Grouping and Gambling: A Gestalt Approach to Understanding the Gambler's Fallacy

Christopher J. R. Roney, King's College, University of Western Ontario
Lana M. Trick, University of Guelph

Abstract The gambler's fallacy was examined in terms of grouping processes. The gambler's fallacy is the tendency to erroneously believe that for independent events, recent or repeated instances of an outcome (e.g., a series of "heads" when flipping a coin) will make that outcome less likely on an upcoming trial. Grouping was manipulated such that a critical trial following a run of heads or tails was grouped together with previous trials (i.e., the last trial of "Block 1") or was the first trial of another group (the first trial of "Block 2"). As predicted, the gambler's fallacy was evident when the critical trial was grouped with the previous trials, but not when it was arbitrarily grouped with the next block of trials. Discussion centres on the processes underlying the gambler's fallacy and practical implications of these findings.

Consider a person who is betting on coin tosses and the prior outcomes were Heads, Tails, Tails, Heads, Heads, Heads. The gambler's fallacy is the tendency to see a given outcome as less likely if it has just repeatedly occurred, in this case, leading to the choice of Tails following three Heads. It is a fallacy to the extent that the person's expectancy deviates from the true probability of getting heads in a coin toss (50%). The gambler's fallacy has been found in a variety of naturalistic gambling situations including playing blackjack in a casino (Keren & Wagenaar, 1985), betting at the racetrack (Metzger, 1985), and in choosing lottery numbers (Clotfelter & Cook, 1993).

We will argue that there are potentially two errors involved in the gambler's fallacy: perceiving separate and independent events as part of an inter-related sequence or pattern, and mistakenly assuming that random events "balance out" in the short term within the pattern. The former is reflected in a tendency to behave as if a present independent event is somehow related to, and influenced by, prior events. The latter predicts a specific direction of bias – toward expecting random events to "balance out" in the short term. Past attempts to explain the gambler's fallacy have tended to focus on the latter, neglecting the former aspect of the phenomenon, something we will attempt to remedy in this paper.

The primary explanation currently cited for the gambler's fallacy is that the phenomenon arises due to failure to understand probability. Tversky and Kahneman (1971) identified the "law of small numbers," which is the erroneous belief that properties of large samples will also apply to very small samples. In fact, though outcomes should be approximately equal over a large number of trials, it does not follow that they "balance out" in the short term. Thus, the gambler's fallacy could simply reflect the false belief in the law of small numbers – the belief that outcomes will balance out in the short term. Consistent with this, when asked to generate random event sequences, people tend to exaggerate alternations of events, and underrepresent "runs" or repetitions (e.g., see Balkan, 1960; Neuringer, 1986).

Although judgment explanations clarify why we overestimate the probability of alternations or reversals after a run, it does not address the initial error of behaving as if independent events were somehow related. We argue that the gambler's fallacy occurs as a result of a natural tendency for people to organize separate events into larger units, groupings of events that form episodes or meaningful patterns, rather than seeing each event as a separate entity, unrelated to others. This tendency to organize individual elements of experience into larger scale units follows from Gestalt principles (e.g., Koffka, 1935; Wertheimer, 1923), and the effects of grouping are commonly observed in a wide variety of perceptual and memory phenomena. Consistent with this, in a literature review of two-choice probability studies, where participants are asked to choose one of two options repeatedly over many trials, Jones (1971, pp. 156-157) notes the evidence suggests people tend to encode outcomes as "patterns of runs and alternations" rather than as individual events. Similarly, Ladouceur, Paquet, and Dubé (1996) had par-

ticipants verbalize while producing a hypothetical sequence of independent two-choice events, such as tossing a coin. Coding of these verbalizations revealed the most consistent error to be mentioning previous outcomes as being relevant to a current event – in other words, not seeming to understand the independence of events.

