HARVARD | BUSINESS | SCHOOL

Last Place Aversion in Queues

Ryan W. Buell

Working Paper 18-053

Last Place Aversion in Queues

Ryan W. Buell
Harvard Business School

Working Paper 18-053

Last Place Aversion in Queues

Ryan W. Buell
Harvard Business School
[rbuell@hbs.edu]

Abstract:
This paper investigates whether people exhibit last place aversion in queues and its implications for their experiences and behaviors in service environments. An observational analysis of customers queuing at a grocery store, and three online field experiments in which participants waited in virtual queues, revealed that waiting in last place diminishes wait satisfaction while increasing the probabilities of switching and abandoning queues. After controlling for other factors, people in last place were more than twice as likely to switch queues, which increased the duration of their wait and diminished their overall satisfaction. Moreover, people in last place were more than four times more likely to renege from queues, altogether giving up on the service for which they were queuing. The results indicate that this behavior is partially explained by the inability to make a downward social comparison; namely, when no one is behind a queuing individual, that person is less certain that continuing to wait is worthwhile. Furthermore, this paper provides evidence that queue transparency is an effective service design lever that managers can use to reduce the deleterious effects of last place aversion in queues. When people can't see that they're in last place, the behavioral effects of last place aversion are nullified, and when they can see that they're not in last place, the tendency to renege is greatly diminished.

[Keywords: Behavioral operations, queues, reference effects, last place aversion, transparency]

1. Introduction

Queues are everywhere. We stand in them at airports, banks, coffee shops, deli counters, gas stations, grocery stores, hospitals, hotels, nightclubs, restaurants, ticket stands, and practically anywhere else that service is physically delivered. We wait in virtual queues as well – when we call customer support, hail an on-demand service, or order food online. By one estimate, Americans spend 37 billion hours waiting in queues each year (Stone 2012), which equates to roughly 118 hours for every man, woman, and child in the country. Since the practice of waiting one's turn and the discipline of first-come, first-served are social norms that are instilled in us at a very young age, we have reason to be repelled by long queues – the more people ahead of us, the longer we'll have to wait for service (Little 1961). However, the results of this paper indicate that it's not just how long the line is in front of us, but also how short the line is behind us – in particular, *whether we're in last place* – that intensifies the pain of waiting and influences our behaviors in queues.

Recent research has shown that people are "last place averse," altering their preferences and behaviors in order to avoid being in last place (Kuziemko et al. 2014). This tendency has been shown in laboratory experiments and in survey data, illustrating how last place aversion affects preferences over redistribution. For example, people making just above the minimum wage are the most likely to oppose increasing the minimum wage (Kuziemko et al. 2014). In many contexts, last place is ambiguous, since it is difficult to assess where in a distribution an individual perceives herself to be, and which distribution is at the top of mind. However, every queue has an end, and with it, an identifiable individual who is in last place.

Research on last place aversion in queues, therefore, holds important promise for the field of operations management. To the extent that an aversion to being in last place alters our preferences and behaviors, then the fleeting period of time that individuals spend at the end of the line might cause them to behave in ways that are myopic for themselves and counterproductive for the operation. Moreover, the observability of who is last in queues makes the last-place individual a ready target for operational interventions designed to diminish their pain of waiting.

Indeed, this paper shows that controlling for other factors, queuing in last place diminishes wait satisfaction, while doubling the probability of switching queues and quadrupling the probability of defecting from the line altogether – behaviors that in service settings can undermine customer experiences and diminish firm performance. Individuals who switch queues wait longer on average than individuals who do not, and as a consequence are less satisfied with their waiting experience. Those who abandon the queue entirely forgo the service altogether, diminishing their own utility and the firm's profits. The results provide evidence that this tendency is due in part to the last place individual's inability to make a downward social comparison, raising the question, "if nobody is willing to wait longer than me, then is staying in this queue worthwhile?" The results also suggest that individuals habituate to being in last place over time, that last place aversion is most pronounced in less-discretionary queues, and that queue transparency is a potent lever for managing last place aversion in queuing environments.

More generally, the present research also holds promise for behavioral science writ large. Queues are a microcosm of the broader human experience. The manner of our arrival influences the state of the queue we inherit, and in turn, the wait we experience. Similarly, the manner of our arrival as humans influences the state of the world we inherit, and in turn, the life we experience. Queues, like the world, have a clear hierarchy — the experiences of those in the back are subordinated to the experiences of those in the front. Also like the world, queues have an underlying order governing their process — first-come, first-served – but no underlying order governing arrivals. With that in mind, queues are important in their own right, but they're also an interesting and useful context in which to study how humans interact in an ordered social system, when they themselves have no influence over their relative position in that system.

2. The psychology of queuing and last place aversion

Although queuing is only the gateway to many service operations, it can wield considerable influence over how services are experienced, or whether they are experienced at all. Queuing imposes psychological costs on customers (Carmon, Shanthikumar, and Carmon 1995), with stress building as a marginally increasing function of the wait time (Osuna 1985). Consequently, the nature and duration of a customer's wait is an important driver of service satisfaction and loyalty (Taylor 1994; Hui and Tse 1996). Moreover, the dynamics of the queues encountered by customers influence their competing impulses to abandon or persist in the interaction, affecting customer utility and firm profitability. Experimental evidence suggests that customers often make suboptimal abandonment decisions – staying too long in queues they should have abandoned, and abandoning queues in which they should have remained (Janakiraman, Meyer, and Hoch 2011). Hence, understanding the drivers of customers' experiences and behaviors in queues is of vital significance to operations management.

A considerable stream of research on the psychology of queuing has enumerated situational and design-based factors that influence the experiences and behaviors of customers in queues (Maister 1985), offering the promise that waiting experiences can be improved and customer abandonment can be reduced through active management (Chase and Dasu 2001; Cook et al. 2002; Norman 2009). Since people treat their time as a precious commodity (Becker 1965) and are risk averse in their decisions regarding its use (Leclerc, Schmidtt, and Dubé 1995), this research has largely focused on how to set conditions that diminish the perceived costs and maximize the perceived benefits of waiting.

Waiting imposes psychic costs on customers that can be mitigated through deliberate service design. Long delays increase uncertainty and anger, particularly when those delays seem controllable by the service provider (Taylor 1994). Waits feel longer when their duration is unknown, unexplained, or highly variable, when progress is imperceptible, when the queue lacks fairness, and when there is nothing to distract from the experience of waiting (Maister 1985). Consequently, providing delay announcements, fostering perceptions of progress, maintaining a fair queuing discipline, and designing a pleasing and engaging queuing environment, can help mitigate these psychic costs.

Providing information about anticipated delays can reduce uncertainty, improving queue performance and diminishing defections (Allon and Bassamboo 2011; Allon, Bassamboo, and Gurvich 2011). Interestingly, in virtual queuing environments like call centers, even long delay announcements can reduce unit-level waiting costs by expanding the catalog of tasks one can engage in while waiting (Yu, Allon, and Bassamboo 2017).

Engendering a feeling of progress is another potent way to reduce the perceived costs of waiting. Frustration and time distortion can occur when customers are not provided with feedback on their queuing progress (Spivak 1967; Haynes 1990). Providing cues to customers that they're making progress, such as crossing a virtual boundary, can improve affect and reduce defections (Soman and Shi 2003; Zhao, Lee, and Soman 2012). Similarly, getting customers to engage in rituals, having them make choices that help them build commitment, and sequencing the queuing experience to unbundle pleasurable experiences and bundle painful ones (ideally, getting them out of the way early), can help influence how costly it feels to endure in a queue (Chase and Dasu 2001).

The perception of social justice, or fairness, similarly influences customers' queuing experiences. Maintaining a first-come, first-served queue discipline can diminish this cost – and in turn, abandonment – from customers who believe they are being treated unfairly (Larson 1987). Even in a hospital's emergency department, where patients vary in severity, customers exhibit an aversion to being jumped in the line and are more likely to defect if a new patient arrives who they perceive to be sicker than they are (Batt and Terwiesch 2015). Even in first-come, first-served queues, waiting time may nevertheless differ among customers – for example, if the parties didn't arrive in a uniform fashion – and the feeling of injustice that arises from knowing that one waited longer than others can itself impose psychic costs (Rongrong Zhou and Soman 2008).

Experiences beyond the queue can also affect the psychic costs of waiting. Occupied waits feel shorter than unoccupied waits (Maister 1985), and introducing ambient, design, and social elements into the service environment can affect customers' emotional, cognitive, and physiological responses to waiting (Baker and Cameron 1996).

Since customers are willing to wait longer for more valuable services (Maister 1985), a complementary approach to reducing the perceived costs of waiting is increasing its perceived benefits. For example, a hidden benefit to a long queue is that people may infer value from congestion – particularly in contexts where quality is uncertain or consumers differ in their knowledge of service quality (Debo, Parlour, and Rajan 2012; Veeraraghavan and Debo 2009). Kremer and Debo (2013) provide experimental evidence of the "empty restaurant syndrome," in which the likelihood of joining a queue might locally increase in wait time. A similar phenomenon has been observed in the probability of customers joining a deli queue, as customers are more likely to join when one customer is waiting, than when no customers are waiting (Lu, Olivares, and Schilkrut 2013).

Although the queue in front of the customer can serve as a signal of service quality that might drive joining and persistence decisions, the queue behind the customer can exert influence over customers' perceptions of service value before and after consumption (Koo and Fishbach 2010). In fact, evidence suggests that wait times and the presence of queues behind the customer may increase purchase intentions when quality is ambiguous and services are unfamiliar (Giebelhausen, Robinson, and Cronin 2010). Moreover, since customers' mental accounting strategies may include making larger purchases to justify longer waits, operational design choices intended to distract from the wait can backfire by reducing customer purchases (Ülkü, Hydock, and Cui, 2017). Customer value perceptions can also be manipulated directly with operational transparency. When customers are shown the hidden work going on behind the scenes to deliver a service, they perceive more effort went into the service, appreciate the effort, mind waiting less, and value the service more (Buell and Norton 2011; Buell, Kim, and Tsay 2017).

Perhaps the costs of waiting are never higher and the perceived benefits are never lower than when one is in last place. The visual cue of a long line in front of the last place customer makes the costs of waiting salient, and is a particularly potent driver of abandonment (Lu, Olivares, and Schilkrut 2013). Although the queue discipline may be just, the inability of the new arrival to see when each party arrived and how the queue formed may trigger concerns about relative throughput times (Zhou and Soman 2008). Moreover, last place customers are likely to experience uncertainty about the wait duration and perceive no evidence of their progress (Maister 1985), exacerbating their perceptions of the cost of waiting.

The perceived benefits of waiting may feel similarly unfavorable at the end of the line. In physical queues, it's often the case that the last place customer can't observe the service process, undermining their perceptions of its value (Buell, Kim, and Tsay 2017). Furthermore, although a long queue ahead may signal that the service is worth waiting for, the absence of anyone with a subordinated position in the line means there's no visible evidence that anyone's willing to wait as long as the last place customer.

