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The Effects of Queue Structure on Attitudes

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Waiting is examined here as a psychological experience, through propositions regarding the relationship between the design of a queue and the emotions and attitudes of people waiting. Propositions are tested using a paradigm that both controls features of queue structure and allows collection of real-time data from people waiting. Data collected from 134 participants confirm that people closer to a service agent are more pleased than those further away. But people waiting in a single-queue structure are shown to feel more predictability and arousal than those waiting in a multiple-queue structure. Waiting in a multiple-queue structure is, however, shown to produce a sense of lack of justice, even when no objective inequalities exist. The study suggests a useful paradigm for evaluating alternative queue structures in a laboratory setting and provides insights about psychological aspects of waiting. Both the method and the results suggest an extensive agenda for future research.

How do customers feel while waiting in line to receive service? Such waiting is a central tenant of modern life, and management of a waiting process can be a critical element of managing customer service operations. A wealth of mathematical and operations research literature searches for more efficient waiting processes, but only limited attention has been paid to how people feel while or about waiting.

Waiting can create attitudes that can be as critical for management as the time and costs of labor (cf. Maister 1985; Osuna 1985; Schwartz 1975). Angry customers can be as hazardous to service quality as time or money spent inefficiently on various aspects of service delivery. Common folklore holds individuals responsible for their behavior in a queue: A person may be called impatient or rude for his or her behavior while waiting. Yet structural reasons (i.e., the design of a wait process) may be responsible for attitudes and behavior in a queue. Our effort here builds on available research to present a model for the study of the psychological underpinnings of waiting in line, along with an initial set of hypotheses and results regarding attitudes produced by queue features. What we describe is a study of conceptually distinct designs or structures of waiting and how they affect individual attitudes while and after waiting.

We begin with a brief overview of available research on waiting and of assumptions that we argue are essential to a systematic study of queue structures. We then develop hypotheses that consider the impact of queue structure on attitudes of pleasantness and arousal and perceptions of social justice and control. Using a novel method, we then test these hypotheses and provide what we believe are insightful implications for both management and future research.

THE EXPERIENCE OF WAITING

Wait queues are social systems that have been structured to coordinate the delivery of goods and services and to reduce the costs of service delivery (Hall 1991; Saaty 1961; Schwartz 1975). The structuring can be physical, as when people are channeled to or through a specific physi-

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cal channel, or it can be abstract—as when people are allocated numbers. In both cases, a psychological process of waiting is imposed on customers, which involves delay of need gratification. This process may generate anxiety about when or whether the need will be fulfilled (i.e., will service be received?) and to what extent the wait process is fair (Milgram et al. 1986; Schmitt, Dube, and Leclerc 1992).

Waiting can be associated with multiple attitudes. One can, for example, feel helpless in a wait of unknown duration or with unknown results (Peterson, Maier, and Seligman 1993). When will the wait end? What will the service provider require of me? Anxiety may also be about the extent to which one is treated fairly: Did others receive service before I did? Feelings of complacency may emerge when a long wait is due, but a clear system of waiting that guarantees social justice exists (Larson 1987). Agitation and irritability may replace complacency when social justice is not maintained by the queue structure (Maister 1985). Each of these scenarios reflects managerial actions that determine the nature of the waiting experience (Hall 1991) but also produce different psychological situations (Diener 1999).

From a systems perspective, wait queues are a buffer between the rate at which customers seeking service arrive and the rate at which service can be delivered, a tool for minimizing waste of resources due to unoccupied service delivery agents. Queues, which determine the flow of service recipients to service providers, should minimize the negative impact of customers' wait (Hall 1991). One critical question is queue structure: Should all people wait in one queue, to be channeled to the first available service provider, or should multiple queues channel people to distinct service providers? In this study, we focus on this aspect of the management of waiting.

Thus, we limit the focus here to a case where multiple employees provide service to multiple recipients. In such a case, waiting can be structured in two conceptually distinct ways. Multiple individuals can be channeled into one single line or queue to receive service. Or, each recipient can, upon arrival, select the line or queue in which to wait and hence the provider from which the service will be received. These two alternative structures are labeled single queue (SQ) and multiple queue (MQ), respectively.

From an operations perspective, each queue structure has advantages. The SQ reduces variations in waiting times because differences in arrival rate and service time can cancel out (Hall 1991). In contrast, MQ structures have been shown to lead to a shorter waiting time because the movement time and distance, the time and distance required for movement from the queue to the server, is minimized (Rothkopf and Rech 1987). MQ structures are also advantageous when service capacity exceeds the speed that customers can move through a SQ and when personalized service is appropriate because they allow customers to choose the service provider (Hall 1991; Rothkopf and Rech 1987).

These two distinct queue structures exist in many service organizations, but comparing them in real organizational settings is likely to introduce multiple sources of experimental "noise" or error because no two queues can be alike in multiple parameters. To conduct a valid study of the effects of queue structures, we propose and test here a paradigm in which parameters of the queue structures are experimentally controlled. In this paradigm, people actually waiting are led—via a dynamic computer display—to feel as if they are waiting in a specific queue structure. The computer display allows people waiting to monitor and control their progress in the queue. Individual attitudes can be measured while people wait through survey questions presented to them on the same screen on which the queues are presented. Hence, the paradigm creates a controlled environment that enables the manipulation of (simulated) queue structures, allowing for a reliable evaluation of the effects of these structures on customer attitudes. The paradigm relies on data collected in a laboratory through visual representations of queues, which may limit the extent to which findings can be generalized. But parameters of the data collected (e.g., means and variances of time waited) provide validation of the external validity of the findings, bolstering validation obtained through self-reports of participants that they really feel they are waiting. More important, the paradigm offers very strong internal validity, providing a solid foundation for future field research.

Multiple parameters may vary among wait structures, so a systematic study must begin by clearly delineating the type of wait structures studied. Attributes of structures examined in one study are *not* necessarily true in *all* waiting structures. But there are attributes that are true in many (although not all) waiting structures, and we selected such attributes for the current study, as a baseline. Thus, our assumptions in the present study are as follows: First, individuals do not have prior information about other people waiting or about service providers. Customers may have expectations about a wait as a result of prior experiences, but because the waiting situation we studied was completely novel to all participants, our assumption here is that any expectations people bring to the study are randomly distributed among participants. Second, the complexity of customer requests and the level of server abilities are randomly distributed and are unrelated to queue structure. Third, everything else being equal, people are expected to prefer short lines. Clearly, additional information may influence preferences, but our first assumption (above) was that people do not have such information. A fourth assumption is that an individual who has entered a specific

queue *cannot* change and push his or her way into another queue. This assumption is limiting because people may desire behaviors besides simply progressing in line (i.e., switching lines, cutting in line). But this assumption is essential at this initial stage of systematic research about waiting, before more complex patterns of behavior can be considered.

