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'Let me dream on!' Anticipatory emotions and preference for timing in lotteries.*

Martin Kocher†, Michał Krawczyk‡and Frans van Winden§

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Abstract We analyze one of the explanations why people participate in lotteries. Our hypothesis stipulates that part of the value that a unit of money buys in lotteries is consumed before the actual resolution in the form of emotions such as hope. In other words, a person holding a lottery ticket may prefer a delayed resolution of risk due to positive anticipatory emotions. This conjecture is tested in an experiment with real lottery tickets. We show that our theoretical considerations may contribute to explaining empirical puzzles associated with lottery participation, timing of resolution and the spreading of drawings. More specifically, we find that a substantial number of participants prefer delayed resolution, that anticipated thrill is the main variable explaining this choice, that emotions actually experienced during the waiting period are indeed predominantly positive and correlated with predictions. Finally, we find that a great majority prefers to 'spread' chances, that is, to obtain one ticket for each of two drawings rather than two for the same drawing.
JEL: C93, D81
Keywords: lotteries, anticipation, experiment

1 Introduction

A lottery is a gamble that involves drawing lots for a prize. Among many varieties (LaFleur and LaFleur, 2003), large state-run Lotto-type lotteries (henceforth also 'traditional lotteries' or simply 'lotteries') tend to attract most players and generate highest earnings. In Lotto, purchasers are typically allowed to select a set of numbers on the lottery ticket out of a set of permissible numbers,

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and the drawing of balls corresponding to winning numbers is often shown live on TV.[1] Such lotteries are extremely popular. Rogers and Webley (2001), for instance, report that 65% of the adult population in the United Kingdom regularly buys Lotto tickets. About half of the world's countries run (national) lotteries, with total revenues of about US-$ 115 billion in 1997 (Garrett, 2001). Other forms of gambling are left behind. For example, Camelot reports that draw-based games such as Lotto and Euromillions account for about 76% of the National Lottery revenue in the UK.[2]

Standard expected utility theory (EUT) cannot explain two important puzzles concerning lotteries: First, why do so many people play Lotto, and in particular, why is Lotto more popular than other types of games? The expected value of an investment in lotteries is lower than in many other games such as roulette or horse races. In the US, for instance, it is about -$0.47 for each dollar spent, on average (LaFleur and LaFleur, 2003). Clotefelter and Cook (1991) actually find that lotteries offer the lowest payout rate of any form of commercial gambling. Still, a typical British household loses about 80 pounds per year playing National Lottery draw games.

The second puzzling observations is that most people play each week with one or only a few tickets at a time. Once a decision to play is made in the first place, it would be much more efficient in terms of transaction costs to buy a much larger number of tickets for, say, one or two drawings each year. Furthermore, one could concentrate one's budget on those drawings that are more attractive, e.g. because of a high jackpot.

There are numerous attempts to resolve these puzzles - we will discuss several of them in the next section - but none of them can explain all behavioral regularities in lottery participation. This study takes up an explanation that we presume to contribute to the understanding of lottery participation. We argue that lotteries enjoy their high level of popularity because of positive anticipatory emotions (Loewenstein, 1987; Wu, 1999). Players in lotteries or at least most of them pay a price for a dream of possibly becoming rich. In other words, lottery players can 'cherish the hope' of winning a million in the time between buying a ticket and the drawing. Hence, players are willing to accept a lower expected value than in other sorts of gambling that are resolved on the spot. They get additional utility from the waiting period and, thus, prefer traditional lottery tickets over instant games. Further, assuming that pleasant anticipation cannot possibly last for too long and that its intensity is less-than-proportional to the stakes, regular play is preferred to an occasional splash out - the second puzzle thus being explained.

Our approach to analyze lottery participation obviously assigns an important role to the timing of the resolution of risk. If a substantial part of the consumption value that a dollar buys is before the actual resolution, immediate disillusion is not welcome. In other words, a person holding a lottery ticket may

[1] In the following we will focus our discussion on this type of lotteries, but many of our arguments and results also apply to other types of lotteries.

[2] Press release, May 26, 2009, available at http://www.camelotgroup.co.uk/pressreleases/2009/May/Endofyearsales2008-9.pdf

prefer a delayed resolution of risk. Note that the standard EUT model implies that immediate resolution is always (weakly) preferred. Hence, our approach leads to some more general insights into behavior under risk. Particularly, it could imply that for some gambles, positive anticipatory emotions lead to a preference for ignorance and, further, that these emotions are sufficiently strong to induce buying a lottery with very high variance and a strongly negative expected value.

In order to test our hypothesis, we devised an experiment that allows us to assess preference over the timing of resolution of risk in a controlled manner. Even though we sustain a high level of control by conducting the experiment in the laboratory, our experimental setup provides a realistic setting, because we use real lottery tickets as the experimental currency unit. More specifically, experimental subjects are offered lottery tickets for different drawings at different prices. Several questionnaires allow us to analyze anticipatory and experienced emotions before and after the drawings. This is obviously of importance, given the role that emotions play in our reasoning. While relying on self-reports is not entirely satisfactory, it seems the only workable way of obtaining data on the pattern of emotional reaction over the long time span that is involved in our experiment. To avoid misrepresentation of the data related to fallible memory and projection of current state, we asked our subjects to periodically report their emotions during the waiting period (see Kahneman, 2003) rather than to recall them after several hours.[3]

Our results indicate that, although many participants prefer lottery tickets for an immediate drawing rather than one for the subsequent day, a substantial fraction actually prefers delayed resolution. Some of them prefer delayed resolution even if they have to pay a small fee for it. The vast majority of our participants prefer a spread in consumption of lotteries, i.e. one on each of two days rather than both on the same day. Self-reported emotions experienced during the waiting period are predominantly positive - entries for hope and excitement are almost universally much higher than for anxiety and irritation - and anticipation of emotions is an important predictor of behavior. We may therefore conclude that we observe mixed support for positive anticipatory emotions as explanation of the first puzzle and full support for our explanation of the second puzzle mentioned above.

The remainder of the paper is organized as follows: Section 2 reviews some of the alternative attempts to resolve the puzzles found in the literature and discusses some of their problems. In Section 3, we present our theoretical approach and derive hypotheses for the empirical part of our study. Section 4 contains the experimental design, while Section 5 expounds our experimental results. A concluding discussion concerning the implication of our results is provided in Section 6.

