

How Buyers Evaluate Temporally Displaced Cost Options

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Introduction

In many commercial settings it is common for a seller to wish to persuade a buyer to make a purchase some time ahead of the latter's expected requirement. For consumers this may take the form of a simple 'buy one get one free' promotion at the supermarket, or a sale advertised in the press where the 'offer must end this Friday'. The same tactics are employed in industrial business-to-business transactions where there is often pressure on the seller to achieve monthly or quarterly sales targets. In all these cases the prospective buyer is making an evaluation and subsequent choice between two or more temporally displaced alternative options.

From the seller's perspective an early commitment on the part of the buyer yields several benefits. The company is able to increase its revenue and so improve profitability in its current accounting period and to simultaneously remove any risk that the seller will buy from the competition, or the requirement will disappear or reduce during an intervening period. For industrial goods there may also be associated operating costs that will provide additional revenue for the supplier, such as spare parts, support charges or the supply of ancillary services, and an early purchase will mean that these income streams start sooner.

For the buyer, in most cases the major benefit will be the potential to obtain a lower price. However, a key factor is when the buyer can reap benefits from the purchase because this will impinge on his choice. For industrial purchases, early availability may not bring forward benefits because these are linked to a future need or project, and owning the goods early may actually incur costs such as storage and the operating costs described above. For consumer purchases the timing of benefit will often be more complex because the transaction may be motivated more by a desire rather than a need and early ownership will therefore be attractive. The disadvantages to the buyer essentially mirror the seller's benefits described above, so that associated incremental costs and the risk of a change in requirements that renders the goods unwanted must be taken into consideration.

It is clear that a number of factors must be considered by both the seller and the buyer when the respectively make such an offer and choose whether or not to accept it. This must reflect too, any constraints on the transaction such as physical availability of the goods at an earlier time and the forgone opportunity cost to the seller of an alternative sale at a higher price to a different buyer. Many purchases are of perishable goods and services which cannot be

stored or whose delivery cannot be temporally displaced. Obviously some foodstuffs must be sold before their quality declines, but the same consideration applies to services such as a seat at a concert or a train journey, where unused capacity cannot be stored and used later. In situations like this, the seller has a very strong motivation to change buyer's behaviour and pricing is varied dramatically according to a dynamic balance between demand and supply.

These general considerations are highly dependent on the nature of the goods in question and associated industry practice in the relationship between seller and buyer. The Enterprise Software industry, including products such as ERP systems, Database, Security Applications and Integration Tools, is particularly prone to this sort of situation because of a number of unique characteristics of the product.

- a) Costs of development and production of software are almost entirely fixed, and the incremental cost of producing an extra copy is close to zero. In fact, the customer purchases a license to use rather than any tangible asset. This means that the impact on the seller's financial performance of additional revenue in the current accounting period is manifested almost completely as pure profit. The seller's incentive is therefore greater than when physical goods are involved.
- b) Physical distribution and manufacture of software do not place constraints on availability. Often the customer will simply download the software from a web address and apply a license key to unlock the program. This means that there are few logistical constraints to a deal being struck at short notice and fulfilled very rapidly.
- c) These products are normally licensed on a per-user or per-server basis, so that the user's requirements are likely to increase over time. For example an ERP system might be implemented in head office for 50 users before being rolled-out to divisional offices over a period of some years with regular need to license additional users throughout this time. This means that both parties have an expectation that incremental purchases will be needed in due course and often the project plan gives a rough idea of the timing of these.
- d) The consequences of making an early purchase and finding that requirements reduce in the intervening period are potentially especially severe. Because the license to use the software is limited to the original buyer, any surplus asset has no re-sale value because the license cannot be transferred. With tangible goods any unexpected surplus may be sold second-hand, but this is not possible with software. Also, many software vendors make it difficult for the user to reduce ongoing support

payments despite lower levels of usage, so these costs will continue at the original higher level.

This particular set of characteristics presents a rich and potentially productive environment in which to investigate how buyers evaluate the value of temporal displacement because many of the possible constraining factors may be eliminated. For example, the seller is free from any restrictions on supply and has great pricing flexibility, whilst the buyer is presented with quite a simple choice to consider.

Temporal discounting *per se* has been extensively studied in the context of rewards (for a review see Green & Myerson, 2004) and a general consensus has been reached on a number of topics. The central finding is that behaviour does not generally follow what would be predicted by normative macroeconomic theory. Preference reversals are observed (Green, Fristoe and Myerson, 1994) when pairs of alternative delays are both increased by a common time factor, so that for example someone might prefer \$100 now to \$120 in 1 month's time but at the same time favour \$120 in 13 month's time to \$100 in one year. This type of effect is incompatible with classic economic theory and indicates the effect of a subjective utility factor in the choice. Empirical findings have been found to be more consistent with a hyperbolic rather than exponential mathematical description of discounting behaviour and in their review of discounting studies Green and Myerson (2004) provide extensive evidence for this.

