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THE IMPACT OF WAITING TIME GUARANTEES ON CUSTOMERS' WAITING EXPERIENCES

Waiting time guarantees improve customer satisfaction but be sure to meet them.

Abstract

Customers often have to wait during the process of acquiring and consuming many products and services. These waiting experiences are typically negative and have been known to affect customers' overall satisfaction with the product or service. In order to better manage these waiting experiences, many firms have instituted a variety of programs not only to reduce the actual duration of the wait but also to improve customers' perceptions of it.

In this paper, we examine the impact of one such initiative, namely, the institution of a waiting time guarantee, on customers' waiting experiences. A waiting time guarantee is a commitment from a firm to serve its customers within a specified period of time. If the firm fails to meet this commitment for some customers then it compensates them for the delay. Today, a large number of firms in a variety of industries such as fast food, banking, industrial distribution, and healthcare offer such time guarantees to their customers.

We develop a utility theory-based model of customers' satisfaction with waiting in line. The model is based upon the assumption that when a customer joins a queue he or she has some prior beliefs about the distribution of service times at the firm. The customer estimates the likely duration of the waiting time on the basis of these beliefs about the service times and the observed queue length. We further assume that as the customer observes the service times for other customers who are ahead in the queue, he or she successively update these beliefs about the distribution of service times in a Bayesian manner. We then posit that the customer's satisfaction both during as well as at the end of the wait is determined by the difference between the customers' updated and the prior estimates of the total waiting time.

We apply the model to derive select hypotheses pertaining to the impact of a waiting time guarantee on customers' waiting experiences. These hypotheses are based upon the assumption that an offer of a time guarantee is a signal of reliability from the firm and reduces customers' perceived variance around the expected service times. We empirically test these hypotheses using data from a series of interactive, computer-based laboratory experiments. In these experiments, we used the computer to create animations of real-life waiting experiences. The computer display consisted of a queue of customers waiting for service at a counter. One of the customers represented the participant in the experiment. During the course of the experiment, each participant joined the queue, waited in line for service, and then exited the system. At several points during the wait, each participant reported his or her level of satisfaction with the waiting experience.

Our results suggest that if customers observe the service times to be less than expected, their satisfaction increases monotonically during the wait. Further, under such circumstances, the explicit provision of a waiting time guarantee enhances satisfaction both during as well as at the end of the wait. However, if customers observe the service times to be more than expected, then their satisfaction typically declines at the beginning of the wait but increases towards the end of the wait. Further, under these circumstances, the initial positive impact of the provision of a waiting time guarantee declines over time. Moreover, at the end of the wait, customers in guaranteed environments are actually less satisfied than those in unguaranteed environments. Overall, we find that a time guarantee, if met, increases satisfaction at the end of a wait; however, if violated, then it decreases satisfaction at the end of the wait. We discuss the implications of these and other empirical findings for the management of customers' waiting experiences.

(Keywords: Waiting Time; Time Guarantees; Services; Customer Satisfaction)

1. INTRODUCTION

Customers frequently have to wait for the delivery of products and services. Waiting is often a negative experience from both an economic and a psychological perspective. It involves economic costs because, while waiting, customers expend a scarce resource: *time*. This perceived loss of time translates into a psychological cost and leads to stress and anxiety during a typical waiting experience. As a result, the nature of the waiting experience is an important dimension which determines customers' overall satisfaction with the firm.

In response, many firms are instituting a variety of programs to enhance customers' waiting experiences. These programs are based on either superior operations or on creative management of customers' perceptions of time (Larson 1987). Operations-based initiatives, such as increasing the number of servers, having a superior queue processing system, or instituting a flexible personnel deployment policy, focus primarily on reducing the actual duration of the wait. Perceptions-based measures, on the other hand, aim to reduce customers' perceptions of either the expected duration of the wait or the uncertainty surrounding it. Many service providers today employ such measures to fill customers' waiting times using devices such as video displays with news updates, weather forecasts, and the latest sports scores (Larson 1987). The institution of such stimulating measures is supported by the finding that filled time appears to pass more quickly than empty time (McGrath and Kelly 1986). Similarly, firms, including leading software developers, often update customers waiting for assistance on the telephone about the expected duration of the wait until service (Pollili 1992; Simpson 1992). By instituting these programs, firms seek not only to demonstrate customer responsiveness but also to reduce the uncertainty surrounding customers' estimates of waiting time, thereby increasing satisfaction.

An additional important initiative that several firms have undertaken for managing customers' waiting time is the institution of waiting time guarantees. A waiting time guarantee (time guarantee, for short) is a firm's commitment to its customers that it will deliver the product (or service) within a specified period of time. If the firm fails to deliver within the guaranteed time, it compensates the customer for the delay.

Today, an increasing number of firms across a wide range of industries, such as banking, industrial distribution and maintenance, health care, and fast food, offer time guarantees to their customers (Hart 1990; Hayden 1989; Jaffe 1990; Kumar and Sharman 1992). However, despite their growing popularity, several important questions regarding the impact of such guarantees on customers' waiting experiences remain unanswered. For example, how do time guarantees affect customer satisfaction during the wait? How do they affect satisfaction at the end of the wait? Do these effects depend on whether time guarantees are met or violated? Answers to these questions will provide useful insights into customers' behavioral responses to offers of time guarantees and help in the design of effective programs for managing customers' waiting time. Superior waiting experiences will, in turn, enhance customers' overall satisfaction with the firm.

In this paper, we examine the impact of a time guarantee on customers' satisfaction with waiting at the beginning of and during as well as at the end of a wait. To this end, we first develop a utility theory-based model of customers' satisfaction with waiting in line for service. We then use the model to derive some testable hypotheses pertaining to the impact of time guarantees on customers' satisfaction both while they wait for service as well as at the end of their wait. We empirically test these hypotheses using data from a series of computer-based laboratory experiments. Our results suggest that, during a wait, an offer of a time guarantee generally enhances customer satisfaction. However, at the end of the wait, the impact of a time guarantee depends on whether it was met or was violated.

The rest of this paper is organized as follows: in the next section, we briefly outline the relationship of our work with the literature in the area. We then develop our model of customers' satisfaction with waiting in line and derive selected testable hypotheses. Next, we describe a series of experiments that we employed to collect the data for testing these hypotheses and present our empirical findings. Finally, we discuss the implications of our key findings and outline some specific directions for future research.

2. RELATIONSHIP WITH THE LITERATURE

Research on the impact of waiting times and queue lengths on customers has traditionally been the domain of Queuing Theory. The primary emphasis of work in this area has been on developing mathematical models that can be used to examine system performance. Although the most tractable of such models assume that all customers who join the system wait until they are eventually served, model-builders in the area have also explicitly allowed for other behavioral responses to waiting experiences. These include balking, that is, choosing not to join the queue if the queue length is too long, or reneging, that is, dropping out of the queue if the waiting time is too long.

Of late, researchers have also begun exploring the psychological ramifications of waiting for service. Osuna (1985) proposes a theoretical model of the psychological stress experienced by individuals during a wait and shows that if individuals cannot observe the service process and are uncertain about the duration of the wait, then stress increases monotonically during a waiting experience. Some of this psychological stress can be alleviated by providing individuals with timely information regarding the actual duration of the wait. Although the theory developed by Osuna (1985) has not been tested directly, in related work, Katz, Larson, and Larson (1991) do find that customers' satisfaction at the end of waiting in line does decrease with an increase in the duration of the waiting time. Clemmer and Schnieder (1989) find that providing customers with prior information regarding busy periods tends to improve their satisfaction with waiting. Finally, Taylor (1994) finds that delays adversely affect customers' perceptions of the overall quality of service, especially if the service provider is perceived to have control over the cause for the delay.

Factors other than the perceived duration of the wait can also influence the quality of customers' waiting experiences. Larson (1987), for example, suggests that perceptions of "social justice," that is, whether or not the service provider adheres to the principle of first-come-first-serve, influence customers' satisfaction with waiting. Katz, Larson, and Larson (1991) find that distractions during waiting experiences tend to make the wait more enjoyable and reduce dissatisfaction with waiting. However, Clemmer and Schnieder (1989) find that, contrary to expectations, expressions of concern by employees regarding customers' waiting time or an input of visible effort on the part of the service provider to meet peak demand does not enhance customers' satisfaction with waiting.

A more recent stream of literature looks at customers' valuation of the duration of waiting times and its implication for the design of service delivery systems. LeClerc, Schmitt, and Dube (1995) find that, contrary to the domain of money, customers are always risk-averse in the domain of time. Carmon, Shanthikumar, and Carmon (1995) assume an increasing marginal disutility of waiting time for customers and show that accounting for this psychological cost of waiting can significantly alter some of the prescriptions of traditional queuing theory.