Clearly, many waiting structures and scenarios violate one or more of these assumptions. Service providers vary in their skills, and people waiting often have access to information about other customers or about service providers (e.g., "I don't stand after people with young children; they are always slow" or "I know this clerk is really slow."). Future research can consider variations of these assumptions, but even within them, differences in attitudes can be predicted between an SQ and an MQ structure, as elaborated next.

Waiting and Pleasantness

It is not surprising that waiting is unpleasant. Pleasantness is defined as the dimension of experience that refers to hedonic tone (Feldman Barrett and Russell 1999, p. 10). Thus, pleasantness is how good (or bad) people feel in an experience. Because waiting stands between customers and the accomplishment of desired goals (Meyer 1994), it often creates frustration and lowers the sense of pleasantness. Shorter queues bring people more quickly to their target and can therefore be expected to improve evaluations of the experience (Maister 1985). People are also likely to notice people ahead of them in line (who form the barrier) rather than those behind them (who are *not* a barrier). So, a customer closer to a service provider is likely to notice fewer people than a customer further away from the service provider (Hall 1991). In this vein, smaller crowds have been shown to be associated with more pleasant feelings than larger crowds (Eroglu and Machleit 1990). Thus, our first (and almost trivial) proposition is that progress in waiting, in any type of queue, leads to improved pleasantness. The implicit hypothesis here is that pleasantness is not a product of queue structure but rather a product of one's place in a queue:

Hypothesis 1: Feelings of unpleasantness will decrease with progress in a wait. People closer to a service provider will report more positive attitudes regardless of the structure of the queue.

In line with current views of the structure of human emotion, this proposition focuses on the pleasantness dimension of affect (Feldman Barrett and Russell 1999; Mehrabian and Russell 1974; Russell 1991). This is important because more refined predictions about the effects of the queue structure can be made about the control and arousal dimensions, as detailed below.

Waiting and Perceptions of Predictability

A second problem with waiting is control: Individuals waiting are required to do something over which they have little or no control (Bateson 1985; Hui and Bateson 1991; Maister 1985). We suggest that the extent to which individuals feel a lack of control can be manipulated through the structuring of the queue.

A key difference between the MQ and SQ structure is the amount of choice offered to the people in the system. The dynamics of control in the two queue structures are in some way paradoxical, however, as has been the relationship between choice and control in scholarly research (cf. Langer 1983, p. 14). An SQ appears to limit both behavioral and decisional control (Averill 1973) because it designates precisely where an individual is to wait, before and after whom. An SQ eliminates much individual input regarding the queue and also does not provide any control regarding the service provider, the implicit rule being that service is obtained from the first available agent. The lack of alternatives to choose from presumably limits the sense of individual control (Averill 1973; Perlmutter and Monty 1979; Thompson 1999).

However, an SQ *does* provide predictability in that the order of service delivery is clear to anyone in the line (Averill 1973). In contrast, an MQ structure seems to give participants more freedom or choice in selecting the line in which to stand and in determining after whom they will wait and from which agent service will be received. This room for choice does not necessarily increase what Averill (1973) defined as cognitive control, because the choice is often made without sufficient information about the other people in line or about the service agents. People forced to select among alternatives do not feel a sense of control if they do not have useful information about how to choose (Averill 1973; Kiesler 1966; Langer and Rodin, 1976). Thus, an SQ structure provides greater clarity of what is about to happen than an MQ structure, so people in the former can be expected to report a greater sense of predictability than people in the latter (cf. Averill 1973; Baum, Fisher, and Solomon 1981; Lanzetta and Driscoll 1966).

Moreover, SQ structures clearly prescribe actions and behavior throughout the wait, but MQ structures can invite counterfactual (or what-if) thinking (Mandel and Lehman 1996; Roese 1997). While waiting in an MQ structure, a customer is continuously reminded that his or her current situation is a product of a decision previously made (i.e., regarding the selection of a queue). That the decision was made without sufficient information may reduce the sense of individual control and amplify frustration (Kahneman

and Miller 1986; Roese 1997). It may be this process that produces the (out-of-control) sentiment "I always get into the wrong line."

In short, assuming everything else is identical, people waiting in an SQ structure can be predicted to report a more consistent and even an enhancement in their sense of predictability relative to people waiting in an MQ structure:

Hypothesis 2: Individuals waiting in an MQ structure will report a lower sense of predictability than individuals waiting in an SQ structure.

Waiting and Arousal

A third problem with waiting is often lack of activity. Arousal or activation is the internal sense of activity, an important element of human emotion (Feldman Barrett and Russell 1999; Russell 1991). The structure of a queue can influence the activity a wait involves. MQ structures, which seem to invite constant social comparison and a certain degree of anxiety regarding whether one has made the correct choice, may suggest a relatively high sense of mental activity. However, if people are *not* free to move among queues, an MQ structure restrains physical movement more than an SQ structure.

In an SQ structure, anyone waiting necessarily passes through all points in the waiting arena and benefits from the progress enabled through the efforts of all service providers. For example, if there are 35 people who are waiting for five service providers, all individuals waiting in an SQ will in some way experience the 35 "waiting spots." SQs thus provide slow but constant and active progress toward a service goal (Baker and Cameron 1996). Such activity can be viewed as a "time filler" (cf. Maister 1985). In contrast, in an MQ structure, people pass through the subset of points in their own queue and benefit from the progress enabled *only* by the efforts of their designated service provider. Thus, MQ structures provide significantly less activity than SQ structures provide (Rothkopf and Rech 1987). Such activity can elevate the sense that one's wait time is occupied as well as reduce the helplessness associated with waiting experiences (Peterson, Maier, and Seligman 1993).

More important, these arousal effects are not related to waiting per se but rather to the way the time waited is experienced. Keeping people actively in progress in an SQ can sway attention away from the frustration of wasting time toward the occupying activity (Baker and Cameron 1996; Kellaris and Moses 1992). Feelings about time waited can vary as a result of how this time is occupied (Zakay 1989), because subjective time estimates are influenced by what happens during a wait (cf. Hornik 1984) and active time is more arousing. Thus, SQ structures can be expected to be arousing in that they provide activity through the constant movement toward the goal of the wait (Meyer 1994; Nasar 1988). In contrast, MQ structures are more restraining if, as we assumed here, once a specific queue is selected, progress can be made only in this queue. This is the essence of our third hypothesis:

Hypothesis 3: Individuals waiting in an SQ structure will report higher levels of arousal than individuals waiting in an MQ structure that does not allow movement from queue to queue.

