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Waiting To Give: Stated and Revealed Preferences

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We estimate and compare the effect of increased time costs on consumer satisfaction and behavior. We are able to move beyond the existing literature, which focuses on satisfaction and intention, and estimate the effect of waiting time on return behavior. Further, we do so in a prosocial context and our measure of cost is the length of time a blood donor spends waiting. We find that relying on satisfaction data masks important time cost sensitivities; namely, it is not how the donor feels about the wait time that matters for return behavior, but rather the actual duration of the wait. Consistent with theory we develop, our results indicate that waiting has a significant longer-term social cost: we estimate that a 38% increase (equivalent to one standard deviation) in the average wait would result in a 10% decrease in donations per year.

Keywords: time costs; prosocial behavior; blood donation; return behavior; waiting; stated and revealed preferences
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1. Introduction

We consider the role of time costs on economic behavior. Unlike many costs people face in everyday transactions that are observable to researchers, time costs are often ignored because they are unobservable, but they can be substantial and affect behavior. For example, Krueger (2009) estimates that more than three million hours were spent obtaining medical services in the United States in 2007. If included in expenditure calculations, this would account for nearly 11% of medical expenditures. Becker (1965) stressed the importance of including various time costs into value calculations, emphasizing that time, like other commodities, has a cost that depends on how it is utilized. Thus, wasted, nonproductive time comes at a high cost in terms of foregone income and utility.

One prevalent nonproductive use of time is the time spent waiting. Not only does waiting time entail large financial costs,[1] but it also exacts large psychological and intrinsic costs (Schwartz 1974), which are borne by both the firm and the consumer (see Taylor and Fullerton 2000 for a review). The consumer psychology literature finds that how consumers feel about the wait is more important than the actual duration of the wait in determining their level of overall satisfaction (Taylor 1994). In particular, longer waits incite customer frustration, which leads to lower service evaluations and intentions (Dube-Rioux et al. 1989, Taylor 1994, Hui and Tse 1996). However, beyond a variety of survey measures (e.g., on emotions, attitudes, satisfaction, and intentions), little is known about the effects of waiting on actual consumer behavior.

To address this gap in the literature, this paper studies the effect of waiting times on consumers' actual return behavior. Thus, we move beyond previous wait time research, which has relied on service evaluation and future intention surveys as proximal outcome measures, to study the subsequent behavior of individuals after they have experienced various waiting times. Examining actual behavior is particularly important since stated attitudes, satisfaction, and intentions may not always predict, and may even contradict, actual behavior. For instance, extensive research in psychology finds that stated intentions align with aspirations and goals while revealed preferences observed in actual behavior may reflect more pragmatic concerns and greater responsiveness to costs (Sheeran 2002, Glasman and Albarracín 2006).

We study the effects of waiting time costs in a prosocial context; specifically, we study the effect of waiting time on blood donors' return behavior. Beyond being the first study to examine the effects of waiting time on actual behavior, studying the effects

[1] Krueger (2009) calculated that the time patients spent waiting for service amounted to $14.4 billion in 2007.

of waiting time on behavior in a prosocial context is especially interesting and important for two reasons. First, the difference between stated intentions and actions may be further exacerbated in a prosocial context by social desirability biases (e.g., using stated intentions to signal altruism) (Vaillant 1977). In the context of blood donations, Glynn et al. (2003) report that survey respondents indicate that offering health-related services would be an effective incentive to donate blood. Subsequently, Goette et al. (2009) offered free cholesterol tests to new and existing donors and found this health-related service was ineffective in increasing donation rates.

The second reason that studying the effects of waiting time in a prosocial context is especially important is that the effects in a prosocial context likely provide a lower bound on the responsiveness to waiting time costs in nonprosocial contexts. Volunteers or donors are often highly intrinsically motivated and thus less responsive to changes in costs and benefits due to external factors crowding out intrinsic motivations (Deci et al. 1999, Gneezy et al. 2011), particularly when there are social status or social norm concerns (Bénabou and Tirole 2006, Ariely et al. 2009, Funk 2010).[2] Thus, we expect that detecting an effect of time costs in prosocial behavior will be more difficult than, and underestimate the effects compared to, nonprosocial contexts.

We use data from the Australian Red Cross Blood Service (the Blood Service), supplemented by survey data that we collected across four donation centers in July 2009, to test the effect of wait time on three outcomes: satisfaction, intention to donate, and actual return donation behavior. Our wait time measure is provided by Blood Service administrative records that record arrival time and needle-in time.[3] In the survey, we also collected information about the emotions the donors experienced while waiting, their attitudes toward the Blood Service, and attitudes toward donation. We use these data to explore whether the effect of wait times on return behavior operates through the same mechanism that wait time affects satisfaction and stated intentions.

[2] For example, Funk (2010) finds that when the time costs to voting are diminished in Switzerland by more flexible voting laws, the rate of voter participation did not increase as the policy intended, but decreased.

[3] The variation in wait times is mainly driven by staffing constraints, but additional variation may also come from differences in the time to complete paperwork and time for the donor's eligibility interview (discussed in Section 2.1). The key identifying assumption is that the length of time a donor waits is not correlated with unobservable factors that may also affect his propensity to donate. We address this concern by instrumenting for the donor's wait time using the wait times of the donor who arrived at the center immediately before and after the focal donor.

Our sample consists of whole blood donors in July 2009 who donate whole blood or plasma on their subsequent return donation or do not return within the following 44 months (see Section 2 for a discussion). The return data are the key and novel component of our contribution and highlights the institutional features of the Blood Service that make it particularly suitable for our question. Namely, in Australia, the Blood Service has a monopoly on all blood product collection and thus, unlike most countries including the United States, we need not be concerned that individuals switch to alternative donation services in response to experiences with the Blood Service (Lacetera et al. 2012). Additionally, unlike other studies, we follow donors for nearly four years after the survey and thus our results are not driven by an arbitrary stopping time or truncated observation.

We report two main sets of findings. First, longer waits negatively affect future donation behavior. As predicted from our theoretical model (see Section 2.4.1) that assumes (a) donors expected future wait time is increasing in their current wait time, and (b) the expected utility of donating decreases the longer they expect to wait, we find that donors who experienced longer waits delay their next donation, regardless of the blood product being donated upon return. The delays caused by experiencing longer waits (in addition to the mandatory 3 to 12 weeks required between donations to protect the health of donors)[4] translate into substantial losses in the expected number of yearly donations. Based on our estimates, we calculate that if whole blood donors waited one standard deviation (or 20 minutes) longer than the average wait time (43 minutes), this would result in a loss of approximately 10% of (or 64,391) whole blood donations.

We further observe that longer waits negatively affect additional prosocial activities. Similar to many contexts in which donors have a range of volunteer options, whole blood donors have several alternatives for donating. We find that longer waits to donate whole blood not only cause whole blood donors to delay their return to donate whole blood, but to also be less likely to convert to a plasma donation at their next donation.[5]

[4] In Australia, whole blood donors can donate plasma 3 weeks after a successful whole blood donation and can donate whole blood 12 weeks after a successful whole blood donation.

[5] This is important for policy because most countries experience much greater plasma than whole blood shortages and thus converting donors from whole blood to plasma is a goal of many blood collection agencies (Slonim et al. 2014). In fact, worldwide plasma shortages are so severe that many countries, including Australia, rely on importing plasma from the United States. Slonim et al. (2014) give a comprehensive review of the benefits of plasma donation over whole blood donation. For instance, plasma donors

Our second set of results examines the relationship between the effects of wait time on the survey responses and on actual behavior. Our survey results corroborate the findings in the psychology literature on waiting times. Consistent with this extant literature, we find that it is not the duration of the wait, but how the donor feels about the wait, that determines overall satisfaction and intention to return. Conversely, we find that the duration of the wait time is a significant predictor of the donor's propensity to return even when we control for emotions and, further, that emotions play no significant role in explaining return behavior.

Thus, we find that relying only on satisfaction or intention survey responses as a proximal outcome for return behavior results in misleading conclusions. The different factors affecting satisfaction and return behavior may be explained by a hot-cold empathy response gap that has been observed in a variety of other contexts (Loewenstein 2000), including medical decision making (Sayette et al. 2008) and sexual arousal (Ariely and Loewenstein 2006). This hot-cold response gap is relevant since survey responses are typically collected immediately after experiencing the wait (as we collected them in our study). This is the time when emotions regarding the wait experience are most salient (i.e., when donors were in a hot state). However, the return decision is typically made several weeks to many months later, when visceral reactions to the experience have dissipated and donors are more likely to be in a cold state. Thus, while their emotional reactions fade, their updated expected future wait time cost continues to drive behavior.