Consistently, the number of people behind in line has been shown to influence abandonment probabilities. In a series of experiments, Zhou and Soman (2003) demonstrate that customers are sensitive to the number of people in line behind them, and that as the number of people behind increases, the affective state of the customer rises, which in turn causes them to be less likely to renege (Zhou and Soman 2003). The authors highlight downward social comparisons as an explanation for the effect, which builds on a rich stream of the social psychology literature. People compare themselves to others in social situations (Festinger 1954; Buunk and Gibbons 2007), and those experiencing negative affect can enhance their subjective wellbeing by comparing themselves to someone who is less fortunate than they are (Wills 1981). Related ideas have also been explored in the operations literature, where behind-averse and ahead-seeking behaviors have been shown to have distinct implications for how systems should be designed to optimize performance and utility (Roels and Su 2014). To the extent that downward social comparisons improve affect and diminish abandonments, we might expect that the inability to make a downward social comparison may cause those in last place to feel the pain of waiting more acutely than others waiting near the end of the line. Prior research of customers waiting in queues suggests that such a discontinuity might exist – people in last place in a line are least likely to accept a payment to allow someone to enter the line in front of them (Oberholzer-Gee 2006).

These results are consistent with recent behavioral economics research that shows people are last place averse. People are more likely to accept risky gambles, are less likely to exhibit generosity, and are more likely to support policies that are against their own best interests, when doing so gets them out of, or helps them avoid, being in last place (Kuziemko et al. 2014). This pattern is consistent with behavioral phenomena empirically observed. For example, emergency room doctors who receive public relative performance feedback are most likely to improve when it becomes transparent that their patients' average length of stay is at the bottom of the distribution relative to those of the patients of their colleagues (Song et al. 2015). Diners in restaurants exhibit an aversion to ordering the cheapest wine on the menu – with preferences clustering around the second cheapest option (McFadden 1999). The pain of rejection stings most when one is picked last in gym class (Weir 2012). Likewise, it is reasonable to hypothesize that the phenomenon of last place aversion will carry over to queues, resulting in experiences and behaviors for last place customers that undermine customer and firm performance.

3. Presentation of experiments

Through four field studies, conducted in physical and virtual queuing environments, this paper provides evidence of the impact of last place aversion on the experiences and behaviors of people waiting in queues. In many contexts, 'last place' is an equivocal concept, but in queues, it is readily identifiable. A person is defined to be in last place when there is no one behind them in the queue, and the studies that follow explore the differential effects of being last, relative to other positions, on peoples' perceptions and behaviors.

Study 1 is an observational analysis of the behavior of 284 customers awaiting service in a grocery store checkout lane. Studies 2-4 leverage an online queuing environment, which enabled the manipulation and careful instrumentation of dynamics experienced by queuing individuals. Study 2 explores the effects of last place aversion on queuing perceptions. Study 3 investigates how last place aversion affects switching behaviors and subsequent queuing experiences. Study 4 analyzes how last place aversion in queues affects reneging behaviors, tests the moderating roles of queue transparency and discretion, and explores the perception that waiting is worthwhile as an underlying behavioral mechanism for the effects of last place aversion in queues. In the presentation of each of the studies that follow, the paper reports how sample sizes were determined, all data exclusions, all manipulations, and all measures collected (Simmons, Nelson, and Simonsohn 2012).

3.1 Study 1: Observational Analysis

As an initial test of the conjecture that last place aversion substantively affects queuing behavior, 284 customers awaiting service in a grocery store checkout lane were observed. Over a five-hour period, the study focused on a single, centrally located queue, which had two additional lanes open on either side (**Figure 1**). The sample represents all customers who joined the queue during the period of observation. Data were collected on the hour, minute, and second that each customer joined the focal queue, completed the checkout process, and if applicable, switched to a non-focal queue. Using these three data points from consecutive customer observations, the state of the queue for each second of each customer's queuing experience was imputed. The resulting 24,210 customer-second level observations included the number of seconds since the customer joined the queue, a running tally of the time the clerk had spent processing the current customer, the number of people ahead of the customer in the queue, the number of people behind the customer in the queue, and whether the customer was in last place.

The analysis focused on behaviors during the 9,440 observations in which customers were waiting for service, but had not yet received it. On average, these waiting customers had 1.48 people in front of them in line (*SD* = 0.850) and 0.47 people behind them (*SD* = 0.850). Customers who didn't switch queues (*N* = 139) spent an average of 124.36 seconds in line (*SD* = 77.14), 53.57 seconds waiting for service (*SD* = 49.80) and 70.79 seconds being served (*SD* = 51.68). Customers who did switch queues (*N* = 71), did so after waiting an average of 26.28 seconds (*SD* = 40.83). Switching probabilities were modeled using random effects logistic regression, with robust standard errors clustered by customer. Controlling for other factors, customers in last place were hypothesized to be most likely to switch to a non-focal queue.

Figure 1: Setting and queue orientation for observational analysis (Study 1).

The pattern of results is consistent with prior theory about customer dynamics in queues (**Table 1**). Column 1 demonstrates that consistent with the sunk cost fallacy, the longer customers waited, the less likely they were to switch from the focal queue (β=-0.0257, $P < 0.01$), though at a diminishing rate (β=0.0001, $P < 0.01$). Customers were more likely to switch queues when there were more people in front of them (β=1.107, $P < 0.05$), but at a marginally decreasing rate (β=-0.202, $P < 0.05$). Customers appeared insensitive to current customer processing time (β=-0.008, P = NS), except in the case of unusually long duration customers (β=0.00004, $P < 0.05$).

Consistent with prior research (Zhou and Soman 2003), customers were less likely to switch when there were more people behind them in the queue (β=-1.083, $P < 0.05$). Crucially, and in line with the last place aversion hypothesis, Column 2 reveals that this effect was strongest when customers were in last place (β=1.368, $P < 0.05$). Controlling for other factors, customers were 3.9 times more likely to switch queues when they were in last place relative to when they were not. Of the 71 customers who switched, 67 did so when they were in last place, 5 did so with a single person behind them, and 1 did so with two people behind them. No customers switched queues with more than two customers behind them.

	(1)	(2)
	Pr(Switch)	Pr(Switch)
Last place indicator		1.368**
		(0.592)
Number behind customer	-1.083**	
	(0.446)	
Number ahead of customer	1.107**	1.043**
	(0.503)	(0.496)
Number ahead of customer^2	-0.202**	-0.188**
	(0.096)	(0.094)
Wait time	-0.026***	-0.026***
	(0.007)	(0.008)
Wait time^2	0.000***	0.000***
	(0.000)	(0.000)
Current processing time	-0.008	-0.007
	(0.006)	(0.006)
Current processing time^2	0.000**	0.000**
	(0.000)	(0.000)
Constant	-5.019***	-6.306***
	(0.576)	(0.822)
Observations	9,440	9,440
Number of customers	210	210

Table 1: Probability of switching queues increases when customers are in "last place" (Study 1). All models are estimated with random effects logistic regression and robust standard errors, clustered by customer, are shown in parentheses. *, **, and ***, signify significance at the 10%, 5%, and 1% levels respectively.

Although these results are consistent with the hypothesis of last place aversion in queues, owing to the short average length of the focal queue, there was a strong correlation between the numbers of people behind each customer and being in last place (ρ=-0.82). Consequently, to cleanly differentiate the effect of last place aversion from the linear effect of the number of customers behind, further analysis was required.

3.2 Study 2: Queue Perceptions

Study 1 revealed that there is a behavioral tendency for customers to switch queues when they are in last place, hinting that being in last place may have a substantive effect on customer experiences, over and above other queuing dynamics. Study 2 explores the effect of last place aversion on customer experiences – specifically, on how being in last place affects customer perceptions of wait duration and wait time satisfaction. To do so, participants were recruited online to wait in an actual queue to complete a five-question survey. As such, this online experiment, and the others that follow, served as field tests of the experiences and behaviors of people waiting in actual queues, but the digital nature of these experiments facilitated higher fidelity data collection and better experimental control than could be achieved with physical queuing environments.

3.2.1 Participants. 301 participants (40.2% female, M_{age}=34.67, SD=11.50) completed this experiment on the Amazon Mechanical Turk platform in exchange for 50 cents (Buhrmester, Kwang, and Gosling 2011; Mason and Suri 2012). Participants were recruited to take part in a five-question survey, and were informed that completing the survey would take 2-5 minutes.

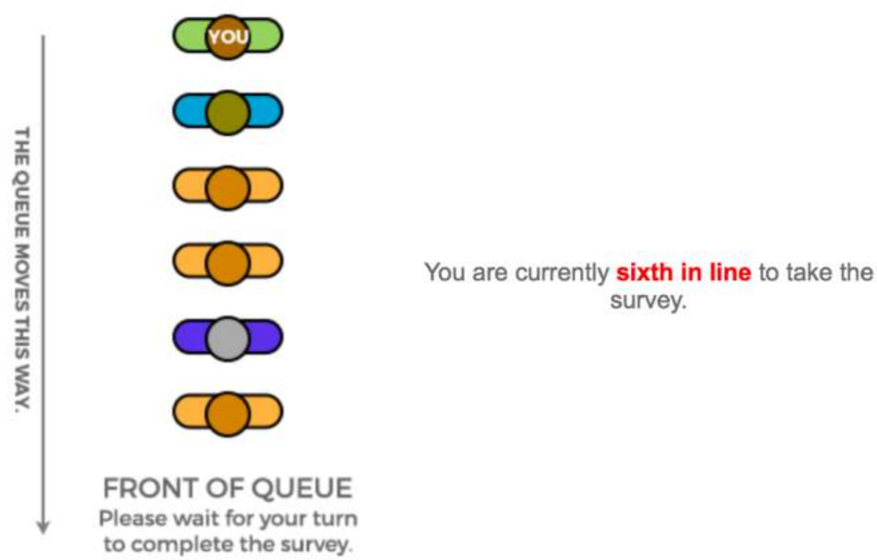

Figure 2: Queue display for virtual field experiment. Participants were able to see their own position in the queue, as well as those of other participants, tracking the queue state in real time.

3.2.2 Design and procedure. As each participant arrived and completed the informed consent process, they were directed to join a first-come, first-served virtual queue to answer a five-question survey. In order to manage their wait duration, each virtual queue's capacity was capped at a maximum of six participants. When the sixth participant was assigned to a particular queue, the queue was closed to new arrivals, and a new queue was opened. This design feature ensured that participants never waited for more than five other participants to complete the survey. It also ensured as-if random variation in participants' relative positions in the queue. The target sample size of 300 participants was chosen in order to capture observations of at least 50 participants who experienced the full duration of their wait in last place.

As participants waited to complete the survey, they were able to observe their current position and progress in the queue, depicted from above, progressing from the top to the bottom of the screen (**Figure 2**). Each participant's current position in the queue was represented pictorially, as well as in words – for example, "You are currently fourth in line to take the survey." Each participant saw himself or herself represented as one of six randomly selected, stylized icons, depicting the head and shoulders of a person standing in line with the word "YOU" superimposed on top of it. Other participants were represented with similar randomly selected icons that varied by color. Throughout the experiment, each participant's avatar was consistently represented to other participants in their queue.

Participants were directed to take the survey when the participant in front of them in the queue completed it. The average participant spent 35.49 seconds responding to the survey questions, but some participants lingered for far longer (SD = 96.11 seconds). In order to manage the experiment duration for participants waiting behind particularly slow respondents, the experiment also allowed the next participant in line to advance if the person taking the survey had spent more than 60 seconds responding. 93.36% of participants completed the survey in less than 60 seconds.

While participants were waiting for their turn to take the survey, a digital display of the queue faithfully represented their progress. If a participant surfed away from the experiment, other participants in the queue observed their departure, and those waiting behind the departing participant advanced in the queue. Similarly, as participants in the front of the queue exited to take the survey, their departure was visible to the participants waiting behind them. When the queue updated, the graphical and textual representations of their position in the queue were updated as well.