A further observation that does not correspond to economic theory is the effect of amount of reward on discounting rate. The so-called magnitude effect (Green, Fristoe & Myerson, 1994; Green Myerson & McFadden, 1997; Myerson & Green, 1995) refers to the observation that smaller delayed rewards are discounted more steeply than larger delayed rewards. This is unexpected because economic theory predicts that temporal discounting should be unaffected by the amount involved. This finding suggests that other variables, such as amount, can influence people's subjective utility of temporally displaced monetary alternatives.

Relationships have also been shown between cultural background (Du, Green & Myerson, 2002), age (Green, Fry & Myerson, 1994) and income level (Green, Myerson, Lichtman, Rosen & Fry, 1996) and discounting rate. Attempts to demonstrate a link between discounting behaviour and personality traits such as impulsivity and introversion versus extraversion (Ostaszewski 1996, 1997; Eysenck, Eysenck, & Barrett, 1985) have not demonstrated a clear pattern. It is generally predicted that a tendency towards impulsivity, which is normally characterised as an inability to delay gratification, will be associated with a preference for immediate rewards. This potential correlation between an impulsivity trait and

discounting behaviour has generated most interest with respect to consumption of addictive substances such as drugs, cigarettes and alcohol rather than monetary rewards (Bickel, Odum & Madden, 1999; Kollins, 2003; Reynolds, Richards, Horn & Karraker, 2004). These studies have in the main found evidence of an association between tendency to use addictive substances and steeper temporal discounting (i.e. a preference for immediate rewards). However, it is not clear if both these observations stem from an underlying tendency towards impulsive behaviour, or whether temporal discounting calculations form part of the decision to use addictive substances or not.

Most of these studies have been undertaken using hypothetical rather than actual rewards, and the authenticity of participants' behaviour under these conditions has been challenged on grounds of poor ecological validity. This concern has been addressed by work which has used real rewards (e.g. Baker, Johnson & Bickel, 2002; Kirby & Marakovic, 1995; Kirby, 1997), albeit with smaller amounts for obvious reasons. These have shown the same type of general discounting behaviour, but did not directly compared discounting behaviour for real versus hypothetical rewards in a within-subjects experimental design.

This comparison was made by Johnson and Bickel (2002), using a larger range of rewards (\$10 to \$250), but with a small sample of six participants. They found that for five of the six participants there was no significant effect of real versus hypothetical rewards. Madden, Begotka, Raiff and Kastern (2003) repeated this comparison using a larger sample of 20 participants and, again, found no significant effect due to the reality or otherwise of the reward. These studies, which specifically consider the use of hypothetical rewards in discounting studies, are further endorsed by a broader review undertaken by Camerer and Hogarth (1999) which deals with the validity of hypothetical financial incentives in experimental economics generally.

Despite this large body of work, little attention has been paid to the corresponding effects for temporal discounting of costs, but there is evidence that they are handled differently from rewards (Murphy, Vuchinich & Simpson, 2001; and Estle, Green, Myerson & Holt, 2006). One reason for this difference may be that unexpected gratuitous rewards (as presented in most experimental procedures) are rare in life and the chance to select between two rewards of different form is even more unusual. Costs and cost alternatives on the other hand are ubiquitous and take many forms and it is hoped that the use of an authentic choice paradigm as described above will be productive.

For example, it is believed that three temporally distinct events will be implicated in the decision process; timing of the cost; timing of the benefit; and timing of the decision itself. Previous studies of temporal discounting of rewards (e.g. Green et al., 1994; Green et al.,

1996; Myerson & Green, 1995) and costs (Estle et al., 2006; Murphy et al., 2001) have only considered timing of reward or cost and have limited timing of the decision to now. The proposed research will seek to manipulate all three components to more fully explore their interaction and so extend the limited work that has been undertaken on cost discounting using a choice paradigm with high ecological validity.

Comparison of temporally displaced alternatives obviously involves some sort of evaluation of delay and its implications, but another factor intrinsically linked to this is the probability of change to key parameters in an intervening period. For example, the risk cited above that an early purchase will be rendered sub-optimal during the passage of time because of change in requirements. In such a case the explicit risks are reasonably obvious, but it may be that people make an implicit allowance for uncertainty when considering any temporally displaced alternatives. Indeed, many argue that temporal and probabilistic discounting are manifestations of a single underlying cognitive construct (Rachlin, Raineri & Cross, 1991; Myerson & Green, 1995). This is consistent with the generalised theoretical model of discounting proposed by Prelec and Loewenstein (1991) where delay and uncertainty are treated as different classes of the same factor.