There are also two additional benefits of examining return behavior rather than relying on satisfaction and intention data. First, return behavior allows us to calibrate the magnitude of the effects of longer waits on the whole blood supply. Second, return behavior captures important sources of heterogeneity that are not observed in the survey responses. In particular, while we observe no gender differences in the survey responses to longer waits, we find significant heterogeneity in how men and women respond to increased time costs; longer waits cause men, but not women, to delay their return to give whole blood. This finding corroborates existing laboratory and field evidence that demand for altruism is more elastic for males than females (Andreoni and Vesterlund 2001, Andreoni et al. 2003, Conlin et al. 2003), but is in contrast to others (Cox and Deck 2006, DellaVigna et al. 2013). However, we also find that women respond to longer wait times by reducing donations through alternative channels. Namely, longer waits cause women, but not men, to be less likely to convert to plasma in their subsequent donation. Thus, our results suggest that both men and women are responsive to wait time cost changes, but respond along different dimensions. These results contribute to the literature that seeks to understand gender differences in responses to variations in the costs and benefits of altruism (Croson and Gneezy 2009).

Beyond the wait time literature, we contribute to the growing literature examining the motivations for prosocial behavior, in which most empirical work has focused on changes on the benefits side (Fehr and Falk 2002; Gneezy and Rustichini 2000; Lacetera et al. 2013, 2014).[6] Far less research focuses on whether (and how) individuals respond to changes in costs for prosocial behavior,[7] and no research has examined how the costs of volunteering time affect prosocial behavior. Wait time, in particular, is a cost incurred by all donors, is observable, and exogenously varies, providing a good test of whether higher costs affect future behavior.

Our results suggest that cost management may be an effective tool to not only encourage prosocial behavior, but also to better coordinate supply and demand in settings where other types of incentives are deemed inappropriate. One possibility that has been discussed by Slonim et al. (2014) is the use of registries to solve the inherent coordination problem in the blood market. Given our estimates, that a one-standard-deviation change in wait time can have a 10% effect on annual donations, time costs may also be a mechanism to manage and encourage donations and volunteering efforts.

2. Design

2.1. Institutional Details

Blood donation in Australia provides an ideal context in which to study waiting times and return behavior at the individual level because the Blood Service has a monopoly on donation services. We are thus able to precisely measure the effects of wait time on future

can give more plasma and make donations more frequently than whole blood donors. Further, recipients can receive plasma donations from a donor of any blood type.

[6] There is related work in laboratory experiments examining costly altruistic punishment in public goods games (Fehr and Gächter 2000).

[7] There is also a supply side literature that examines charitable contributions at various matching rates (Eckel and Grossman 2008, Karlan and List 2007, Meier 2007). This literature exclusively examines the price of giving in terms of monetary value (i.e., where the price to donate each dollar falls as the match increases), whereas the "price" of giving in our study is determined by variation in the time to make a blood donation. To the extent that social status concerns affect prosociality, we think this distinction is relevant since it is easier and more natural for a third party to observe the amount of time a donor spends being prosocial than to observe the amount of a monetary donation.

Table 1 Donors in Survey Sample

Survey respondents			1,370
Matched to administrative data			1,251
July 2009 donation type			
Whole blood (WB)	916	Other	335
By return donation type		Plasma	245
(1) WB, plasma, or no return	914	Autologous	3
No missing outcome data	848	Apheresis platelets	46
Return, WB	649	Therapeutic	41
Return, plasma	72		
No return (right censored)	127		
(2) Other product	2		

donations no matter what blood product a donor supplies or where in Australia it is supplied.[8]

To give whole blood in Australia, a donor must not have made a whole blood donation within the preceding 12 weeks or a plasma donation in the preceding 3 weeks.[9] Thus, a donor who donates only whole blood can make four or five whole blood donations per year. The eligibility requirements for other blood products are often individual specific and depend on the health needs of the donor. Table 1 classifies the type of donation made in July 2009 among our survey population by blood product. For our purposes, we will focus only on donors who gave whole blood in July 2009 and returned to give whole blood or plasma, or did not return.[10]

When a donor arrives at the donation center, he registers at the front desk, completes a short personal history survey, and then waits in the lobby until he is escorted to the processing interview where his eligibility is assessed via an interview with the Blood Service staff. If deemed eligible, he is directed to a second waiting room and waits until a staff member calls him into the donation room where he begins his donation. The centers record the time the donor registers with the front desk upon arrival and the time the needle is inserted to begin the draw of blood. We consider the total wait time to be the number of minutes that elapse from the time the donor registers at the front desk to the time the needle is inserted.

During a whole blood donation, 470 milliliters of whole blood are extracted in a procedure that lasts approximately 8–12 minutes. When his donation is complete, he exits the donation room and enters the recovery room where drinks and food are provided. The donor is encouraged to remain in the recovery room for at least 15 minutes for precautionary health reasons, but is free to leave.

2.2. Data

We administered a field survey from July 8 to July 31, 2009, in four donation centers in the greater Sydney region to collect feelings about the wait experience and attitudes about donating and about the Blood Service.[11] Trained surveyors administered the survey in the recovery room after the donation process. The survey took approximately 5–10 minutes to complete and 98% of donors completed the survey, resulting in 1,370 completed surveys.[12]

We then matched the respondents with administrative data provided by the Blood Service. The administrative data include donation histories after July 2009 so that it is possible to identify when, if ever, a survey respondent returned and the blood product donated upon return. Table 1 shows that of the 1,370 survey respondents, 1,251 donors were successfully matched to an administrative record.[13] Of those 1,251, 73% donated whole blood, 20% donated plasma, and 7% gave another blood product.

Since blood products require varying time lags between donations, it is necessary to know the type of blood product the donor gave when (if ever) he returned to analyze return behavior. Of the 916 whole blood donors in July 2009, 66 observations were dropped because of missing outcome data and implausible wait times (see below for a further discussion), 649 returned to donate whole blood, 72 returned

[8] The lack of alternative donation organizations means that we do not have to be concerned with past donors choosing to make their future donation with another organization (Cairns and Slonim 2011, Gross 2005). This is a particularly important feature when studying the effect of costs and benefits on subsequent donation behavior. As shown in Lacetera et al. (2012), donors will substitute across donation locations in search of the best donation experience.

[9] In Australia, there are several requirements to be an eligible whole blood or plasma donor, however only the requirements relevant to our study will be discussed here. See http://www.donateblood.com.au/ (accessed August 7, 2016) for a full description of the eligibility requirements.

[10] We do not study the behavior of donors who give anything other than whole blood in our 12-week window mainly because the number of these donors that we observe is too small. We also do not study donors who give for therapeutic reasons since their donations are the result of health conditions that require they give blood. Finally, we do not study less common blood product donations since they do not have the same standard window of eligibility as whole blood that is key for our identification of delayed return behavior.

[11] See Supplementary Material C (available at http://dx.doi.org/10.1287/mnsc.2016.2504) for a copy of the survey instrument. The majority of survey variables are used throughout our analysis with the exception of the data on wait time expectations. While this could be a valuable variable, the survey was given after the donation (and importantly after the donor experienced his wait time) and thus we cannot be sure to what extent the current wait time influenced the self-reported expectations about the wait time.

[12] The 98% response rate is not surprising in this context; the blood service encourages donors to remain up to 15 minutes before leaving the center, thus the survey offers them something to do before leaving.

[13] Unsuccessful matches occurred due to invalid donor numbers.