In this paper, we build upon this existing body of research and explicitly focus on the impact of waiting time guarantees. However, unlike Babad, Dada, and Saharia (1996), who show how the terms of time guarantees can be set in appointment-based systems, and So and Song (1996), who examine the impact of such guarantees on firms' pricing and capacity decisions, our interest is on understanding the differences in customers' satisfaction between guaranteed and unguaranteed waiting environments. Like Osuna (1985), we begin by developing a formal behavioral model of customers' response to waiting in line. We then apply the model both to guaranteed and unguaranteed or traditional waiting environments to derive select hypotheses pertaining to customers' satisfaction before, during, and at the end of a waiting experience. Finally, we empirically test these hypotheses using data from a series of computer-based laboratory experiments. Our experimental setup and computer interfaces are similar to those developed by Carmon (1994) and, much like Carmon and Kahneman (1994), allow subjects to record their satisfaction both during as well as at the end of their waiting experiences.

3. MODEL AND HYPOTHESES

In our model of customers' satisfaction with waiting in line, we refer to the satisfaction that a customer experiences during the wait as ***in-process satisfaction.*** The level of in-process satisfaction is an important determinant of whether a customer, after having joined the system, will continue to wait or will renege. We label the satisfaction after the wait as ***end-of-process satisfaction.*** End-of-process satisfaction affects a customer's evaluation of the firm and the probability of a return visit.

The development of our model of customer satisfaction from waiting is based upon several assumptions. First, we assume that when a customer arrives at a service facility, he or she has some prior beliefs about the distribution of service times at the facility. The customer uses these beliefs together with the number of customers in the system to arrive at a distribution for the total waiting time. After joining the queue, the focal customer observes the service times of customers who are ahead in the queue. We further assume that, based upon these observations, the customer successively updates his or her prior beliefs regarding the distribution of service times in a Bayesian manner. We finally assume that the customer's satisfaction with waiting depends upon the gain or loss in utility that arises because of differences between these updated and the initial beliefs about the duration of the total waiting time.

In this section, we first develop a model for the formation and updating of customers' estimates of the total waiting time. We then use these estimates of the duration of the waiting time to develop a utility theory-based model of customers' satisfaction with waiting in line. We later apply the model to guaranteed and unguaranteed waiting environments to derive a set of testable hypotheses.

Formation and Updating of Expectations of the Total Waiting Time

Consider a customer who visits a service provider and has to wait in line for service. Upon arrival, the customer can precisely judge the queue length, L, but his or her subjective estimate of the service time, that is, the time to serve each customer, is typically uncertain. This uncertainty regarding service times arises because of (i) chance variation in service times around its mean, and (ii) because of the customer's not knowing the mean service time at the service provider.

We model the focal customer's subjective prior beliefs regarding the service time of a given customer in the system, X, as an identically and independently distributed random variable drawn from a normal distribution with unknown mean, λ, and known variance σ^2. That is,

$$f_1 (X \mid \lambda) \sim N(\lambda, \sigma^2). \quad (1)$$

We model the unknown mean, λ, as a draw from a normal distribution with mean μ and variance ρ^2. That is,

$$f_2 (\lambda) \sim N(\mu, \rho^2). \quad (2)$$

From Equations (1) and (2), it follows that the unconditional density function of service times (also called the predictive density) is also normal with mean μ. The variance of this unconditional distribution can be obtained by using the formula:

$$\begin{aligned} \mathrm{Var}[X] &= \text{mean conditional variance} + \text{variance of the conditional means} \\ &= E[\mathrm{Var}[X \mid \lambda]] + \mathrm{Var}[E[X \mid \lambda]] = \sigma^2 + \rho^2. \quad (3) \end{aligned}$$

Note that even if the customer knew the mean service time with certainty he or she would still be uncertain regarding the service times on a given occasion because of σ^2.

We posit that when the i^{th} customer (i=1,.2,..,L) in the system receives service, the focal customer observes the service time, x_i, and updates his or her subjective distribution of service times in a Bayesian manner. In other words, every time a customer in the system receives service, the focal customer uses the observed service time in conjunction with his or her current updated distribution of service time ("the prior") to arrive at a posterior distribution of service time. For example, after the first customer in the system receives service, the focal customer's posterior distribution of service times will depend on x_1, the time taken to serve the first customer. It is well known that, in this case, the updated posterior distribution of the mean service times is also normal with mean $\lambda_1(x_1)$ (Berger 1985, p 126), where:

$$\lambda_1(x_1) = \frac{(\mu/\rho^2 + x_1/\sigma^2)}{(1/\rho^2 + 1/\sigma^2)}. \tag{4}$$

The variance of the updated distribution of λ is $1/(1/\sigma^2 + 1/\rho^2)$. In Equation (4), it can be seen that the customer's posterior estimate of the mean service time, $\lambda_1(x_1)$, is a weighted average of the prior estimate, μ, and the time taken to service the first customer, x_1. The weights are determined by the precisions of the two distributions, $f_2(.)$ and $f_1(.)$, respectively, where precision is the reciprocal of the variance. Further, after the first customer in the system receives service, the focal customer's unconditional distribution of service times is also normal with mean $\lambda_1(x_1)$. The variance of the distribution, computed using the relationship given in Equation (3), is equal to $(\sigma^2 + \rho^2/(1 + \rho^2/\sigma^2))$, which is less than the original variance, that is $(\sigma^2 + \rho^2)$.

It can be shown that after *i* customers in the system receive service, the focal customer's posterior distribution of the mean service time is normal with mean $\lambda_i(x_i\text{'s})$, where:

$$\lambda_i(x_i\text{'s}) = \frac{(\mu/\rho^2 + (1/\sigma^2)\sum_{j=1}^{i} x_j)}{(1/\rho^2 + i/\sigma^2)}, \qquad i = 1, 2,.., L. \tag{5}$$

The variance of the posterior distribution for λ is:

$$\frac{\rho^2}{(1 + \frac{i\rho^2}{\sigma^2})}, \qquad i = 1, 2,.., L. \tag{6}$$

Once again, the unconditional distribution of service time is normal with mean given by (5) and variance given by:

$$(\sigma^2 + \frac{\rho^2}{(1 + \frac{i\rho^2}{\sigma^2})}), \qquad i = 1, 2,.., L. \tag{7}$$

Note that the mean or the scale parameter of the unconditional distribution of service times depends on xi's, the observed service times, but the shape parameter or the variance is decreasing in i, the number of updates, so updating always makes the distribution more precise.

We now use the information regarding the customer's estimates of the service times to compute his or her prior and updated estimates of the total time in the system. It follows from our assumptions regarding service times that the total time the focal customer expects to spend in the system, a priori, is a sum of L independent and identically distributed random normal variables, each with a mean μ and variance $(\sigma^2 + \rho^2)$; hence the total waiting time has a normal distribution with mean T_0, given by:

$$T_0 = L\mu. \tag{8}$$

The variance of the total waiting time at the beginning of the wait, S_0^2, is given by:

$$S_0^2 = L^2(\sigma^2 + \rho^2). \tag{9}$$

After the first customer at the head of the queue is served, the focal customer's updated belief is that the service times are drawn from a normal distribution whose mean is $\lambda_1(x_1)$ rather than μ. Therefore, his or her revised estimate of the expected total waiting time, T,, is given by:[1]

$$T_1 = L\frac{(\mu/\rho^2 + x_1/\sigma^2)}{(1/\rho^2 + 1/\sigma^2)}. \tag{10}$$

Note, however, that after the first customer in the queue has received service, the focal customer faces uncertainty only regarding the service times of the remaining L-l customers. Therefore, the variance of the revised estimate of the total waiting time is given by:

$$S_1^2 = (L-1)^2(\sigma^2 + \frac{\rho^2}{(1 + \frac{\rho^2}{\sigma^2})}). \tag{11}$$

[1] The more "classical" approach would give the expected value as the sum of the elapsed time and the expected time from the remaining completions.

The revised estimate of total waiting time also has a normal distribution. It can be shown that after i customers have been observed to receive service, the focal customer's updated estimate of total waiting time has a normal distribution with mean, Ti, and variance, S_i^2, given by:

$$Ti = L \frac{(\mu / \rho^2 + (1/\sigma^2)\sum_{j=1}^{i} x_j)}{(1/\rho^2 + i/\sigma^2)}, \qquad i = 1, 2,.., L, \qquad (12)$$

and,

$$S_i^2 = (L\text{-}i)^2(\sigma^2 + \frac{\rho^2}{(1 + \frac{i\rho^2}{\sigma^2})}), \qquad i = 1, 2,.., L. \qquad (13)$$

Note that the variance of the total waiting time decreases as the number of customers who receive service, i, increases. This is because once *i* customers receive service, the uncertainty in the total waiting time is affected only by the variance of the time required to serve the remaining (L-i) customers. Furthermore, having observed the service time of *i* customers, the focal customer's uncertainty about the mean service times declines from ρ^2 to $\rho^2/(1 + i\rho^2/\sigma^2)$.