3.2.3 Independent measures. As participants waited to complete the survey, data were recorded every ten seconds on the number of participants in front of them in the queue (M = 1.82, SD = 0.93), the average number of participants behind them in the queue (M = 1.32, SD = 1.07), whether they were in last place (M = 0.44, SD = 1.07), and the number of seconds that had elapsed since they joined the queue. To aggregate these data for analysis, the maximum number of people each participant experienced in front of them (M = 2.47, SD = 1.71) and behind them in the queue (M = 1.89, SD = 1.52) were encoded, and an indicator variable was created noting which participants spent the entirety of their waits in last place (M = 0.24, SD = 0.43). The amount of time each participant waited in the queue (M = 58.82 seconds, SD = 37.02 seconds) was also captured.

3.2.4 Survey Measures. Participants were asked to rate their wait satisfaction, "Please rate your overall satisfaction with the length of your wait, on a scale of 1-7 (1= extremely dissatisfied; 7 = Extremely satisfied)," (M = 4.34, SD = 1.64) and to estimate the duration of their wait, "Please estimate how long you waited to take the survey (in seconds)," (M = 82.93, SD = 65.45). Due to the nature of the free text response field, this average was skewed upward by outliers. The maximum wait time experienced by any participant in this study was 195 seconds. Participants whose estimates exceeded 900 seconds (N = 2), where there existed a discontinuous break in wait time estimates, were excluded from the analysis, though the results are substantively similar if all observations are included.

Participants were also asked to report their gender, their year of birth, and the highest level of education they had completed. Participants who left survey questions blank (N = 3) were also excluded, resulting in a final sample of 296 participants (40.9% female, M_{age}=34.63, SD=11.49).

3.2.5 Analysis and Results. Wait estimates and wait satisfaction were modeled using OLS regression with robust standard errors. As shown in **Table 2**, Column 1, the proportion of time a participant spent in last place had no effect on their estimate of the duration of their wait (β = 4.747, P = 0.665), suggesting that being in last place does not make a wait feel longer. In fact, the only significant predictor of a participant's estimate of their wait time was the actual duration of their wait (β = 1.256, P < 0.01). Notably, and consistent with prior research on how people experience passive waits (Hornik 1984), participants' overestimated the time they spent waiting in line, indicated by the coefficient on wait time being greater than 1 (F(1,288)=6.16, P=0.01).

	(1)	(2)	(3)	(4)	(5)	(6)
	Wait Estimate	Wait Satisfaction	Wait Satisfaction	Wait Satisfaction	Wait Satisfaction	Wait Satisfaction
Wait time	1.257***	-0.015***	-0.018***	-0.018***	-0.017***	-0.025***
	(0.104)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
Always in last place	4.747			-0.881*	-1.190***	-2.072***
	(10.944)			(0.469)	(0.273)	(0.426)
Always in last place × wait time						0.016**
						(0.007)
Maximum number ahead	-4.679	-0.164*	-0.644***	-0.614***	-0.534***	-0.155
	(3.194)	(0.099)	(0.172)	(0.178)	(0.179)	(0.258)
Maximum number ahead^2			0.115***	0.110***	0.091**	0.011
			(0.038)	(0.039)	(0.038)	(0.052)
Maximum number behind	-1.695	-0.143*	0.735***	0.089	-0.293***	-0.354***
	(3.708)	(0.082)	(0.241)	(0.444)	(0.090)	(0.090)
Maximum number behind^2			-0.185***	-0.073		
			(0.051)	(0.085)		
Female indicator	4.761	0.216	0.178	0.163	0.164	0.169
	(6.112)	(0.180)	(0.178)	(0.177)	(0.177)	(0.175)
Age	0.397	0.018**	0.018**	0.017**	0.017**	0.019**
	(0.365)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Education	1.246	-0.063	-0.074	-0.076	-0.074	-0.071
	(2.352)	(0.067)	(0.065)	(0.064)	(0.064)	(0.063)
Constant	2.687	5.406***	5.205***	5.997***	6.317***	6.528***
	(19.456)	(0.478)	(0.492)	(0.617)	(0.464)	(0.459)
Observations	296	296	296	296	296	296
Adjusted R-squared	0.393	0.185	0.211	0.217	0.218	0.235

Table 2: Estimate of wait time is unaffected by the proportion of time a participant spent in last place, but their wait satisfaction is negatively affected by the amount of time they spent in last place (Study 2). All models are estimated with OLS regression and robust standard errors, are shown in parentheses. *, **, and ***, signify significance at the 10%, 5%, and 1% levels respectively.

Columns 2-3 begin to disentangle the determinants of wait time satisfaction. Column 2 shows that satisfaction is negatively affected by the duration of the wait (*βs* < -0.15, *Ps* < 0.01). In Column 2, participants reported marginally lower levels of satisfaction when there had been more people ahead of them in the queue (β = -0.164, P < 0.10), and when there had been more people behind them in the queue (β = -0.143, P < 0.10). Column 3 demonstrates the non-linearity of these effects. Controlling for other factors, participants were less satisfied with their wait when there had been more people in front of them (β = -0.644, P < 0.01), but at a decreasing rate (β = 0.115, P < 0.01). Moreover, consistent with prior research on downward social comparison (Zhou and Soman 2003), participants reported higher levels of satisfaction when there were more people behind them in the queue (β = 0.735, P < 0.01), but this effect too was attenuated as the number of people behind the participant increased (β = -0.185, P < 0.01).

Importantly, Column 4 demonstrates that this non-linear effect of the number of people behind the participant on wait time satisfaction was attributable to last place aversion. Introducing an indicator variable for participants who spent the duration of their wait in last place revealed a negative, and marginally significant relationship with wait satisfaction (β = -0.881, P < 0.10), while reducing the binomial coefficients on the number of people behind the participant to insignificance, (β = 0.089, P = 0.84) and (β = -0.073, P = 0.40), respectively.

Column 5 shows that after controlling for whether the participant spent the duration of their wait in last place, the effect of the number of customers behind is better modeled as a linear term. Interestingly, that term reveals that once a waiting participant is not in last place, having more people waiting behind actually *diminishes* satisfaction (β = -0.293, P < 0.01). Perhaps once a participant is able to make a downward social comparison because they are no longer in last place, the effect of adding incrementally more people behind them in the line serves to reduce satisfaction by making the number of people waiting, and in turn, the wait itself, more salient. This pattern of results is consistent with the idea that the absence of a target for downward social comparison may be the psychological process that explains the aversive effects of last place aversion in queues.

After removing the non-linear term from the model, as described above, the negative relationship between waiting in last place and satisfaction with the wait intensifies considerably. Controlling for other factors, participants who spent the duration of their wait in last place reported wait time satisfaction that was 18.8% lower on average than participants who were not in last place (β = -1.190, $P < 0.01$).

These results are interesting, since the sizable effects of last place aversion persist after controlling for the time the participant waited in the line to complete the survey. This suggests that being in last place is, in and of itself, what's diminishing customer experiences – not the prolonged wait duration that's associated with being in last place. What's more, these effects are particularly interesting because of their magnitude. The drop in wait time satisfaction experienced by a last place participant is the same as the drop experienced by participants who waited 70 additional seconds to take the survey – the equivalent of waiting behind two additional people. The results suggest that from a satisfaction perspective, participants would rather wait in a substantively longer queue to avoid waiting in last place.

A characteristic of first-come, first-served queues is that people who are in last place have to wait longer for service. Hence, the pain of waiting in last place may intensify or diminish as time progresses. To explore this empirical question, Column 6 incorporates an interaction term between the participant's total wait duration and the indicator of whether they spent the entirety of their wait in last place. The results suggest that people habituate to being in last place. The differential impact of being in last place is most detrimental for short waits (β = -2.07, $P < 0.01$), and its negative effects diminish over time (β = 0.016, $P < 0.05$). Practically speaking, this result suggests that interventions that target last place individuals early in their waits might be the most fruitful for improving waiting experiences, and perhaps for forestalling counterproductive switching and reneging behaviors.

These results highlight one way that last place aversion in queues may reduce customer satisfaction. The mere circumstance of waiting in last place, which is neither under the control of the customer nor the firm, is enough to meaningfully diminish wait satisfaction. The studies that follow investigate how and why the negative experiences attributed to being in last place may translate to behaviors that might further affect service performance for customers and firms alike. In particular, they explore the effects of last place aversion on switching and reneging behaviors – the customer choices to switch from one queue to another, or to opt out of the queue and forgo the service altogether. They also investigate the promise of a managerial intervention – queue transparency – that can be used to attenuate the negative effects of last place aversion in queues.

3.3 Study 3: Last place aversion and switching behavior

Study 2 highlighted how controlling for other factors, peoples' queuing experiences are substantively affected by being in last place. Study 3 replicates the conditions of the observational analysis from Study 1 in the online queuing environment, to investigate the effects of last place aversion on customer switching behaviors, and those switching behaviors' subsequent effects on customer experiences of the service.

Replicating Study 1 in the online queuing environment provides better experimental control over the conditions and higher fidelity data than could be captured in a physical queuing environment. These features facilitate the elimination of alternative explanations for the pattern of effects in Study 1. In particular, lengthening the line permits an analysis that can disentangle the effect of last place aversion on switching behavior from the linear effect of the number of people behind a person in the queue. Additionally, better instrumentation in the virtual queuing environment enables the continuous observation and documentation of the status of the opposing queue to control for whether it might be shorter than the line in front of the participant. Moreover, the virtual queuing environment lacks any physical barriers (e.g., magazine racks, merchandise displays, shopping carts, shoppers, etc.) that may have impeded customers from switching among queues in the grocery store environment of Study 1. Furthermore, the virtual queuing environment enables the tracking of switching behavior and survey completion time of every participant "standing" in each line, which facilitates counterfactual analyses that were not possible in Study 1 (e.g., how long would this participant have waited if she had not switched queues?). Finally, participants can be directly surveyed in the virtual queuing environment, enabling Study 3 to build on Studies 1 and 2 by investigating how last place aversion affects switching behaviors and, in turn, queuing experiences.

3.3.1 Participants. 301 participants (41.7% female, M_{age}=35.08, SD=10.63) completed this study on the Amazon Mechanical Turk platform in exchange for 50 cents. Participants were recruited using the same language as Study 2.

3.3.2 Design and procedure. Study 3 replicated the design of Study 2 with four important modifications. First, upon completing the informed consent process, participants were asked not to surf away from the experiment while waiting in line. They were notified, "when your turn comes, you must click a button within 10 seconds to progress to the survey, or you will be disqualified from the HIT [and will not receive payment]." This step was added in an attempt to reduce the number of people who would disengage from the queue by opening a separate browser window and surfing to a different website while they waited. Such disengagement would censor the degree of switching that could be observed through the experiment. In physical queuing environments, a participant's continued presence is required to maintain one's place in line, and ultimately, to receive service. Hence, requiring a participant's continued presence in the virtual queuing environment is appropriately consistent.

Accordingly, the intended sample size for Study 3 was increased to 360 participants in anticipation of losing more participants due to this more stringent attention check. Although 365 participants completed the online informed consent process and joined a queue, 40 participants (10.9%) dropped out of the study by closing the browser window while waiting in the queue, and an additional 24 participants (6.6%) were disqualified when they failed to click the button to proceed to the survey within 10 seconds. Data from the remaining 301 participants were analyzed.

Second, after completing the informed consent process and reading the notification, participants joined the shorter of two queues in a paired queue system (**Figure 3**). As before, each queue was allowed to reach a maximum of 6 participants. When both queues reached a maximum number of participants, a new paired queue system was opened to accommodate the new arrivals. However, unlike Study 2, when a queue fell below 6 participants, due either to participants quitting the queue or advancing through the survey, that queue was again eligible to accept new arrivals. Each new arrival was automatically added to the shortest available queue across all systems, resulting in the true-to-life queuing dynamic of new customers arriving perpetually.