Table 2 **Summary Statistics**

	All donors	Survey donors	Whole blood return	Plasma return	No return
Actual wait time (min)	41.21	42.74	42.39	39.07	46.62
	(18.38)	(18.79)	(18.44)	(16.73)	(21.05)
Median wait time (min)	38	39	39	35.5	39
Yearly donation rate	1.43	1.35	1.39	1.39	1.15
	(1.14)	(0.66)	(0.65)	(0.72)	(0.65)
Female	0.46	0.46	0.45	0.43	0.54
	(0.50)	(0.50)	(0.50)	(0.50)	(0.50)
Age	40.95	43.96	46.02	40.75	35.20
	(15.67)	(15.95)	(16.10)	(13.55)	(13.00)
AB positive	0.03	0.04	0.03	0.10	0.05
	(0.17)	(0.20)	(0.18)	(0.30)	(0.21)
O negative	0.10	0.10	0.11	0.04	0.07
	(0.30)	(0.30)	(0.31)	(0.20)	(0.26)
Center locations					
A	0.46	0.60	0.59	0.68	0.60
	(0.50)	(0.49)	(0.59)	(0.47)	(0.49)
B	0.13	0.03	0.02	0.04	0.03
	(0.34)	(0.16)	(0.16)	(0.20)	(0.18)
C	0.11	0.03	0.03	0.01	0.03
	(0.31)	(0.17)	(0.17)	(0.11)	(0.18)
D	0.30	0.34	0.35	0.26	0.34
	(0.46)	(0.48)	(0.48)	(0.44)	(0.48)
Morning arrival (07:00–11:00)	0.34	0.35	0.36	0.31	0.33
	(0.47)	(0.48)	(0.48)	(0.46)	(0.47)
Lunch hour arrival (11:00–13:00)	0.33	0.38	0.36	0.54	0.35
	(0.47)	(0.48)	(0.48)	(0.50)	(0.48)
Afternoon arrival (13:00–17:00)	0.32	0.27	0.27	0.15	0.32
	(0.47)	(0.44)	(0.45)	(0.36)	(0.47)
Observations	2,389	848	649	72	127

to donate plasma, and 127 had not returned within 44 months after the survey date, our last collection of data (henceforth referred to as never returned).[14]

The majority of our analyses will focus on the 848 individuals we could match to administrative records, have a complete record on all outcomes, donated whole blood during our survey time, and subsequently returned to donate whole blood, plasma or did not return (noted throughout as Survey Donors). However, in addition to these 848 survey donors, we obtained an additional eight weeks of data (four weeks before and four weeks after the survey period) from the same four donation centers. This sample of donors allows us to test the robustness of our return behavior results on a larger sample and we will report our main set of results with this larger sample (noted throughout as All Donors).[15]

Table 2 describes summary statistics for All Donors and the Survey Donors. The average time spent waiting before the donation begins was 43 minutes (median of 39 minutes), and donors arrived throughout the day (morning, lunch, and afternoon) in relatively similar proportions. Survey respondents made an average of 1.4 donations per year. Slightly less than half of our survey respondents are female and the average donor was 44 years old. Nearly all of the survey respondents made their donation at two of the four donation centers. Roughly 4% and 10% of our sample have AB positive and O negative blood types, respectively, reflecting the national average; controlling for blood type is important because the Blood Service encourages (discourages) AB positive (O negative) donors to convert (from converting) to donating plasma because of the relatively limited (universal) usefulness of their blood type. On average, the donors in the All Donors sample are similar to the Survey Donors across relevant dimensions. The one point of departure appears in the proportion of donors from

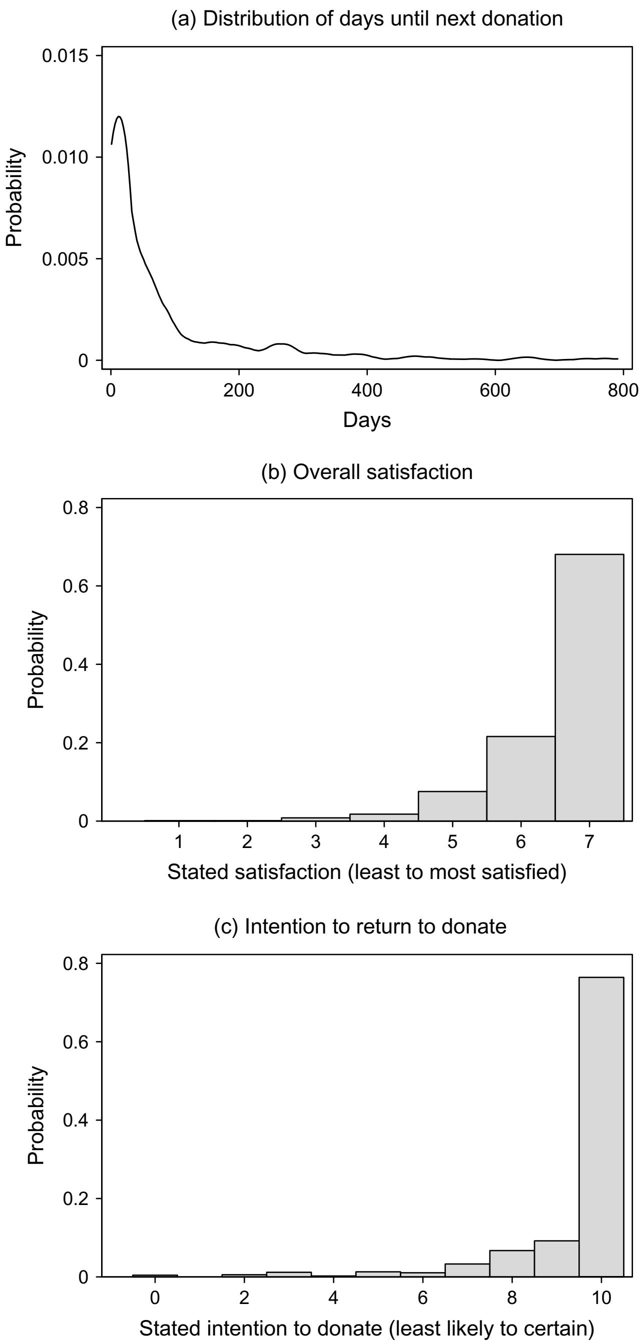
[14] There may be an additional group of individuals we do not observe who arrive at the donation centers to make a donation, but then leave prior to checking in. These individuals may leave for a variety of reasons, including reasons that are orthogonal to the wait time. However, they may also leave because they are discouraged by long lines or crowded waiting rooms that could signify a long wait. To the extent that these individuals leave because they are more sensitive to longer wait times, while the donors in our analysis chose to wait, we will underestimate the true population effect of wait time on the outcomes.

[15] The initial purpose of these data was to test whether the survey directly affected behavior.

each of the four centers. This difference reflects the fact that surveyors focused on the centers with a higher volume of donors to maximize the number of surveys collected.

Our results focus on three outcomes: satisfaction, intention, and return behavior. Return behavior will be measured in terms of the number of days, beyond eligibility, before the donor returned to donate. Figure 1(a) shows the distribution of this duration, which is characterized by a long right tail. Satisfaction is measured by the donor's response to the question "How satisfied were you with the overall experience today?" where 1 indicated "not at all satisfied" and 7 indicated "completely satisfied." Intention to donate is measured by the donor's response to the question "What is the likelihood that you will donate again in the next 6 months?" where 0 indicated "no chance" and 10 indicated "completely certain." We draw from the psychology and marketing literature in our use of overall satisfaction since this is typically treated as the ultimate outcome of importance, whereas satisfaction with wait time and acceptability of wait time are more intermediate outcomes (Taylor 1994).[16] Figures 1(b) and 1(c) show the heavy left skew of the responses to these two survey questions, which is a common feature in satisfaction and intention survey responses (Peterson and Wilson 1992).

Figure 1 **Outcomes: Duration to Return, Satisfaction, and Intention**



We analyze return behavior from three perspectives. First, we examine the return behavior of all whole blood donors irrespective of the product they donated upon return. Second, we analyze the return behavior of the same whole blood donors, but distinguish whether the return donation was whole blood or plasma. Third, we exclude the whole blood donors from July 2009 who returned to donate plasma in their subsequent donation in order to quantify the effect of longer waits on the whole blood supply.

Our measure of wait time is taken from the administrative data and is recorded as the difference, in minutes, between the registration time (i.e., arrival time) and the start of donation (i.e., needle-in time). This includes the time the donor spends completing paper work and waiting for the eligibility interview, the interview time, and then the time after the interview before the needle is inserted to begin the blood draw.[17] Figure 2 shows the distribution of wait time in minutes. Interpretation of the estimates is facilitated by subtracting the average wait time, $\overline{Wait}$. Thus our measure of wait is $\widetilde{Wait}_i = Wait_i - \overline{Wait}$.

Finally, Figure 3 graphs the relationship between wait time and days until next donation. The nonparametric regressions show that increased wait times are associated with increased days until next donation.

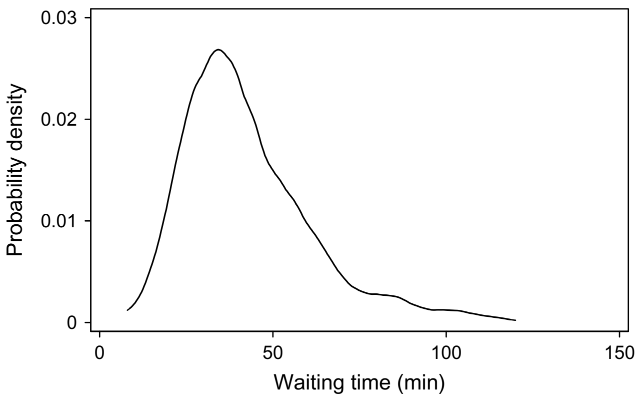
2.3. Identification

Figure 2 shows the variation in wait time across donors, which is driven mostly by variation in staffing

[16] In Supplemental Table S1, we consider additional outcome variables for satisfaction and intention and obtain qualitatively equivalent results.