We now use the customer's successively updated unconditional posterior distributions of the service times to develop a model of their dissatisfaction with waiting in line. The observation that the updated unconditional distribution of the total waiting time is normal with mean and variance given by Equations (12) and (13) respectively, is sufficient to compute the customer's utility from having to wait.

A Utility Theory-Based Model of Customer Satisfaction with Waiting in Line

We posit that a customer's satisfaction with a waiting experience depends on his or her most recent evaluation of the expected utility from waiting. Let W_i be a random variable that represents the customer's updated estimate of the waiting time after i customers have been observed to receive service. Recall, we use the terms T_i and S_i^2 to denote the mean and variance of the random variable W_i. The choice of an appropriate functional form for the utility associated with W_i depends on three issues. First, as a customer updates his or her beliefs about the distribution of the total waiting time, the utility is related to the expected level of disconfirmation between the updated distribution of the total waiting time and the mean of the initial estimate of it, T_0 (Oliver 1980). The more favorable the disconfirmation the higher the utility; conversely, the more unfavorable the disconfirmation the lower the utility. Second, as the literature in both customer satisfaction (Oliver 1980) and service quality (Boulding et al. 1993; Boulding, Kalra, and Staelin 1997) suggests, between two customers, who have the same level of disconfirmation, the one with a longer prior expected waiting time, T_0, will experience lower satisfaction. Finally, the choice of a functional form must recognize that customers are known to be risk-averse in the domain of time (Leclerc, Schmitt, and Dube 1995). This suggests the use of a decreasing risk-averse utility function. We have chosen to use a negative exponential utility function because Keeney and Raiffa (1976) have found it easy to use empirically, and, because its expectation is easy to compute for a large number of probability distributions.

Keeping these three issues under consideration, we model the expected utility of a customer whose updated estimate of the total waiting time is represented by W_i, as:

$$E[U(W_i, T_0)] = E[-A_1(T_0)^{\gamma}\exp(-c(T_0 - W_i))], \qquad i = 0, I,.., L. \qquad (14)$$

where A_1, γ, and, c are positive constants, and E is the expectation operator. A_1 can be interpreted as a measure of a customer's value of time, γ captures the direct impact of the initial expectation of the total waiting time, T_0, and c is a measure of risk-aversion. It is useful to move all constants outside the expectation operator to get:

$$E[U(W_i, T_0)] = -A_1(T_0)^{\gamma}\exp(-cT_0)E[\exp(cW_i)], \qquad i = 0, 1,.., L. \qquad (15)$$

As discussed above, after *i* customers have been served, the focal customer's estimate of the total waiting time, W_i, is a random variable that has a normal distribution with mean and variance given by

Equations (12) and (13) respectively. Now, $E[\exp(cWi)] = \exp(cTi + c^2(SF))$. Therefore, following Keeney and Raiffa (1976), Equation (15) becomes:

$$E[U(Wi, T_0)] = -A_1(T_0)^\gamma \exp(-cT_0)\exp(cT_i + c^2(S_i^2)), \qquad i = 0, 1,.., L. \qquad (16)$$

Collecting terms and equating satisfaction to expected utility gives:

$$SAT(Wi, T_0) = -A_1(T_0)^\gamma \exp(-c(T_0 - Ti) + c^2(S_i^2)), \qquad i = O,..,L, \qquad (17)$$

where SAT(.) denotes the customer's satisfaction with waiting. It can be seen from Equation (17) that the expected utility from waiting time reduces to a modified mean-variance model. Thus, increases in both the customer's subjective estimate of the total waiting time, Ti, as well as in the variance around this estimate, S_i^2, reduce customers' satisfaction from waiting in line. This implication of our model is consistent with Maister's (1985) conjecture that both the duration of waiting time as well as the level of uncertainty around it adversely affect customers' waiting experiences.

The interpretation of Equation (17) as a modified mean-variance model is facilitated by the specification of both the service time distribution in Equation (1) as well as its natural conjugate prior in Equation (2) as normal distributions. If another distribution, say the exponential, is used to describe service times, an expression equivalent to Equation (17) can be derived but the hypotheses below cannot be delineated as clearly. This is because when service times are drawn from an exponential distribution, the uncertainty in its single parameter is drawn from a gamma distribution, its natural conjugate. In this case, after each update, both the mean and the variance of the revised parameter describing the service time distribution change in the same direction, and depend on the observed service times. In contrast, the variance in the normal case decreases monotonically with each update.

Statement of Hypotheses

The model of satisfaction represented by Equation (17) provides an integrated approach to modeling customers' responses to waiting experiences. It can be used in a variety of ways to gain qualitative insights into customers' responses to various queuing environments. Our objective here is to apply it to examine the impact of time guarantees on customer satisfaction. We are specifically interested in (i) the impact of a time guarantee on customer satisfaction at the time of joining the service system, while in-process in the service system, and after the completion of the service, and (ii) the impact of the interaction between a time guarantee and other conventional variables that are known to affect customers' waiting experiences, such as initial queue length and initial expectations of the total waiting time.

Before we begin examining these issues it is useful to intuit the plausible impact of a time guarantee on a customer. A comparison with a product warranty offers some insights. In particular, it has been reported that when customers cannot evaluate a product, a warranty serves as a pre-purchase signal of quality and acts as a risk reducing mechanism (Spence 1974; Bearden and Shimp 1982). It follows from Equation (17) that "quality" within the context of a waiting experience is determined by both the mean as well as the variance of the customer's estimate of the total waiting time. Therefore, in general, a time guarantee can be thought of as a signal from a high quality or reliable service provider for low total waiting time as well as low variance of the waiting time. The compensation that such a service provider offers in case it is not able to meet the guarantee can be interpreted as a mechanism for making this signal credible.

Our primary interest in developing our hypotheses is to examine the differential impact of a time guarantee on customers' waiting experiences. In order to make the hypotheses as clear as possible, we propose them in terms of a comparison between the waiting experiences of customers in guaranteed and similar unguaranteed waiting environments. We assume that the prior distribution of μ is the same in both environments, but that σ^2, the variance of the conditional service time distribution is lower in the guaranteed environment. Under these assumptions, algebraic manipulation of Equation (17) leads to the following hypotheses.

Customer Satisfaction at the Beginning of a Waiting Experience

Impact of Expected Waiting Time: The assumptions leading up to Equation (17) suggest that, at the time a customer joins a queue, his or her initial level of satisfaction is affected by the a priori expectation regarding the total waiting time, T_0. Therefore, we hypothesize that:

> *H_1: At the beginning of a waiting experience, a customer who expects the duration of the waiting time to be shorter will have a higher level of satisfaction with waiting than would a customer who expects the duration of the waiting time to be longer.*

Impact of a Waiting Time Guarantee: As mentioned earlier, we assume that an offer of a waiting time guarantee is a signal of reliability and reduces customers' estimates of the variance in service times due to chance reasons, σ^2. Now, if we consider two customers waiting in queues of identical length, L, with similar prior beliefs about the mean service time, μ, we expect both customers to have the same estimate of the total waiting time, T_0, but the customer in the guaranteed queue to have lower variance, S_i^2. Therefore, following Equation 17, we hypothesize that:

> *H_2: Given similar prior beliefs about the mean service time and the same initial queue length, a customer who is offered a waiting time guarantee will have a higher level of satisfaction at the beginning of a waiting experience than would a customer who is not offered a waiting time guarantee.*

Impact of Initial Queue Length: Consider two customers waiting in queues of different lengths, L, but having equal prior estimates of the total mean waiting time, T_0. Recall that at the beginning of a waiting experience, a customer's variance of the total waiting time is proportional to the square of the number of customers waiting to be served (see Equation (9)). Therefore, following Equation (17) we hypothesize that:

H_3: Given equal prior expectations of the duration of the total waiting time, a customer in a shorter queue will be more satisfied at the beginning of the wait than a customer in a longer queue.

Customer Satisfaction During a Waiting Experience

Impact of Expected and Perceived Waiting Time: Consider a customer who, after joining a queue, observes that the service times are shorter than what he or she expected a priori. Following Equation (12), we expect that both the mean estimate of the total waiting time, T_i, as well as the variance, S_i^2, will be systematically lowered as this customer progresses in the queue (see Equations (12) and (13)). The reduction both in T_i and S_i^2 will systematically increase his or her satisfaction as other customers in the queue receive service (see Equation (17)). Therefore, we hypothesize that:

H_4: The in-process satisfaction of a customer who perceives the service times to be less than expected a priori will increase as he or she progresses in a queue.