Queue structures that allow movement from queue to queue may elicit arousal as a result of both monitoring and moving to the other queues. The relative speed of the other queues may be a factor as well; if alternative lines are faster, for example, arousal may be heightened. However, if the speed of the other lines is equivalent to one's own line and movement between lines is not possible, as were our assumptions here, lower arousal can be expected in an MQ structure than in an SQ structure.

Waiting and Perceptions of Justice

A fourth and final aspect of waiting perceptions regards social or procedural justice (or lack thereof) (Larson 1987). Procedural justice concerns individual perceptions about the fairness of procedures and is separate from distributive justice, which regards the fairness in the distribution of desired outcomes (Thibaut and Walker 1975). Both Taylor (1995) and Larson (1987) identified perceived justice as a key variable in social analyses of waiting.

One thing that SQ structures promise is fairness: Service delivery is disciplined by the rule of "first come, first serve" (Hall 1991, p. 417), so that both distributive and procedural justice are maintained. The amount of time that all people in the SQ wait is governed by the same distribution, which maintains distributive justice. All people are also subject to the same rules regarding order of service, which maintains procedural justice. In an MQ structure, however, procedural justice may be threatened, as it is possible that people waiting in one queue will receive service *after* people who came later but selected another queue. Distributive justice may be threatened in an MQ structure because there may be variations in the speed of specific queues, and some people may need to wait longer than others. Even if a specific MQ experience does not subject one to fairness violations, prior experiences may generate concerns. Thus, concerns about justice are more likely to evolve in MQ structures than in SQ structures:

Hypothesis 4: People in an SQ structure will report more perceived fairness than people in an MQ structure.

The hypothesis regards the structure of a queue, not the experience of justice violations per se. MQ structures that produce justice violations may lead to valid perceptions of injustice. Our proposition is that among individuals waiting and *not subjected* to fairness violations, those waiting in an MQ structure will view the process as more unfair than those waiting in an SQ structure. This proposition suggests that justice needs to be evident in the way a queue is structured because it emanates not only from people's subjective experience.

A final proposition integrates our previous propositions to suggest that overall, everything else being equal, individuals will largely prefer SQ structures to MQ structures. SQs were predicted above to produce higher predictability (Hypothesis 2), higher arousal (Hypothesis 3), and a greater sense of justice (Hypothesis 4). Together, these predictions suggest our final proposition:

Hypothesis 5: Individuals will prefer waiting in an SQ structure to waiting in an MQ structure.

METHOD

Testing our hypotheses in a live setting would have been severely handicapped because it is difficult if not impossible to find two waiting settings in which everything else is held equal except for the structure of the queue. The reliability and validity of measures collected from people in live settings would be challenged by variations in the context. We therefore sought a paradigm that would combine an actual waiting experience with a controlled type of service and reliable measurements that introduce only minimal intrusion into the waiting experience. We developed such a paradigm by designing a study in which participants experience an actual wait in the laboratory (while waiting to participate in an unrelated experiment). Each participant actually waited for 12 minutes while using a computerized screen to progress in one of two queue structures—an SQ or an MQ. Participants were randomly assigned to one of these two conditions.

Overview and Process

Participants (volunteers for a paid experiment) were told that there was a short wait before their experiment would begin but that, for their convenience, there was a computerized representation of their progress in the wait. They were asked to select an icon to represent them in the wait from eight options (red, yellow, green, or blue circle or square), a step intended to enhance their identification and their involvement with the computer screen queue. Participants were then asked to respond to a set of questions unrelated to the goals of the study in order to unobtrusively familiarize them with the computer program. These questions referred to a display of a social situation depicted on the screen with similar icons, and participants were asked to use their mouse to rate (on the screen) how the situation depicted on the screen made them feel.

Once they completed these preliminary questions, participants were told: "You now have to enter the queue. This will be done by clicking with your mouse on the end of the queue. Please click now on the end of the queue."

Participants then saw on the screen either an SQ of icons or an MQ of icons (see Figures 1 and 2). The queue condition of each participant was randomly allocated. Participants used their mouse to move to the end of the queue. As the icon moved, participants were asked (on the screen) to respond to a series of questions that appeared on the right side of the screen (see below and Figures 1 and 2), using a response format similar to that used in the preliminary questions.

After an initial set of questions, participants progressed through the queue, waiting and moving through the queue for 12 minutes; they moved in line by clicking with the mouse on their icon. If they did not click, they did not move up in line; if two spaces opened up between a participant and the icon ahead in line, a note in bold letters appeared on the screen stating, "To move ahead in line, click with the mouse on your icon." This feature simulated the reminder of other patrons to a person opening up a gap in a queue. This wait process continued until a participant's icon reached a service provider, at which point he or she participated in a second, unrelated experiment, was paid, and released.

During the wait process, measures (described below) were collected using the same computer interface. In the instructions about the experiment, participants were told that they could leave at any time but that only if they completed the experiment (which would start at the end of the queue), they would receive payment. Thus, the queue presented actual waiting for an outcome sought by the participants—participation in a paid experiment. Similar to other waiting situations, participants could leave, but doing that meant forgoing a sought outcome.

Participants

Participants in the study ($N = 146$; 72 women, 74 men) were students who were recruited through ads posted around an Institute of Technology in Israel. Students in Israel are generally financially independent, making them representative of the general population. The average age was 25.3 (range 19-31).

FIGURE 1
One Shot of Screen Participants See When Participating in Multiple-Queue Condition of Waiting Simulation

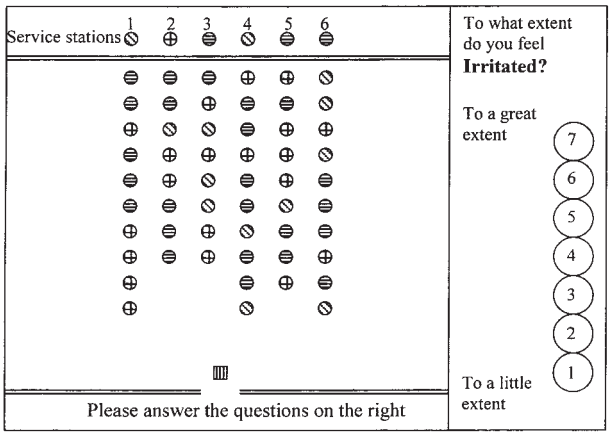
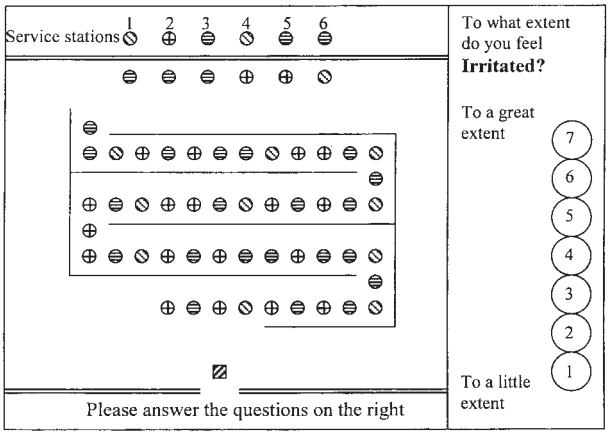