Third, in order to accommodate a greater number of participants on the screen, and to facilitate social comparisons within and across queues, the way participants were presented to one another in the virtual environment was revised. The queue was inverted so that it progressed from the bottom of the screen to the top, and the variety and realism of the avatars was increased. Each participant saw themselves represented as a yellow circle, with the word "YOU" superimposed over the top of it. Other participants were represented with one of 41 randomly-assigned avatars, each representing different races, ages, and genders (**Figure 3**). Throughout the experiment, each participant's avatar was consistently represented to the other participants in their queue.

A.

B.

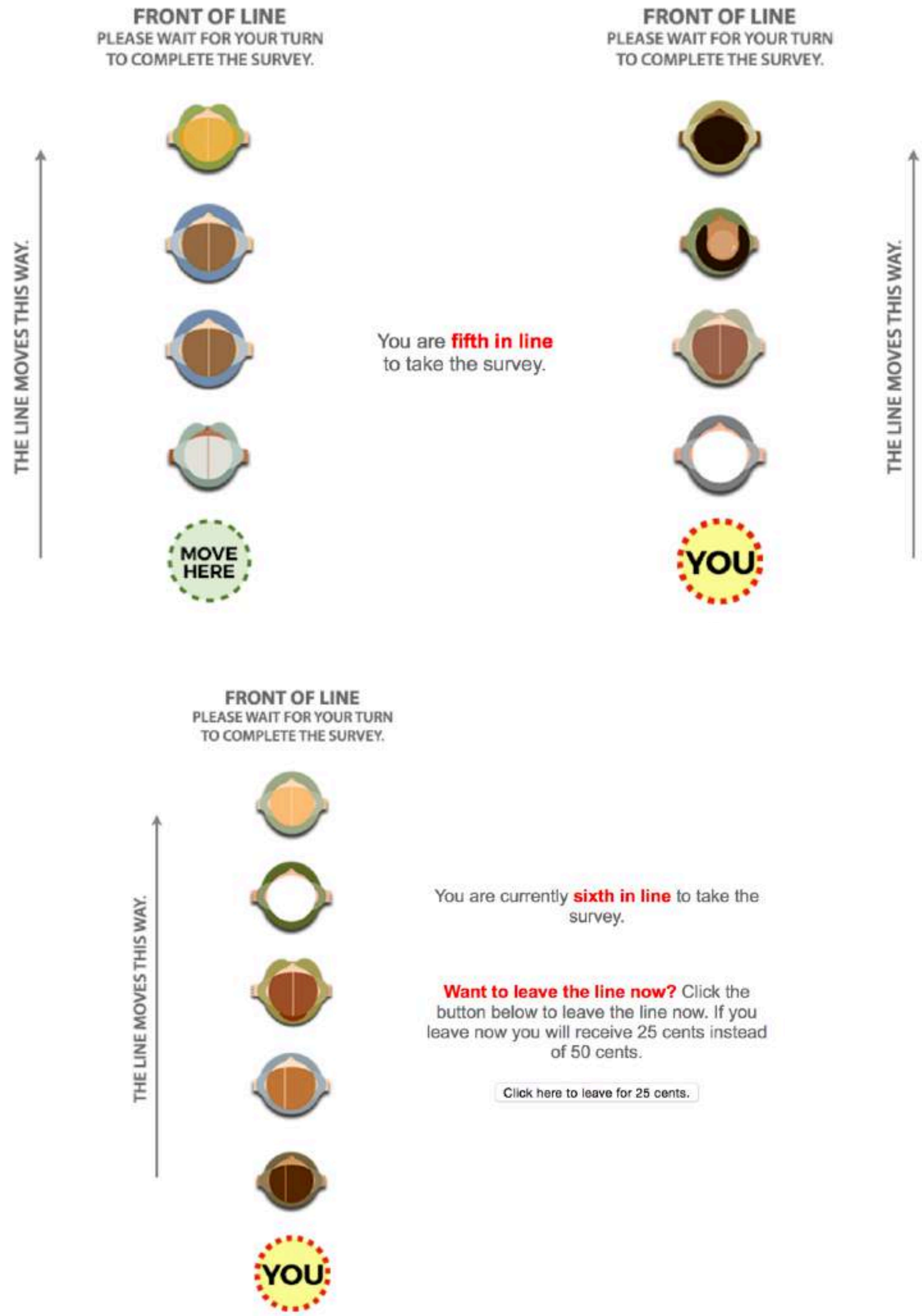

Figure 3: Queue displays for virtual field experiments. Study 3 explored how relative queue position affected switching behavior (Panel A). Study 4 explored how relative queue position affected defection from the queue (Panel B).

Fourth and finally, unlike Study 2, participants were given the opportunity to switch between the paired queues. If a participant desired to switch to the other queue, they could do so by clicking a green circular button at the end of the opposing queue that was labeled, "Move Here" (**Figure 3**). Clicking the button would result in being placed at the end of the opposing queue, a behavior that served in the experiment as the indicator of switching queues. Importantly, as in physical environments, if a participant switched queues, they would lose their place in line, if there was another participant already behind them, or if a new participant subsequently arrived.

3.3.3 Independent measures. As in Study 2, while participants waited to complete the survey, data were recorded every ten seconds on the number of participants in front of them in the queue (M = 1.90, SD = 1.67), the number of participants behind them in the queue (M = 1.25, SD = 1.48), whether they were in last place (M = 0.48, SD = 0.49), and the number of seconds that had elapsed since they joined the queue. Participants waited in the queues for an average of 91.25 seconds (SD = 78.07 seconds) before progressing to the survey.

Moreover, every ten seconds the status of the opposing queue was recorded. Participants might logically choose to switch to the opposing queue if it was shorter than the queue in front of them. Hence, a "paired queue advantage" metric was generated that designated whether the number of people in the opposing queue was less than the number of people in front of the participant in their current queue (M = 0.29, SD = 0.45).

3.3.4 Dependent Measures. The key dependent measure for this study was whether the participant chose to switch queues during a particular ten-second window. Consistent with Study 1, the hypothesis underlying Study 3 was that controlling for other factors, participants would be more likely to switch queues when they were in last place. The average participant switched queues 1.27 times during their wait (SD = 5.58). For this analysis, we focus on participants who switched queues 12 or fewer times, which excludes (N = 5) participants, who switched a disproportionate number of times (M = 39.4, SD = 16.24). However, the results are substantively similar if all observations are included.

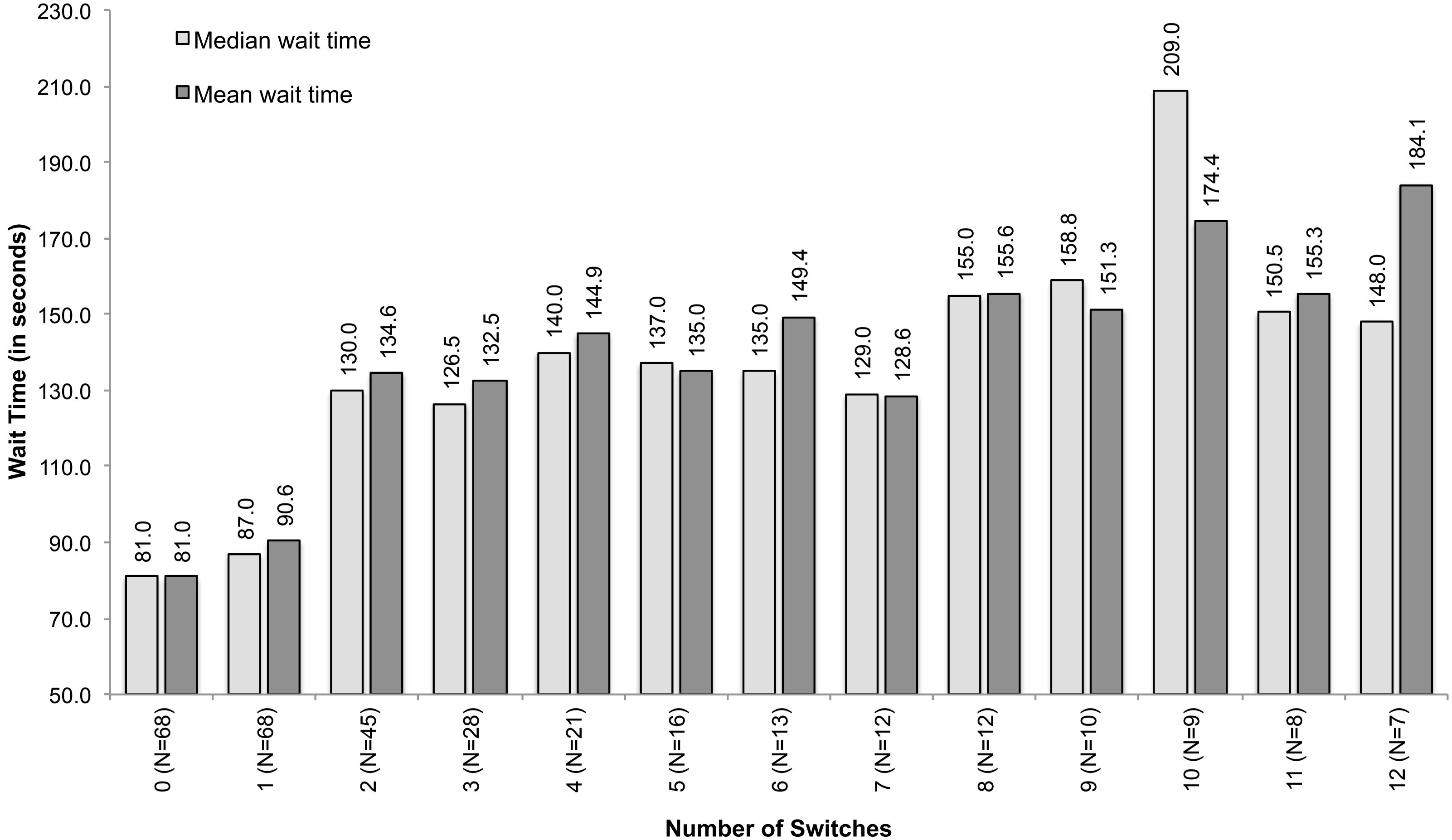

Figure 4: Switching queues increases the average and median wait times of switchers (Study 3). Each pair of column graphs shows the median and mean number of seconds the switcher would have waited to take the survey if they had not switched again. N = 68 participants chose to switch at least once, N = 45 participants chose to switch at least twice, N = 28 participants chose to switch at least three times, etc.

As a secondary dependent measure, the total queuing times for participants were captured, as well as measures of what their queuing times would have been had they not switched queues. Being in last place was hypothesized to increase the probability of switching behavior, which in turn was predicted to extend the duration of a participant's wait. Participants who did not switch queues (N = 234) waited an average of 77.47 seconds to take the survey (SD = 67.90). Participants who did switch queues (N = 68) waited an average of 138.69 seconds (SD = 91.66). The virtual queuing environment made it possible to track the behavior and survey time of every individual within the paired queue system, such that for every switch made by a participant, a counterfactual could be calculated reconstructing the wait times the participant would have had if she and those in front of her had not switched queues. Had no queue switching occurred, participants (N = 302) would have waited an average of 81.50 seconds (SD = 48.97 seconds) before taking the survey. Participants who chose not to switch (N = 234) would have waited an average of 81.65 seconds (SD = 49.95 seconds), and participants who chose to switch would have waited an average of 80.99 seconds (SD = 45.78 seconds), wait times that are statistically indistinguishable ($T(302)=0.099$, $P=0.92$). However, in general, each additional switch by a participant resulted in longer wait times (**Figure 4**), suggesting that switching behavior was costly for participants.