[3]The details are described in Section 4.

2 Related literature

We have mentioned two puzzling questions in the previous section. There are several possible answers to these questions that have been proposed by economists and psychologists. Let us start with the question why people participate in lotteries at all, even though other forms of gambling would provide higher expected values.

2.1 Why to participate in lotteries?

The probably simplest answer to the puzzle is that people do not know or have a very biased perception of how bad the odds actually are. Rogers and Webley (2001), for instance, provide evidence that only about 1/3 of Camelot players in the United Kingdom know the probability of winning the jackpot.[4] However, from an economic viewpoint this is a weak argument, since the odds of winning can be found out at a very low cost, and we are not talking about inexperienced decision-makers. Most of the lottery players play every week, and they know how many people participate and how few actually win.

A similar argument is provided by Kahneman and Tversky (1974). They propose the existence of an availability bias in the context of lottery participation, because only winners or winning is discussed on TV or in other media. Again, one could argue that it is easy to learn the odds as well as expected values and that the average player is experienced.

Another line of reasoning is associated with cumulative prospect theory (Tversky and Kahneman, 1992) and other rank-dependent models (Quiggin, 1982). Without going into the details of these models and the discussion on decision weights or probability weighting functions (see, for instance, Starmer, 2000, for an extensive overview), one can summarize that all these models accommodate for the empirical fact that humans tend to overweight low probabilities (e.g., Wu and Gonzales, 1996). If this is the case, lottery participation may appear more attractive than it actually is. However, it is not entirely clear from this literature what probabilities are overweighted and what are ignored altogether (in the original formulation of prospect theory, the probability weighting function is not well-behaved near 0 and 1). Clearly, a probability in the vicinity of 10^{-7} is a good candidate for being ignored. Furthermore, it remains an open question what actually drives this overweighting: Is it primarily cognitively-perceptional as in the original Tversky-Kahneman formulation or perhaps affective? Behavioral consequences of these two cases may be rather different.

There are several other fallacies that could explain lottery participation, but they usually require some dynamic reasoning. Consequently, they cannot explain why people start to buy lottery tickets. One of these presumed biases, the gamblers' fallacy, implies that people think that the large win is 'due', because they have been losing for a long time (Clotefelter and Cook, 1993; Jarvik, 1951).

[4] Stearns and Borna (1995) find that providing players with information on the expected value decreases sales of lottery tickets.

Yet another is the 'near miss' fallacy (Reid, 1986). It often appears that one has missed the huge win only by a small margin. However, many gambles have similar characteristics, and the 'near miss'-idea is even more salient there than in Lotto (for instance, with scratch cards or one-armed bandits, where one often gets one identical image less than required for winning).

Another theory that helps explain why people continue to participate in lotteries, but fails to explain why they start at all, is regret theory. Crosbie (1996) reports that 67% of players choose the same numbers every week. Regret aversion postulates that lottery players think about how they would feel if they had stopped playing and their usual numbers would have won. Hence, there could be a strong force of inertia when it comes to continued participation in a lottery, but the same holds true for many other gambles.[5]

Several additional arguments may contribute to the popularity of lotteries, but all of them can only explain parts of the empirical phenomenon. Among them are peer pressure (many people participate in lotteries in teams), illusion of control (Langer, 1975) and wishful thinking (many people think that the combinations of numbers they choose are more likely to win than others), the fact that lotteries support charities or sports organizations and participation is, hence, perceived as a donation (Griffiths and Wood, 1999), or that lotteries create a form of entrapment (after one has lost money through buying tickets, he or she goes on to try to get it back through winning). Many of these arguments are, however, much more convincing in the context of sports bets, playing cards or roulette.

Finally, some would simply view lottery participation as being somewhat stupid. Stewart (1996) refers to lotto as a 'tribute to public innumeracy'. In line with this reading of it, lottery play is negatively correlated with education (Rogers and Webley, 2001). Nevertheless, its revenues have also risen dramatically over the last decades despite a general rise in the education level. In the Netherlands, for instance, yearly sales went up from 35 million guilders in 1964 to 638 million guilders in 1987 (Hermkens and Kok, 1990). Even if you take into account inflation and population growth, this is a considerable rise in sales. Wessberg (1999) estimates an annual world sales growth rate of 9% for the 1990ies. In other words, dismissing lottery play as stupid does not really help us understand its massive and increasing popularity.

Yet another argument in the discussion stipulates much higher levels of sophistication on the part of the players. Compared to other forms of gambling, lottery participation entails a relatively low level of addictive potential, and it usually does not involve high amounts of money at one point in time. Thus, somebody who perceives him- or herself as having self-control problems could easily set a rule with a certain number of lottery tickets each week and, there-

[5]Some gambles are even designed in a way that exploits regret aversion to the greatest extent. The Dutch Postcode Loterij (postcode lottery) chooses a Dutch post code each drawing. Anybody who bought a lot and lives in the drawn post code area shares the prize. This obviously creates a strong pressure out of regret aversion to buy the ticket for each drawing (see Zeelenberg and Pieters, 2004). Note that Dutch post code areas are usually very small and contain, on average, only eight addresses.

fore, sustain a much higher degree of self-control over him- or herself than for instance in a casino or at a horse track.

Probably, all of the above-mentioned arguments contribute at least in part to explain lottery participation. None of them, however, can explain why a considerable fraction of players does not prefer *instant* lottery games.

2.2 Why to play regularly?

Regarding the second puzzling question of why many people play each week with one or only a few tickets at a time, there are also several conceivable explanations.

First of all, some (i.e. the highest) prizes are shared. Hence, if someone owns several tickets for one drawing with overlapping numbers, he or she might have to, as it were, share the prize with him- or herself. However, for most lottery systems it is easy to come up with many different number combinations that rule out such a possibility. Second, overweighting of small probabilities would make participation in each drawing appear subjectively more attractive, as long as two tickets for two drawings are perceived as independent gambles but two tickets for the same drawing are not. In such a case, the sum of decision weights associated with the event of winning in each of the two drawings would be higher than the decision weight of the higher, but single chance of winning. It is difficult to say whether this is the way a typical player frames the situation, and the theories of decision-making under risk we are aware of do not seem to be very specific in this respect. Third, anticipated regret in connection with regret aversion dictates to play for every drawing if one consistently chooses the same numbers. However, other patterns (e.g., playing with different combinations of the digits of one's date of birth on this very date) that involve occasional play with many tickets could also be sustained by anticipation of regret. Fourth, sustaining self-control could be easier with a regular participation for small amounts than with betting on the high jackpots for higher amounts of money, but evidence on alcohol consumption suggest the reverse, namely that sales of small bottles facilitates falling prey to addiction.