FIGURE 2
One Shot of Screen Participants See When Participating in Single-Queue Condition of Waiting Simulation



NOTE: The screen is navy, and dots representing people in line are red, yellow, green, or blue. Participants select color and shape to represent them throughout the study. The program represents all other individuals in line using colors and shapes different from those chosen by the participant. Queues proceed dynamically until the participant has reached the service provider. To proceed in the queue, participants need to click on their icon. The screen asking for participant reactions on the right appears only at selected points during the wait. Content of this screen, number of people in line, rate of progress in line, number of service providers, and so on can be predetermined through programming.

Variables

Means, standard deviations, and Cronbach's alpha values of all study variables, as well as correlations between variables, are reported in Table 1.

Pleasantness and *arousal* were measured using items selected from Russell and Mehrabian (1977). Pleasantness was an index of three items (pleasant, satisfied, comfortable), and arousal was an index of three items (active, interested, bored) (reverse coded). *Predictability* was also measured using a three-item index, derived from Averill (1973): "I feel I can predict what will happen to me," "I know what is happening to me," and "I have a choice in what is happening to me." Pleasantness, arousal, and predictability were measured twice, once just before participants entered the wait and a second time after 50% of the patrons waiting had received service. All items comprising these three variables were rated on a 7-point scale, where 1 = *not at all* and 7 = *to a very great extent*.

Perceived fairness was a measure loosely based on the measure described by Greenberg (1993) that included three items: (a) To what extent was the wait method fair? (b) To what extent was there an appropriate process for determining the order in which service was received? (c) To what extent was the method of order of receiving service fair to people?

Queue structure preference was assessed after the wait. Each participant was presented with a graphic depiction of the queue in which he or she had just waited and told: "You have just finished waiting in a line that looked like this." They were then shown a picture of the alternate way a queue can be structured and were asked to indicate which of the two structures they preferred. Responses were on a scale of 1 to 5, where 1 indicated "The line in which I did *not* wait is far more desirable," and 5 indicated "The line in which I waited is far more desirable."

Manipulation check. After the wait, participants rated (on a 5-point scale) to what extent they felt as if they were the person waiting in line on the screen.

Materials

The computer program (in Visual Basic 5, run on Pentium II computers with a 17-inch screen and 1024 × 768 resolution) had two conditions, an MQ structure and an SQ structure (see Figures 1 and 2). Identical aspects in the two conditions included the number of service persons (six), the average number of customers present (54 throughout the experiment, including 6 at clerk stations), the time taken to handle a customer (sampled from a normal distribution) (M = 61 seconds, SD = 14 seconds), and the pace of arrival of new customers (one every 25 seconds). Also identical was the size of participants' icons (0.8 cm in diameter) and the distance between icons.[1] A pretest verified that participants saw the depiction on the

TABLE 1
Means, Standard Deviations, Internal Consistencies, and Intercorrelations of Research Variables (*N* = 134)

					Pleasantness		*Predictability*		*Arousal*		
	Range	M	SD	*Cronbach's* α	*Before Entering*	*While Waiting*	*Before Entering*	*While Waiting*	*Before Entering*	*While Waiting*	*Perceived Fairness*
Pleasantness											
Before entering	1-7	2.36	1.30	.82							
While waiting	1-7	2.82	1.39	.91	.595**						
Predictability											
Before entering	1-7	3.31	.75	.70	.483**	.280**					
While waiting	1-7	3.64	.69	.81	.328**	.521**	.568**				
Arousal											
Before entering	1-7	2.93	1.25	.74	.259**	.186*	.381**	.208*			
While waiting	1-7	2.73	1.31	.81	.335**	.646**	.298**	.567**	.432**		
Perceived fairness	1-7	5.32	1.30	.91	.084	.196*	.003	.239**	.092	.196*	
Queue structure preference[a]	1-5	2.30	1.53		.204*	.110	.061	.083	.091	.078	.044

a. This is a one-item measure in which lower values indicate a preference for the single-queue structure.
*$p < .05$. **$p < .01$.

screen as a representation of the queue in which they were waiting, and debriefing sessions that followed the second study confirmed that all participants saw the second study as the study in which they participated.

Experimental Manipulation

The difference between the two conditions was the structure of the queue depicted on the screen and through which participants progressed while they waited. In the SQ condition (Figure 1), participants saw and made their electronic clicking through a single line of 54 spots. In the MQ condition, participants saw six lines that included 8, 9, or 10 people with equal probability. In this condition, therefore, participants saw and made electronic progress through 8, 9, or 10 spots. New arrivals went to the end of the line in the SQ condition or to the shortest line in the MQ condition. In all other respects, the research process was identical.

RESULTS

Manipulation Check

Two issues require validation if the results of the study are to be trusted: that participants felt they were really waiting in line and that the distinct queue structures (SQ and MQ) really differed. The first issue was confirmed by the results of the manipulation check. Only 12 of the participants responded with values of 1 or 2 to this item, meaning that only 12 of the participants did not feel that they had waited in line for the experiment. These people were excluded from the analyses, yielding an effective sample of 134. Thus, the majority of participants accepted the study premise. The overall average response of participants to the question was 3.7 ($SD = 0.89$), with no significant difference between responses in the two conditions (SQ: $M = 3.73$, $SD = 0.83$; MQ: $M = 3.75$, $SD = 0.96$), $\chi^2(4) = 2.938$, *ns*.

The second issue—the extent to which the queue structures differed—was confirmed by empirical progress of the waits in the two structures, which was consistent with empirical findings in operations research. Because participants were responsible for progressing (clicking) their way through a queue, the actual amount of time spent by participants in a queue varied somewhat. The computer program determined the rate at which service providers became free and the rate of new arrivals, but delays could occur if, for example, participants took longer to move ahead. Operations research studies report that wait times in an SQ are typically longer than waits in an MQ, a difference often explained by the larger distance traveled in an SQ (Hall 1991; Rothkopf and Rech 1987). This distance could not be held constant here because participants had to "click" through 48 places (or 21 cm) in the SQ condition compared with 8 places (or 3.5 cm) in the MQ condition.