3.3.5 Survey Measures. As with Study 2, participants were asked to rate their wait satisfaction, "Please rate your overall satisfaction with the length of your wait, on a scale of 1-7 (1= extremely dissatisfied; 7 = extremely satisfied)," (M = 4.36, SD = 1.70) and to estimate the duration of their wait, "Please estimate how long you waited to take the survey (in seconds)," (M = 115.23, SD = 98.16). Participants were also asked to report their gender, their year of birth, and the highest level of education they had completed.

3.3.6 Analysis and Results. As in Study 1, switching probabilities were modeled using random effects logistic regression, with robust standard errors clustered at the individual level. In **Table 3**, Column 1 corroborates the results from Study 1 by showing that, controlling for other factors, people are more likely to switch queues when they are in last place (β = 0.971, $P < 0.10$). Column 2 demonstrates that these results persist after controlling for the state of the alternative queue. Although people are 42% more likely to switch when the other line is shorter (β = 0.512, $P < 0.05$), they are 103% more likely to switch when they are in last place (β = 0.959, $P < 0.10$).

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Pr(Switch)	Pr(Switch)	Pr(Switch)	Time remaining$_{t+1}$	Time remaining$_{t+1}$	Total wait	Wait satisfaction	Wait satisfaction
Last place indicator	0.971*	0.959*	0.984**	3.307***	0.130			
	(0.500)	(0.501)	(0.501)	(0.844)	(0.816)			
Time remaining$_t$			-0.006	0.866***	0.870***			
			(0.004)	(0.012)	(0.013)			
Switch indicator					17.458***	47.506***	-0.778***	-0.075
					(2.191)	(10.250)	(0.256)	(0.288)
Extra waiting								-0.015***
								(0.003)
Time since joining queue	-0.010**	-0.010*	-0.011**					
	(0.005)	(0.005)	(0.005)					
Number ahead	0.244***	0.205***	0.287***					
	(0.076)	(0.075)	(0.081)					
Number behind	-0.358	-0.401	-0.436					
	(0.288)	(0.291)	(0.295)					
Paired queue advantage		0.512**	0.529**	-2.234***	-2.670***			
		(0.255)	(0.256)	(0.650)	(0.693)			
Female indicator	-0.633*	-0.608	-0.589	-0.432	-0.056	-1.008	0.480**	0.508***
	(0.373)	(0.372)	(0.364)	(0.541)	(0.539)	(8.422)	(0.202)	(0.188)
Age	-0.064***	-0.065***	-0.063***	0.029	0.069***	-0.332	0.002	-0.003
	(0.018)	(0.018)	(0.018)	(0.025)	(0.025)	(0.413)	(0.009)	(0.008)
Education	0.043	0.044	0.034	0.063	0.065	-3.920	0.005	0.011
	(0.128)	(0.129)	(0.126)	(0.197)	(0.206)	(3.314)	(0.072)	(0.068)
Constant	-2.011**	-2.027**	-1.671*	2.753*	0.814	105.864***	4.257***	4.355***
	(0.940)	(0.943)	(0.944)	(1.426)	(1.416)	(18.519)	(0.444)	(0.408)
Observations	2,916	2,916	2,916	2,619	2,619	297	296	296
Model type	RE Logit	RE Logit	RE Logit	RE GLS	RE GLS	OLS	OLS	OLS
Adjusted R-squared						0.0743	0.0512	0.148
Number of participants	297	297	297	230	230	297	296	296

Table 3: Being in last place significantly increases switching behavior, and switching prolongs wait duration, undermining satisfaction (Study 3). Columns 1-3 are estimated with random effects logistic models. Columns 4-5 are estimated with random effects GLS models. Columns 6-8 are estimated with OLS. Robust standard errors, clustered at the individual level, are shown in parentheses in Columns 1-5. Robust standard errors are shown in parentheses in Columns 6-8. Columns 4-5 have a diminished number of observations because future period wait can't be modeled for participants who are "next" in line. Columns 7-8 have a diminished number of observations because one participant didn't answer the wait satisfaction question. *, **, and ***, signify significance at the 10%, 5%, and 1% levels respectively.

Conventional wisdom suggests that switching is a rational behavior used by people to get through lines faster. That is, if a person intuits that their line is slower than the alternative, they will switch to reduce their overall wait. Because the virtual queuing environment used in this study affords the reliable calculation of counterfactuals, it is possible to directly test whether people are more likely to switch when their wait would have been longer, and whether the impulse to switch results in a shorter wait. Column 3 reveals that controlling for other factors, the time remaining in a person's wait is not predictive of whether they will switch to an alternative queue (β = -0.006, P = 0.11), but being in last place is predictive of switching (β = 0.984, $P <$ 0.05), as is the number of people ahead in the queue (β = 0.287, $P < 0.01$). These results suggest that the switching decision is driven more by observable queue factors than by peoples' ability to intuit the remaining duration of their wait.

Columns 4-8 investigate the effects of last place aversion and switching on total wait duration and wait time satisfaction. Columns 4-5 use random effects GLS with robust standard errors, clustered by participant, to model future period wait duration as a function of current period wait duration and one's position in the queue. Intuitively, Column 4 shows that current period wait duration is strongly and positively associated with future period wait duration (β = 0.866, $P < 0.01$) – a person with a long wait will have a slightly less long wait ten seconds later if they don't switch queues. Paired queue advantage is negatively associated with future period wait duration (β = -2.234, $P < 0.01$) – if the other queue is shorter, future period wait duration is reduced, as the person will switch to the other queue. Tellingly, the effect of being in last place is positively associated with future period wait duration. Controlling for other factors, the expected duration of a person's wait increases by 3.31 seconds when they are in last place (β = 3.31, $P <$ 0.01).

Column 5 reveals that this increase in expected wait time is due to the behavioral tendency to switch queues when one is in last place. Switching is associated with a 17.46 second increase in future period wait duration (β = 17.458, $P < 0.01$), and controlling for whether a person switches drops the last place coefficient near zero (β = 0.130, P = 0.873). That is, being in last place increases the probability of switching, and switching increases the overall wait duration. Columns 6-8 model cross sectional wait time and wait satisfaction data using OLS models with robust standard errors. Column 6 shows that people who switch at least once in Study 3 wait an average of 47.51 seconds longer to take the survey than people who do not switch (β = 47.506 P < 0.01). Column 7 shows that switchers are 30.2% less satisfied with their waits (β = -0.778, $P <$

0.01), and Column 8 shows that their diminished satisfaction is almost entirely explained by their increased wait times. Extra wait time is strongly predictive of diminished wait time satisfaction (β = -0.015, $P < 0.01$), and controlling for extra wait time reduces the effect of having switched queues to insignificance (β = -0.075, P = 0.794).

These results highlight a second way that last place aversion in queues substantively affects service performance. The diminished satisfaction that arises from being in last place can translate to switching behaviors, which can further prolong waits, exacerbating diminished wait time satisfaction. Adding insult to injury, not only did switching prolong total wait duration, last place participants who switched wound up spending more than twice as much time in last place on average – up from 20.05 seconds (SD = 25.01) to 50.51 seconds (SD = 33.41) ($T(295) = 7.95$, $P < 0.01$). Although the experience of waiting in last place reduced average wait time satisfaction by 18.8% in Study 2, allowing participants to switch queues in Study 3 resulted in satisfaction that was 30.2% less among switchers.

3.4 Study 4: Last place aversion and reneging behavior

Study 4 explores the effects of last place aversion on reneging behaviors – the choice to quit a line and forgo a service altogether. To the extent that being in last place diminishes customer experiences, queuing individuals may be most likely to give up on the line when they are in last place. Study 4 also investigates the moderating role of completion utility. Last place aversion's effects may be more acute when the service for which one is queuing is less discretionary – wherein completion utility and hence, the stakes of waiting are sufficiently high to justify persisting after having progressed beyond last place. Furthermore, Study 4 explores the impact of queue transparency, a service design choice that may be used by managers in some circumstances to combat the deleterious effects of last place aversion on service performance. If last place aversion drives reneging behaviors in queues, transparency into one's relative position may increase abandonment when participants can see that they are in last place and it may reduce abandonment when participants can see that they're not.

3.4.1 Participants: 1,429 participants (50.5% female, M_{age}=36.45, SD=11.61) completed this study on the Amazon Mechanical Turk platform in exchange for 50 cents. Participants were recruited using the same language as in the prior online studies.

3.4.2 Design and Procedure: Study 4 replicated the design of the previous online studies, returning to a single queue with a capped capacity of six participants. Unlike the prior studies, the design of Study 4 allowed participants to abandon the queue. Beneath the textual description of the participant's current status in the queue was included an additional instruction that invited participants to leave the line early in exchange for a reduced level of compensation (**Figure 3**).

The degree to which waiting in the queue was discretionary was manipulated by offering different levels of compensation to participants who chose to renege – ranging in ten cent increments from 5 cents to 45 cents. When a low level of compensation was offered for abandoning, the incremental compensation for completing the survey was relatively high, mimicking service scenarios in which waiting for service is less discretionary – such as completing a necessary banking transaction or mailing a time-sensitive package at the post office. Conversely, when a high level of compensation was offered for abandoning, the incremental compensation for completing the survey was relatively low, mimicking service scenarios in which waiting for service is more discretionary – such as ordering a dessert item at a cafe or buying a non-mandatory product at a convenience store. Participants read "Want to leave the line now? Click the button below to leave the line now. If you leave now, you will receive [5, 15, 25, 35, 45] cents instead of 50 cents."

Study 4 additionally manipulated queue transparency, whether or not participants could see the queue itself. In the transparent condition, participants saw both the pictorial and textual representations of their current position in the queue. In the non-transparent condition, participants only saw the textual representation of their current position in the queue. Importantly, although the textual representation presented information about how many participants were ahead in the queue, for example, "You are currently fourth in line to take the survey," it presented no information about the status of the queue behind the participant; crucially, whether the participant was in last place.

Since there were ten conditions in this study, a recruiting target of 1,200 participants who did not renege from the queue was established. The aim of this strategy was to yield a minimum of 20 observations per rank per condition from participants who did not renege, plus additional observations from participants who chose to renege – offering sufficient power for the analysis.

3.4.3 Independent measures. As in the previous online studies, while participants waited to complete the survey, data were recorded every ten seconds on the number of participants in front of them in the queue (*M* = 1.47, *SD* = 1.49), the number of participants behind them in the queue (*M* = 0.99, *SD* = 1.16), whether they were in last place (*M* = 0.47, *SD* = 0.50), and the number of seconds that had elapsed since they joined the queue. The 240 participants who reneged did so after waiting an average of 15.94 seconds (*SD* = 22.29 seconds). The remaining 1,189 participants, who did not abandon the queue, waited for an average of 75.00 seconds (*SD* = 54.67 seconds) before progressing to the survey.

3.4.4 Dependent Measures. The focal dependent measure for this study was whether the participant chose to renege from the queue. Study 4 was designed to test the hypothesis that controlling for other factors, people would be more likely to renege when they were in last place. Indeed, of the 240 participants who reneged, 146 (60.8%) did so when they were in last place.