A recent study by Haisley et al. (2008) deserves special attention. In their elegant field experiment, the authors show that people tend to buy more lottery tickets ('instants') when they make one purchase decision at a time (narrow bracketing) rather than all at once (broad bracketing). That is what they call 'myopic risk seeking'. However, in lotteries of the sort that we are discussing, the timing of purchase is logically independent of the timing of play, since one can buy tickets for the same drawing on several occasions or many tickets for different drawings at once. Myopic risk seeking would dictate that the former is attractive while the latter is not. Our intuition is that these predictions are not correct, though we are not aware of a data set permitting verification.[6] Inter-

[6]Playing by subscription (direct debit from a bank account) in the Camelot lotteries is one example of a one-time decision to play regularly. While only half a million players used it in the first half of 2008, this is not a clear rejection of the conjecture, because the low number is probably due to the fact that the service has only been introduced recently. The sales via this

estingly, the findings by Haisley et al. (2008) seem to suggest that a difference in the timing of resolution is not necessary in order to consider two identical gambles separately. This actually exacerbates rather than explains our puzzle.

Empirically, surprisingly little is known about the preference for timing in lotteries. Oster (2002) provides evidence that Powerball lottery sales increase as the drawings (conducted on Wednesdays and Saturdays) approach. About 8% of the tickets is being sold as 'futures' (i.e. not for the nearest drawing). On the face of it, this suggests that most players dislike an extended waiting period, but there are many possible of confounds in the field such as, for instance, procrastination of purchase. Most importantly, however, suppose somebody plans on Monday to buy a ticket for the drawing on Wednesday. Then, perhaps she or he does not have to actually hold the ticket to enjoy the anticipation. Besides, drawings differ in terms of expected return because of changing jackpots and numbers of participants.

In contrast, Mittone and Savadori (2008) provide laboratory evidence that decision-makers tend to prefer outcomes with high values and low probabilities more strongly, the more these outcomes are postponed. Their findings are in line with the savoring hypothesis and confirm previous laboratory results based on hypothetical decision by Lovallo and Kahneman (2000).

3 Theoretical approach and hypotheses

In this section we elaborate on our main claim that participation in lotteries is affected by anticipatory emotions. More specifically, players are taken to enjoy waiting for the resolution, as their dream of becoming rich prolongs. Two models in the economics literature seem suited to account for such anticipatory emotions: Caplin and Leahy (2001) and Wu (1999). Formally, a decision-maker chooses at time $t = 0$ between having the uncertainty connected to a lottery play resolved at $t = 0$ or $t = 1$. Let us denote the random variable representing possible outcomes of the lottery play by Y. In the perspective of Caplin and Leahy's (2001) model of anticipatory anxiety, the induced expected utility function of a decision-maker choosing to play at time t ($t = 1, 2$) is given as:[7]

$$U(t) = u_1(a(Y, t)) + E[v(Y)], \tag{1}$$

where $a(Y, t)$ captures anxiety (or, more generally: all anticipatory feelings) associated with the gamble given timing of resolution t. Without loss of generality we can assume that $\frac{\partial u_1}{\partial a} < 0$. Now the timing of resolution affects utility only via the term capturing anticipatory feelings. Specific predictions can only be made if further assumptions are imposed on this relatively unstructured general model. One such assumption made by Caplin and Leahy is that anxiety decreases in mean and increases in variance of the risk to be resolved in the

channel soared by 32% (while total sales only went up by 7.6%), suggesting that its potential has not been realized yet.

[7] See Caplin and Leahy (2001), p. 67f. Note that there is no consumption in the first period in the situation under consideration. We thus consider a single-argument function u_1.

future. Because negative anticipatory emotions can be avoided through immediate resolution, a straightforward conclusion is that immediate resolution will be preferred. However, the very premise that variance of future payments is necessarily aversive, seems difficult to reconcile with the participation in lotteries in the first place.

When deciding on the allocation of *two* tickets, a decision-maker behaving in line with the model will again prefer the option yielding the lowest future variance of outcomes. Thus a "spread" will be preferred if and only if the first ticket has already been allocated to the later date.

In the approach proposed by Wu (1999) delay of resolution may affect preferences via distortion of probabilities. Positive or negative anticipatory feelings are modeled by having the probability weighting function reflect the fact that cognitive attention devoted to future outcomes may be disproportional to their likelihood. This approach corresponds with the well-founded claim that anticipatory feelings respond to the mere possibility (rather than probability) of an outcome. Thus, it might overweight low-probability events. The approach is also related to 'temporal construal' theory proposed by Trope and Liberman (2003) where temporal distance facilitates thinking in terms of 'what' (the essence) rather than of 'how' (the technical details).[8]. Under the assumption that the outcome of a gamble is the matter of 'what' and the probability is the matter of 'how', the theory predicts dampenening of sensitivity to probability changes with delayed resolution. Lotto play results in a simple temporal lottery resolved at $t = 0$ or $t = 1$. For simplicity, assume that only two outcomes are possible: a player wins the jackpot J with (low) probability p and nothing otherwise.

Preferences for lotteries may, under assumptions made by Wu (Axioms 1-6), be represented by a strictly increasing value function v and a probability weighting function $f : [0,1] \times \{0,1\} \rightarrow [0,1]$, such that utility of a simple temporal lottery resolved at t is given by:

$$U(t) = f(p,t)v(J), \tag{2}$$

whereby $f(p,0) \equiv p$ and $f(p,1)$ is continuous and strictly increasing in p with $f(1,1) = 1$ and $f(0,1) = 0$.[9]

Following the logic of the paper we shall assume that for longer waiting periods, probabilities are more distorted. More specifically, the probability weighting functions are assumed to be sub-additive (Tversky and Wakker, 1995) and the more so the more resolution is delayed, at least up to a certain point in time. This means that the possibility effect is stronger with delayed resolution, i.e. low probabilities are heavily overweighted. More precisely, the assumption implies that $f(p,0)$ and $f(p,1)$ cross only once in the interval $(0,1)$, such that

[8] For example, when thinking about moving to another city *scheduled for next year* we may picture it as a start of a new life, whereas if it is *next week* we will likely dwell on packing our belongings, terminating the cable TV contract etc.