In essence, we are proposing a two-stage process involved in the gambler's fallacy. The first stage involves determining whether the present event is to be grouped with previous events or considered as a part of a separate unit. If the present event is grouped with past ones, then a second stage occurs, one involving a decision about *how* the past events are related to the present. At this point faulty beliefs about probability, such as the "law of small numbers," may be applied, which would result in the classic gambler's fallacy. It should be noted that other beliefs may also be applied at this stage, such as the "hot hand" (belief that a streak will continue because an athlete is "hot," see Gilovich, Vallone, & Tversky, 1985) or the "Type II" gambler's fallacy (deciding too quickly that there is bias in a supposedly random procedure, see Keren & Lewis, 1994). These can lead to errors in the opposite direction – that is, favouring continuation of runs. In contrast, if an event is not grouped with the others in the past, then only the attributes of the immediate situation will be taken into account (i.e., knowledge that coins have two sides, and that the sides are equally balanced so one side is as likely to show as another).

Although this two-stage approach has not yet been directly tested, it may help to shed light on some inconsistencies in previous research. Much of the early research that discussed the gambler's fallacy used a two-choice probability learning paradigm (e.g., see Anderson, 1960; Anderson & Whalen, 1960; Jarvik, 1951; Nicks, 1959). In these studies participants would, over many trials, be asked to predict which of two events would occur trial by trial (often, which of two lights would come on). The actual probabilities varied from study to study (in some cases being a manipulated variable), and participants were generally not told the probability initially. Thus, participants had little information about the event (the two lights) and had to infer the relative probabilities from experience. In these studies it was often found that participants were less likely to choose an alternative that has just recently repeatedly occurred. At the time this was called the "negative recency" effect and was likened to the gambler's fallacy.

However, some studies (e.g., Edwards, 1961; Lindman & Edwards, 1961) found that after many trials, this tendency went away, often being replaced by a "positive recency" effect (i.e., a tendency to choose options that have recently occurred). Edwards (1961) suggested that this disappearance, and even reversal, of negative recency after many trials reflects mental fatigue or boredom, reducing cognitive ability or effort to track previous outcomes. Consistent with this explanation, it has been found that young children exhibit positive recency effects up to about Grade 3 (see Derks & Paclisanu, 1967). Negative recency becomes increasingly evident after that age. To the extent that the process of grouping multiple events requires cognitive ability and effort to recall several past outcomes, these results may be interpreted as suggesting that fatigue, boredom, or low capacity may reduce this initial grouping tendency in sequential tasks.

Note that grouping events over time, taking into account the previous outcomes, is more likely to occur in some tasks than others. It does not seem to occur in psychophysical tasks, for example. Colle, Rose, and Taylor (1974) reported two studies, one using a task where participants were asked to indicate which of three possible patterns they saw (based on "Xs" with the angles of the lines varying), and another involving whether the intensity of an auditory stimulus was greater or less than that of a target stimulus. The trials were arranged such that there would sometimes be "runs" of a particular outcome, but in this case neither negative nor positive recency was evident, in that participants' judgments were not influenced by prior trials (Colle et al., 1974).

We propose that the reason that positive and negative recency are observed in probability learning and not psychophysical tasks is that in the former participants must infer contingencies between events and the relative frequency of different outcomes, and that requires considering the population of past outcomes as a whole. In contrast, in a psychophysics task the correct answer requires attention to the present event (stimulus) and prior events are not considered.

Basing predictions on previous events is only truly a "fallacy" when applied to events that are known to be independent and where the individual event probabilities are to some extent known in advance (as with coins, dice, roulette wheels). In these cases participants should not consider the past when predicting the future. Nonetheless, there is still a bias to group independent coin flips into larger-scale episodes, and to expect there to be relationships between individual events within an episode. This bias distorts the perceived probabilities of individual events (coin flips) and is an important component of the gambler's fallacy.

If our Gestalt analysis of the gambler's fallacy is correct, then it should be possible to reduce or eliminate the gambler's fallacy by altering the way people group the events involved. This was done in the current

research by presenting events (bets on the toss of a coin) in blocks. Participants were told either that they would be betting on two blocks of six coin tosses, or on two blocks of seven. The fourth, fifth, and sixth tosses all had the same outcome (three "heads" or three "tails"). The critical seventh trial was thus either at the end of one block of trials, or at the beginning of the next. If the gambler's fallacy is dependent on grouping processes then these arbitrary groupings should influence the tendency to commit the fallacy. It was predicted that the gambler's fallacy would be most evident when the critical trial was in the same block as the run, and thus would be seen as part of the same unit as the run.