[17] We dropped 10 observations whose wait times appeared to be data entry errors: four donors with recorded wait times less than eight minutes and six donors with recorded wait times beyond two hours. A wait time of less than eight minutes seems technically impossible given the time for an eligibility interview, and the wait times over two hours are more than four standard deviations above the average wait time. The results that follow are not sensitive to the exclusion of these 10 observations.

Figure 2 **Distribution of Wait Time**



and arrival rates of donors. However, additional variation may also occur because of differences in the length of the eligibility interview, which raises some concern that unobserved heterogeneity at the individual level may cause wait time to be an endogenous variable. We take several steps to address this concern.[18]

First, we directly control for variables that might affect the types of unobserved heterogeneity we are concerned about, such as differences in experience and knowledge, differences in opportunity costs of time, and differences in health status. For example, more frequent donors are likely to have better knowledge of the center's policies and thus we control for donation history with the donor's average yearly donation rate. Additionally, we control for blood type with dummies for AB positive (the universal recipient and therefore the least usable type) and O negative (the universal donor and therefore the most useable type) since they may have experienced different marketing campaigns from the Blood Service that would affect their institutional knowledge. We include dummy variables for female and donors over the age of 65, since women and older donors are more likely to have unobserved health conditions that lengthen their eligibility interview and would also affect their propensity to return; and older donors are also more likely to be retired and thus also face different opportunity costs of time. We also include a set of fixed effects at the center level, the time-of-day level and the day-of-week-level.

Second, we include a variety of robustness checks in Supplementary Material A. We show that we obtain the same results when we include other variables, such as appointment status and proximity to the center (see Supplemental Table S2). We also show that wait times are not highly correlated across visits: that is, we find that a donor's wait time when he donated most recently is not highly predictive of his next donation wait time (see Supplemental Table S3).[19] Additionally, we conduct a placebo test (see Supplemental Table S4), which shows that the current wait time does not predict the donor's *previous* delay between donations (duration) and it also shows that the donor's future wait time does not predict the donor's *current* delay (duration). Finally, we estimate a hazard model allowing for unobserved heterogeneity and obtain qualitatively equivalent estimates on the effects of wait time (see Supplemental Table S5).[20]

Third, we instrument for a donor's wait time, which we discuss in detail in the following section.

2.3.1. Instrumenting for Wait Time. To address the possibility that wait time is endogenous at the individual level, we instrument for the individual's wait time with the wait time of the donor who arrived just before and just after the focal donor. The wait times of the donor just before and just after fit the definition of an instrument since the variation in these wait times is associated with variation in the wait time of the focal donor, but changes in other donor's wait times do not directly affect the focal donor's delay until the next donation.

There are two potential threats to our identification by instrumental variables that we will explicitly address here: (1) the wait times of the donor just before and just after do not predict the wait time of the focal donor (weak instruments); and (2) that the donors just before or just after resemble the focal donor along important margins (opportunity costs, age, gender, appointment status, health status) that affect both wait times and donation frequency (invalid instruments).

Table 3 shows that the instruments are neither irrelevant nor weak instruments: donors' wait times are highly correlated with the wait time of the donor who arrives just before and just after them (p-values

[18] Another concern is whether donors with appointments have different wait times than donors without appointments. However, we cannot reject the null hypothesis that the distribution of wait times are the same across appointment status (p-value $= 0.35$). We show the distribution of wait times for donors with and without appointments in Supplemental Figure S2.

[19] In Supplemental Table S3, we run eight specifications to test for autocorrelation in wait times, two tests per center. We find no evidence of autocorrelation in seven of the eight tests. To address any concern that our results are driven by the autocorrelation found in column (2) of Supplemental Table S3, we run our main analysis without Center B and obtain qualitatively equivalent results. These estimates are available from the authors upon request.

[20] Following Lancaster (1992), we parameterize the unobserved component with a gamma distribution. Incorporating unobserved heterogeneity allows for the estimated hazard to potentially depend on variables unobserved by the researcher. The null hypothesis is that the variance of the random component is 0. When the null hypothesis cannot be rejected, the model collapses to one without unobserved heterogeneity.

Table 3 **Instrument Relevance, OLS Estimates**

	Wait time	
	Survey Donors	All Donors
Wait, previous donor	0.29***	0.29***
	(0.04)	(0.03)
Wait, next donor	0.38***	0.29***
	(0.04)	(0.03)
Yearly donation rate	−2.98***	−2.50***
	(0.57)	(0.32)
Female	−0.1	−0.62
	(1.01)	(0.6)
Older than 65 years	4.11**	3.52***
	(1.73)	(1.30)
Constant	−21.12***	−17.89***
	(3.42)	(1.88)
Observations	848	2,385
R^2	0.43	0.38
F statistic	29.19	55.84
Center fixed effects	Y	Y
Day of week fixed effects	Y	Y
Time of day fixed effects	Y	Y
AB positive and O negative	Y	Y

Notes. OLS regression coefficients. Robust standard errors in parentheses. ** and *** indicate statistical significance at the 5% and 1% levels, respectively.

<0.001). Further, the *F*-statistics for both subpopulations easily surpass the standard "rule of thumb" between 5 and 10 (Staiger and Stock 1997).

We argue that the instrument is valid provided that the preceding and proceeding donors do not resemble the focal donor on any important unobservable dimension that may jointly affect their donation propensity and the length of wait time, such as opportunity costs and health concerns. We are able to rule out the most plausible of such mechanisms by considering gender, age, and appointment status. Specifically, we argue that our instrument is valid if donors who are similar across specific observable traits, that may proxy for important unobservable traits, do not cluster their arrival times around certain times of day or days of the week. For example, if female donors are less likely to donate because of gender-related health concerns (e.g., pregnancy or low iron levels) and these concerns prolong the eligibility interview and lengthen wait times, then our instrument is only valid if the donors who arrive before and after the female donor are as likely to be female as the overall population of donors. Similarly, if donors who have higher opportunity costs are more likely to make appointments in hopes of obtaining a shorter wait time, then our instrument is only valid if the probability of the donors before and after the focal donor having an appointment is independent of the focal donor having an appointment.

Supplemental Figure S3 shows that there are no systematic patterns in arrival times by gender, age, or appointment status.[21] The proportions of females, older donors, and donors with appointments are not significantly different across times of day or day of week.[22]

2.3.2. Strategic Arrival. Before concluding that our instrument is valid, we also check for evidence of strategic behavior in the sense that certain donor characteristics may allow them to more strategically plan their arrival in order to obtain a shorter wait time. Two such dimensions that may allow donors to obtain a strategic advantage is proximity to the donation center and donation frequency.

First, donors who live closer to the center may have lower opportunity costs to monitor the wait time and thereby obtain a shorter wait time. However, we do not find any relationship between proximity to the donation center (measured in kilometers) and wait time. A spearman rank test cannot reject the null that they are uncorrelated ($\rho = -0.04$, p-value $= 0.33$).