[9] While in Wu (1999) the probability weighting function is the identity function when resolution is immediate, in view of the available experimental evidence, we do not impose this restriction.

$f(p,0) < f(p,1)$ for p smaller than some p_0, and $f(p,0) > f(p,1)$ for p greater than p_0. Assuming that the probability of winning a jackpot is lower than p_0, we immediately see that delayed resolution of risk is preferred. In other words, the decision-maker mentally overweights the unlikely event of winning the jackpot by paying too much time and attention to it when resolution is delayed. Based on this approach we can thus formulate our following main hypothesis:

Hypothesis 1 *We expect a non-negligible fraction of decision-makers to exhibit and anticipate positive anticipatory emotions leading to a preference for delayed resolution.*

Because of subadditivity, if one is offered several identical lottery tickets for different drawing dates with the same expected value, one should have a preference for spreading the days of drawing (assuming that tickets for the same drawing are bracketed together as a single, greater chance).[10] This provides us with our second hypothesis.

Hypothesis 2 *We expect to observe that subjects spread their offered tickets over different drawings.*

4 Experimental design and lab procedure

Our experiment consisted of two separate sessions on two consecutive nights. For the first session, subjects were invited to come at 20:45 and received written instructions (see Appendix A). They were informed that the decisions they were supposed to make were connected to lottery tickets and made familiar with the rules of the Dutch version of Lotto. The instructions explained that each subject obtains a provisional endowment of 40 euro and is supposed to buy a 7-in-1 kind lottery ticket either for the drawing taking place on the same night or the following night.

This choice of timing was made under each of three conditions: 1. Both tickets cost euro 7.-; 2. The ticket for the first night costs euro 7.-, and the ticket for the second night costs euro 6.90; and 3. The ticket for the first night costs euro 6.90, and the ticket for the second night costs euro 7.-. Subjects had to indicate a preference or indifference for each of the three conditions. Immediately after the decisions, one of the conditions was randomly selected by the computer (independently for each subject), and the experimenter distributed the appropriate tickets.

Next, if less then half of the tickets had been distributed,[11] subjects were informed that there were still tickets available and that they were expected to buy another one. A new sheet of instructions (see Appendix A) was distributed. This time only one condition (both tickets cost euro 7.-) was offered in order to simplify the allocation procedure. The instructions also explained that numbers

[10] We are assuming here that subadditivity is sufficiently strong relative to the difference between the weighting functions.

[11] We made sure that this would be typically the case, and it indeed was in every session.

on the tickets were chosen in such a way that no two tickets had more than four numbers in common. This implies that there was no risk of having to share the prize with oneself, and we emphasized that in the instructions. Thus, any ticket had exactly the same expected return, no matter whether a particular participant had one or two tickets for a given drawing. It also meant that there was no chance to play with the same set of numbers on two different days.

After all participants had made their decisions, a short questionnaire was distributed, asking subjects to rate (on a seven-point scale) several potential motivations in terms of their importance for the individual choice of timing of the drawings. It included questions regarding emotions, planning motives and price perception (see Appendix B). In the meantime, the experimenter publicly distributed, in a randomized order, the second round of tickets, in accordance with individual preferences as long as possible (this procedure was announced before the decision on the second ticket). That is, after one type of tickets for one of the two drawings was gone, all remaining participants obtained tickets of the remaining type, regardless of their preferences. Since the initial parts of the experiment took a bit more than half an hour, there were just a few minutes left until the time when drawing results are posted by De Lotto (21:30).

Subsequently, another short questionnaire (provided in Appendix B) was distributed, concerning anticipatory emotions experienced before the resolution. It included the following set of emotions: happiness, anxiety, hope, sadness, irritation, excitement, curiosity, disappointment, confidence and regret.[12] These had to be rated in terms of intensity on a scale from 1 to 7. Upon finishing this questionnaire, participants were asked to look at the results of the drawing on the De Lotto website in order to find out how much they had won. Immediately after checking the website, they filled in a questionnaire on experienced emotions. It contained the same set of emotions as in the questionnaire on anticipatory emotions. Individuals who did not have any tickets for the drawing on the first evening were (instead of filling in the two questionnaires and inspecting the results) asked to fill in a Sensation Seeking inventory (Arnett, 1994).

At the end of the session, take-home sheets were distributed. Figure 1 gives a sample of such a take-home sheet. It asked for the intensity of certain emotions related to the drawing and allows us to follow the development of these emotions over time until the second drawing. Each subject received five such take-home sheets for the following time periods: (i) the time after the experiment and before going to bed, (ii) the morning of the next day until noon, (iii) noon next day until 15:00, (iv) 15:00 next day until 18:00, and (v) 18:00 next day until the start of the second experimental session. Participants were sent SMS reminders at the end of each reporting period specified in the take-home sheets.[13]

[12] In order to facilitate understanding, all terms were provided in English and in Dutch.

[13] This is akin to experience-sampling methods (see De Vries, 1992). The method reduces possible recollection biases associated with one-time reporting of a longer period. We cannot guarantee that all subjects filled in the forms when asked to do so. However, they were explicitly asked and paid for doing it. Further, in any case we can assume that most carried them during the day (at the end of which, in the second session, they were supposed to hand them in), such that they were constantly ready to be used. Furthermore, a vast majority reported having received the SMS reminders. Finally, reported times of filling in and informal

BETWEEN THE TIME I WOKE UP AND 12 NOON WHEN THINKING ABOUT THE COMING DRAWING…

(Time of filling in):	not at all very much							Can't recall	
	1	2	3	4	5	6	7		
… I was hopeful (hoopvol)									I did not think about the drawing at all:
… I was excited (opgewonden)									
… I was irritated (geirriteerd)									
…I was anxious (ongerust)									
… I was curious (benieuwd)									
…I was ……..									