On the other hand, if the customer observes the service times to be longer than what he or she expected a priori, then his or her updated estimates of the total mean waiting time, T_i, will progressively get larger (see Equation (12)). However, the variance around this customer's estimate of the total waiting time, will systematically decline (see Equation (13)). A combination of these two mutually opposing effects will determine the customer's in-process satisfaction during the waiting experience. For example, if the difference $(T_i - T_0)$ is relatively large, its adverse effect may dominate the favorable effect of a reduction in the variance, S_i^2. As a result, in-process satisfaction may monotonically decline during the waiting experience. On the other hand, if the difference between the expected and the observed service times is relatively small, then the reverse can be true. Finally, for moderate differences between the expected and the observed service times, in-process satisfaction may initially decrease because of an upward revision in the estimates of the total duration of the waiting time and may later increase because of a progressive reduction in the variance of the estimate of the total waiting time.

In this situation, that is, when the observed service times are longer than expected, we do not propose a simple directional hypothesis pertaining to the impact of expected and perceived waiting times on customers' satisfaction with waiting. We will, however, later examine whether the observed pattern of changes in customers' in-process satisfaction is consistent with our model.

<u>Impact of a Waiting: Time Guarantee</u>: Recall, we posit that σ^2 for customers in guaranteed queues is smaller than that for customers in similar unguaranteed queues. This difference in σ^2 has two effects on customers' waiting time estimates. First, it follows from Equation (12), that a customer in a guaranteed queue will give greater weight to the observed service times, xi, i=l, 2,.., L, vis-a-vis his or her prior expectation, μ, than would a customer in an unguaranteed queue. As a result, the updated estimates of the mean waiting time, T_i, for a customer in the guaranteed queue will adjust more quickly towards the actual service times than would the estimates of a customer in the unguaranteed queue. Second, it follows from Equation (13) that, after every update, the variance of the total waiting time, S_i^2, will be lower for the customer in the guaranteed queue when compared with the corresponding variance of the customer in the unguaranteed queue. Now, consider the case where customers perceive the service times to be smaller than expected. In this case both T_i, the total mean waiting time, and S_i^2, its variance, will be smaller for customers in guaranteed queues than for those in unguaranteed queues. Therefore, based on Equation (17), we hypothesize that:

> H_5: *Given equal prior expectations of the total waiting time, in-process satisfaction for a customer who is offered a waiting time guarantee is always higher than that for a customer who is not offered a waiting time guarantee, if the observed service times are smaller than the expected service times.*

On the other hand, consider the case where customers observe the service times to be longer than expected. In this case, the estimates of the total expected waiting time, T_i, will be larger for a customer in a guaranteed queue than for a customer in a similar unguaranteed queue. However, the variance of the estimate of the total waiting time, S_i^2 , will be smaller for the customer in the guaranteed queue. Recall that at the beginning of the wait, customers in guaranteed queues are hypothesized to have a higher level of satisfaction than those in unguaranteed ones (H_2). Therefore, during the wait, the relative levels of satisfaction for customers in guaranteed queues vis-a-vis those in unguaranteed queues will depend on the difference in the initial level of satisfaction as well as the relative magnitudes of the differences in the estimates of the total mean waiting time, T_i, and their variance, S_i^2. Overall, although we do not propose a directional hypothesis for this case, our model suggests that the difference in in-process satisfaction between the guaranteed and unguaranteed environments will shrink and may even reverse as customers progress in their respective queues.

Impact of Initial Oueue Length: Consider two customers who are in queues of different initial lengths but have the same prior expectation of the total waiting time, T_0. Then, the two must have different beliefs about the implied mean service time, μ. In order to develop our hypotheses we assume that σ^2 is independent of μ and is the same for both customers. Then it follows from Equation (13) that the customer in the longer queue is likely to perceive a larger variance in his or her estimates of the total waiting time, S_i^2, than the one in the shorter queue. Second, the customer in the longer queue will have more frequent opportunities to update his or her estimate of the mean service time than the one in the shorter queue. To evaluate the impact of these effects of queue length again, let us consider two cases. First, if the observed service times are smaller than expected a priori, then the customer in the longer queues will adjust earlier to these short service times. However, this customer is also likely to have a larger variance around his or her estimates of the total expected waiting time than would the customer in the shorter queue. Therefore, if the observed service times are shorter than expected, whether customers in longer queues have a higher or lower level of in-process satisfaction than those in shorter queues depends upon the relative magnitude of the mutually opposing effects of updated total waiting times and their variance.

However, if the service times are longer than expected, then the customer in the longer queue not only has a larger variance in his or her estimate of the total waiting time, he or she also learns about the slow service times much earlier than customers in shorter queues. Therefore we hypothesize that:

> *H_6: Between two customers who have the same prior expectation of the total waiting time but observe different queue lengths, the customer in the shorter queue will be more satisfied during the wait than the customer in a longer queue, if both observe the service times to be less than expected.*

Customer Satisfaction at the End of a Waiting Experience

Note that, at the end of the wait, the variance of customers' updated estimate of the total waiting time, S_i^2, reduces to zero (see Equation (13)). Therefore, customers' satisfaction at the end of a wait is determined by their prior estimate of the total waiting time and their most recent updated estimate of it.

Impact of a Waiting; Time Guarantee: It follows from Equation (12), that, if the queue proceeds at a rate that is faster than what the customer had expected, then the subjective estimates of the total waiting time for customers in the guaranteed queue are always lower than those of customers in unguaranteed queues. On the other hand, if the queue proceeds at a rate that is slower than what the customer had expected, then the subjective estimates of the total waiting time for customers in the guaranteed queues are always higher than those for customers in unguaranteed queues. Therefore, based on Equation (17), we hypothesize that:

> *H_{7a}: For a given expected waiting time and favorable level of disconfirmation, end-of-process satisfaction will be higher for a firm that offers a time guarantee than for a firm that does not offer a time guarantee.*

> *H_{7b}: For a given expected waiting time and unfavorable level of disconfirmation, end-of-process satisfaction will be lower for a firm that offers a time guarantee than for a firm that does not offer a time guarantee.*

Impact of the Expected Waiting Time: Finally, given equal levels of disconfirmation,we expect longer prior expected waiting time to result in lower end-of-process satisfaction (see Equation (17)). Therefore, we hypothesize that

> H_8: *For similar levels of disconfirmation between perceived and expected waiting times, end-of-process satisfaction will be lower if the expected waiting time is long than if the expected waiting time is short.*

Scope of the Hypotheses

In the derivation of Equation (17) and its manipulation to derive the hypotheses presented above, we explicitly assumed that the conditional distribution of service times, X, is normal, which has two free parameters, namely, its mean and variance (see Equation (1)). As the discussion following Equation (17) indicates, if we had instead assumed the conditional distribution of service time to be exponential, then the mean and standard deviation of the distribution would be perfectly correlated. In the latter case, a lower σ implies a lower μ. This would happen, if for example, customers believe that a reliable service provider is, on average, quicker than an unreliable one. When this is the case, we need to make additional assumptions in order to derive some of our directional hypotheses pertaining to the impact of time guarantees on customer satisfaction. The hypotheses pertaining to queue length, however, cannot be derived as easily if we assume the conditional distribution of service times to be exponential. This is because when two customers with the same initial expectation for waiting time face different initial queue lengths, the one in the longer queue must impute a lower value for μ. However, because μ and σ are correlated it will not be true that σ^2 is independent of L. Consequently, H_3 and H_6 cannot be stated as crisply.

Next, we describe a series of experiments that we employed to collect the data for testing these hypotheses and present our empirical findings.

4. EXPERIMENTAL STUDIES AND FINDINGS

The objective of our experimental studies was to collect data for testing the foregoing hypotheses. Following Carmon (1994), we created a sequence of observable queues on a computer screen using an animation of a real-life waiting experience. The computer display comprised a queue of customers and a service provider stationed at a counter (see figure 1). During the animation, customers in the queue moved forward, were served, and exited the system. As the animation progressed, new customers arrived at approximately a uniform rate and joined the queue. The arrival rate of new customers was similar to the rate at which existing customers were served. The customer representing the respondent participating in the experiment as the focal customer was color-coded to appear different from all other customers. Thus participants could visually track their progress in the queue. In addition, participants could record their in-process satisfaction on a scale at the bottom of the computer screen.

Study 1

A total of 256 students enrolled in undergraduate management courses voluntarily participated in Study 1. The respondents were not compensated for their participation. We found a student sample to be appropriate for this study because students are a subset of the actual customer population that often has to wait in line and students have relatively similar opportunity costs of time and hence are likely to have relatively homogeneous reactions to similar waiting experiences.