Accordingly, it is planned to recognise the impact of risk associated with delay in the work outlined here, both from an explicit and implicit perspective, and to investigate how it interacts with temporal displacement. Empirical study of combination of delay and uncertainty on rewards has shown a consistent ratio of effect (Yi, Xochitl de la Piedad & Bickel, 2006) and evidence that the two dimensions are to some extent interchangeable (Weber & Chapman, 2005). It is believed that no corresponding investigation of the effect of uncertainty on temporal discounting of costs has so far been undertaken and the planned research will seek to evaluate this.

Objectives for Proposed Research

The proposed research programme will investigate the psychological factors that influence the choice between temporally displaced cost options for the purchase of software and seek to develop a theoretical model for the cognitive processes involved and their interaction. Where appropriate, this will make reference to the extensive existing literature dealing with the corresponding temporal discounting of rewards.

For reasons outlined above, it is believed that the proposed experimental scenario will provide a productive context for study that exhibits: -

- a) Ecological validity because it deals with costs rather than rewards

- b) Flexibility to vary a number of factors that comprise the offer, but also
- c) A manageable number of other influencing factors

In seeking to organise the parameters that are likely to be evaluated (consciously and unconsciously) by a buyer making a choice between two temporally displaced alternative costs, three broad categories have been defined. The first relates to the extent of the temporal displacement between the two alternatives and the second to the cost incentive offered for early purchase. The third category represents other factors which may affect temporal discounting rate. For example, preliminary experiments in this study have shown that discounting rate is affected by the nature of the cost involved and it is predicted that a number of other contextual factors will also have an effect.

The proposed research will investigate the nature and size of effects in each of these three categories in turn and also seek to describe how they interact. Initial thoughts relating to each of the categories are presented below.

Temporal displacement between alternatives

The length of delay until the expected requirement for the items being purchased will clearly be a factor in what offer will motivate a buyer to purchase now. This potentially reflects three components - the subjective utility of the money used to make the purchase; the risk of a reduction in the level of requirements as described above, which will be related in turn to the length of the delay; and any costs of maintaining or storing the purchase during the interim period. The latter element may simply be considered as an additional cost, and therefore incorporated into the alternative purchase prices being evaluated, so that the subjective influences on choice will be largely limited to first two elements

It is quite common for the seller to include a payment plan with the offer that matches the cash-flow of the expected future purchase and so to eliminate considerations of opportunity cost of a premature purchase by the buyer. In this case, the buyer's subjective comparison of the two alternatives should equate to an estimation of the risk of a change in requirements during the intervening period.

Central to these considerations of temporal displacement is a theory of how people represent time to themselves when making choices. We are all used to the phenomenon whereby the passage of time seems to run at different rates depending on the occasion - faster when our football team is losing a game with only a few minutes to go and slower when we are bored

in a lecture. These experiential differences in how we think of time may or may not be reflected in conscious decisions between alternatives that have a temporal component.

A key consideration in this is the extent to which we have persistent internal psychophysical scales for time that may be referred to across different contexts. Instead of referring to such scales we may actually weigh a delay with reference to other easily available points of comparison so that a three month delay compared to a six month delay will be evaluated differently from a three month delay compared to a one day delay. This type of mechanism forms the basis of the decision by sampling theory advanced by Stewart, Chater and Brown (2006) and has obvious relevance to the question being examined here. Preliminary experimental work on the hypothetical decision scenario being considered here suggests that people are able to make use of internal reference scales for delay that persist at least for short periods of time (15 to 30 minutes).

Size and nature of the incentive for early purchase

The incentive for early purchase will be evaluated according to its size and utility to the buyer. There is significant scope to vary the nature of the incentive, for example a simple reduction in price, an offer of more for the same price, or a promotion such as the inclusion of another product or service for no additional charge. Prospect Theory (Kahneman & Tversky, 1979) predicts that these different forms of incentive will carry different utility for buyers and will therefore be more or less effective for the same cost to the seller.

Structure of the transaction and framing effects

This type of situation takes two broad forms - the case where a buyer is making a purchase now and the seller incentivises him to buy more ('discount for volume') and the alternative when the purchase is expected purely in the future ('pull-forward'). In each case the principle is the same - an incentive to buy product before it is needed, but the structure may have an effect on the buyer's evaluation of an offer. In the case of consumer purchase, there is often a benefit to the buyer that arises from an early purchase because it satisfies a 'want' rather than a 'need'.