Indeed, the mean wait time was 726 seconds or 12.10 minutes in the SQ condition and 719 seconds or 11.98

1. This distance was the same regarding two aspects: (a) intersubject distance, the distance between two subjects standing one after another (1.2 cm); and (b) interline distance, the distance between the individual lines of the multiple queue (MQ) or the "curves" of the single queue (SQ) (2.4 cm).

TABLE 2
Pleasantness, Predictability, and Arousal Before and While Waiting

Variable	*Queue Structure*	N	M (SD) *Before Entering*	M (SD) *While Waiting*	t *Value*	df	*Significance*
Pleasantness	MQ	69	2.33 (1.20)	2.74 (1.27)	3.41	68	.001**
	SQ	65	2.39 (1.41)	2.90 (1.52)	2.89	64	.005**
Predictability	MQ	31[a]	3.06 (0.77)	3.23 (0.81)	0.90	30	.376
	SQ	32	3.56 (0.73)	4.04 (0.57)	3.09	31	.004**
Arousal	MQ	69	2.81 (1.15)	2.46 (1.14)	2.62	68	.011*
	SQ	65	3.06 (1.36)	3.02 (1.49)	0.17	64	.864

NOTE: MQ = multiple queue; SQ = single queue.
a. Due to a technical problem, measurements of the predictability variable were available only for 63 of the participants.
*$p < .05$. **$p < .01$.

TABLE 3
Perceptions in Multiple- Versus Single-Queue Structures

Dependent Variable	*N (MQ/SQ)*	*M* (SD) *MQ*	*SQ*	t *Value*	df	*Significance*
Predictability						
Before entering	31/32	3.06 (0.77)	3.56 (0.73)	2.64	61	.01*
While waiting	31/32	3.23 (0.81)	4.04 (0.57)	4.60	61	.000**
Arousal						
Before entering	69/65	2.81 (1.15)	3.06 (1.36)	1.15	132	.25
While waiting	69/65	2.46 (1.14)	3.02 (1.49)	2.45	132	.016*
Perceived fairness	69/65	4.58 (1.51)	6.10 (1.07)	6.69	132	.000**

NOTE: MQ = multiple queue; SQ = single queue.
*$p < .05$. **$p < .01$.

TABLE 4
Perceived Fairness as a Function of Justice Violation and Queue Structure

Condition	N	M	SD	t *Value*	df	*Significance*
Justice violation in MQ	33	4.14	1.68	2.42[a]	67	.018*
No justice violation in MQ	36	4.99	1.22	4.75[b]	99	.000**
No justice violation in SQ	65	6.10	1.07			

NOTE: MQ = multiple queue; SQ = single queue.
a. This *t* test compares the justice violation in MQ structure with the no justice violation in MQ structure.
b. This *t* test compares the no justice violation in MQ structure with the no justice violation in SQ structure.
*$p < .05$. **$p < .01$.

minutes in the MQ condition, a difference of 7 seconds between the two queue structures, which is statistically significant, $t(108) = 1.65$, $p < .01$. Also consistent with prior research, variations in wait time between participants were considerably smaller in the SQ condition ($SD = 9.6$ seconds) than in the MQ condition ($SD = 17.4$ seconds), $F(68) = 3.25$, $p < .001$. Thus, both subjective reports and empirical qualities of the wait are consistent with previous operations research literature, confirming the validity of the study manipulation.

Hypothesis Testing

Table 1 lists the descriptive statistics of study variables. Comparison tests (*t* tests) pertinent to the study hypotheses are summarized in Table 2 (within-subject comparisons) and Tables 3 and 4 (between-condition comparisons).

PLEASANTNESS

Hypothesis 1 predicted that hedonistic feelings of pleasantness increase with progress in the waiting experience, independent of queue structure. The hypothesis was confirmed. As evident in Table 2, pleasantness while waiting was significantly higher than pleasantness before entering the queue in both structures. In the MQ condition, pleasantness changed from a mean of 2.33 (before entering) to a mean of 2.74 (during the wait), $t(68) = 3.41$, $p < .001$. In the SQ condition, the change was from a mean (before entry) of 2.39 to a mean (while waiting) of 2.90, $t(68) = 2.89$, $p < .005$. An ANOVA confirmed that in the complete sample, pleasantness was higher at the second time of measurement, $F(1, 132) = 18.894$, $p < .001$. No effect of queue structure or of the interaction between queue structure and progress in waiting was found in this ANOVA, $F(1, 132) = .277$, *ns*, and $F(1, 132) = .256$, *ns*, respectively.

PREDICTABILITY

Hypothesis 2 predicted that waiting in an SQ structure produces a greater sense of predictability than waiting in an MQ structure. Due to a technical problem and data about the predictability variable were available only for 63 of the participants. Nonetheless, the hypothesis was confirmed. In the initial meeting with the queue, a significant difference was evident between participants entering an MQ structure and those entering an SQ structure, with less reported predictability in the MQ structure ($M_{MQ} = 3.06$, $M_{SQ} = 3.56$), $t(61) = 2.64$, $p < .01$ (see Table 3). Also consistent with the second hypothesis, at the second point of measurement, reported predictability had not changed (compared to the point of entry) for participants in the MQ condition but did significantly increase among participants in the SQ condition (see Table 2). The change in the MQ condition was from 3.06 to 3.23, $t(30) = 0.90$, *ns*. In the SQ condition, the change was from 3.56 to 4.04, $t(31) = 3.09$, $p < .01$. Thus, as predicted, the SQ structure provided a sense of predictability not provided by the MQ structure.

AROUSAL

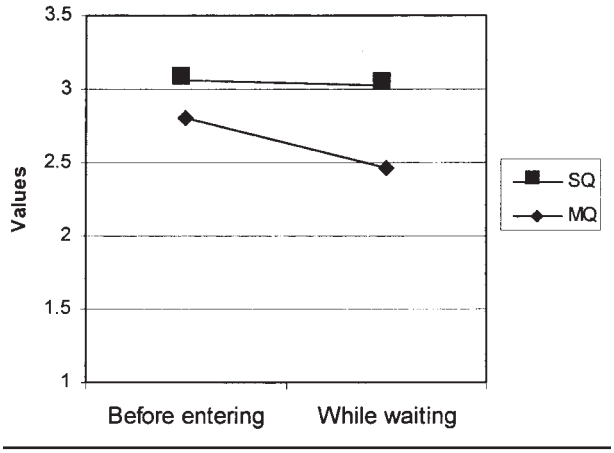
Hypothesis 3, predicting that arousal (or the sense of activity) among participants waiting in an SQ will be higher than among participants waiting in an MQ structure, was also confirmed ($M_{MQ} = 2.46$, $M_{SQ} = 3.02$), $t(132) = -2.45$, $p < .05$. Moreover, in the MQ structure, arousal significantly *decreased* between entering the queue and waiting in line (see Table 2) ($M_{\text{before entering}} = 2.81$, $M_{\text{while waiting}} = 2.46$), $t(68) = 2.62$, $p < .05$. No such trend was evident among SQ participants, where participants' arousal remained at a stable and relatively higher level throughout the line ($M_{\text{before entering}} = 3.06$, $M_{\text{while waiting}} = 3.02$), $t(64) = .17$, *ns*.