Procedure

At the outset, we told the participants that our experiment involved understanding their responses to waiting. We also told them that the duration of the experiment was between 15 and 30 minutes and that they were free to leave upon completion. We requested the participants to remove their watches. After a brief introduction, the participants were taken through a training session on the computer to familiarize them with the animation as well as the method for recording their responses.

Following the training session, we asked the participants to imagine that they were visiting a typical firm in an industry they patronized. The participants then went through the animation of the waiting experience. At different points during the wait, viz., every 30 seconds, participants reported how satisfied they felt at that moment. We collected data on this measure of in-process satisfaction on a 0-100 point scale, with 0 representing "very dissatisfied" and 100 representing "very satisfied" (Corfman and Lehmann 1993). After the completion of service, the participants reported the following:

(i) the level of their overall satisfaction with the first waiting experience on a O-100 point scale, and

(ii) their subjective estimates of the duration of the first waiting experience.

Thereafter, we told the participants that it is often difficult to form accurate perceptions of the duration of time and told them the actual time that they had waited for in the first queue.

Next, we told the participants to assume that they were visiting a second firm in the same industry. We indicated to one-half of the participants that the second firm was similar to the first one. We told the other half that the first and second firms were similar in all respects except that the second one offered a time guarantee. We informed these participants that the second firm promised to serve its customers within a guaranteed period of time, failing which it compensated them for the delay. We set the guaranteed time equal to the actual duration of the first waiting experience.

Thereafter, all the participants went through the animation of the waiting experience at the second firm. Visually, the second animation was identical to the first one. In the second experience too, participants reported their in-process satisfaction at regular intervals of 30 seconds. At the end of the second waiting experience, participants reported the following:

(i) their levels of overall satisfaction with the second waiting experience on a O-100 point scale, and

(ii) their subjective estimate of the duration of the second waiting experience.

Experimental manipulations. We employed a 2(guarantee) x 2(expected waiting time) x 2(direction of disconfirmation) x 2(magnitude of disconfirmation) x 2(initial queue length) full factorial design to manipulate the variables of interest. In a complete between-subjects design, we manipulated the five variables as follows:

i) *Time Guarantee:* In one-half of the treatments the second firm offered a time guarantee; in the other half, the second firm did not offer such a guarantee.

ii) *Expected Waiting Time:* We used the duration of the first waiting experience to set the expectation for the likely duration of the second waiting experience. We manipulated the expectation variable at two levels, 4 minutes and 6 minutes. We chose these levels because they closely match customers' perception of the duration of a typical wait at a bank, an experience with which the participants in the experiment were familiar (Katz, Larson, and Larson 1987). We kept the expected waiting times one minute above and below what is perceived to be a reasonable time for a routine waiting experience.

iii) *Disconfirmation:* Disconfirmation is defined as the difference between the duration of the first and the second waiting experiences. We set disconfirmation at two levels, positive and negative.

iv) *Magnitude of Disconfzrmation:* The magnitude of disconfirmation was set at two levels, 1 minute and 2 minutes. We chose these levels because (i) we wanted to keep the disconfirmation larger than 10% of the expected waiting time, that is, approximately the threshold for perceiving differences between durations (Fraisse 1984), and (ii) we wanted the disconfirmation to be in completed minutes because customers tend to code similar durations in completed minutes (Katz, Larson, and Larson 1991).

v) Initial Queue Length: We manipulated the number of customers in the queues at two levels, 8 versus 12 customers. Participants typically come across these lengths in their daily experiences.

Results

We used the data from the experiment to test the hypotheses proposed in the previous section. Our results were generally consistent with all our hypotheses.

We adjusted each respondent's in-process satisfaction scores for the second experience to account for individual level differences in response styles and attitudes towards waiting (Couch and Keniston 1960). We assumed that the respondents had the same degree of risk aversion for waiting times but differed in their valuation of time as well as in their response-style biases when recording in-process satisfaction scores. In other words, we assumed that the respondents were heterogeneous only with respect to the parameter A, in Equation (17). We used the respondents' initial in-process satisfaction score in the first queue as a measure of this heterogeneity. Note that our customer satisfaction model in Equation (17) is nonlinear but can be linearized by taking logarithms. Because we used linear models to empirically examine the effects of our experimental treatments on in-process satisfaction, we used the logarithm of the ratio of the reported in-process measures during the second waiting experience and the initial in-process measure during the first waiting experience as the adjusted measures of in-process satisfaction. Similarly, we used the logarithm of the ratio of the end-of-process satisfaction score reported at the end of the second waiting experience and the end-of-process satisfaction score reported at the end of the first waiting experience as the adjusted measure of end-of-process satisfaction.

<u>Customer Satisfaction at the Beginning of a Waiting Experience:</u> Recall that we hypothesized that at the beginning of a waiting experience, the three factors that enhance satisfaction are (i) shorter total waiting time expectations (H_1), (ii) an offer of a waiting time guarantee (H_2), and (iii) shorter queue lengths (H_3). In order to test these hypotheses, we conducted a three-way Analysis of Variance, with interactions, using the respondents' first in-process score in the second queue as the dependent variable. The results from this ANOVA are presented in Table 1. Consistent with hypotheses H_1 and H_2, we find that an offer of a waiting time guarantee as well as a prior expectation of shorter duration of the waiting time had a significant effect on increasing customers' satisfaction at the beginning of the wait. As per H_3, the effect of queue length was also in the predicted direction but was only marginally significant ($p < 0.15$).

Customer Satisfaction During a Waiting Experience: The plots of respondents' adjusted in-process satisfaction scores for each treatment are presented in Figures 2(a) through 2(h). The results presented in Figure 2 are generally consistent with our model. Specifically, as per H_4, we find that, when the waiting time was less than expected, in-process satisfaction did increase from the time the respondents joined the queue till the time they received service. Further, consistent with H_5, we also find that when waiting time was shorter than expected, in-process satisfaction scores were higher for those respondents who were offered a time guarantee when compared with the scores of those who were not. Finally, as expected, the effect of queue length was not consistent across all combinations of expected and actual waiting times.

We further analyzed the adjusted in-process scores using repeated measures Analysis of Variance. Because the number of in-process measures were different across the experimental cells, we selected a subset of measures from each cell for conducting this analysis. Specifically, we conducted the statistical analysis using the initial, the middle, and the final in-process satisfaction scores reported by each participant. Key results from this analysis are presented in Table 2.

Generally, the between-subject effects reported in Table 2 are consistent with our model and lend support to our hypotheses. Specifically, based upon the results reported in Table 2 and an examination of the relevant cell means, we find that, consistent with hypothesis H_5, an offer of a time guarantee had the most significant impact on in-process satisfaction. Second, disconfirmation, that is, whether or not customers were served within their expected waiting time had a statistically significant impact on the level of their in-process satisfaction ($p < 0.01$). This finding supports hypothesis H_4. The main effect of the magnitude of this disconfirmation was also significant ($p < 0.01$). An examination of the relevant cell means showed that this was because, on average, the difference between the in-process scores for a one minute disconfirmation and a two minute disconfirmation was larger when the disconfirmation was negative than when it was positive. Further, consistent with the expectation-disconfirmation paradigm of customer satisfaction, we find that the level of the prior expectation of the duration of the total waiting time had a significant impact on in-process satisfaction (p c 0.01). However, the main effect of the initial queue length on in-process satisfaction was not statistically significant ($p > 0.01$).

Interestingly, we find that the interaction between time guarantee and disconfirmation did not have a significant impact on participants' in-process satisfaction ($p > 0.10$). This is not altogether surprising if we note two characteristics of our model and our assumptions regarding the impact of a time guarantee on satisfaction from waiting. First, our model suggests that, at the beginning of the wait, the level of in-process satisfaction depends only on the prior expectation of the duration of the waiting time and whether or not the customer is offered a time guarantee. Thus, given identical prior estimates of the total waiting time, a customer who is offered a time guaranteed will have a higher initial level of in-process satisfaction than a customer who is not offered a time guarantee. Second, our model is based upon the assumption that the level of in-process satisfaction adjusts gradually, rather than abruptly, as customers observe the service times of other customers in line. Therefore, even when the disconfirmation is unfavorable, customers in guaranteed queues may continue to have higher levels of in-process satisfaction through much of the waiting process than those in unguaranteed queues because of the differences in the levels of their satisfaction at the beginning of the wait.