A further likely factor is the relationship between the buyer and seller and the resultant emotional state of the former may be influential in his evaluation of the cost alternatives. The role of effect in decision making generally has been the subject of much recent study (e.g. Lowenstein & Lerner, 2003) and a central role for emotion is being recognised. It is also likely that the framing of the transaction and relevant priming of the buyer will have an impact and these factors will be explored.

Individual differences in temporal discounting

Running in parallel with the potential general effect of factors in these three categories is the specific impact of individual differences on temporal discounting behaviour. As described above, an effect of various demographic factors on temporal discounting of rewards has been observed and a corollary is to be expected in this context. Whilst this may not mirror the findings for rewards it seems intuitively likely that age, gender, education level, income level etc. will affect how people evaluate this type of choice. These factors will therefore be recorded in all experiments and analysed accordingly.

Research Questions

The high level research question will be what factors influence the price that a buyer is willing to pay to make a software purchase now rather than at some point in the future and how do they contribute and combine in the overall evaluation of alternative options. A number of lower-level specific questions may be posed at the outset which stem from the suggested factors and categories discussed above. These are likely to be supplemented with more detailed considerations during the course of the research, but serve to establish a guiding framework for the type of considerations that are likely to be relevant to the real-world situation that underpins this work. They are as follows.

How do buyers combine implicit risk with temporal discounting and are there individual differences in the rate of translation?

Is there a difference between discount for volume and pull-forward?

Is the nature of the incentive important - discount, more for the same cost or promotion?

How does buyer affect influence discounting rate?

What effect does a payment plan have?

How do demographic factors and individual differences affect discounting rate?

Is psychophysical representation of time constant or can it be influenced by priming effects?

Planned Methods

This work extends the study of cost discounting that was undertaken for the author's MSc dissertation in which a significant finding was of a parallel effect of amount in temporal and probabilistic discounting. This contrasts with the generally observed magnitude effect for rewards described above which shows opposite effects for temporal and probabilistic

conditions. This finding indicates that the two dimensions may share a single underlying cognitive process for costs and confirms Estle et al's (2006) observations that costs are treated differently from rewards. It is planned to use a similar methodological approach in the work described here.

A series of experiments will be undertaken to investigate participants' preferences for alternative cost options, incorporating manipulation of the variables discussed above. In general terms the participant will choose between a purchase at some time in the future, corresponding to the actual requirement for the product and a purchase now, in advance of the requirement. The intertemporal displacement between the two alternatives will be a key independent variable and this will be manipulated across a number of levels in order to form some estimate of discounting rate. This will take the range of 1 month to 18 months to reflect the range of delay which might actually occur in a real situation. It is anticipated that manipulation of other variables such as the ones discussed above will affect the participant's discounting rate.

Participants

Experiments will be presented to participants online via the internet wherever possible, since this should allow the use of large and heterogeneous samples in order to investigate and control expected effects of demographic characteristics such as age and gender and other individual differences on discounting behaviour. Participants will be recruited through a combination of invitations to friends and Birkbeck students and advertisement on web-sites which collate online psychological experiments.

There is increasing evidence that this medium does not compromise data quality (Stanton, 1998; O'Neill & Penrod, 2001; Joinson, 2001; Buchanan & Smith, 1999) and it has been demonstrated that participants actually find computer surveys more interesting and perceive them to be shorter than equivalent conventional paper based equivalents (Rosenfeld, Booth-Kewley & Edwards, 1993). Steps will be taken to reduce dropout rate and to guard against multiple submissions that present potential issues for internet based experiments, as recommended by Frick, Bächtiger and Reips (2001) and Musch and Reips (2000). For example, email addresses will be requested to discourage multiple submissions and elapsed time to complete the procedure will be recorded in order to detect frivolous responses.

Procedure

Experiments will typically ask participants to consider two alternative cost options - a baseline option to purchase in the future, in line with expected requirements and an

incentivised option to purchase now. By iterative modification of the value or structure of the incentive in the light of the previous preference, a point of subjective indifference will be estimated, where the participant is assumed to show no preference for either of the two alternatives. This will constitute the dependent variable which will be analysed against the relevant independent variable(s) listed above. This procedure was employed successfully in the MSc dissertation work mentioned above and largely replicates the procedure employed in previous discounting studies such as Estle et al (2006), Green et al (1994) and Myerson and Green (1995).