Method

Participants

One hundred and twenty-seven students enrolled in first-year psychology courses at the Surrey and Richmond campuses of Kwantlen University College (British Columbia, Canada) participated. Participants were run in groups of up to 30. Classes were randomly assigned to groups.

Materials

The experiment took place in standard (nontiered) classrooms with seating maximum capacity of 35. The blackboard at the front of the room was used for giving the directions at the beginning of the study, and also to record the outcome of each trial. The board was blank save for "Block 1" and "Block 2," with Block 1 above Block 2, and the numbers from 1-6 or 1-7 under each block, depending on the condition the group was in, to reflect the trial numbers. (The layout of the board was the same as that in the participant's answer book.) A clear plastic container with a top was used as the coin shaker and the coin was shaken into the upturned lid of a cardboard box. Participants could not see the coin from their vantage point in the room both because of the distance away and because of the lid of the box. The coin was a normal quarter.

A two-page handout was distributed to the class. On one side of the handout were background questions about the participant's gender and previous gambling experience. Participants rated their experience on a scale from 0 (indicating no betting experience) to 4 (indicating regular gambling experience several times a month or more). For purposes of this study, buying lottery tickets and playing bingo were not considered betting.

The second page of the handout was where participants recorded their choices and bets. At the top there was a brief summary of the instructions (these were also read to the participants) and a 7-point Likert-type scale showing the range of responses for the confidence ratings, where "1" indicated extreme lack of confidence and "7" indicated extreme confidence.

Under that were places for participants' responses, organized into two blocks of trials, where each trial was a coin flip. Each trial occupied a horizontal line of the page, leftmost was the trial number, then there were spaces for a choice (head or tails), an amount bet (the maximum was $1.00), a confidence rating, and then the actual outcome. Participants were asked to record the actual outcome after it occurred, ostensibly to enable them to calculate their winnings at the end of the study, but in fact this was done to make sure that they were aware of the outcome of each trial.

Trials were divided into two blocks, labeled "Block 1" and "Block 2" above each group of outcomes. In the "Same block" condition there were seven trials per condition and in the "Different block" condition there were six.

Procedure

The experimenter followed a predetermined script throughout the study, which was standard across conditions. First, participants were told that they would be taking part in a study on betting behaviour, and that there would be a series of coin tosses that they would be betting on. They were informed that the bets would be hypothetical, in that no real money would be won or lost, but were asked to bet as if they had money – $1.00 per trial.

After completing the background questions (gender, gambling experience), participants were shown the materials used for the study and familiarized with the procedure. The experimenter displayed the coin, showing both sides, and informed them that the coin was a typical quarter (which it was). She also told them that she would be willing to use a coin provided by one of them. At that point none of the participants indicated any doubts about the coin.

The experimenter then read the instructions, making use of the blackboard at the front of the room, which listed rows for each trial to show how the response would be listed on the second page of the handout (where participants recorded their bets). Two practice trials were given to ensure that everyone understood the procedure. For the first trial participants were told the actual outcome of the toss, but for the second the opposite outcome was indicated to enhance conviction that the outcomes were truly random.

Once the two practice trials were complete, participants began the study, making use of the record sheets in the handout to record their bets and the outcomes for each trial. Care was taken to ensure that approxi-

TABLE 1
Mean Magnitude of Bets ($1.00 maximum) as a Function of Grouping Condition and Choice

Grouping Condition		Direction of Choice: Gambler's Fallacy (reversal)	Direction of Choice: Continuation of run
Same Block	Mean	.80	.52
	SE	.04	.07
	N	48	18
Different Block	Mean	.74	.71
	SE	.05	.07
	N	21	38

TABLE 2
Mean Confidence Rating (7-point scale) as a Function of Grouping Condition and Choice

Grouping Condition		Direction of Choice: Gambler's Fallacy (reversal)	Direction of Choice: Continuation of run
Same Block	Mean	5.1	3.9
	SE	.23	.39
	N	48	18
Different Block	Mean	4.4	4.2
	SE	.36	.27
	N	21	38

mately the same amount of time was taken between each trial including the first trial of Block 2. Also, the experimenter wrote the outcomes of each trial on the blackboard to ensure that all participants were on the right trial and were aware of the sequence up to that point.