This finding is conceptually consistent with Hypothesis 3, because it confirms that the continuous progress toward the service provider in the SQ condition maintains a constant level of arousal in participants, whereas the more limited physical progress in the MQ condition debilitates arousal. These results are evident in Table 2 and in Figure 3. In a repeated measures analysis of the data, the two measurement points were entered as repeated measures of the arousal of the same participant, and the queue condition was entered as an independent variable. In this analysis, a similar, although nonsignificant, pattern of results was observed, $F(1, 132) = 2.63$, $p = .107$.

PERCEIVED FAIRNESS

Hypothesis 4 predicted that SQ structures will produce higher ratings of fairness or will be perceived as more procedurally just than MQ structures. Participants who had waited in an SQ were expected to rate the waiting process as fairer than those who had waited in an MQ structure. This hypothesis was confirmed: Average ratings of fairness were significantly higher for SQ participants than for MQ participants ($M_{SQ} = 6.10$, $M_{MQ} = 4.58$), $t(123) = 6.69$, $p < .001$. This finding is particularly interesting because, as noted above, SQ participants had actually waited longer than MQ participants, albeit only for 7 seconds.

FIGURE 3
Changes in Arousal Levels of Participants in Multiple Queue and Single Queue



An additional analysis that could separate between the effects of actual justice violations and the effects of queue structure on perceptions of fairness is reported in Table 4. Because of the nature of the program, some instances of the MQ condition produced a violation of the first-come, first-serve (FCFS) rule, whereas others did not. The MQ condition could therefore be separated into two groups: One group includes participants who waited in an MQ and experienced a justice violation because an icon that entered the waiting arena after them reached the service provider before them ($n = 33$). A second group includes participants who also waited in an MQ but did not experience such a violation, because all the icons that arrived after them reached the service provider after they did ($n = 36$). As evident in Table 4, a significant difference in perceived justice was found between the two groups ($M_{\text{FCFS violation}} = 4.14$, $M_{\text{no FCFS violation}} = 4.99$), $t(67) = 2.42$, $p < .05$, meaning that participants who *did* experience a justice violation and waited in an MQ structure reported significantly lower fairness than participants who waited in the same MQ structure but *did not* experience such a violation.

A more revealing analysis using these two groups, however, is one that can provide insight about the influence of the queue structure independent of actual justice experiences. Participants in the MQ condition who *did not*

experience a justice violation actually experienced the same objective procedural justice condition as participants who waited in the SQ condition, because in both cases, a person received service before any one else who arrived after them. A comparison of these two groups is therefore a pure comparison of the effects of the structure of the queue. Indeed, as evident in Table 4, the reported fairness of the former (participants who had waited in the SQ condition) was significantly higher than among the latter (those in the MQ condition who had not experienced a justice violation) ($M_{SQ} = 6.10$, $M_{MQ\ no\ FCFS\ violation} = 4.99$), $t(99) = 4.75$, $p < .001$. The magnitude of the difference here is significantly larger than between the two groups within the MQ condition. In short, participants who *did not* experience a justice violation but waited in an MQ structure reported significantly lower fairness than participants who also *did not* experience a justice violation but waited in an SQ structure. Thus, it is not only the actual experience of violations of justice while waiting that creates perceptions of justice violations. Rather, the structure of the queue independently elicits feelings of injustice.

QUEUE PREFERENCE

The item measuring preferences regarding queue structure was recoded for the participants in the SQ condition, so that lower values indicate a preference for an SQ structure and higher values indicate preferences for an MQ structure. Three analyses were then conducted to test the hypothesis.

First, the mean of responses to the item was established as statistically different from the midpoint of the scale (3.0), which was a response indicating *no preference*. The mean of MQ participants was 2.17 ($SD = 1.44$). The mean of SQ participants was 2.43 ($SD = 1.64$). Tests confirmed that both these means were significantly lower than 3.0: For MQ, $t(68) = 5.233$, $p < .01$; for SQ, $t(64) = 2.816$, $p < .01$. Thus, the average of responses of participants to the question regarding queue preference indicated a clear preference for the SQ structure.

Second, a test of percentages was conducted. About 74% of participants who waited in the MQ condition and 62.3% of participants who waited in the SQ condition expressed a preference for the SQ structure. Both of these are significantly different from 50% (for MQ, $Z = 2.89$, $p < .05$; for SQ, $Z = 2.04$, $p < .05$. Thus, the two tests confirm that, as Hypothesis 5 predicted, participants predominantly preferred the SQ structure regardless of the queue structure they had just experienced.

Finally, queue preferences of participants who had waited in an MQ structure ($M = 2.17$, $SD = 1.44$) were compared with preferences of participants who had waited in an SQ structure ($M = 2.43$, $SD = 1.64$). Our prediction was that it is qualities of the structure that influence queue preferences, so there was no reason to expect a difference between the preferences of the two groups. Indeed, the difference between the two groups is statistically insignificant, $t(132) = 0.95$, *ns*.

DISCUSSION

Our study suggests a paradigm for experimentally testing the psychological implications of queue design. The results confirm our predictions, in that people who experienced queues structured differently reported predictably different attitudes. We specifically confirm that as people get closer to their destination, they are more content, regardless of queue structure. But waiting channeled into an SQ is shown to produce higher arousal and a higher sense of predictability than waiting channeled into an MQ. An SQ was also shown to produce significantly greater perceptions of justice than an MQ. These results both validate the research paradigm and enhance the understanding of the impact of queue structure on consumer attitudes, offering implications for managers and an agenda for future research. We begin the discussion by noting what we believe has been learned about the research paradigm. We then recognize the limitations of the study, followed by what we see as the managerial implications of the findings. In closing, we suggest additional research that we hope the study will inspire.

The Research Paradigm

The paradigm we suggested was validated both by participants' subjective reports and by the empirical results regarding the time a queue takes. Participants saw the paradigm as a real wait, and the movement through the computer screen queues maintained previously known properties of queues (cf. Hall 1991). Specifically, the SQ took longer than the MQ but provided service in a fair (FCFS) fashion that also guaranteed a fair distribution of the wait time. The MQ overall took less time but produced violations in fairness and variations in the time waited. More important, although what is hated about queues is that they waste time, the queue structure that took longer (SQ) was actually preferred by more people and was shown in the subjective reports to produce more positive attitudes.