We also find that the interaction between the time guarantee and the initial expectation of the waiting time affected in-process satisfaction. As examination of the cell means revealed that the difference between the average level of in-process satisfaction between guaranteed and unguaranteed environments was larger for the 4-minute guarantee than for the 6-minute guarantee. One possible explanation for this effect could be that, when the expected waiting time was shorter, the time guarantee was more credible and signaled a larger reduction in the variance of the service times. Finally, we found a couple of higher order interactions to have a significant impact on in-process satisfaction.

Most of the within-subject effects reported in Table 2 are also consistent with our hypotheses. We find that the participants' in-process satisfaction scores changed significantly as they made progress in their respective queues ($p < 0.01$). Further, we find that both the direction as well as the magnitude of the final disconfirmation between participants' prior and updated estimates of the total waiting time affected their level of in-process satisfaction ($p < 0.01$ for both). We also find that, although the queue length did not have a between-subject main effect on in-process satisfaction, it did have a within-subject effect. This suggests that, although on average, participants were as satisfied while waiting in short queues as they were in long ones, the rates at which they adjusted their level of satisfaction during the wait were different. Overall, the results from the repeated measures Analysis of Variance of in-process satisfaction scores are largely consistent with the hypotheses that follow from our model.

Customer Satisfaction at the End of the Waiting Experience: An examination of the cell means for the adjusted end-of-process satisfaction scores revealed that, when the service times were lower than expected, with two exceptions, the magnitude of the end-of-process scores was larger for respondents who were offered a waiting time guarantee than those who were not. Conversely, when the service times were larger than expected, the end-of-process scores were more negative for respondents who were offered a waiting time guarantee than for those who were not. These observations are consistent with our hypotheses H_{7a} and H_{7b}.

We report results from a 5-way Analysis of Variance, with interactions, in Table 3. The results from Table 3 lend further support to our hypotheses. We find that, as expected, disconfirmation, representing, whether or not customers were served within their expected waiting time, had the most significant impact on end-of-process satisfaction. We also find that the interaction term between the direction and the magnitude of disconfirmation is statistically significant. In other words, the absolute value of the deviation between the expected and the perceived waiting times had a significant impact on customers' end-of-process satisfaction. Importantly, we find that the interaction between the time guarantee and the direction of disconfirmation is significant. This finding supports our hypotheses that, when disconfirmation was favorable, then time guarantees enhanced end-of-process satisfaction (H_{7a}); and when unfavorable, then they reduced end-of-process satisfaction (H_{7b}). Finally, as hypothesized in H_8, we find that the level of prior expectation had a significant impact on end-of-process satisfaction.

Thus, given equal levels of disconfirmation, customers with expectations of a shorter wait had higher end-of-process satisfaction that those with an expectation of a longer wait. We find that none of the other interactions were statistically significant. Overall, the results of the ANOVA provide empirical support for the hypotheses derived from the model.

Studies 2 and 3

In Study 1, the same set of respondents provided data on both in-process satisfaction as well as end-of-process satisfaction. Although the results from this experiment were consistent with the hypotheses that follow from our model, there were a few issues that we needed to address in order to rule out alternative explanations for our findings pertaining to the impact of time guarantees on end-of-process satisfaction. First, it is possible that in Study 1 the process of recording frequent in-process satisfaction measures was intrusive and systematically altered the respondents' waiting experience and hence their end-of-process satisfaction scores. Second, subjects recorded their in-process satisfaction scores at fixed intervals of 30 seconds. It is conceivable that the regularity in the spacing of in-process responses may have provided respondents with essentially an external clock and affected their perceptions of time and hence their satisfaction at the end of the wait. Finally, we had asked respondents to remove their watches at the beginning of the experiment and had also queried them regarding the duration of the first waiting experience. This may have made respondents overly concerned about correctly estimating the duration of the waiting time and may have affected their waiting experience.

In order to address these issues, we conducted two additional experiments. In the first of the these follow-up experiments (Study 2), we wanted to examine whether the effects of a waiting time guarantee on end-of-process satisfaction that we found in Study 1 persisted, even when the participants are not asked to record their in-process satisfaction ratings and are not concerned about correctly estimating the duration of the waiting time. In Study 3, we wanted to examine whether the impact of a waiting time guarantee on end-of-process satisfaction persisted even when respondents had access to a precise clock. Recall, our model is based on the assumption that a customer uses information regarding the time taken to serve other customers in the queue in conjunction with his or her prior estimates of the mean service time to update his or her estimates of the mean service time. An external clock merely changes the precision of this information from a subjective to a more objective one and should not affect the nature of the updating process. Therefore, our model predicts that the effects of a time guarantee on end-of-process satisfaction would persist even when customers have access to a clock.

Procedure

The stimuli for the second and the third experiments were generally the same as those for the first. However, we did not ask the respondents to record in-process satisfaction scores and also did not query them regarding the duration of the first waiting experience. We also did not request respondents to remove their watches. We used a 2(guarantee) x 2(disconfirmation) x 2(expected waiting time) full factorial design to manipulate the variables of interest. All the queues in the second experiment consisted of 8 customers. A total of 64 management undergraduate students participated in each experiment. The only difference between the two studies was that in Study 3 we presented a digital clock that displayed the current time in hours, minutes, and seconds, in the top right-hand comer of the computer screens on which the experimental stimuli were presented.

Results

We adjusted the end-of-process satisfaction scores just as we did for the data from Study 1. We analyzed the adjusted end-of-process satisfaction scores using a 3-way Analysis of Variance, the results from which are presented in Table 4. As in Study 1, we find that disconfirmation, that is, whether or not the actual waiting time was more or less than the expected waiting time, had the most significant impact on end-of-process satisfaction ($p < 0.01$). Further, the interaction between the presence or absence of a guarantee and the direction of disconfirmation had a significant effect on end-of-process satisfaction ($p<0.01$). An examination of the cell means revealed that end-of-process satisfaction was higher for a firm that offered and met a waiting time guarantee than that for a firm that did not offer a time guarantee but served its customers within their expected waiting time. Conversely, end-of-process satisfaction was lower for a firm that offered but violated a time guarantee than for a firm than did not offer a time guarantee but took more time to serve its customers than what they had a priori expected. Finally, we find that the level of initial expectation had a marginally significant effect on end-of-process satisfaction ($p<0.10$). Thus, between two customers whose expectations have either been met or violated by equivalent amounts, the one with an expectation of a smaller duration of the waiting time had a higher level of end-of-process satisfaction.

We analyzed the adjusted end-of-process scores from Study 3 using a 3-way Analysis of Variance, the results from which are presented in Table 4. These results confirm that the effects of a time guarantee on end-of-process satisfaction that were found in the earlier two experiments persisted even when the respondents were provided with a clock. We find that the direction of disconfirmation still had the most significant impact on end-of-process satisfaction ($p < 0.01$). Further, the interaction effects between the presence or absence of a guarantee and the direction of disconfirmation were again significant ($p<0.01$). Finally, the level of initial expectation had a direct and marginally significant effect on end-of-process satisfaction ($p<0.10$).

Overall, the findings from Studies 2 and 3 closely replicated those from Study 1 and provided further empirical support for our hypotheses. We suggest that the implication is that while recording in-process satisfaction ratings might have influenced the magnitude of the effects of a time guarantee, it probably did not affect the direction of the results.

5. DISCUSSION

Impact of Waiting Time Guarantees

In this paper, we examined the impact of time guarantees on customers' satisfaction with waiting, at the beginning of, during, as well as at the end of a waiting experience. We believe that it is important to understand the determinants of satisfaction during a negatively valued "consumption" experience such as waiting as much as it is for positively valued ones, such as entertainment. Such an understanding can help managers design better systems that improve satisfaction and minimize premature termination of waiting experiences by customers.

Overall, the results of our study support the move towards providing time guarantees. We find that, at the beginning of, during, as well as at the end of a waiting experience, customer satisfaction with waiting is higher at firms that choose to offer and meet time guarantees than at firms that merely serve customers within their expected time. However, our study also sounds a note of caution regarding the indiscriminate use of time guarantees. Our finding that the adverse effect on end-of-process satisfaction of violating time guarantees is stronger than that of merely not meeting customers' waiting time expectations suggests that firms that offer time guarantees but do not invest in the operations necessary to support them are likely to lose customer goodwill. It is worthwhile to note that we find time guarantees to have an effect on customer satisfaction, even in an environment where customers can form reasonably good estimates of the expected duration of the wait, based on the observed queue lengths and prior estimates of service times. In other waiting environments, such as those where customers cannot observe either the queue length or the service times, we conjecture that the differential impact of a time guarantee on customer satisfaction will be larger than that found in this study.