The pattern of outcomes for the first six trials was predetermined to ensure a run in trials 4, 5, and 6. Thus, although a coin was tossed, the experimenter did not necessarily report the actual outcome. Instead, the specific outcomes were scripted for the first six trials. To control for possible response biases, there were two predetermined patterns of outcomes (HTHTTT, or THTHHH); approximately half of the participants in each condition had each pattern. Following a run of three heads, the gambler's fallacy would be reflected in a choice of tails, whereas it would be a choice of heads after three tails. After the first six trials all outcomes were reported as they truly came out. After the two blocks of trials, the participants were allowed to calculate their winnings (a project undertaken with some enthusiasm). To ensure that participants did not learn of the true purpose of the study, debriefing was delayed until the last of the participants had performed the study.

The primary independent variable was whether the pages were set up for two blocks of six trials (Different block condition, because the critical seventh trial would be the first trial of the second block), or two blocks of seven trials (Same block condition, as the critical seventh trial would be the last trial of the first block).

Results

The primary tests of our hypothesis were done using two gambler's fallacy indices calculated by multiplying the direction of the option chosen (1 = gambler's fallacy, -1 = against the gambler's fallacy) by amount bet, and by confidence. A large positive score would thus indicate a large bet on the one measure, and a high certainty rating on the other, for a decision in the direction of the gambler's fallacy. A large negative score would indicate a large bet and high certainty for a decision in the direction favouring the continuation of the run (against the gambler's fallacy). As predicted, this gambler's fallacy score was higher in the Same block condition (M = +$0.40, SE = .09 for amount bet, and M = +2.7, SE =.54 for confidence) than in the Different block condition (Ms = -$0.20, SE =.09 and -1.1, SE = .57, respectively). There was thus stronger evidence for the gambler's fallacy in the same block condition using either amount bet, $t(123) = 5.15$, $p < .001$, or confidence in one's bet, $t(124) = 4.82$, $p < .001$. These results were unaffected when type of outcome (i.e., whether the run was of heads or tails), gender, and past gambling experience were included as covariates, indicating that the effects are independent of these variables.

Results for the different components of the gambler's fallacy measure (direction of pick, amount bet, and certainty) are shown in Tables 1 and 2.

The cell counts in Table 1 reveal that a higher proportion of the participants chose an outcome consistent with the gambler's fallacy in the Same block condition (49 of 67, or 73%) than in the Different block condition (21 of 59, or 36%). This Difference was significant, χ^2 (1, N = 126) = 17.91, $p < .01$. In the Same block condition, a binomial test revealed that significantly more than 50% of the people chose in a direction consistent with the gambler's fallacy, $p < .01$. Unexpectedly, a binomial test revealed that in the Different block condition, there was a significant reversal, with people more

likely to pick in the direction of continuation of the run, $p < .05$. As a point of comparison, binomial tests on the first trial, fourth trial (prior to the critical run) and sixth trial (prior to the grouping manipulation) all revealed no significant deviations from 50%.

A stronger test for the gambler's fallacy would not only show differences in the direction of the pick, however, but would also show that people's perceptions of the probability of an outcome are altered. To test this, separate condition by direction of pick ANOVAs were done on amount bet, and on certainty ratings. We expected higher bets and greater confidence when one's pick was in the direction of the gambler's fallacy than when it was against it (i.e., in the direction of continuation of the run). This should only be in evidence in the Same group condition, however. Tables 1 and 2 show the pattern of means to support this. The predicted interaction was significant for amount bet, $F(1,121) = 6.48$, $p < .05$, but not for certainty, $F(1,121) = 1.88$, ns. In both cases, however, planned contrasts revealed significant differences in the Same group condition between those picking in the gambler's fallacy direction versus those picking against it, $t(121) = 3.59$, $p < .05$ for amount bet, and $t(122) = 2.62$, $p < .05$ for certainty. In the Different group condition, the same comparison was not significant, $t(121) = 0.38$, ns, for amount bet, and $t(122) = 0.60$, ns, for certainty. Thus, those who bet in the direction of the gambler's fallacy and those who bet in the opposite direction had approximately equal expectancy of winning, as indicated by certainty ratings and the amount wagered.