Some of the assumptions maintained in this use of the paradigm may be too restrictive, limiting external validity. For example, the assumption that customers can only move forward in line and cannot switch between MQ lines contradicts many people's notions of such queues. We adopted this assumption to simplify the first test of the par-

adigm, and we show that participants accepted the situation as an actual waiting situation despite this constraint. The findings showing that the paradigm proved itself under these severe constraints only suggest that additional research should explore queues with a different set of assumptions. Nonetheless, the option to switch is clearly an issue that must be examined in future research. The current findings establish that the paradigm we used is viable for such research.

Limitations of the Study

There are limitations to this study that may hamper the external validity of the results. As noted above, the lack of ability to move among queues is one critical limitation. More important, there may be a queue where this constraint exists, that is, where entry into one line in an MQ restricts movement into another line. The restriction may be imposed, for example, by physical barriers such as ropes or fences between the different lines. Movement between lines may also be restrained by physical difficulties, as is the case in supermarkets or in airport check-in lines, where a move involves moving a heavy cart or luggage. Notwithstanding, the inability to switch lines is a limitation of the current findings.

The visual representation of the queue is also a limitation because people did not actually feel or physically see the other people waiting with them. People waiting clearly lacked the opportunity to watch the service providers or to interact with other patrons. In addition, participants' progression in the experiment entailed a conscious effort (of clicking), whereas progression in real-life queues can be argued to have acquired an element of automaticity or mindlessness (Ashforth and Fried 1988; Bargh and Chartrand 1999). As a patron mindlessly shuffles through a physical queue, he or she can observe other people or observe service providers, for example. The waiting experience we studied was basically an individualized experience, lacking the opportunity for social observation (what is the person ahead of me buying?) as well as social interaction, although wait queues are notorious in producing social organization (Schwartz 1975). In fact, it may be that the wait situation was closer to a telephone wait than to a physical wait, in that people were left on their own while waiting, but they had to stay tuned to the queue. However, the analogy to telephone queues is limited because the queue designated where the person waiting was relative to other patrons.

The composition of the sample— students from Israel—also presents constraints. First, a sample of students may not be completely representative of the general population, even though students in Israel are generally financially independent, making them relatively similar to the general population of consumers. However, a replication with a sample from the general population is essential. Second, it is unclear to what extent findings from Israel can be generalized to other parts of the world.

Finally, the study did not address the issue of customer expectations at all. The data did not assess customer expectations, the implicit assumption being of some form of random distribution of expectations. Yet research on customer service repeatedly asserts expectations as a critical factor (cf. Zeithaml and Bitner 1996). The measures we collected at the point of entry into the queues can be viewed as initial attitudes customers had as they entered the queue situation (Bargh and Chartrand 1999). Our results demonstrate that these initial reactions are subject to effects of the queue structure (see below). But more elaborate analyses of expectations are necessary, especially analyses that recognize differences in expectations for different types of services (cf. Gutek 1997; Gutek et al. 1999). Here again, the paradigm suggested can be easily adapted to examine both expectations about queues and the impact of either confirmation or disconfirmation of expectations. Through the setup process, participants may be led to believe that they are waiting for one type of service or another, and the associated expectations as well as queue attitudes can then be examined. That such expectations were not considered in the current study is clearly a limitation.

Within these limitations, however, participants saw the situation as a real waiting situation, and empirical data confirmed the validity of the behavior of the queues and the research hypotheses. Thus, the study seems to represent a valid customer experience, similar to videotapes (Bateson and Hui 1992), and can provide useful insights about the management of waiting, as discussed next.

Applied Managerial Implications

Our data provide multiple insights for managerial actions vis-à-vis queues. First, it suggests that saving time may not always be the most important criterion for customers. The actual time waited in MQ structures is documented here and elsewhere as being shorter than the time waited in SQ structures (Rothkopf and Rech 1987). Yet this time difference does not warrant a managerially preferable structure because fairness perceptions in the MQ structure are lower even though the actual average time in this queue structure is shorter. At a time when SQ structures seem to be adopted by more and more service providers, the realization that such structures can impose longer waits is important. There may be a point at which the trade-off between waiting longer in a structure that "feels" fair is not desirable to consumers. Yet special managerial caution needs to be exercised with structures that

save time but produce feelings of lack of justice and lack of predictability.

A common sentiment people relate to MQ structures is that "I always select the wrong queue." Our findings suggest that such feelings are due to the mere structure of the queue rather than actual justice violations that may occur in such structures. Recall that patrons in the MQ who *did not* experience justice violations were still significantly *less content* than patrons in SQs. This sentiment is a psychological cost of MQ structures that managers should recognize.

Second, our data suggest that what influences customer satisfaction is how many people are ahead in line rather than a queue structure. The implication seems to be that the length of a queue should be minimized, but if a queue cannot be avoided, its structure should balance considerations of the distance that people need to travel against the costs of feelings of lack of justice and loss of control. As far as consumer attitudes are concerned, only when the distance traveled is a critical factor should an MQ structure be maintained. The SQ structure is both preferred by most people and likely to produce more positive attitudes.

Third, the experimental paradigm may seem contrived, but it is similar to increasingly popular modes of conveying progress in electronic commerce "virtual waits." Thus, the paradigm suggested here may be valuable not only for studying the dynamics of queues but also for studying how alternative modes of depicting such progress are accepted by consumers. What information is provided by organizations to customers about their progress and how this information is conveyed is currently an open question, with decisions often relying on managerial instinct rather than on thoughtful research. Some systems currently recognize the multiple queues they maintain, such as tracking systems that distinguish between different types of services or different types of customers. Other systems present a facade of one queue in that no distinctions between customers are recognized. If our findings can be generalized, then one line seems preferable to multiple lines, although this is clearly a problematic extrapolation barring additional research. What is not problematic is the assertion about the utility of our paradigm for improving such decisions.

Fourth, our findings reveal how critical the issue of a queue structure can be. We documented that similar initial feelings evolved into completely different attitudes in distinct queue structures. In the SQ structure, arousal was relatively high throughout the wait, whereas in the MQ structure, there was a significant decrease in arousal during the wait. The managerial question is what brought about the drop in arousal in the MQ structure. One suggestion we make is that this is attributable to the slow and episodic activity (progress) in the MQ structure, which is inherent to the MQ structure (Rothkopf and Rech 1987). Lack of activity reduces arousal (Feldman Barrett and Russell 1999) and increases the frustration of waiting (Baker and Cameron 1996; Kellaris and Kent 1992).