However one important methodological difference between the proposed work and previous studies has been identified in preliminary work and this relates to the sequence of presentation of the different levels of delay. Generally, previous studies have presented delay in sequential increasing order (e.g. 3 months, 6 months, 12 months etc.) and it is felt that this could lend itself to a confounding anchoring effect. An experiment was undertaken to test this and found no significant effect of sequence of presentation (sequential versus random) on discounting rate. However, given the increased focus on the importance of proximal reference points suggested by the Decision by Sampling theory, it is considered that these potential effects should be explicitly acknowledged in experimental design and managed carefully.

Discounting rate will be calculated using the normalised area under the curve method described by Myerson, Green and Warusawitharana (2001) which uses the actual observed subjective values for each participant, rather than estimated values based on best fit of a hypothesised discounting function. This has the benefit that it avoids any debate about which form of equation provides the best fit to experimental data and, furthermore, results in a set of values which are approximately normally distributed. With this approach, a smaller area under the curve equates to a steeper rate of discounting.

Design

It is expected that a combination of within-subjects and between-subjects designs will be employed. Although a within-subjects design may be preferable for analysis, preliminary experience suggests that participants tend to be motivated to produce consistent discounting behaviour across different situations and this has a confounding effect on other independent variables. The dependent variables in all cases will be the estimate of the point of subjective indifference described above and the area under the discounting curve derived from a series of such results. Independent variables will vary by specific experiment but will reflect the

factors suggested above that are likely to affect discount rates. Analysis will be undertaken at both a group and individual levels of discounting behaviour wherever possible and attention will be paid to the effect of demographic factors.

Proposed Timetable

The proposed research programme will be undertaken on a part-time basis, and it is expected that the following outline schedule of experiments will be undertaken during the next two years. It is likely that each of the experiments listed below will comprise multiple procedures. This provisional schedule will obviously be subject to change in the light of experimental findings. It is planned to submit the associated doctoral thesis by end 2012.

Experiment 1: Combination of temporal and probabilistic discounting of costs

A key question concerns how temporal discounting behaviour is influenced by associated risk, whether it is explicit or implicit in nature. As discussed above, the decision to make a purchase of software before it is needed carries with it the risk that the requirement will reduce during the intervening period resulting in unnecessary and sunk cost. In this case the risk may be thought to be explicit and may be consciously estimated by considering the likelihood that various events will occur, for example the cancellation of the project. The assessment of risk is likely to reflect the length of the delay until the software is expected to be needed - the longer the delay the greater the risk.

Implicit risk may also affect temporal discounting behaviour, so that even when there is no perceived explicit risk that requirements may change during an intervening period some unconscious allowance is made. This idea questions whether people can ever evaluate a temporal displacement *per se* without a consideration of the uncertainty that the future inevitable holds for us.

This experiment will manipulate these conditions to investigate the effect of both implicit and explicit risk on temporal discounting rate. This will provide a preliminary indication of how temporal and probabilistic discounting combine and interact for costs, extending the work of Yi et al (2006) and Weber and Chapman (2006) working with rewards.

Experiment 2: Effect of transaction type on temporal discounting rate

As discussed above, it is thought that buyers may treat so-called 'discount for volume' situations differently from 'pull forward' situations. The key difference being that in the former

the buyer is making a purchase now and the offer is intended to increase its size and in the latter no immediate purchase is planned and the offer is purely intended to motivate an early purchase of a future expected need. The different framing of the incentivized purchase in the two situations may lead to different discounting rates. For example, prospect theory would predict that the discount for volume situation would require a smaller incentive for a buyer to agree to the offer.

This experiment will compare the effect of these different transaction structures on temporal discounting rate.

Experiment 3: Effect of nature of sales incentive on temporal discounting rate

The incentive offered to a buyer for an early purchase may take several forms. The most obvious is a reduced price, but alternative incentives include promotions such as free extra product and advantageous terms on future purchases etc. There is scope also to vary the presentation of the incentive, for example as an absolute monetary value or as a discount percentage. This experiment will manipulate these factors to investigate their effect on temporal discounting rate.

Experiment 4: Effect of buyer affect on temporal discounting rate

This experiment will investigate whether buyer affect has an impact of temporal discounting rate in this situation which represents an industrial rather than consumer setting. This may reduce the importance of emotional state, as may the fact that the purchase represents a 'need' rather than a 'want' with no confounding effect arising from desirability of early availability of goods. Some preliminary experience in measuring participant mood on a number of self-rated scales has been gained from previous experiments. It is planned to use experimental procedures both to passively record and actively manipulate participant mood through such techniques as gifts or online games.

4,893 words

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