Discussion

The present study illustrates the importance of grouping processes in the gambler's fallacy. After a run of heads or tails, participants expected a reversal on a trial that was arbitrarily grouped with those previous trials. A reversal following a run (i.e., the gambler's fallacy) was not evident, however, when the critical trial was presented as the first of a new block of trials. Also, those who made picks that went against the gambler's fallacy bet less, and seemed less confident in their choices, than those who picked with the gambler's fallacy. This suggests that even those who did not pick in the direction of the gambler's fallacy were affected by the idea that continuation of the sequence is less likely. Here again, though, this was only evident in the Same block condition.

One unanticipated but interesting finding in the results was the reversal in participants' picks for the critical trial in the Different group condition. Although we expected the picks in that condition to be independent of previous choices, in fact people were more likely to pick in the direction of continuation. This was not reflected in either their bets or certainty ratings, however, as these were equal regardless whether choosing in the direction of a reversal or discontinuity. Thus the expectancy in the Different group condition does appear to be independent of previous outcomes, even though the direction of the pick was not. Perhaps, since people have to make a choice even when they actually do see the outcome as random, salience will be reflected in the choice people make; in this case, the previous outcome may be salient in choosing, resulting in a choice in the direction of continuation. This could be consistent with the research cited in the Introduction showing a tendency to choose in the direction of continuation of runs when in a less "thoughtful" mode (tired, bored, or in the very young). Although the direction is consistent with a "hot hand" belief, the fact that expectancies are not higher for those picking in that direction leads us to believe it is not actually belief in a "hot hand," but rather a lower-level process involved in choosing heads or tails that is occurring here.

Interestingly, choices on the sixth trial (after two similar outcomes, and before the break in grouping in the one condition) showed no significant deviation from 50%. In the same group condition the implication of this is that people do not appear to treat outcomes as a "run" until there are three same outcomes. With respect to the Different group condition, it suggests that the choice continuation *only* occurs after the set is broken. It may only be when people are not deliberately considering past outcomes to decide present probabilities (i.e., after the grouping is broken, if they think it does not matter which choice they make in terms of probability) that this effect occurs. Although the results are generally consistent with our hypotheses in relation to the gambler's fallacy, therefore, there is apparently another phenomenon in evidence in the Different group condition that warrants further study.

The findings of this study suggest the need for a different approach to the understanding of choice and betting behaviour, one that considers two separate aspects: determination of whether to group the present event in with the past events, and the decision about the specific expected outcome. Grouping should be considered first because it has an impact on the later determination. If an event is considered in and of itself, then the expected outcome must be determined based on attributes of the event itself. This appears to be what happened in the Different group condition, when the critical trial was perceived as the first of a new block. If an event is considered as part of a group of events (i.e., is not perceived as separate and inde-

pendent), then expectancy will reflect past outcomes in addition to the attributes of the event. This appears to be what happens in the Same block condition, where the gambler's fallacy occurs.

Just as we are arguing that judgment approaches to explaining the gambler's fallacy are incomplete, it should be noted that the same is true of the grouping account presented here. An explanation is still required as to why choices and bets are biased in the direction that they are – that is, why do people expect reversals? The "law of small numbers" account proposed by Tversky and Kahneman (1971) may well still be the correct answer to this question, but it is necessary to add that this judgment process will only be engaged when the events are perceived as a group. This somewhat "rational" process – applying knowledge about randomness, although mistakenly expecting the balancing out to occur in the long run – occurs following a less rational process – assuming that events that have already occurred may somehow affect a current toss of a coin. Similarly, the "hot hand" (Gilovich, Vallone, & Tversky, 1985) and "Type II gambler's fallacy" (Keren & Lewis, 1994) are also examples of faulty beliefs that require that a sequence of events be considered as a whole.