3.4.5 Survey Measures. As with Studies 2 and 3, participants who waited in the queue were asked to rate their wait satisfaction, "Please rate your overall satisfaction with the length of your wait, on a scale of 1-7 (1= Extremely dissatisfied; 7 = Extremely satisfied)," (*M* = 4.36, *SD* = 1.70). Unlike the previous studies, participants who waited and participants who reneged were additionally asked to rate the degree to which they agreed or disagreed with the statement, "It was worth my time to wait in the line I just experienced," on a scale of 1-7 (1 = Strongly disagree; 7 = Strongly agree). Participants were also asked to report their gender, their year of birth, and the highest level of education they had completed.

3.4.6 Analysis and Results. In **Table 4**, Columns 1-2 model the probability of reneging from the queue using random effects logistic regression, with robust standard errors clustered at the participant level. Column 1 shows that when the queue was transparent, controlling for other factors, participants were 4.29 times more likely to renege from the queue when they were in last place (β = 2.692, $P < 0.05$). Unsurprisingly, participants exhibited an increased willingness to defect when the compensation for defecting was higher (β = 0.133, $P < 0.01$). Interestingly, and consistent with the hypothesis that last place aversion would wield a more significant impact in less-discretionary queuing environments, an interaction exists wherein participants who received more attractive compensation for reneging were less prone to reneging when they were in last place (β = -0.097, $P < 0.01$).

	(1) Pr(Renege)	(2) Pr(Renege)	(3) Wait satisfaction	(4) Worth waiting	(5) Worth waiting	(6) Pr(Renege)	(7) Pr(Renege)
Last place	2.692**	0.465					
	(1.047)	(0.739)					
Time since joining queue	-0.015	-0.020***	-0.011***	0.005***	-0.006***	-0.062***	-0.072***
	(0.011)	(0.007)	(0.002)	(0.001)	(0.002)	(0.008)	(0.010)
Compensation to quit	0.133***	0.082***	-0.010**	-0.021***	-0.016***	0.045***	0.034**
	(0.035)	(0.023)	(0.004)	(0.004)	(0.004)	(0.013)	(0.016)
Compensation x last place	-0.097***	-0.015					
	(0.030)	(0.020)					
Number ahead	0.187*	0.054	-0.154	-1.502***	-0.454*	3.846***	2.791***
	(0.112)	(0.067)	(0.253)	(0.247)	(0.235)	(0.628)	(0.700)
Number ahead^2			0.025	0.224***	0.064*	-0.580***	-0.432***
			(0.036)	(0.034)	(0.033)	(0.085)	(0.095)
Number behind	-0.036	0.066	-0.008	-0.070	-0.113*	-0.043	-0.307
	(0.214)	(0.132)	(0.056)	(0.066)	(0.059)	(0.181)	(0.245)
Transparency		-1.797*					
		(1.005)					
Transparency x last place		2.567**					
		(1.129)					
Transparency x compensation		0.047*					
		(0.028)					
Transparency x last place x compensation		-0.080**					
		(0.031)					
Always in last place			0.025	-0.796***	-0.103	1.273**	0.855
			(0.231)	(0.212)	(0.200)	(0.624)	(0.767)
Renege indicator					-2.605***		
					(0.232)		
Worth waiting							-1.030***
							(0.161)
Female indicator	-0.804*	-0.773***	0.427***	0.276**	0.220**	-0.327	-0.064
	(0.438)	(0.286)	(0.116)	(0.122)	(0.109)	(0.345)	(0.403)
Age	0.001	-0.001	0.014***	0.018***	0.017***	-0.002	0.014
	(0.018)	(0.011)	(0.005)	(0.005)	(0.004)	(0.016)	(0.017)
Education	0.020	0.010	-0.014	-0.023	-0.002	0.141	0.069
	(0.136)	(0.092)	(0.042)	(0.045)	(0.040)	(0.122)	(0.134)
Constant	-8.740***	-6.573***	5.734***	6.865***	6.488***	-5.847***	1.079
	(2.310)	(1.337)	(0.453)	(0.499)	(0.451)	(1.384)	(1.855)
Observations	4,964	10,208	571	670	670	670	670
Number of participants	665	1,418	571	670	670	670	670
Model selection	RE Logit	RE Logit	OLS	OLS	OLS	Logit	Logit
Sample selection	Transparent	Full sample	Transp. / waited	Transparent/ full	Transparent/ full	Transparent/ full	Transparent/ full
Adjusted (Pseudo) R-squared			0.179	0.100	0.287	0.558	0.708

Table 4: Reneging behavior is significantly increased by being in last place (Study 4). Columns 1-2 are estimated with random effects logistic models. Columns 3-5 are estimated with OLS models. Columns 6-7 are estimated with logistic models. Adjusted R-squared measures are provided for Columns 3-5 and Pseudo R-squared measures are provided for Columns 6-7. All models are estimated with robust standard errors, which are shown in parentheses, with Columns 1-2 clustered at the individual level. *, **, and ***, signify significance at the 10%, 5%, and 1% levels respectively.

Column 2 repeats the analysis for the full sample of participants. The results reveal that in the absence of queue transparency, when participants could not see that they were in last place, the effects of last place aversion on reneging from the queue were insignificant (β = 0.465, P = 0.529). Queue transparency marginally reduced the probability of reneging from the queue (β = -1.797, $P < 0.10$), but there exists a significant interaction, wherein participants who were able to observe that they were in last place were significantly more likely to renege (β = 2.567, $P < 0.05$). Consistent with the earlier results, the effect of last place aversion on reneging in transparent queues is most significant when waiting is less discretionary. The three-way interaction of transparency, last place, and compensation for quitting the queue is significant and negative (β = -0.080, $P < 0.05$).

These results have important practical implications. First, they reveal that last place aversion not only adversely affects the experiences of waiting customers in ways that may diminish their satisfaction with the service, but also their behaviors, in ways that stand to undermine the performance of the service itself. Controlling for other factors, customers who were in last place were 4.3 times more likely to quit the line, giving up on the service entirely. Second, the results suggest that the effects may be most significant in less discretionary service contexts, where the cost of abandonment may be more severe for the customer. It should be noted that these results do not speak to behaviors in non-discretionary queuing environments, wherein completion utility is so high (and/or abandonment disutility is so high) as to preclude reneging. In such environments, it seems reasonable to assume that the benefits of waiting (and/or the high costs of quitting) would outweigh the pain of last place aversion, though this question remains an opportunity for future research. Finally, these results highlight queue transparency as a lever that may be used to reduce customer defections due to last place aversion. For example, since queue transparency reduces defections in general, but increases defections when individuals are in last place, managers of a call center may choose to provide information to customers about the state of the queue in front of them until a queue has accumulated behind them. Then, the call center might transition to providing transparency about the shrinking line ahead, and the growing line behind.

Columns 3-5 model wait satisfaction and evaluations that it was worth the participant's time to wait using OLS regressions with robust standard errors. Column 3 replicates the wait satisfaction analysis from Study 2, focusing on the subset of participants who experienced queue transparency and who chose to wait. Intuitively, wait satisfaction falls as wait time increases (β = -0.011, $P < 0.01$) and compensation to quit the line rises (β = -0.010, $P < 0.05$). However, unlike in Study 2, being in last place for the duration of the participant's wait doesn't significantly impact their wait satisfaction ($\beta = 0.025$, $P = 0.915$). This pattern of results is consistent with the idea that when participants are given the opportunity to quit the queue, those who are most dissatisfied with the wait will choose to do so, leaving those who are relatively more satisfied behind to evaluate their experience.

Columns 4 and 5 provide converging evidence in support of this hypothesis. These columns focus on all participants who experienced a transparent wait – those who could see whether they were or were not in last place. All participants – those who chose to renege and those who did not – were asked to evaluate whether it was worth it to wait in the queue. Similar to the wait satisfaction results, participants rated waiting in the line to be less worthwhile as the compensation offered for quitting increased ($\beta = -0.021$, $P < 0.01$). Intuitively, they also rated the wait to be less worthwhile as the number of people ahead of them in the queue grew ($\beta = -1.502$, $P < 0.01$), though at a diminishing rate ($\beta = 0.224$, $P < 0.01$). The linear effect of the number of people behind the participant didn't influence their evaluation of whether waiting in the queue was worthwhile ($\beta = -0.070$, $P = 0.29$). However, being in last place for the duration of their time in the line was a significant predictor of whether the participant evaluated waiting in the line to be worthwhile, with those in last place rating the wait to be 14.7% less worthwhile ($\beta = -0.796$, $P < 0.01$) than those with other positions in the queue.

Column 5 shows that reneging from the queue is strongly associated with whether the participant evaluated waiting in the queue to be worthwhile ($\beta = -2.605$, $P < 0.01$). Importantly, we also note that after controlling for whether the participant reneged, the relationship between being in last place and evaluating the wait to be less worthwhile diminishes near zero ($\beta = -0.103$, $P = 0.608$). This pattern of results is consistent with the notion of self-selection: that participants who perceive the wait to be less worthwhile are more likely to renege. Taken with the wait satisfaction results above, these findings highlight one of the shortcomings of the common managerial practice of evaluating the experiences of waiting customers on the basis of evaluations provided by those who chose to wait. If individuals who perceive the wait to be more worthwhile are less likely to renege and are more likely to evaluate their experiences positively, then managers will be left with a biased picture of their performance.

Why does last place aversion in queues lead to reneging? Columns 6-7 use logistic regression to model the likelihood that a participant who is always in last place will renege from the queue. The columns reveal that controlling for the perceptions of the worth of waiting diminishes the relationship between being in last place and reneging. Being in last place is positively associated with reneging ($\beta = 1.273$, $P < 0.05$). Perceptions of the worth of waiting are negatively associated with reneging ($\beta = -1.030$, $P < 0.01$), and controlling for these perceptions drops the strength of the relationship between being in last place and reneging to insignificance ($\beta = 0.855$, $P = 0.265$). A causal mediation analysis that accounted for the alternating specifications of the mediator and outcome variables (Hicks and Tingley 2011; Imai, Keele, and Tingley 2010) revealed that the average causal mediation effect, the change in the probability of defecting from the queue that was due to being in last place's reduction in the perceptions of the worth of waiting, was 0.0454 (95% confidence interval: 0.0196, 0.0777) relative to a total effect of 0.095 (95% confidence interval: 0.0004, .2097). Diminished perceptions of the worth of waiting explained 46.2% of the total effect of being in last place on the probability of quitting the queue. These results are consistent with the idea that part of what may drive the effect of last place aversion in queues is the absence of a target for downward social comparison. When there is no one who is worse off, the last place individual is left feeling uncertain about whether waiting in the queue itself is worthwhile and may choose to defect in response.

4. General discussion

In four studies, conducted in physical and virtual queuing environments, this paper has demonstrated that last place aversion is a potent driver of the experiences and behaviors of people waiting in queues. As initial evidence, an observational analysis of a grocery store queuing environment reveals that customers waiting for service are more likely to switch queues when they are in last place, controlling for the number of people ahead of them, how long they have been waiting, and how fast the line is moving (Study 1). Subsequent studies provide converging evidence of the effects of last place aversion (**Figure 5**), disentangling it from the linear effect of the number of customers behind in the queue, tracing out its implications for experiences and behaviors, identifying a psychological mechanism underlying the effect, and highlighting a potential managerial approach for reducing its impact in practice.