Although, in this paper, we focus on how a time guarantee affects the customers of the firm that offers it, we believe that the guarantee also affects the customers of the firm's competitors because it serves as a benchmark for superior waiting time management within the industry. Our model of satisfaction, as presented in Equation (17), can be extended in a straightforward manner to capture this effect. Consider, for example, a customer who visits a service provider and expects to wait for T_f minutes. However, he or she uses a competitor's time guarantee of T_g minutes $(T_g < T_f)$ as a benchmark. We can accommodate this effect by rewriting our satisfaction model it as follows:

$$SAT(T_i; T_f, T_g) = -(A_1(T_f^{\gamma}))\exp[-c(T_g - Ti) + c^2(S_i^2)], \qquad i = 0, 1,..,L, \qquad (20)$$

where SAT(.) is the level of satisfaction at the focal service provider that does not offer a time guarantee. Under these circumstances, if T_f improves, that is, the average service time for the focal service provider becomes shorter, then, all else equal, satisfaction goes up. On the other hand, if the competitive service provider's total waiting time, T_g, improves, then satisfaction goes down. Thus, T_f can be thought as operating like a *will* expectation, and T_g like a ***should*** expectation (Boulding et al. 1993). Note that Equation (20) can also be used to model the satisfaction of the customers of the firm that offers the guarantee if it is empirically found that these customers' expectation of the total waiting time are substantially different from the guaranteed time.

Last, measures designed to manage waiting time have often been classified as being either operations-based or perceptions-based (Katz, Larson, and Larson 1991). Our results suggest that it may not be appropriate to maintain this dichotomy for measures such as time guarantees. A time guarantee is a composite measure. On the one hand, it is a powerful device to manage *perceptions* by externally influencing the variance around customers' expectations of the duration of the waiting time. On the other hand, for it to be successful, a time guarantee needs to be supported by superior *operations* that have lower variance.

Scope and Generalizability of Our Results

The utility theory-based model presented in this paper can easily be extended to other waiting time environments such as those where service completions cannot be observed or where customers cannot readily update their beliefs regarding service times. Some of these environments may require changes in certain behavioral assumptions that can be incorporated easily. This generalizability shows the rich potential of the approach undertaken in the present study for examining satisfaction with waiting time in other pertinent situations.

Although the primary objective of our paper is to examine the impact of waiting time guarantees on customers' waiting experiences, our model and empirical findings do provide additional insights into customers' responses to queuing environments in general. For instance, we find that while customers wait in line, their in-process satisfaction does not necessarily increase or decrease monotonically with elapsed time. Specifically, our empirical findings are consistent with the implication of our model that a customer's level of in-process satisfaction is determined by the difference between his or her updated real-time estimates of the total waiting time and the a priori estimate of it and the variance of customers' updated estimates of the total waiting time. Based upon our findings, we believe that firms can enhance customers' waiting experiences by providing assurances of service within the expected time as well as evidence for the progress that customers are making in the system. In addition, we suggest that firms should design their service delivery systems in a manner that not only reduces the average duration of the customers' waiting time but also the variance around the average.

Opportunities for Future Research

Although we believe that our work can be extended in many ways, we confine the discussion to three specific areas. First, in this study, we did not manipulate the level of compensation that the firm offered its customers for whom it could not meet the time guarantee. We feel that the amount of compensation is an important operational variable that can influence customers' satisfaction level if a time guarantee is violated. Future research should investigate important issues such as the determination of the optimum levels of compensation and the impact of over- and undercompensation on customers' satisfaction levels. Second, we focused on the impact of a time guarantee during a single waiting experience. However, many purchase situations involve frequent contact between firms and their customers. Future research should assess the cumulative impact of a time guarantee on both satisfaction with waiting as well as on customers' waiting time updating mechanisms. Of particular interest will be the differences, if any, between cases where time guarantees were met and those where they were violated. Last, in the present study, we focused on the impact of time guarantees on the satisfaction of the focal firm's customers. An important extension of this work, that follows from Equation (20), will be to investigate whether and how time guarantees *simultaneously* impact the *will* expectations of a firm's own customers and the *should* expectations of its competitor's customers and how these expectations, in turn, affect the satisfaction with waiting for the two groups of customers.

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Table

Results from the ANOVA of the In-Process Satisfaction Measure at the Beginning: of the Waiting Experience (Study 1)†

Class	S.	D. F.	F-value
Expected Waiting Time	1.96	1	3.09*
Time Guarantee	8.30	1	13.03***
Queue Length	1.40	1	2.21
Expected Waiting Time x Time Guarantee	0.97	1	1.93
Expected Waiting Time x Queue Length	0.03	1	0.05
Time Guarantee x Queue Length	0.04	1	0.06
Expected Waiting Time x Time Guarantee x Queue Length	0.01		0.02

***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.

†The satisfaction scores have been adjusted to account for individual level differences. The adjusted score = log(Initial in-process satisfaction score from the second experience/Initial in-process satisfaction score from the first experience).

Table 2

Results From Repeated Measures ANOVA of In-Process Satisfaction Scores (Study 1)

Between Subjects Effects@

Class	Degrees of Freedom	Sums of Squares	F-value
Expected Time (EXP)	1	9.60	6.26^{***}
Disconfirmation (DIS)	1	12.40	8.08^{***}
Time Guarantee (GRNT)	1	16.90	11.02^{***}
Queue Length (LENGTH)	1	0.87	0.57
Magnitude of Violation (MAG)	I	5.02	3.28^{***}
EXP x GRNT	1	5.67	3.70^{***}
DIS x GRNT	1	0.06	0.03
DIS x GRNT x LENGTH	1	5.44	3.55^{***}
EXP x DIS x GRNT x MAG	1	8.18	5.33^{***}
EXP x DIS x GRNT x LENGTH x MAG	I	4.32	2.82^{***}

Within Subjects Effects@

Class	Degrees of Freedom	Sums of Squares	F-value
Progress#	2	71.51	81.59^{***}
Progress x Expected Time (EXP)	2	1.39	1.59
Progress x Disconfirmation (DIS)	2	15.97	18.22^{***}
Progress x Time Guarantee (GRNT)	2	0.84	0.96
Progress x Queue Length (LENGTH)	2	3.59	4.10^{***}
Progress x Magnitude of Violation (MAG)	2	4.02	4.59^{**}
Progress x EXP x MAG	2	2.33	2.66^{*}

***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.

†The satisfaction scores have been adjusted to account for individual level differences. The adjusted score = log(In-process satisfaction score from the second experience/Initial in-process satisfaction score from the first experience).

#Progress is a variable that represents whether the within-subject in-process satisfaction measure was the initial, the middle or the final one.

@None of the other effects were statistically significant.

Table 3

Results From ANOVA of End-of-Process Satisfaction Scores[†]
(1)tudy

Class	Degrees of Freedom	Sums of Squares	F-value
Expected Time (EXP)	1	0.63	3.75”
Disconfirmation (DIS)	1	24.75	147.39***
Time Guarantee (GRNT)	1	0.05	0.32
Queue Length (LENGTH)	1	0.26	1.56
Magnitude of Violation (MAG)	I	0.025	0.15
EXP x DIS	1	0.07	0.42
EXP x GRNT	1	0.03	0.20
EXP x LENGTH	1	0.02	0.14
EXP x MAG	1	0.02	0.09
DIS x GRNT	1	1.47	8.77***
DIS x LENGTH	1	0.13	0.76
DIS x MAG	1	1.60	9.52***
GRNT x LENGTH	1	0.01	0.04
GRNT x MAG	1	0.01	0.06
LENGTH x MAG	1	0.00	0.03
EXP x DIS x GRNT	1	0.00	0.00
EXP x DIS x LENGTH	1	0.16	0.97
EXP x DIS x MAG	1	0.00	0.00
EXP x GRNT x LENGTH	1	0.12	0.70
EXP x GRNT x MAG	1	0.10	0.57
EXP x LENGTH x MAG	1	0.02	0.11
DIS x GRNT x LENGTH	1	0.27	1.59
DIS x GRNT x MAG	1	0.01	0.07
DIS x LENGTH x MAG	1	0.05	0.27
GRNT x LENGTH x MAG	1	0.03	0.17
EXP x DIS x GRNT x LENGTH	1	0.08	0.46
EXP x DIS x GRNT x MAG	1	0.00	0.00
EXP x DIS x LENGTH x MAG	1	0.00	0.00
EXP x GRNT x LENGTH x MAG	1	0.00	0.00
DIS x GRNT x LENGTH x MAG	1	0.43	2.58
EXP x DIS x GRNT x LENGTH x MAG	I	0.15	0.87

***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.

[†]The satisfaction scores have been adjusted to account for individual level differences. The adjusted score = log(End-of-process satisfaction score from the second experience/End-of-process satisfaction score from the first experience)

Table 4

Results From ANOVA of End-of-Process Satisfaction Scores
[Studies 2 and 3)