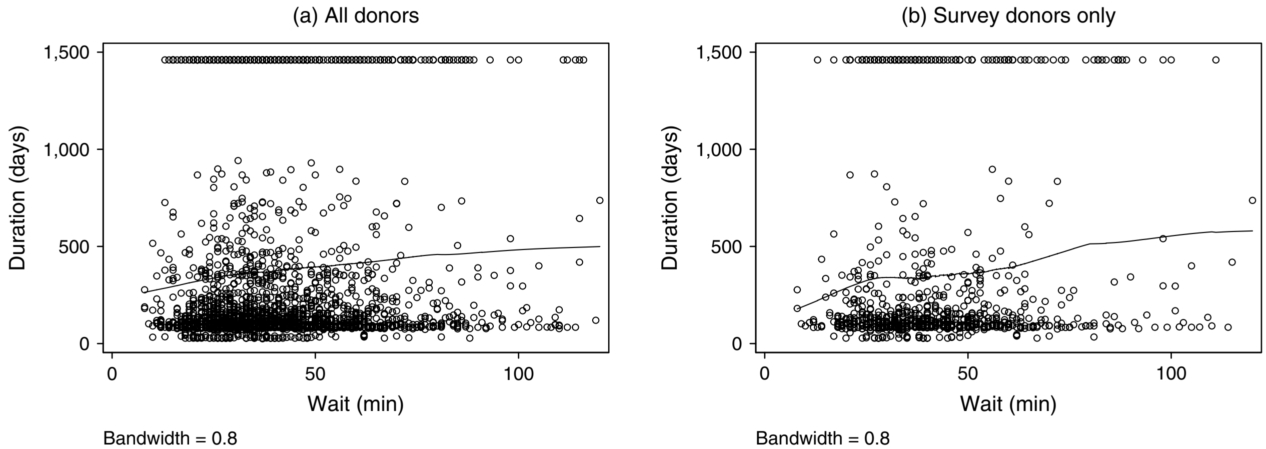
Second, more frequent donors might have better institutional knowledge and know when the center is least likely to be busy. For this to be possible, there must be certain days of the week or times of day that have significantly shorter wait times at each center. Using the available historical wait time data (from July 2007 to July 2009), we estimate the average wait time each day of the week and at three times during the day (morning, lunch hour, and afternoon) at each center (resulting in 15 time blocks per center). Supplemental Figure S7 plots the 15 time blocks in order from the shortest historical wait times to the longest historical wait times at center A and at center D. The height of each of the 15 bars represents the average yearly donation rate of the donors from our sample who arrived during the time block. Strategic arrivals would suggest that the height of the bars would decrease from left to right (i.e., more frequent donors would arrive during the periods with the historically shortest wait times and less frequent donors arrive at during periods with the longest wait times). Instead, we find no evidence of strategic arrivals; the average donation frequencies of donors across the 15 time blocks are not different at center A or center D.[23]

[21] In Supplementary Material A we show arrival by gender, age, and by appointment status by center in Supplemental Figures S4, S5, and S6, respectively.

[22] We also cannot reject the null hypothesis that the probability of the preceding and proceeding donor being female (over 65, with an appointment) is independent of the donor's gender (likelihood of being over 65, or with an appointment) in 10 out of the 12 possible tests (3 tests × 4 centers).

[23] It is also possible that donors behave strategically in that they plan their donation at specific times when they expect the donation center to be less busy (i.e., during sports events). However, this is only a threat to our identification if we think there is an a priori reason that individuals with a distaste for sporting events are also more likely to have a preference for blood donation.

Figure 3 **Duration by Wait Time**



Note. We also present these figures with samples restricted to whole blood donors only in Supplemental Figure S1.

2.4. Econometric Specification, Conceptual Framework, and Hypotheses

Figure 3 suggests a positive relationship between wait times and time to next donation. Ordinary least squares (OLS) regression analysis suggests that this is indeed a significant relationship: Supplemental Table S6 shows that a 20-minute increase in the average wait time results in an additional average delay of between 39 and 51 days, depending on the set of controls used.[24]

However, the OLS regression does not account for the right censoring of the data at 1,460 days nor the nonnormality of the duration distribution (see Figure 1(a)).[25] Thus, we estimate a hazard model to study return behavior of whole blood donors in order to take into account the right censoring and the nonnormality of the duration variable.[26]

We parameterize the baseline hazard with the Gompertz distribution in order to estimate the expected number of days a donor delays his return donation. We chose the Gompertz distribution because it performed the best in terms of likelihood, although, in the supplementary material, we present a Cox proportional hazard model that does not parameterize the baseline hazard to demonstrate that our results are not sensitive to our parametrization. Hazard functions parameterized with the Gompertz distribution are monotonic, which fits the nonparametric hazard estimates shown in Figure 4. We estimate the hazard function of three subpopulations: (1) all 848 whole blood donors, irrespective of their return donation choice (i.e., plasma or whole blood); (2) all 848 whole blood donors, but allowing the baseline hazard to vary depending on the type of product donated upon return; and (3) the 776 whole blood donors who returned to give whole blood or did not return.

In addition to the parametric hazard model presented in the main analysis, we ran several additional specifications and robustness checks, which are presented in Supplementary Material A. These include OLS (see Supplemental Table S6), Tobit (see Supplemental Table S7), probit regressions (see Supplemental Table S8; we discretize the outcome variable to a return within 50 (100) days of eligibility), a semiparametric hazard model (Cox proportional hazard), and an additional parametric model with a log-logistic distribution (see Supplemental Table S9).

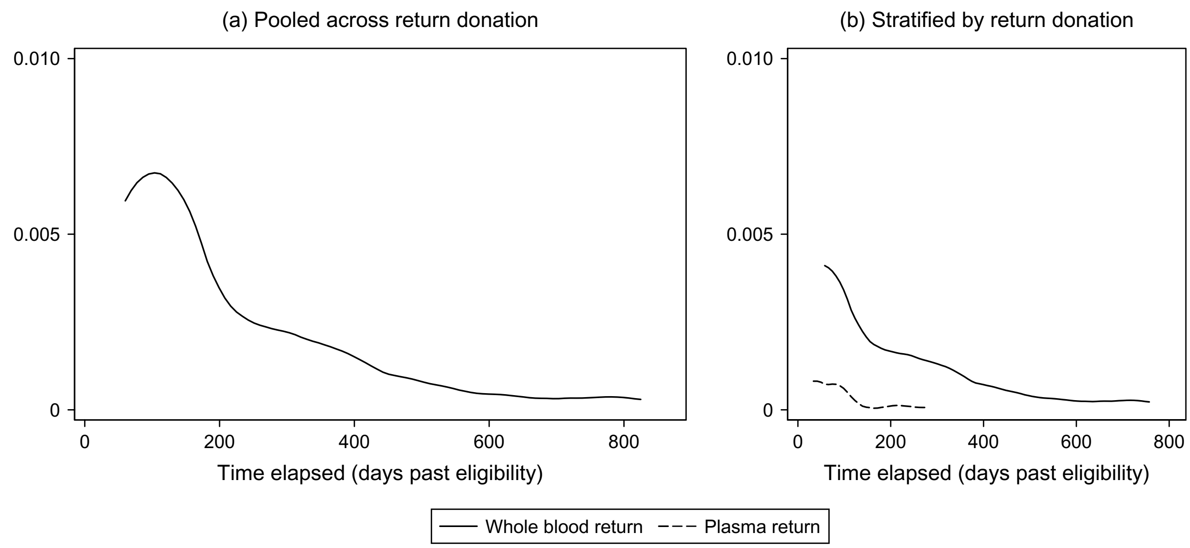
2.4.1. Conceptual Framework. We model the decision of when to return to donate after a successful donation. It is important to note that this decision is made several weeks after the current donation and we thus represent the decision as a cold calculation of the costs and benefits, rather than being viscerally driven. Let t denote time, where a donation event occurs at $t = 0$ and a second donation event occurs at $\hat{t} > 0$. At $t = 0$, donor i receives a benefit, b^i, and pays a cost of $c^i_{t=0}$ at the time of donation, which we assume increases in the waiting time and may include other costs. A donor's preferences for blood donation can be represented by a utility function $u(b^i, c^i_t)$, which maps $(b^i, c^i_t) \to \mathcal{R}^+$, where $\partial u(b^i, c^i_t)/\partial b \geq 0$, $\partial u(b^i, c^i_t)/\partial c \leq 0$, $\partial^2 u(b^i, c^i_t)/[\partial b]^2 \leq 0$.

[24] We estimate the OLS with three specifications: (1) without additional controls, (2) with the set of controls discussed in Section 2.3, and (3) with the main set of controls plus the emotions and attitude variables discussed in Section 6.

[25] A Tobit model can account for the right censoring (although not the nonnormality) and provides qualitatively equivalent results as the OLS for the same three specifications (see Supplemental Table S7).

[26] Nearly 88% of whole blood donors eventually return to donate. Thus, in understanding the effect of wait times on subsequent donation behavior, the question is not whether donors return, but by how long their return is delayed. Second, unlike a discrete choice model (i.e., return or not return), the hazard model does not require a predetermined "return date," which would be arbitrary.