A. **Switching Behavior**
(Study 1)

B. **Switching Behavior**
(Study 3)

C. **Reneging Behavior**
(Study 4)

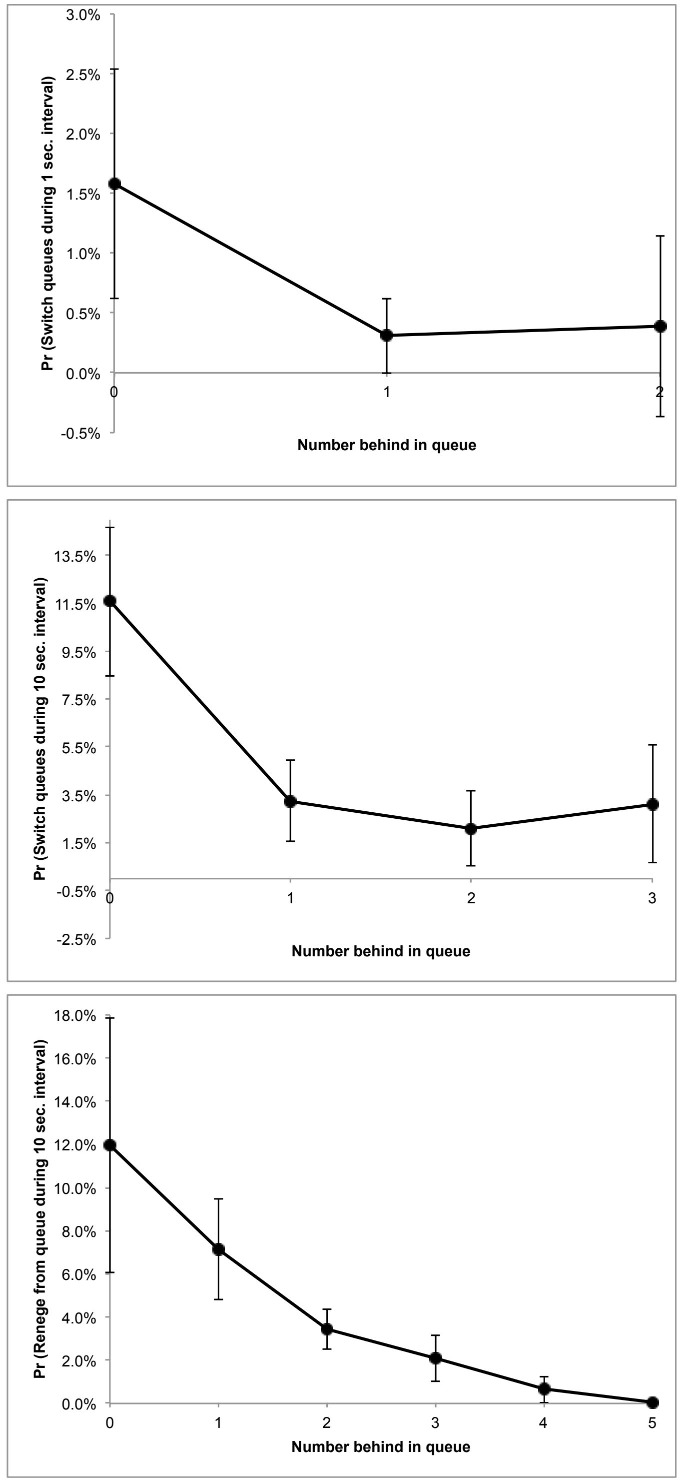

Figure 5: Margin Plots for Behavioral Studies. Study 1 (Panel A) explored how relative position affected switching behaviors in a grocery store. Study 3 (Panel B) explored how relative queue position affected switching behavior in the lab. Study 4 (Panel C) explored how relative queue position affected reneging behavior in the lab. All plots are estimated with robust standard errors, clustered at the individual level. They reveal a discontinuity in behavior when a person is behind the focal individual in the queue.

The results demonstrate that waiting in last place diminishes satisfaction, but that people habituate to being in last place over time, suggesting that interventions targeting customers early in their waits might be most promising for nullifying the effects of last place aversion in queues (Study 2). People are more than twice as likely to switch queues (Study 3) and more than four times as likely to quit queues (Study 4) when they are in last place. When people in last place switch queues, it can increase the overall duration of their wait, which diminishes their wait satisfaction (Study 3). When people in last place renege from queues, they do so in part because the absence of a target for downward social comparison causes them to perceive the wait to be less worthwhile – effects that are especially potent when queuing is less discretionary (Study 4). Finally, the results provide evidence that actively managing queue transparency, by obscuring from customers when they are in last place, and revealing to customers when they are not in last place, holds promise for reducing abandonment (Study 4).

4.1 Managerial Implications

Although considerable attention is devoted to designing efficient service processes that reduce waiting times and to designing experiences that manage customers' perceptions of what's ahead of them in the queue, this research highlights the counterintuitive and outsized effect of what's taking place behind them – in particular, whether they're in last place. Controlling for other factors, when customers are waiting in last place, they're significantly less satisfied with the wait, are twice as likely to switch queues, and are four times as likely to abandon queues, than when they're in other parts of the line. Since the last place customer is readily identifiable in any queue, these dynamics have important practical implications for managers, who can design queuing environments and service practices that account for the powerful effects of last place aversion. This section highlights a handful of important managerial implications that arise from this research.

4.1.1 Last place aversion matters more in queues that are less discretionary for customers. Customers are more likely to abandon queues when the service for which they are waiting is highly discretionary. For example, all else equal, a customer waiting to buy ice cream on a cool summer day is more likely to quit the line than a customer waiting to buy ice cream on a hot summer day. However, when the service is less discretionary for customers, the effects of last place aversion loom larger. In Study 4, when participants who were able to see their relative position in the queue were offered a low level of compensation to abandon the queue (5 cents, relative to 50 cents for remaining in the queue), those in last place were 6.7 times more likely to defect than those who were not in last place (**Figure 6**). In contrast, when participants were offered a high level of compensation to abandon the queue (45 cents, relative to 50 cents for remaining in the queue), participants were substantially more likely to abandon in general, but those in last place were no more nor less likely to renege than those who were not in last place (those in last place were 86% as likely to renege, a difference that is statistically indistinguishable from zero). This is interesting, because it suggests that last place aversion may lead to customer behaviors that are irrational, in the sense that people are more willing to give up on services that are less discretionary for them, simply because they are in last place. Said differently, the effects of last place aversion might be particularly potent in queues where abandoning is especially costly for consumers. Hence, service designs that can reduce defections due to last place aversion may help ensure that customers who need services the most are more likely to receive them.

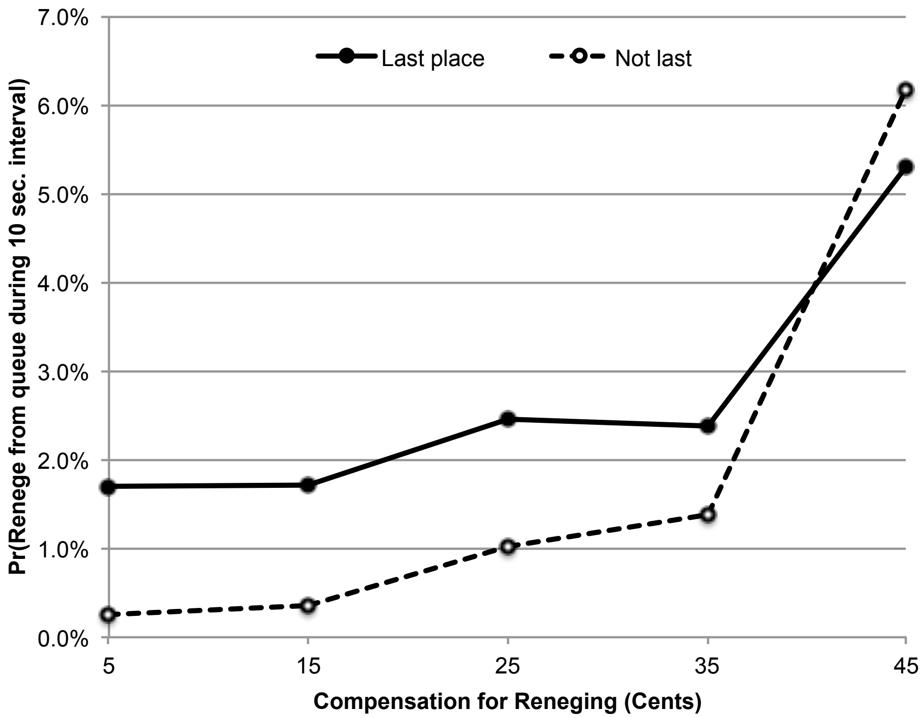

Figure 6: Probability of reneging from the queue over any 10-second interval for participants in last place vs. participants who were not in last place, when the queue was transparent, as a function of compensation offered for abandoning (Study 4). Raw averages are plotted above.

4.1.2 The effects of last place aversion in queues may not be immediately detected and may be misattributed to other factors. To the extent that the effects of last place aversion may be most pronounced among customers who value the service more, those who abandon due to last place aversion may be more likely to blame the service provider for the queuing experiences that led to their defection. To the extent these customers feel particularly aggrieved, there may be important long-term implications for the service relationship that would not be captured through traditional post-sales customer survey initiatives. Moreover, even the experiences of customers who choose not to abandon the queue may be jeopardized by last place aversion. In Study 2, we observed that controlling for other factors, participants who spent the duration of their wait in last place reported being 18.8% less satisfied with their waiting experience than participants who waited elsewhere in the queue. In Study 3, participants were more likely to switch between queues when they were in last place. Individuals who switched queues spent more time in last place and more time in the queue overall. By virtue of the prolonged total wait switchers experienced, switchers were 30.2% less satisfied with their waiting experience than non-switchers. Hence, even interactions that result in a near-term sale may erode the long-term service relationship if the dynamics of last place aversion undermine customers' experiences and drive behaviors that are counterproductive to a satisfying interaction. Moreover, since a customer's relative position in the queue and their choice to switch queues are data that are rarely tracked in practice, diminished satisfaction with the interaction, if it is captured at all, may be misattributed to other factors, such as the agent who served the customer, rather than to the queuing dynamics themselves.

4.1.3 People habituate to being in last place. Study 2 reveals that wait satisfaction is most compromised by last place aversion when wait times are short. As wait times increase, the effect of last place aversion on wait satisfaction is attenuated. Consequently, interventions targeting last place customers early in their waits may hold the most promise for improving their experiences and forestalling switching and reneging. Indeed, maxims like "people want to get started" (Maister 1985), may stem in part from the discomfort of last place aversion. Being immediately asked, "is there something I can start for you?" by the barista at a coffee shop, or being instantly triaged by a nurse in an emergency room may feel particularly settling to us as customers in part because we experience those interactions when we are in last place. The pattern of results observed in this paper would suggest that being acknowledged in an identical way even a minute into the interaction, when we have habituated to being in last place, may be less impactful.