I got the SMS (please circle): YES NO

Figure 1: Sample take-home sheet

Before dismissing subjects we reminded them to bring their lottery tickets back for the second session for inspection (such that they could not cash them in the meantime). This procedure avoids any confounds with simple time preferences over monetary income, because subjects were aware of the rule before they decided about their preferred drawing days. The whole first session took about an hour.

The second session started at 21:20 on the following evening and lasted only for about 25 minutes. First, take-home sheets were collected. Then, the before-resolution questionnaire, inspection of the results and the post-resolution questionnaire (or the Sensation Seeking inventory for participants with no tickets for the second drawing) followed as in the first session. A short final questionnaire (see Appendix B) including items related to individual gambling practices as well as demographic characteristics was filled in by the subjects, after which participants obtained their cash payments of whatever was left of their endowment, topped by an additional euro 5.-, provided they had filled in the take-home sheets. Figure 2 summarizes the entire procedure of the experiment and the order of events.

The experiment was conducted at the CREED laboratory in Amsterdam in

conversations with some participants after the experiment suggests that most subjects did actually fill in most fields when instructed to do so. Two different orders of emotions were used, but there was no significant order effect. Actually, averages were remarkably close, and the lowest p-value for the five ranksum-tests was around 0.5.

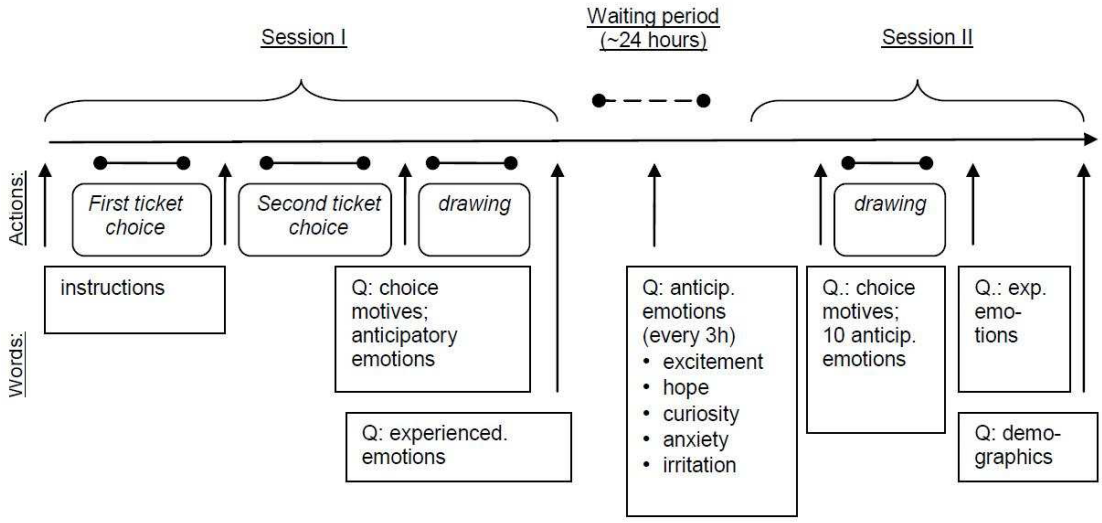

Figure 2: The order of events

September-October 2008. A total of 65 student subjects participated in three double-sessions (one of them failed to show up for the second session). 51.6% of them were male, and the mean age was 23 years. Earnings averaged about euro 32.- per person in cash, on top of which every participant received two lottery tickets of nominal value of euro 7.- and an expected value of about euro 3.40 each. The actual winnings from the two tickets ranged from 0 to 30 euro with an average of about 4 euro.

5 Experimental results

We first present general preferences for the first lottery ticket (section 5.1), then preferences for the timing of the second drawing (section 5.2). Finally, we analyze the impact of anticipatory emotions on choices and take a closer look on the consistency of emotions and choices over time (section 5.3).

5.1 General timing preference for the first lottery ticket

Early resolution is preferred by a relative majority of subjects, but clearly not by everyone. As indicated in Table 1, when prices are equal, 41.5% opt for immediate resolution, 21.5% for delayed resolution, and about one third is indifferent. The price has a substantial impact on buying decisions, but does not rule out other motives. Only 66.2% and 69.2% buy the cheaper ticket, when it is the ticket for tomorrow or for tonight, respectively.[14]

[14]Note that the expected value of a ticket is around euro 3.40. Hence euro 0.10 is about 3% of the expected value.

Table 2 presents a logistic regression that takes into account each of the three decisions a subjects takes under the three conditions. Today is coded 0, tomorrow is coded 1, and indifferent choices are dropped. The regression includes dummies for two of the three conditions, anticipated emotions when deciding on the preferred tickets (on a seven-point intensity scale) and other questions that are presumed to be important for timing but actually are not. Standard errors are adjusted for clustering on the individual level. Figures in Table 2 are odds ratios to facilitate assessment of the strength of the effects (recall that smaller-than-one odds ratios correspond to negative coefficients). Obviously, prices play a dominant role. However, in addition to prices two anticipated emotions are important: thrill[15] increases the chance of a preference for delayed resolution, while curiosity decreases this chance. Planning motives, 'lucky days' or 'psychological preparation' for the drawing do not influence the timing decision. Our results confirm that prices and anticipatory emotions play the main roles in determining choices. The comparison of the three models shows that the odds ratios are very stable.

Table 1: *Timing preferences for the first ticket*

Equal prices	Frequency	Percent
Today	27	41.54
Indifferent	24	36.92
Tomorrow	14	21.54
Total	65	100.00
Tomorrow 10 cent cheaper	Frequency	Percent
Today	13	20.00
Indifferent	9	13.85
Tomorrow	43	66.15
Total	65	100.00
Today 10 cent cheaper	Frequency	Percent
Today	45	69.23
Indifferent	11	16.92
Tomorrow	9	13.85
Total	65	100.00

We added several socio-demographic variables such as age, gender and field of study, but none of them turned out to be significant. The same holds true for two variables regarding individual gambling and lottery participation of subjects that we took from our final questionnaire. More generally speaking, we do not observe any differences in behavior between regular gamblers and/or lottery players and others in our experiment.[16] It is, however, comforting to note that

[15]Thrill was highly correlated with hope.

[16]Half of our participants report that they never play lotteries and a further 28.1% do that very rarely. Answers are similar for other sorts of gambling, only card games are somewhat

anticipatory emotions variables remain highly significant, regardless of which variables are added.