Figure 4 **Nonparametric Hazards (Survey Donors)**



For each $t \in [0, \hat{t}-1]$, the donor receives utility of $\delta^t u(b^i, 0)$ with $\delta \in (0,1)$. This captures the idea that donors continue to receive benefits over time from having made a donation t periods earlier, but we assume that this utility diminishes over time reflecting the pure, impure, and warm glow benefits of the donation depreciating. At time t, the donor has an expectation of the cost given by $E_t[c_t^i \mid c_0^i] = f(c_0^i)$, where $\partial f(c_0^i)/\partial c_0^i \geq 0$. Additionally, donor i discounts future utility by a factor of β^t, where $\beta \in (0,1)$. The donor's problem is to choose $\hat{t} = t^*$, where t^* maximizes his lifetime utility:

$$u(b^i, c_t^i) = \sum_{n=1}^{\infty}\left[\sum_{t=0}^{\hat{t}-1}(\delta\beta)^{nt} v(b^i) - \beta^{n\hat{t}} E[c_{nt}^i]\right]. \quad (1)$$

Equation (1) can be written recursively:[27]

$$V(c_0^i) = \max_{\hat{t}}\left[v(b^i)\frac{1-(\beta\delta)^{\hat{t}}}{1-\beta\delta} - \beta^{\hat{t}} E[c_{\hat{t}}^i] + \beta^{\hat{t}} V(c_{\hat{t}}^i)\right],$$
$$E_t[c_{\hat{t}}^i] = f(c_0^i). \quad (2)$$

From the perspective of time t, the problem for $t' > t$ is exactly the same and so $V(c_0^i) = V(c_{\hat{t}}^i)$. Hence, we substitute $V(c_0^i) = V(c_{\hat{t}}^i) = V$ into Equation (2) and obtain

$$V = \max_{\hat{t}} \frac{1}{1-\beta^{\hat{t}}}\left[v(b^i)\frac{1-(\beta\delta)^{\hat{t}}}{1-\beta\delta} - \beta^{\hat{t}} f(c_0^i)\right]. \quad (3)$$

Maximizing Equation (3) to determine the optimal time until the next donation, t^*, the first-order condition simplifies to

$$\ln(\beta)[1-(\beta\delta)^{t^*}] - \delta^{t^*}\ln(\beta\delta)[1-\beta^{t^*}] = \frac{f(c_0^i)(1-\beta\delta)\ln(\beta)}{v(b^i)}. \quad (4)$$

Implicitly differentiating (4), it is straightforward to show that t^* increases as the cost of the last donation c_0^i increases and the benefits of donating decrease:

$$\frac{\partial t^*}{\partial c_0^i} = -\frac{f'(c_0^i)(1-\beta\delta)\ln(\beta)}{v(b^i)\delta^t \ln(\beta\delta)\ln(\delta)(1-\beta^{t^*})} \geq 0, \quad (5)$$

$$\frac{\partial t^*}{\partial b^i} = \frac{f(c_0^i)v'(b^i)(1-\beta\delta)\ln(\beta)}{v(b^i)^2\delta^t \ln(\beta\delta)\ln(\delta)(1-\beta^{t^*})} \leq 0. \quad (6)$$

Equation (5) indicates that as the experienced wait time increases, the optimal time until the next donation will be longer; intuitively, the higher expected wait time costs will be pushed further into the future as the anticipated marginal cost of donating ($f'(c_0^i)$) increases. Equation (6) shows that as the benefits of donating increase, the optimal time until the next donation will become shorter; intuitively, donors will return sooner to receive the higher benefits.[28]

In the preceding analyses, we assumed that wait time costs only enter the utility function by increasing the costs of donating. However, longer waiting times may also increase the benefits to the extent that longer waits are a greater sacrifice, providing potentially more warm glow (Andreoni 1989, 1990), and even status to the extent that the longer waits are

[27] The Principle of Optimality indicates that the solution to the maximization problem of the sequential problem written in Equation (1) is equivalent to the solution of the recursive problem in Equation (2).

[28] The supplementary material shows that the relationship between t^* and δ and β depends on the relative magnitudes of β and δ.

observed (e.g., Lacetera and Macis 2010 find that people are more likely to donate blood if they are recognized in the newspaper for making a donation.). To the extent that longer waits also increase the benefits of donating, the prediction from Equation (5), that longer waits will increase the delay until a donor returns, will be reduced by the positive increase in benefits operating through Equation (6). Moreover, if the benefit effect dominates the higher cost effect, then longer waits could even reduce the time between donations. This counterintuitive result is similar to the idea that introducing extrinsic incentives might reduce prosocial behavior by crowding out intrinsic motivation; here, it is possible that higher extrinsic costs (longer waiting times) might increase prosocial behavior by crowding in intrinsic motivation.

2.4.2. Empirical Model. To empirically analyze the effect of wait time on the delay until the next donation, we estimate the following log-likelihood equation via maximum likelihood:[29]

$$\ln L(p,\theta) = \sum_{i=1}^{n} d_i \ln \lambda(t_i, \mathbf{x}_i \mid p, \theta) S(t_i, \mathbf{x}_i \mid p, \theta) + \sum_{i=1}^{n} (1-d_i) \ln S(t_i, \mathbf{x}_i \mid p, \theta), \tag{7}$$

where the Gompertz distribution specifies

$$\lambda(t_i, \mathbf{x}_i \mid p, \theta) = \exp(pt)\exp(\mathbf{x}_i'\mathbf{B} + \gamma \widetilde{Wait}_i)$$

is the hazard function,

$$S(t_i, \mathbf{x}_i \mid p, \theta) = \exp(-p^{-1}\exp(\mathbf{x}_i'\mathbf{B} + \gamma \widetilde{Wait}_i)\exp(pt) - 1)$$

is the survival function, and p is the shape parameter of the Gompertz distribution. The parameters on the covariates, γ_i and $\mathbf{B}$, govern the relationship between wait time and likelihood to return at time t and a vector of control variables described in Section 2.2, respectively.

We hypothesize that, ceteris paribus, longer waits will have a negative effect on donors' future donation behavior, which is theoretically motivated in Section 2.4.1 by Equation (5) by (1) assuming donors update future wait time expectations based on current experience (i.e., a longer current wait indicates a longer future wait) and (2) that volunteer donors respond to costs and benefits in standard ways; i.e., they donate more (less) when the benefits (costs) increase. That is, the longer a donor waits the less likely he will return at time t conditional on having not yet returned.

[29] We have also estimated a random effects estimator in which we allow for unobserved heterogeneity. The results are qualitatively similar and available in the supplementary material.

Hypothesis 1. *Longer wait times have a negative effect on the hazard rate,* $\exp(\hat{\gamma}_i) < 1$ *or* $\hat{\gamma}_i < 0$.

To study the effect of wait time on satisfaction and intention we estimate an ordered probit model, which takes into account the ordinal nature of the discrete survey responses (Aitchison and Silvey 1957, McKelvey and Zavoina 1975).

We estimate the probability that a donor states each level of satisfaction or intention by maximum likelihood. The probability of donor i choosing response m is modeled as

$$P[\text{survey response} = m] = \Phi(\mu_m - \alpha_i \widetilde{Wait}_i) - \Phi(\mu_{m-1} - \alpha_i \widetilde{Wait}_i). \tag{8}$$

The second hypothesis is motivated by past research that finds that longer waits incite customer frustration and annoyance and lead to lower service evaluations in nonprosocial contexts (Dube-Rioux et al. 1989, Hui and Tse 1996, Taylor 1994).

Hypothesis 2. *Longer wait times have a negative effect on satisfaction and intention,* $\hat{\alpha}_i < 0$.

Overall, we hypothesize that wait times negatively affect all outcomes. Donors who wait longer are more likely to report feeling less satisfied, less likely to intend to donate again, and more likely to have adverse return behavior in the form of either a delayed return or a cessation of donation activities.

3. Main Findings

Table 4 reports estimates of the effect of wait time from Equations (7) and (8) on our three outcomes of interest. The dependent variable in columns (1), (2), and (5), *Likelihood to return*, is the probability of returning at day t to give whole blood or plasma given no return prior to day t. The dependent variables in columns (3) and (4) are the probability of reporting a higher level of satisfaction and intention to donate, respectively. The marginal effects are calculated at the means and represent the change in the probability of reporting the highest level of satisfaction or intention.[30]

The negative coefficients on $\widetilde{Wait}$ displayed in Table 4 support Hypotheses 1 and 2. Conditional on being eligible, but having not returned to donate, we estimate that a donor who experiences a wait that is

[30] We do not cluster standard errors at the center level because there are only four donation centers with an imbalance in observations due to two of the centers having the vast majority of the observations (Cameron and Miller 2015). In estimates not presented here, in which we nonetheless clustered standard errors at the center level, all of the significance levels reported in Table 4 are stronger (since the estimated standard errors are smaller).