4.1.4 Last place aversion is a lever that can be used to positively and negatively moderate behavior. Study 4 suggests that queue transparency is one lever that can be used to nullify the behavioral effects of last place aversion in queues. What's interesting about this intervention is that it highlights both the demotivating and motivating aspects of last place aversion. Controlling for other factors, when participants could see they were in last place in the non-discretionary queue (5 cents offered for quitting), they were 1.5 times more likely to renege than when they could not see they were in last place. Making the fact that they were in last place salient had a demotivating effect, increasing the likelihood they would give up on waiting. In contrast, when participants could not see that they were not in last place, they were 3.7 times more likely to renege than when they could see they were not in last place. Making the fact that they were not in last place salient had a motivating effect, decreasing the likelihood they would give up on waiting. This pattern of results suggests that interventions that engage, distract, or obscure one's relative position when they are in last place, and that emphasize one's relative position when they are not, may help motivate individuals to stay the course. Interventions that do the opposite – emphasizing that one is in last place, while obscuring one's relative position when they are not, may drive individuals to take action. One example of the latter approach is the "we are the 99%" political slogan coined by the Occupy movement in the United States in mid-2011 to highlight the inequity between the wealthiest 1% of the country's population and the remaining 99%. An interesting effect of the slogan is that it promoted the narrative that 99% of the electorate was in last place, which helped fuel conversations and a political movement. The experimental results presented here demonstrate how last place aversion is a general human tendency that persists regardless of one's gender, age, or level of education – which were directly controlled in Studies 2-4. Consequently, although these results have important implications for queues, it's interesting to consider how last place aversion might be productively managed to motivate behavior in a broader array of contexts. For example, operations could be designed to facilitate social comparisons among customers in ways that help them more deeply engage in their own medical care, save more for their own retirement, or persist in their pursuit of exercise or education. Similarly, these insights hold promise for improving the productivity and performance of employees. These results provide converging evidence with prior research (Kuziemko et al. 2014; Song et al. 2015) that the desires to get out of last place, and to avoid falling into last place, are powerful motivators that can help drive human behavior.

4.1.5 Last place aversion in queues may be a natural process that regulates the length of queues. An important caveat to these results is that just as last place aversion may be an innate part of human psychology, it may also be a natural process that regulates the length of queues – a means by which those with the least invested in the interaction can censor themselves from the system, thereby preventing the exponential queue growth that occurs when the arrival rate exceeds the service rate. In congested queuing environments, the pursuit of reducing abandonment by actively managing last place aversion may lead to longer lines and broader challenges with the operation. However, these results suggest that active management of last place aversion may be beneficial in many contexts and that thoughtful consideration of its effects may improve experiences in performance in a wide array of settings – in queuing and beyond.

References

Allon, Gad, and Achal Bassamboo. 2011. "The Impact of Delaying the Delay Announcements." *Operations Research* 59 (5): 1198–1210.

Allon, Gad, Achal Bassamboo, and Itai Gurvich. 2011. "'We Will Be Right with You': Managing Customer Expectations with Vague Promises and Cheap Talk." *Operations Research* 59 (6): 1382–94.

Baker, Julie, and Michaelle Cameron. 1996. "The Effects of the Service Environment on Affect and Consumer Perception of Waiting Time: An Integrative Review and Research Propositions." *Journal of the Academy of Marketing Science* 24 (4): 338–49.

Batt, Robert J., and Christian Terwiesch. 2015. "Waiting Patiently - An Empirical Study of Queue Abandonment in an Emergency Department." *Management Science* 61 (1): 39–59.

Becker, Gary. 1965. "A Theory of the Allocation of Time." *The Economic Journal* 75 (299): 493–517.

Buell, Ryan W., Tami Kim, and Chia-Jung Tsay. 2017. "Creating Reciprocal Value through Operational Transparency." *Management Science* 63 (6): 1673–95.

Buell, Ryan W., and Michael I. Norton. 2011. "The Labor Illusion: How Operational Transparency Increases Perceived Value." *Management Science* 57 (9): 1564–79.

Buhrmester, M., T. Kwang, and S. D. Gosling. 2011. "Amazon's Mechanical Turk: A New Source of Inexpensive, Yet High-Quality, Data?" *Perspectives on Psychological Science*.

Buunk, Abraham P., and Frederick X. Gibbons. 2007. "Social Comparison: The End of a Theory and the Emergence of a Field." *Organizational Behavior and Human Decision Processes* 102 (1): 3–21.

Carmon, Ziv, J George Shanthikumar, and Tali F Carmon. 1995. "A Psychological Perspective on Service Segmentation Models: The Significance of Accounting for Consumers' Perceptions of Waiting and Service." *Management Science* 41 (11). INFORMS: 1806–15.

Chase, Richard B, and Sriram Dasu. 2001. "Want to Perfect Your Company's Service? Use Behavioral Science." *Harvard Business Review* 79 (6). Harvard Business School Publication Corp.: 78–84.

Cook, Lori S, David E Bowen, Richard B Chase, Sriram Dasu, Doug M Stewart, and David A Tansik. 2002. "Human Issues in Service Design." *Journal of Operations Management* 20 (2): 159–74.

Debo, Laurens G., Christine Parlour, and Uday Rajan. 2012. "Signaling Quality via Queues." *Management Science* 58 (5): 876–91.

Festinger, L. 1954. "A Theory of Social Comparison Processes." *Human Relations* 7 (2): 117–40.

Giebelhausen, Michael D., Stacey G. Robinson, and J. Joseph Cronin. 2010. "Worth Waiting for: Increasing Satisfaction by Making Consumers Wait." *Journal of the Academy of Marketing Science* 39 (6): 889–905.

Haynes, Paula. 1990. "Hating to Wait: Managing the Final Service Encounter." *Journal of Services Marketing* 4 (Fall): 20–26.

Hicks, Raymond, and Dustin Tingley. 2011. "Causal Mediation Analysis." *The Stata Journal* 11 (4): 1–15.

Hornik, Jacob. 1984. "Subjective vs. Objective Time Measures: A Note on the Perception of Time in Consumer Behavior." *Journal of Consumer Research* 11 (1): 615–18.

Hui, Michael K., and David K. Tse. 1996. "What to Tell Consumers in Waits of Different Lengths: An Integrative Model of Service Evaluation." *Journal of Marketing* 60 (2): 81. doi:10.2307/1251932.

Imai, Kosuke, Luke Keele, and Dustin Tingley. 2010. "A General Approach to Causal Mediation Analysis." *Psychological Methods* 15 (4): 309–34.

Janakiraman, Narayan, Robert J. Meyer, and Stephen J. Hoch. 2011. "The Psychology of Decisions to Abandon Waits for Service." *Journal of Marketing Research (JMR)* 48 (6): 970–84.

Koo, Minjung, and Ayelet Fishbach. 2010. "A Silver Lining of Standing in Line: Queuing Increases Value of Products." *Journal of Marketing Research (JMR)* 47 (4): 713–24.

Kuziemko, Ilyana, Ryan W. Buell, Taly Reich, and Michael I. Norton. 2014. "Last-Place Aversion: Evidence and Redistributive Implications." *Quarterly Journal of Economics* 129 (1): 105–49.

Larson, Richard C. 1987. "Perspectives on Queues: Social Justice and the Psychology of Queueing."

Operations Research 35 (6). INFORMS: 895–905.
Leclerc, France, Bernd H Schmidtt, and Laurette Dubé. 1995. "Waiting Time and Decision Making: Is Time Like Money?" *Journal of Consumer Research* 22: 110–20.
Little, John D. C. 1961. "A Proof for the Queuing Formula: $L = \lambda W$." *Operations Research* 9 (3): 383–87.
Lu, Yina, Marcelo Olivares, and Ariel Schilkrut. 2013. "Measuring the Effect of Queues on Customer Purchases." *Management Science* 59 (8): 1743–63.
Maister, David H. 1985. "The Psychology of Waiting Lines." In *The Service Encounter*, edited by John D Czeipel, Michael R Solomon, and Carol F Surprenant, 113–23. Lexington, MA: Lexington Books.
Mason, Winter, and Siddharth Suri. 2012. "Conducting Behavioral Research on Amazon's Mechanical Turk." *Behavior Research Methods*.
McFadden, D. 1999. "Rationality for Economists?" *Journal of Risk and Uncertainty* 19 (1–3): 73–105.
Norman, Donald A. 2009. "Designing Waits That Work." *Sloan Management Review* 50 (4): 23–28.
Oberholzer-Gee, Felix. 2006. "A Market for Time Fairness and Efficiency in Waiting Lines." *Kyklos* 59 (3): 427–40.
Osuna, Edgar ElÌas. 1985. "The Psychological Cost of Waiting." *Journal of Mathematical Psychology* 29 (1): 82–105.
Roels, Guillaume, and Xuanming Su. 2014. "Optimal Design of Social Comparison Effects: Setting Reference Groups and Reference Points." *Management Science* 60 (3): 606–27.
Simmons, Joseph P, Leif D Nelson, and Uri Simonsohn. 2012. "A 21 Word Solution." *SPSP Dialogue*, 1–4.
Soman, Dilip, and Mengze Shi. 2003. "Virtual Progress: The Effect of Path Characteristics on Perceptions of Progress and Choice." *Management Science* 49 (9): 1229–50.
Song, Hummy, Anita L. Tucker, Karen L. Murrell, and David R. Vinson. 2015. "Public Relative Performance Feedback in Complex Service Systems: Improving Productivity through the Adoption of Best Practices."
Spivak, M. 1967. "Sensory Distortions in Tunnels and Corridors." *Hospital Community Psychiatry* 18 (12): 12–18.
Stone, Alex. 2012. "Why Waiting in Line Is Torture." *New York Times*.
Taylor, Shirley. 1994. "Waiting for Service: The Relationship between Delays and Evaluations of Service." *Journal of Marketing* 58 (2): 56–69.
Ülkü, Sezer, Chris Hydock, and Shiliang Cui. n.d. "Making the Wait Worthwhile: Experiments on the Effect of Queueing on Consumption." *Working Paper*, 1–35.
Veeraraghavan, Senthil K., and Laurens Debo. 2009. "Joining Longer Queues: Information Externalities in Queue Choice." *Manufacturing & Service Operations Management* 11 (4): 543–62.
Weir, K. 2012. "The Pain of Social Rejection." *American Psycological Association Monitor on Psychology* 43 (50).
Wills, Thomas A. 1981. "Downward Comparison Principles in Social Psychology." *Psychological Bulletin* 90 (2): 245–71.
Yu, Qiuping, Gad Allon, and Achal Bassamboo. 2017. "How Do Delay Announcements Shape Customer Behavior? An Empirical Study." *Management Science* 63 (1): 1–20. doi:10.1287/mnsc.2015.2335.
Zhao, Min, Leonard Lee, and Dilip Soman. 2012. "Crossing the Virtual Boundary: The Effect of Task-Irrelevant Environmental Cues on Task Implementation." *Psychological Science* 23 (10): 1200–1207.
Zhou, Rongorng, and Dilip Soman. 2003. "Looking Back: Exploring the Psychology of Queuing and the Effect of the Number of People Behind." *Journal of Consumer Research* 29 (March 2003): 517–30.
Zhou, Rongrong, and Dilip Soman. 2008. "Consumers' Waiting in Queues: The Role of First-Order and Second-Order Justice." *Psychology and Marketing* 25 (3): 262–79.

Acknowledgements

I gratefully acknowledge and thank Michael Norton for his invaluable feedback and insight, Jay Chakraborty for his thoughtful comments, assistance, and dedication during the early stages of this research, including data collection for the first study, and Nihal Raman for his helpful contributions. I'm also grateful to Marketing Science Institute, which provided a research grant (#4-2005) that helped support the costs of this research. This research also benefited tremendously from seminar participants at the University of Washington Foster School of Business, the 2016 and 2017 INFORMS Annual Conferences, the 2016 and 2017 POMS Annual Conferences, and the 2017 MSOM Annual Conference, whose constructive questions and suggestions influenced its development. I'm also very appreciative of Michael Conlon, Kim Jacobson, Carmen Massbaum, Melissa Ouellet, and Nikhil Shetty who assisted with this work in a variety of critical ways. All errors remain my own.