Hence, we can confirm that anticipatory emotions play a significant role in preference for delayed resolution of the lottery risk.

Table 2: *Timing preferences for the first ticket: a logit regression*

Dep. var.: tomorrow = 1	I	II	III
Today cheaper	0.39**	0.35*	0.32**
	[0.18]	[0.19]	[0.19]
Tomorrow cheaper	6.38***	8.85***	8.62***
	[2.80]	[4.77]	[4.84]
Anticipated thrill	x	1.29**	1.33**
	[0.14]	[0.18]	
Anticipated anxiety	x	1.19	1.22
		[0.16]	[0.16]
Anticipated curiosity	x	0.68***	0.68***
		[0.07]	[0.07]
Bargain buyer	x	x	1.14
			[0.10]
Prepare for drawing	x	x	0.90
			[0.14]
Not in mood today	x	x	1.10
			[0.12]
No. of observations	151	151	151
Pseudo R^2	0.22	0.30	0.31

Note: The columns show estimated odds ratios of the logistic regression with their corresponding standard errors adjusted for clustering on the individual level in parentheses. The symbols *, ** and *** indicate statistical significance at the 10%, 5% and 1% level.

5.2 Preference for the second lottery ticket

As predicted by the model that takes anticipatory utility into account, we observe a large fraction of spreading across the two drawings. Around 70% of the subjects want tickets on two days rather than on one ($p < 0.001$; binominal test). Only a small number of participants is indifferent between spreading and pooling. Table 3 provides an overview of the results.

Admittedly, it is difficult to disentangle whether subjects prefer to spread the drawings because of the joy of waiting for the drawing or because they expected to get a boring task while others inspect the results of the drawing in the laboratory. Indeed, both motivations seem to play a role. In the questionnaire

more popular. It appears, therefore, that the possibilities to identify behavioral differences between players and non-players are limited.

we asked for them and obtain a mean of 3.7 (on a seven-point scale from 'strongly disagree' to 'strongly agree') for the expectation of a boring task, but an even higher mean of 4.0 for the question regarding the joy of experiencing the drawing twice. We take that at least as weak confirmatory evidence for our second hypothesis.

Table 3: *Timing preferences for the second ticket*

Day 1 = today; Day 2 is...	Frequency	Percent
Today	6	18.18
Indifferent	4	12.12
Tomorrow	23	69.70
Total	33	100.00
Day 1 = tomorr.; Day 2 is...	Frequency	Percent
Today	23	71.88
Indifferent	4	12.50
Tomorrow	5	15.63
Total	32	100.00

5.3 Anticipatory emotions during the waiting period

Figure 3 presents an overview of average anticipatory emotions from the take-home sheets that we created to follow emotions between the drawings.

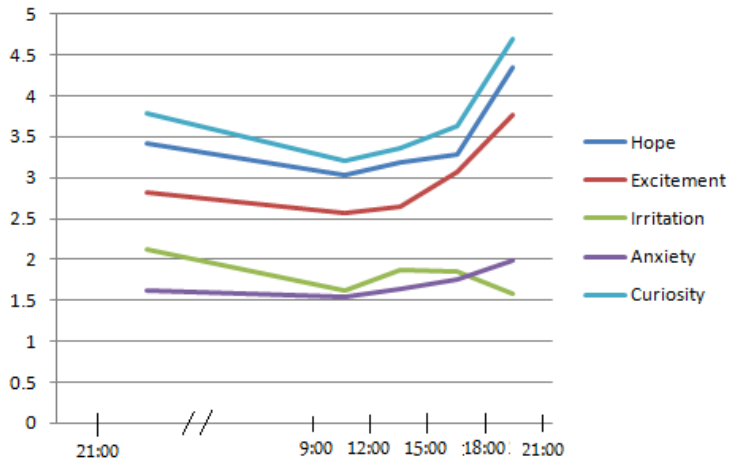

Figure 3: Mean anticipatory emotions over time

Note: If subjects ticked 'I did not think about the drawing at all', this is coded as the emotion being least intense (= 1).

Expectedly, scores for the negative emotions irritation and anxiety are small and do not develop much over time. In contrast, the positive emotions hope, excitement and curiosity follow a U-shaped or J-shaped pattern and score much higher. Hence, positive emotional arousal is high just after the first experimental session, drops over time, but picks up again a few hours before the second session. Notably, the intensity of positive emotions is significantly higher over the last hours before the second session than right after the first session. The high overall intensity of positive emotions is quite remarkable, given that we 'forced' experimental subjects to buy lottery tickets.

One interesting question is whether actually experienced anticipatory emotions were correlated with the declared 'emotional' choice motives. For example, is someone who was leaning toward delayed resolution because of the expected hope and thrill likely to actually report such emotions? Indeed, we find some evidence for such congruence. More specifically, we have aggregated the data on recalled emotions by adding up the entries along the temporal dimension and correlated our general measures of four emotions (hope, anxiety, curiosity and excitement) with their counterparts among the choice motive questions.

Table 4: *Correlation of emotions during waiting and expected emotions*

	Expected emotions			
Emotions during waiting	Hope	Anxiety	Curiosity	Thrill
Hope	0.265*	-0.075	0.057	0.247*
Anxiety	-0.038	-0.096	-0.113	0.031
Curiosity	0.156	-0.016	0.044	0.132
Excitement	0.101	-0.106	-0.091	0.191

Note: * indicates statistical significance at the 10% level.

We see in Table 4 that expected thrill correlates mostly with experienced hope and excitement, while hope correlates with experienced hope, curiosity and excitement. Though most of these correlations are not significant on standard levels (and only 2 out of 16 are significant at the 10% level), one gets the general impression that subjects expecting positive emotions did actually experience them when they went for a later resolution. However, we do not see much evidence for the counterfactual, i.e. that subjects who actually preferred earlier resolution tended to experience more negative emotions during the waiting period.

6 Concluding discussion

Our experiment was designed to verify the hypotheses that the popularity of Lotto-type lotteries and the fact that most players only buy one ticket at a time are driven by players' expectations of positive anticipatory emotions experienced while waiting for the resolution. Indeed, considerations of these emotions make the traditional sort of lotteries a particularly attractive form of gambling.