Class	Degrees of Freedom	Study 2 Sums of Squares	Study 2 F-value	Study 3 Sums of Squares	Study 3 F-value
Expected Time (EXP)	1	0.12	2.96*	0.09	3.07*
Disconfirmation (DIS)	1	7.24	180.47***	5.66	197.99***
Guarantee(GRNT)	1	0.04	0.99	0.03	0.89
EXP x DIS	1	0.00	0.00	0.00	0.00
EXP x GRNT	1	0.00	0.01	0.00	0.06
DIS x GRNT	1	0.35	8.61***	0.28	9.76***
EXP x DIS x GRNT	1	0.00	0.00	0.01	0.19

***$p < 0.01$, **$p < 0.05$, *$p < 0.10$.

‘The satisfaction scores have been adjusted to account for individual level differences. The adjusted score = log(End-of-process satisfaction score from the second experience/End-of-process satisfaction score from the first experience)

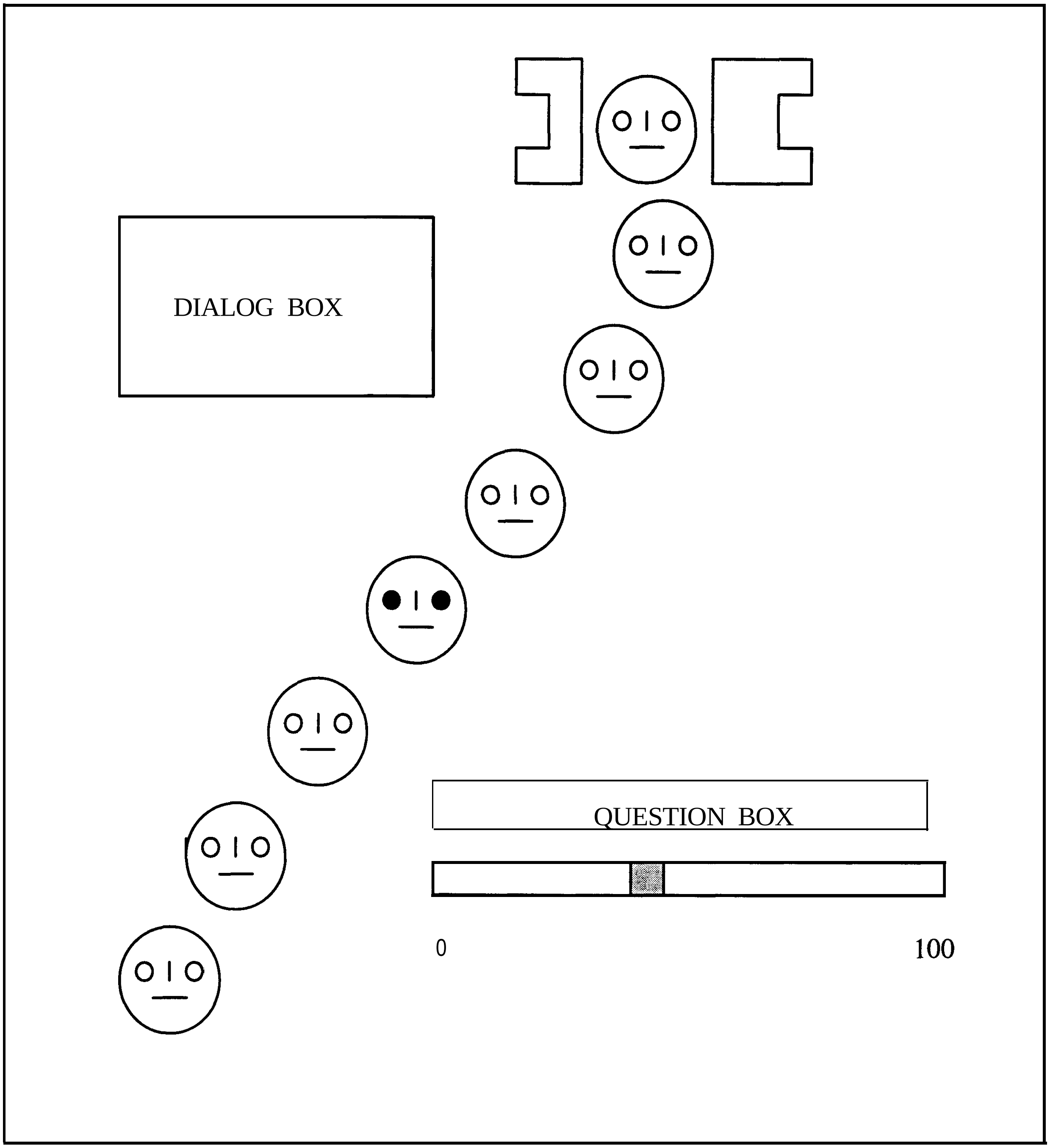

Figure 1. Animation of a Waiting Experience: An Illustrative Computer Screen

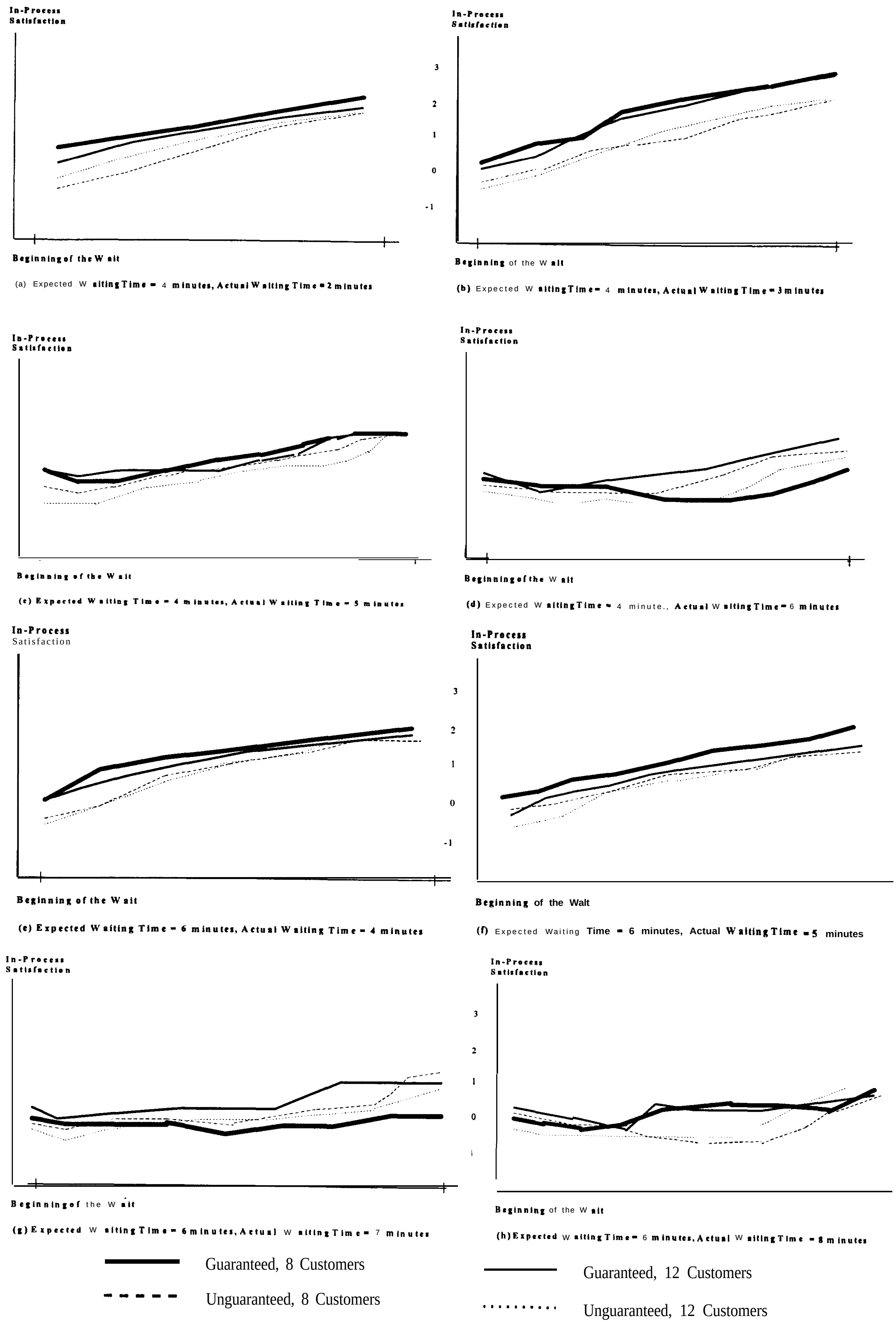

Figure 2. Plots of In-Process Satisfaction.