Why are separate and independent events seen as interrelated parts of a sequence? This is a question that challenged Gestalt psychologists who proposed a bias to look for meaningful patterns (although "meaning" proved hard to operationalize). Marr (1982) incorporated Gestalt principles into his theory of vision as natural constraints, suggesting that innate biases to cluster nearby similar contours are adaptive because they reflect a truth about the world: In the world, contours that are proximal, similar, and continuous tend to belong to the same object. Similarly, grouping adjacent events may serve as a heuristic to organize experience into meaningful units or episodes. In this case, meaning is likely defined by patterns of cause and effect. In our daily life, relatively few events are truly random and arguably few are completely independent of events prior – and even if they are it may be hard for us to perceive and remember them that way. Thus grouping events may generally be functional, enabling us to encode our experiences into a more manageable number of units to understand, providing clues about causality, and helping us predict future events. Thus, the logical errors that arise from this grouping tendency may be pervasive and difficult to eradicate because they reflect heuristics that are usually adaptive (cf. Gigerenzer, Todd, & the ABC Research Group, 1999).

Although the judgment and Gestalt approaches both contribute to the understanding of the gambler's fallacy, there are different practical implications. If we were to use these ideas to prevent people from continuing to gamble when they are losing (expecting that their luck has to turn around – a variant of the gambler's fallacy), what would we do? A judgment approach would involve teaching people the erroneous belief that random events will balance out in the short term – and thus perhaps lead the person to believe they must continue their gambling for a long period in order to recoup their losses. A Gestalt approach would suggest we try to get people to reframe the situation such that the next event is seen as a beginning rather than a continuation. At that point the individual can consider whether he or she can afford to *start* gambling given his or her current monetary situation and the current probability of success or failure. Given the role grouping seems to play in biases like the gambler's fallacy, a fruitful line for future research is to explore other ways of manipulating the environment to disrupt this grouping tendency. In this study, it seemed enough to simply label them as part of Block 1 or Block 2.

The implications of these two approaches clearly differ, supporting our view that the Gestalt aspects of this phenomenon are also important. Past efforts to eliminate the gambler's fallacy by teaching people about the nature of randomness have not been particularly effective (see Beach and Swensson, 1967). In contrast, the present study showed that the gambler's fallacy can be eliminated by altering the grouping of events.

Correspondence concerning this article should be addressed to Chris Roney, Department of Psychology, King's College, Epworth Ave., London, Ontario N6A 2M3. (Telephone: (519) 433-3491; E-mail: croney@julian. uwo.ca).

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Sommaire

On appelle « illusion du joueur » cette tendance à croire à tort que des événements indépendants et des résultats récents ou répétés (par exemple, une suite de « faces » après avoir tiré à pile ou face) abaissent la probabilité de voir se produire ces mêmes résultats à l'essai suivant. Nous avançons que l'illusion du joueur fait appel à deux processus distincts : la perception d'un événement en cours comme faisant partie d'événements passés et le recours à une croyance quant à une tendance qui influera sur les résultats. Nous avons prédit que la croyance rattachée aux séquences de résultat (dans le cas présent, la croyance voulant que les résultats s'équilibreront) ne sera utilisée que lorsque l'événement observé est perçu comme faisant partie d'une séquence. Le groupement a été manipulé de telle sorte qu'un essai critique, qui suivait la présentation d'une série de faces ou de piles, était associé aux essais précédents (c.-à-d., le dernier essai du bloc 1) ou devenait le premier essai d'un autre groupe (le premier essai du bloc 2). À chaque essai, les participants choisissaient entre pile ou face, plaçaient un pari hypothétique quant à l'issue de l'essai et indiquaient la confiance qu'ils accordaient à leur choix. Comme nous l'avions prédit, l'illusion du joueur était manifeste (elle s'observait dans le choix, le pari et la confiance) lorsque l'essai critique était associé aux essais précédents, mais ce n'était pas le cas lorsqu'il était associé arbitrairement au bloc d'essais expérimentaux suivant. En revanche, nous avons observé un revirement imprévu lorsque les essais étaient soumis à une condition expérimentale différente quant au groupe, notamment quand les participants arrêtaient leur choix sur la continuation de la séquence (choix opposé à l'illusion du joueur); cependant, nous n'avons pas observé cette particularité en ce qui concerne le montant du pari ou la confiance. La discussion porte principalement sur la nécessité de prendre en compte les processus de groupement en plus des croyances (par exemple, la « loi des petits nombres » proposée par Tversky et Kahneman, 1971) pour comprendre l'illusion du joueur.