Our results yield support for our main hypothesis, at leaset for a non-neglibible subset of our subjects. First, we find that a sizable fraction of participants indeed prefers delayed resolution of risk in a situation where such motives as differences in transaction costs or characteristics of a particular drawing were ruled out. Second, a vast majority prefer to consume the chances of winning one at a time. Third, our subjects point at 'thrill' that they expect to enjoy while waiting as an important drive for choosing delayed resolution. Fourth, they indeed self-report predominantly positive emotions during the waiting period and, fifth, there is some link between reported affect-related choice motivations and the actually experienced anticipatory emotions, suggesting that subjects were, to some extent, able to predict their emotions correctly.

One of the more direct implications of our findings is that they provide a hint for the behaviorally optimal design of gambling schemes from the viewpoint of lotteries. In particular, it is possible that there is still a market for non-lotto games with delayed resolution. Furthermore, in view of the observed tendency to 'spread', organizing the drawings twice rather than once a week could be profitable - a trend actually observed in many countries. More generally, our study is yet another piece of evidence that anticipatory emotions play a role in decision-making under risk. Importantly, earlier accounts tended to focus on the negative affect of anxiety (e.g., Noussair and Wu, 2006). Our findings suggest that positive anticipatory emotions may be as important in risky contexts as they are elsewhere (Loewenstein et al., 1987), but making delayed resolution an advantage. Aside from lotteries, economists are beginning to appreciate the role of suspense in other domains. As potential examples, sport contests (cf. Chan et al., 2009) and films come readily to mind.

Some caveats are in place. First of all, as emphasized before, we observe that only a minority prefers delayed resolution of risk when choosing the first ticket. While this is in our view an interesting finding and clearly a violation of standard theory, it seems to suggest that the consideration of positive anticipatory emotions alone cannot account for the massive lottery play in some countries. However, it has to be stressed that we have used a sample of students, who were generally inexperienced with Lotto. We speculate that our subjects were less able to predict and appreciate the anticipatory emotions associated with holding a ticket. Further and perhaps more importantly, students tend to have more analytical skills and formal education than a typical lottery player. Actually, a considerable fraction of our participants were economists, who are explicitly trained to think in terms of expected value maximization rather than to follow their intuition about the more subtle fabric of one's own future emotional states. Therefore, we probably are underestimating the true size of the effects. Clearly,

it would be of interest to re-run a similar design with actual lottery players. Unfortunately, De Lotto suspended the daily drawings as of January 2009. Our preferred interpretation of the fact that we only observe a minority choosing delayed resolution is, however, that 'paying for a dream' is just one out of a few important motivations to buy lottery tickets. More research is necessary to assess the particular weights of these alternative explanations.

Second, as mentioned before, our findings of a predominant preference for spreading the chances over two days might have partly been driven by the anticipation of a more boring task for the night on which, in the absence of spreading, no drawing was to take place. However subjects were aware that checking the results would take only minutes and sessions are generally short; thus, the fear of boredom is unlikely to be a strong force in our experimental design.

Appendix A: Instructions - not for publication; will be made available online

[These instructions were accompanied by and refer to a screenshot that is not reproduced here to save space]

Welcome to this experiment on decision-making.

In the experiment, participants will earn cash (paid at the end of the second session tomorrow - you have to participate in both sessions) and lottery tickets of Lotto.

We will first explain how Lotto works. You can play Lotto every day (rules are different on Saturday). You can buy a lottery ticket for 1 Euro, on which 6 numbers between 1 and 45 are selected. Just before 9.30 PM, 39 out of 45 balls numbered from 1 to 45 are drawn. Look at the screen-shot below which shows the results of one drawing:

If you happen to have on your lottery ticket the first 6 numbers that were drawn (that is: 11, 13, 21, 28, 36 and 37) - you win a million euro (possibly shared with other lucky winners). If your 6 numbers are among the first 7 that were drawn (e.g.: 1, 11, 13, 28, 36 and 37) - you win 25 thousand euro (possibly shared), and so on. If your numbers are the six not drawn (see bottom row) - you win 10 thousand euro (possibly shared). Prizes lower than 10 thousand euro are not shared. Sometimes you win a coupon for a new lottery (called "Speltegoed"; see bottom-right of the screen-shot). All in all, you win something in about 40% of the cases. You can cash low prizes at any shop where they sell tickets. If you win a higher prize,

you have to contact De Lotto on 0900-0202.

Now, in this experiment you will be rewarded with a special type of lotto ticket, "Lotto Systeem", which is essentially a 7-in-1 kind of ticket. Seven numbers are printed on your ticket and you play with every combination of 6 of them.

How to check how much you have won with a Lotto Systeem ticket? There are two ways; you can use the one that seems easier (e.g. if you like Method 1, you do not even have to read about Method 2.)

Method 1: On the lotto website, choose from the menu "Trekkingen" option "Wat heb ik gewonnen". You will then have to fill in six numbers from your ticket (leaving out one), choose appropriate date and click "toon de uitslag". You will then see how much you have won ("geen prijs gevallen" means no prize at all). Click then at "opnieuw", fill in six numbers leaving out another one and so on. Check all seven combinations, adding up your winnings.

Method 2: From the menu "Trekkingen" choose "Bekijk de trekkinguitslag", which will give you a screen similar to the one presented above. If 6 of your numbers were never drawn (i.e. are the six in the bottom row), you win 10 000 euro. If not, find the last two of your balls to be drawn (or not drawn at all). E.g. if your numbers are 8, 20, 21, 28, 33, 36 and 44, then the last one is 20 (not drawn at all) and the second last (drawn as the 18th ball) is 33. Your earnings are equal 6 times the prize above your last ball plus 1 time the prize above your second last ball. Here, there is no prize above ball number 20 and there is a prize of 10 euro above the ball number 33, so you receive 6*0+1*10=10 euro. (Note that it means that you win nothing if 2,3,4 or 5 of your balls were not drawn).

Because a "Lotto Systeem" ticket (from now on simply called "ticket") is a kind of 7-in-1 ticket, it sells in shops for 7 euro.

We have two types of tickets on stock for the purpose of this experiment: some for the drawing that will take place tonight and some for the drawing of tomorrow night. Note that available prizes and corresponding chances to get them are identical for every drawing.

For a start, you receive a provisional endowment of 40 euro. (on top of that, every participant will earn 5 euro provided he or she completes a simple take-home task, which will be explained later).