Table 4 Average Effect of Wait Time

	Survey Donors				All Donors
	((1) Likelihood to return	(2) Likelihood to return	(3) Satisfaction with experience	(4) Intent to donate	(5) Likelihood to return
$\widetilde{Wait}$	−0.005*** (0.002)	−0.005** (0.002)	−0.005*** (0.0009)	−0.002** (0.0008)	−0.003*** (0.001)
Yearly donation rate	.	0.24*** (0.05)	−0.02 (0.01)	0.13*** (0.01)	0.28*** (0.03)
Female	.	−0.09 (0.07)	0.05* (0.03)	0.07*** (0.03)	−0.17*** (0.04)
Older than 65 years	.	0.26*** (0.1)	0.1* (0.06)	0.04 (0.06)	0.15** (0.07)
Constant	−4.92*** (0.04)	−5.42*** (0.21)	.	.	−5.35*** (0.11)
Observations	848	848	848	848	2,389
Ancillary parameter ($\hat{p}$)	−0.004	−0.004	.	.	−0.003
Center fixed effects	N	Y	Y	Y	Y
Day of week fixed effects	N	Y	Y	Y	Y
Time of day fixed effects	N	Y	Y	Y	Y
AB positive and O negative	N	Y	Y	Y	Y

Notes. Columns (1) and (2): coefficients of survival model with Gompertz parametrization. Colums (3) and (4): marginal coefficients from order probit regressions. Column (5): coefficients of survival model with Gompertz parametrization, donors from 12-week-window sample. Robust standard errors in parentheses.

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Given that we have a directional hypothesis for the effect of wait time, the estimates on $\widetilde{Wait}$ are one tailed; all other coefficient tests are two tailed.

20 minutes (one standard deviation) longer than average is 10% (= −0.005 ∗ 20) less likely to return on any given day. Column (5) also shows that this result holds in the larger sample of donors.

Result 1. *The return behavior of whole blood donors is negatively affected by longer wait times. An increase in wait time of one standard deviation (20 minutes) above average reduces the likelihood that a donor returns on any given day by 6%–10%.*

Column (2) of Table 4 shows the negative effect of wait time on reported satisfaction. We find that an increase in wait time of one standard deviation results in a decrease in the likelihood of reporting the highest level of satisfaction by 8 percentage points.[31] Column (3) reports similar effects of wait time on the donor's stated intention to return–an increase of one standard deviation above the average wait time corresponds to a 6 percentage point decrease in the probability that a donor is "completely certain" he will donate again in the next six months.

Result 2. *The satisfaction and intention of donors is negatively affected by longer wait times. An increase in wait time of one standard deviation (20 minutes) above average reduces the likelihood of a donor reporting the highest level of satisfaction by 8 percentage points and reporting that he is "completely certain" to donate again by 6 percentage points.*

Table 4 shows that the negative, significant effect of wait time on both satisfaction and intention to return are overall consistent with the effect on actual return behavior. However, observing the actual return behavior lets us, for the first time, also detect the magnitude of this effect. Moreover, Table 4 shows similar effects of age on satisfaction, intentions, and actual return behavior and similar effects of history on intentions and actual return behavior, but a notable gender difference: women stated being both more satisfied and having a greater intention to return, but in fact have a lower actual propensity to return. Thus, the survey response data mask potentially important heterogeneity, which we explore further below.

3.1. Instrumenting Wait Time

To implement the IV strategy discussed in Section 2 we discretize the return data and estimate a discrete-time hazard model. Donors who returned during the first year are grouped by the week of their return, donors who returned in years 2–4 following the survey are grouped by year. The probability of return is then estimated as a stacked logit regression with the same set of variables as Equation (7) and a dummy for each potential return group (Cameron and Trivedi 2005).

The IV estimators are obtained with the logit regression via the control function approach (CF) and the

[31] Given the propensity for positivity biases in satisfaction surveys (Peterson and Wilson 1992), we feel this estimate is reasonable.

Table 5 Discrete Time Hazard and IV Estimators: Likelihood to Return

		IV estimator	
	(1) Discrete time hazard	(2) Control function estimation	(3) GMM estimation
$\widetilde{Wait}$	-0.007^{***}	-0.007^{**}	-0.007^{**}
	(0.002)	(0.004)	(0.004)
Donation history	0.28^{***}	0.28^{***}	0.28^{***}
	(0.08)	(0.06)	(0.06)
Female	-0.17^{**}	-0.16^{*}	-0.16^{**}
	(0.12)	(0.08)	(0.08)
Older than 65 years	0.55^{***}	0.55^{***}	0.56^{***}
	(0.13)	(0.13)	(0.13)
AB positive	0.07	0.07	0.07
	(0.22)	(0.20)	(0.21)
O negative	0.13	0.13	0.13
	(0.12)	(0.13)	(0.13)
Residual	.	−0.0009	.
		(0.004)	
Constant	-2.55^{***}	-2.28^{***}	-2.27^{***}
	(0.32)	(0.45)	(0.39)
Observations	19,442	20,504	20,504
Log likelihood	−2,670.39	.	.

Notes. Column (1): coefficients of the discrete time hazard model estimated via logistic regression. Column (2): coefficients from second stage of the IV estimation, using the control function approach and standard errors bootstrapped with 199 replications. Column (3): coefficients from IV estimation, using a one-step GMM estimation. Center fixed effects, time of day, and day of week. Robust standard errors in parentheses.

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Given that we have a directional hypothesis for the effect of wait time, the estimates on $\widetilde{Wait}$ are one tailed; all other coefficient tests are two tailed.

generalized method of moments (GMM). The CF approach estimates the first stage via OLS and the second stage via maximum likelihood with bootstrapped standard errors (Cameron and Trivedi 2013). The results of the discrete time hazard, and the IV estimated by CF and GMM are displayed in columns (1)–(3) of Table 5, respectively, and provide qualitatively similar estimates to those shown in Table 4. In the discrete time hazard and the two IV models, we find that a longer wait significantly extends the time until a donor returns, and on average a one-standard-deviation increase in the wait time reduces the probability of returning at any t by 12% to 14%. We repeat the identical analysis for the larger sample and find qualitatively equivalent results; these estimates are reported in Supplemental Table S10.

3.2. Effect of Emotions and Attitudes

We have established that longer waiting times have a negative effect on return behavior, overall satisfaction, and intention to donate. We hypothesized that longer wait times affect return behavior through the donor's expected costs upon return. However, it is not clear that waiting times operate through the same mechanism for satisfaction and intention. As mentioned in Section 2.4.1, the marketing and psychology literatures argue that longer wait times negatively affect satisfaction and intention through the negative emotions generated by the experience (Taylor and Fullerton 2000). However, unlike return behavior, which is only manifest well after the wait experience, satisfaction and intention are typically assessed immediately following the experience and hence are potentially more subject to the influence of emotional responses. Thus, we will explore whether there is evidence of alternative mechanisms for the three outcome measures.

To address this question, we use variables collected through the survey about donors feelings, emotions, and satisfaction with various aspects of the wait time. We construct five factors from the emotion and attitude questions: (1) positive feelings about the wait experience, (2) negative feelings while waiting, (3) positive feelings while waiting, (4) positive attitude about blood donation, and (5) positive attitude about the Blood Service. In addition, we include a variable that captures satisfaction specifically with the waiting time ("Was the wait time acceptable?"). The factor loadings are presented in Supplemental Table S11.

Table 6 presents the results using the same model estimated from Table 4, but including the emotions and attitudes variables. Columns (1) and (2) are consistent with the findings in the psychology literature on waiting: the emotion variables are jointly significant (p-value < 0.0001 and p-value $= 0.0013$, respectively, for columns (1) and (2)) and the coefficient on

Table 6 **Effect of Emotions and Attitudes on Satisfaction, Intention to Return, and Return Behavior (Survey Donors Only)**

	(1) Overall satisfaction	(2) Intent to return	(3) Likelihood to return
$\widetilde{Wait}$	−0.0005	−0.0009	−0.004**
	(0.0009)	(0.0008)	(0.002)
Yearly donation rate	−0.01	0.12***	0.24***
	(0.02)	(0.01)	(0.04)
Female	0.03	0.06**	−0.1
	(0.03)	(0.03)	(0.07)
Older than 65 years	0.003	0.01	0.21**
	(0.06)	(0.06)	(0.09)
Emotions			
Positive about wait	0.1***	0.03*	−0.03
	(0.02)	(0.02)	(0.05)
Negative while waiting	−0.02	−0.008	−0.11*
	(0.02)	(0.01)	(0.06)
Positive while waiting	0.07***	0.04***	0.04
	(0.02)	(0.01)	(0.05)
Attitudes			
Positive donation attitude	−0.004	0.06***	0.1**
	(0.02)	(0.01)	(0.04)
Positive view of blood service	0.08***	0.04***	0.11**
	(0.02)	(0.01)	(0.04)
Acceptable wait time	0.07***	−0.003	−0.03
	(0.01)	(0.01)	(0.03)
Constant	.	.	−5.30***
			(0.27)
Observations	848	848	848
Ancillary parameter ($\hat{\rho}$)	.	.	−0.003
Log likelihood	.	.	−1,285.66
Center fixed effects	Y	Y	Y
Day of week fixed effects	Y	Y	Y
Time of day fixed effects	Y	Y	Y
AB pos and O neg	Y	Y	Y

Notes. Columns (1) and (2): marginal coefficients from ordered probit regressions. Column (3): coefficients of survival model with Gompertz parametrization. Robust standard errors in parentheses.