Although clicking on a mouse—the activity here—may seem trivial, the situation is similar to real-life waits where the progress of a queue can be followed. For example, electronic signs that report on the progress of numbers in a numbered queue offer precisely such (mental) activity, while providing information about progress in the queue. Online tracking systems, such as that offered by United Parcel Service (UPS) and DHL, are also similar in that they provide patrons a sense of active progress toward a goal. Additional forms of activity may be even more effective in improving attitudes while waiting. In our work in progress, we find, for example, that completing paperwork while waiting for a service transaction (e.g., filling out forms at the bank) improves attitudes toward the wait (Rafaeli, Cohen, and Barron 2001). The entertainment provided by the Disney Corporation is illustrative of how activity can make even long waits fun.

Generalizing our findings further may suggest that activity of progress toward the goal could reduce the frustration and improve the attitudes of customers in telephone waits. Having to "click" your way through a telephone queue is an odd idea. But customers waiting for a call center representative can be reminded to have a pen, their account number, or their credit card number available. They may even be asked to key in some of these numbers, which might be construed by customers as facilitating the service process. Our analysis suggests that such activity may also improve attitudes because people prefer some form of activity to being completely passive while they wait in a queue (Maister 1985).

Of course, the management of queues presents issues not directly assessed in this experiment, above and beyond the limitations of the study noted above. For example, shorter physical travel that MQs demand means that service providers *appear to be closer* to a customer entering this type of queue. It may be that the preferences we observed *after* consumers waited in line are not indicative of preferences and decisions about entering a line. Hall (1991, p. 4) and others defined "balking" as a decision *not* to join a queue upon arrival, and balking may actually be greater in an SQ because of the faulty intuition it produces about how close one is to the end of a wait (Tversky and Kahneman 1991). The frustration while waiting in an MQ, as documented here, needs to be balanced against the benefits of having customers actually join a queue.

Suggestions for Future Applied Research

The study opens up a vast research agenda, while also suggesting a paradigm for progress in this agenda. Addi-

tional research, with large, heterogeneous samples, is necessary to fully understand the psychological dynamics of queue structures. Certain groups of people (e.g., elders, retired) may actually like long lines because they provide opportunities to socialize with other people. Future research can also examine other queue structures (e.g., numbered queues) and multiple parameters of any queue (e.g., how long the wait is, how many people are in the line, how many service stations are available, and how many of them are staffed). The basic question is how these parameters influence customer attitudes. As noted above, critical elements for future research are also customer expectations regarding a wait, the nature of the service for which one is waiting, and what else a customer can do while he or she is waiting. Our findings establish that the current paradigm can be used for such research. They also establish that the structure of a queue produces reactions independent of objective properties of the wait and above and beyond variations in initial reactions. Together, this amounts to the suggestion that such research is both necessary and feasible.

One important direction may be how cultural issues play into queue and waiting dynamics. Common intuition suggests cultural differences in queue-related attitudes and perceptions (not to mention behavior). Israel in particular is a unique society with a low power distance and a relatively high level of collectivism (Hofstede 1991). Rafaeli (1989) described the unique service climate among supermarket cashiers in Israel, a climate that may also carry over to queue behaviors. An obvious question remains regarding queue behaviors in other cultures. On the other hand, David (2000) argued that the belief in the queue as an expression of national culture should be treated as a myth. Most important, there is a surprising lack of empirical studies of how these cultural differences translate into queue behaviors. The paradigm suggested here provides a potential tool for systematic investigations of cultural issues. Identical queue conditions can easily be presented to samples in different parts of the world as well as to samples from different demographic backgrounds. Given globalization trends of customer service outlets, such analyses will be extremely useful to managers.

Future research may also consider using the current paradigm for research of driving behaviors. The bird's-eye view of queues provided by the current simulation can contribute, for example, to a debate about the role of perceptual biases in driving behavior. Driving in one of multiple lanes has been argued to generate perceptual errors that lead drivers to feel that the lane in which they are driving is (always) slower than other lanes. An argument has been made that switching between lanes is motivated by the fact that a driver can only see the progress of one or at most two cars in one's own lane (the cars ahead of you and behind you), whereas progress of multiple cars in other lanes can be perceived (Redelmeier and Tibshirani 1999). Our data shed new light on this problem. Our participants were offered a bird's-eye view of the waiting situation and could therefore see progress of multiple people both in their own line and in the other lines. Yet perceptions of lack of justice in the MQ situation persisted, suggesting that dynamics other than perception bias account for the discomfort associated with systems of multiple lanes.

An additional research direction that we can suggest is of reversing the paradigm presented here, so that the information about a queue is presented to employees rather than to customers. The idea is that even when customers do *not* physically visit a service location (e.g., call centers), the people waiting for service and their progress through the wait queue can be visually represented to employees. Currently, this is done in an abstract and remote fashion, if at all, with displays of how many people in total are waiting. But technology can integrate the model presented here to provide a real-time presentation of a waiting queue to customer service representatives. Relating such information about the people waiting may be viewed as a form of feedback (Hackman and Oldham 1980) and can be used as a part of goal-setting efforts (Locke and Latham 1990) but in both cases can be expected to influence employee motivation. On the other hand, such information may turn out to be a stressor if it produces perceptions of role overload (Katz et al. 1981) or instills conflict between giving careful, personal attention to each customer and moving quickly through the queue of people waiting (Kerr 1975).

This idea brings up a host of questions to be answered about the best depiction of queues to employees. Should employees be allocated customers in one SQ or in an MQ? In other words, should each employee see a "personal" target set of customers, or should a common pool proceed among all clerks? Should employees be able to see the progress of their own queue and how it compares with queues of other employees? Perhaps it is possible to provide employees additional information through the visual presentation, if, for example, it is possible to differentiate between types of customers or types of problems through different colors of icons. These are all intriguing questions for future research, with important applicable implications.

More broadly, the study affirms the importance of integrating conceptual developments in psychology into future research on wait queues. Theory about the structure of emotion, in which pleasantness is distinguished from arousal and control, is shown to be relevant. Waiting structures are shown here to influence patrons' arousal and sense of predictability, but not their pleasantness (Feldman Barrett and Russell 1999; Kluger and Rafaeli 2000). Pleasantness or its partner—satisfaction—is the more common variable of focus in studies of service management. A fo-

cus only on whether consumers are satisfied might fail to notice other issues pertinent to consumer behavior and effective management of the customer service interface.

In closing, we return to the thesis with which we opened this article—waiting is a central tenant of modern life, and management of a waiting process can be a critical element of managing customer service operations. To complement extensive mathematical and operations research literature, a focus is needed on how people feel while or about waiting. Such a focus could help explain why people feel that they "always end up in the wrong queue."

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