We will ask you to buy from us a ticket of your choice: either one for today or one for tomorrow. In either case, you will see the results of the drawing immediately after they are posted - either during this session or during the session tomorrow. And, in either case, you will be allowed to cash your tickets only after the second session - you can take your tickets home but, even if your drawing takes place tonight, you have to show us the ticket tomorrow in order to get your cash earnings.

There are no correct or incorrect choices - just indicate your personal preference.

You have to make a choice between buying a ticket for tonight and buying a ticket for tomorrow under three conditions: 1. both tickets cost 7 euro; 2. a ticket for tonight costs 7 euro, a ticket for tomorrow night costs 6.90 euro; 3. a ticket for tonight costs 6.90 euro, a ticket for tomorrow night costs 7 euro.

After you have made your choices, one of these three conditions will be randomly chosen by the computer and you will buy the ticket of your choice for the corresponding price.

Please raise your hand if you have any question. Otherwise, click on the button on your screen to make your choices.

Instructions sheet 2 [handed out upon completion of the first part of the experiment]

Because it turns out that there are some tickets left, **we shall ask you to buy another ticket.**

We would like to know on which day you would like to have the drawing for this second ticket - tonight or tomorrow night. We will sell the tickets in accordance with your choices, unless we run out of tickets of a given type - it might then happen that you receive a ticket for the day you did not prefer. A dice roll will determine the order in which the tickets will be assigned (A1,, A10, B10, , B1, C1, , C10 or the opposite). Note that each pair of tickets we have on stock will have at most 4 numbers in common. This means that if you have two tickets for the same day, you cannot have 6 numbers on both tickets corresponding to numbers on the first 6 or 7 balls that are drawn, in which case you would have to, as it were, share the prize with yourself. Consequently, each ticket gives you the same chances for same prizes, no matter whether you have one or two tickets for a particular day.

There are no correct or incorrect choices - just indicate your per-

sonal preference.

This is the last choice you are asked to make during this session.

Please raise your hand if you have any question. Otherwise, click on the button on your screen to make your choices.

Appendix B: Questionnaires - not for publication; will be made available online

Post-decision questionnaire - motives for choices

You may have had several different reasons to choose between the tickets to buy the way you did. For each of the reasons mentioned below, please indicate on the attached scale (randing from 1="not important at all"to 7="very important") how important this reason was to you when you were choosing the day for YOUR FIRST TICKET (in three conditions). Note that there are no correct or incorrect answers - we are just interested in your personal opinion.

- I thought I would enjoy the excitement of anticipating the possible winnings, and therefore preferred to have the drawing tomorrow.
- I though I would worry about the possibility of not winning anything and wanted to get over it as soon as possible.
- I was courious how much I might win and wanted to find out as soon as possible.
- I thought I would cherish the hope of winning a considerable amount of money; therefore, I preferred to have the drawing later.
- I thought I would enjoy seeing the results of the drawing and thus did not want to wait for it.
- I simply wanted to buy a ticket for a possibly low price [bargain buyer]
- I wanted to have time to get into the right mood before the drawing, thus preferred tomorrow's drawing.
- I don't feel like thinking about such things tonight, so I preferred tomorrow's drawing.

- I tried to choose the day on which I though I would enjoy seeing the results of the drawing most.
- I simply followed my intuition about which day may be my lucky day
- I simply followed my intuition about which day may be my lucky day
- I wanted to know as soon as possible how much I would win to be able to better plan possible expenses (I could start spending more tomorrow morning if I knew I won a considerable sum of money).
- Regardless of what had been said in the instructions, I thought there were differences between the probabilities of winning on different days and chose the days on which I am most likely to win a lot.
- Other reason

And now, please answer the questions REGARDING YOUR CHOICES FOR THE SECOND TICKET. For each of the reasons below, please indicate how important it was to you when you were thinking how to choose between the tickets. Note that there are no correct or incorrect answers - we are just interested in your personal opinion.

- It seemed to me that I was more likely to win a lot if I had two tickets for the same day, rather than separate days.
- It seemed to me that I was more likely to win a lot if I had two tickets for separate days, rather than same day.
- I wanted to enjoy the drawing twice, thus preferred the second ticket to be for a different day than the first ticket.
- I thought it would be boring not to have a drawing on one night, so I preferred to have one ticket for each night.
- I don't enjoy lotteries, so I didn't want to play in two of them
- I preferred two tickets for the same day because only then it would start to be fun.

Questions before the resolution

In a few moments you will the results. Now, we would like you to rate several emotions related to the drawing. In each case you will have to indicate with what intensity you are at the given moment experiencing these emotions. There are no correct or incorrect answers. Do no spend too much time thinking. Just choose the answer that reflects best how you feel.

- I am happy (blij)
- I am anxious (ongerust)
- I am hopeful (hoopvol)
- I am sad (verdrietig)
- I am irritated (geirriteerd)
- I am excited (opgevonden)
- I am curious (benieuwd)
- I am disappointed (teleurgesteld)
- I feel confident (vol vertrouwen)
- I feel regret (spijt)

Questions after the resolution

You have just witnessed the drawing. How do you feel now having seen the results of the drawing? [1-7 scale from "not at all" to "very much so"]

[same questions as before the drawing]

[at the second session: same questions]

Take-home sheets

In this sheet, you are asked to record emotions related to the drawing taking place during the second session (ignore it if you have no ticket for this drawing) The time between the sessions (except for the night) has been divided into periods. For each period and each of the following emotions -hope, excitement, irritation, anxiety and

curiosity - please indicate, the strongest intensity that you experienced within this time period, by putting an X in the appropriate field. We would like you to fill in every table at the end of the relevant period - thus the first one before going to bed tonight, the second one at about 12 noon tomorrow and so on. Please note the time when you fill each table in. We will send you SMS reminders at the end of each period (except for the first one and the last one). There are no correct or incorrect answers - we are just interested about your personal feelings. For each time period you can also indicate an additional emotion (not included in the list) that you were experiencing. If you don't know or cannot recall, choose the last column ('Can't recall.') If you did not think about the drawing at all in this period (perhaps until we sent the SMS), only put an X in the field in the bottom right corner of the table, leaving the rest empty. Also please for each period indicate whether you actually got an SMS reminder from us. [for the table – see figure in the main text]

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