gamblers. *American Journal of Psychiatry*, 144, 1184–1188.
- Lichtenstein, S., Slovic, P., Fischhoff, B., Layman, M., & Combs, B. (1978). Judged frequency of lethal events. *Journal of Experimental Psychology: Human Learning and Memory*, 4, 551–578.
- MacKillop, J., Anderson, E. J., Castelda, B. A., Mattson, R. E., & Don-

- ovick, P. J. (2006). Divergent validity of self-report and behavioral assessment measures in pathological gamblers. *Journal of Gambling Studies*, 22, 339–354.
- Mazur, J. E. (1987). An adjusting procedure for studying delayed reinforcement. In M. L. Commons, J. E. Mazur, J. A. Nevin, & H. Rachlin (Eds.), *Quantitative analyses of behavior: The effect of delay and of intervening events on reinforcement value* (Vol. 5, pp. 55–73). Hillsdale, NJ: Erlbaum.
- Muramatsu, R., & Hanoch, Y. (2005). Emotions as a mechanism for boundedly rational agents: The fast and frugal way. *Journal of Economic Psychology*, 26, 201–221.
- Myrseth, H., Litré, I., Stoylen, I. J., & Pallesen, S. (2009). A controlled study of the effect of cognitive-behavioural group therapy for pathological gamblers. *Nord J Psychiatry*, 63, 22–31.
- Oaksford, M., & Chater, N. (1992). Bounded rationality in taking risks and drawing inferences. *Theory and Psychology*, 2, 225–230.
- Oei, T. P., & Gordon, L. M. (2008). Psychological factors related to gambling abstinence and relapse in members of gamblers anonymous. *Journal of Gambling Studies*, 24, 91–105.
- Petry, M. P. (2004). *Pathological gambling: Etiology, comorbidity, and treatment*. Washington, DC: American Psychological Association.
- Rachlin, H. (1990). Why do people gamble and keep gambling despite heavy losses? *Psychological Science*, 1, 294–297. doi:10.1111/j.1467-9280.1990.tb00220.x
- Raylu, N., & Oei, T. P. S. (2004). The gambling related cognition scale (GRCS): Development, confirmatory factor validation and psychometric properties. *Addiction*, 99, 757–769. doi:10.1111/j.1360-0443.2004.00753.x
- Riniolo, T. C., & Schmidt, L. A. (1999). Demonstrating the gambler's fallacy in an introductory statistics class. *Teaching of Psychology*, 26, 198–200. doi:10.1207/S15328023TOP260308
- Rogers, P., & Webley, P. (2001). "It could be us!": Cognitive and social psychological factors in UK national lottery play. *Applied Psychology: An International Review*, 50, 181–199. doi:10.1111/1464-0597.00053
- Roney, C. J. R., & Trick, L. M. (2003). Grouping and gambling: A Gestalt approach to understanding the gambler's fallacy. *Canadian Journal of Experimental Psychology*, 57, 69–75. doi:10.1037/h0087414
- Rudski, J. (2004). The illusion of control, superstitious belief, and optimism. *Current Psychology*, 22, 306–315. doi:10.1007/s12144-004-1036-8
- Sévigny, S., & Ladouceur, R. (2003). Gamblers' irrational thinking about chance events: The "Double Switching" concept. *International Gambling Studies*, 3, 163–170. doi:10.1080/1356347032000142261
- Sharpe, L., & Tarrrier, N. (1993). Towards a cognitive-behavioral theory of problem gambling. *British Journal of Psychiatry*, 162, 407–412. doi:10.1192/bjp.162.3.407
- Sharpe, L. (2002). A reformulated cognitive-behavioral model of problem gambling: A biopsychosocial perspective. *Clinical Psychology Review*, 22, 1–25. doi:10.1016/S0272-7358(00)00087-8
- Simon, H. (1957). *Models of Man: Social and Rational*. New York, NY: Wiley.
- Sylvain, C., Ladouceur, R., & Boisvert, J. (1997). Cognitive and behavioral treatment of pathological gambling: A controlled study. *Journal of Consulting and Clinical Psychology*, 65, 727–732. doi:10.1037/0022-006X.65.5.727
- Toneatto, T., Blitz-Miller, T., Calderwood, K., Dragonetti, R., & Tsanos, A. (1997). Cognitive distortions in heavy gambling. *Journal of Gambling Studies*, 13, 253–261. doi:10.1023/A:1024983300428
- Toneatto, T., & Gunaratne, M. (2009). Does the treatment of cognitive distortions improve clinical outcomes for problem gambling? *Journal of Contemporary Psychotherapy*, 39, 221–229. doi:10.1007/s10879-009-9119-3
- Toneatto, T. (1999a). Cognitive psychopathology of problem gambling. *Substance Use and Misuse*, 34, 1593–1604. doi:10.3109/10826089909039417
- Toneatto, T. (1999b, August). The Gambling Cognition Questionnaire. Paper presented at the annual convention of the American Psychological Association, Boston, MA.
- Tversky, A., & Kahneman, D. (1971). Belief in the law of small numbers. *Psychological Bulletin*, 76, 105–110. doi:10.1037/h0031322
- von Neumann, J., & Morgenstern, O. (1944). *Theory of games and economic behavior*. Princeton, NJ: Princeton University Press.
- Wagenaar, W. A., & Keren, G. B. (1988). Chance and luck are not the same. *Journal of Behavioral Decision Making*, 1, 65–75. doi:10.1002/bdm.3960010202
- Wagenaar, W. A. (1988). *Paradoxes of Gambling Behaviour*. London, UK: Erlbaum.
- Walker, M. B. (1992). *The psychology of gambling*. Oxford, UK: Pergamon Press.
- Walker, W. R., Skowronski, J. J., & Thompson, C. P. (2003). Life is pleasant—And memory helps to keep it that way! *Review of General Psychology*, 7, 203–210. doi:10.1037/1089-2680.7.2.203
- Williams, R. J., & Connolly, D. (2006). Does learning about the mathematics of gambling change gambling behavior? *Psychology of Addictive Behaviors*, 20, 62–68.
- Wohl, M. J. A., & Enzle, M. E. (2002). The deployment of personal luck: Sympathetic magic and illusory control in games of pure chance. *Personality and Social Psychology Bulletin*, 28, 1388–1397. doi:10.1177/014616702236870
- Yurica, C. L., & DiTomasso, R. A. (2005). Cognitive distortions. In A. Freeman, S. H. Felgoise, C. M. Nezu, A. M. Nezu, & M. A. Reinecke (Eds.), *Encyclopedia of cognitive behavior therapy* (pp. 117–122). New York, NY: Springer. doi:10.1007/0-306-48581-8_36

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