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

the duration of the wait time is a precisely measured 0 to three decimal points. In other words, the duration of the wait appears to affect satisfaction and intentions entirely through the way the donor feels about the wait time. However, this is not true for return behavior modeled in column (3). The emotion variables are not jointly significant (p-value $= 0.20$) and the coefficient on wait time is qualitatively equivalent to the estimate in Table 4. Attitudes regarding the importance of donating and the Blood Service are jointly significant in all three columns.

The findings in Tables 4 and 6 are consistent with the idea that wait time operates through different channels for satisfaction and intention than it does for return behavior. Satisfaction and intention were elicited directly after the wait experience and thus may reflect a hotter emotional state; whereas the return decision is made several weeks to several months after the wait experience and may more accurately reflect a cold cost-benefit calculation.

3.3. Social Cost of Longer Wait Times

Data from the Blood Service indicates that there were roughly 330,290 whole blood donors in Australia in 2009, resulting in approximately 604,000 donations. This section explores the effect of longer waits on the whole blood supply. The estimates in Table 4 suggest that increasing the expected cost to donate can have large implications on the blood supply. Of the 848 whole blood donors surveyed in July 2009, only 72 returned to give plasma and 649 eventually returned to give whole blood. In light of this propensity to return to give whole blood, this section explores the social costs of longer waits on the whole blood supply. To do this, we exclude the 72 donors who returned to donate plasma and focus the analysis on the remaining 776 donors.

Column (1) of Table 7 estimates the same model as column (1) of Table 4 with the 776 whole blood donors who returned to give whole blood or did not return. Again, longer waits negatively affect return behavior of whole blood donors.[32] Using these estimates, we calculate the effect that an increase in the average wait by 20 minutes (one standard deviation) would have on the whole blood supply in Australia.

Figure 5 plots the survival function estimated in column (1) of Table 7 at the average wait time and at a wait time that is one standard deviation (20 minutes) longer than average. The survival function gives the probability that a donor has not returned to donate by day t. Alternatively, $1 - S(t)$ gives the probability that a donor has returned by day t; $1 - S(t)$ can also be interpreted as the proportion of donors who have returned at day t.

One way to calculate the change in donations due to a longer wait is to consider the change in behavior of the median donor—the donor who returns after 50% of the other donors have already returned. From the survival function, we compute the number of days after which the median donor returns conditional on his wait time. With an average wait time, the median donor returns 71 days *after* he is eligible to return. With a wait that is one standard deviation longer than average, the median donor returns 82 days *after* becoming eligible. Thus, the median donor delays his return by 11 days due to the increased average wait time. The median donor with an average wait can

[32] See Supplemental Table S12 for the semiparametric Cox proportional hazard model. The coefficient estimate on $\widetilde{Wait}$ is qualitatively equivalent, which provides evidence that the parametrization of the baseline hazard is appropriate.

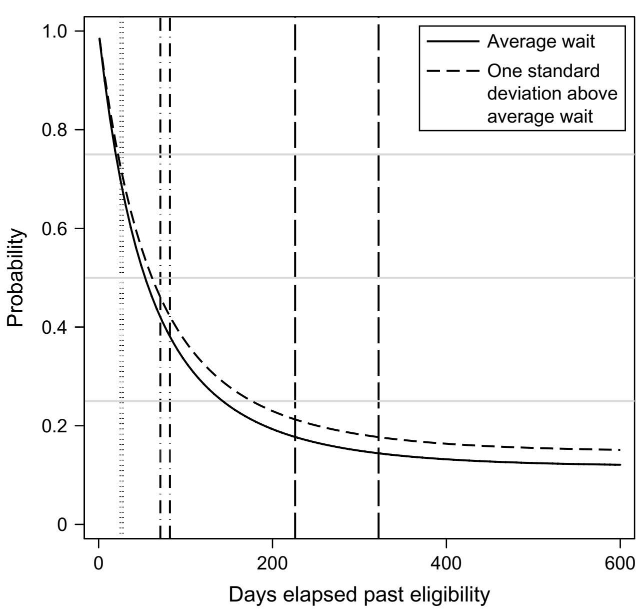
Table 7 Effect of Wait Time on the Whole Blood Supply

	Survey Donors		All Donors	
	(1) Likelihood to return for whole blood	(2) Likelihood to convert for plasma	(3) Likelihood to return for whole blood	(4) Likelihood to convert for plasma
$\widetilde{Wait}$	−0.006**	−0.0008*	−0.004**	−0.0003
	(0.003)	(0.0005)	(0.002)	(0.0003)
Yearly donation rate	0.34***	0.005	0.43***	0.03***
	(0.08)	(0.008)	(0.06)	(0.004)
Female	−0.12	−0.01	−0.2***	−0.01
	(0.09)	(0.02)	(0.06)	(0.01)
Older than 65 years	0.55***	−0.07***	0.37***	−0.08***
	(0.19)	(0.01)	(0.13)	(0.006)
AB positive	0.07	0.11*	0.006	0.07*
	(0.26)	(0.07)	(0.16)	(0.04)
O negative	0.19	−0.04*	0.25***	−0.008
	(0.15)	(0.02)	(0.09)	(0.02)
Constant	−4.78***	.	−4.73***	.
	(0.29)		(0.16)	
Observations	776	843	2,199	2,389
Log likelihood	−1,645.73	−224.08	−4,700.3	−615.21
Ancillary parameter ($\hat{p}$)	−0.007	.	−0.007	.
Pseudo R^2	.	0.09	.	0.08
Center fixed effects	Y	Y	Y	Y
Day of week fixed effects	Y	Y	Y	Y
Time of day fixed effects	Y	Y	Y	Y
AB pos and O neg	Y	Y	Y	Y

Notes. Columns (1) and (3): coefficients of survival model with Gompertz parametrization. Columns (2) and (4): marginal effects of probit model, outcome variable is 1 if the donor converted to plasma on his subsequent visit and 0 otherwise. Robust standard errors in parentheses.

*, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively. Given that we have a directional hypothesis for the effect of wait time, the estimates on $\widetilde{Wait}$ are one tailed; all other coefficient tests are two tailed.

Figure 5 Estimated Survival Curve (Whole Blood Donors Only)



Notes. The estimated survival curves at the average (42 minutes) and one standard deviation above average (+20 minutes). Each pair of vertical lines indicates the estimated day of return for the first 25% (the left most vertical lines), the middle 50% (the middle lines), and the last 25% (the right-most vertical lines) of donors.

thus make 2.35 donations per year. Conversely, if the average wait time were to increase by one standard deviation, then the median donor would only make 2.20 donations per year. This is an estimated loss of 0.15 donations per donor per year in Australia, resulting in a total loss of 51,540 donations per year.

However, Figure 5 indicates that the difference between the survival functions widens as time increases, suggesting that donors who are among the first 25% to return have a shorter delay because of an increase in the average wait time than the median donor, while the donors who are among the last 25% to return have a longer wait-induced delay than the median donor. Thus, to obtain a more accurate estimate of the number of lost donations, we consider donors in three categories: those among the first 25% to return, those donors who are the last 25% to return, and those in the middle 50% to return. We estimate that donors who return among the first 25% will donate three or more times per year, while donors who are among the last 25% to return will donate once per year. The donors who are among the middle 50% to return will donate one to three times per year.

The three sets of parallel vertical lines in Figure 5 indicate the extra days of delay estimated for donors who return among the first 25%, the middle 50%, and the bottom 25% of donors, respectively. A 20-minute increase in the average wait time for the most frequent donors results in an estimated three day delay in their return donation. However, for the middle 50% and the bottom 25% of donors, a 20-minute increase in the average wait results in a delay of 11 and 96 days, respectively.

In Table 8, we calculate the number of lost donations due to wait-induced delays. We estimate that a one-standard-deviation increase in wait time results in 64,391 fewer donations per year. This implies that an increase in wait time by 38% (i.e., one standard deviation) corresponds to a decrease in donations by 10%, an elasticity of −0.27.[33] Given the prosocial context, no alternative blood collection agencies and the lack of a close substitute for donating blood, it is not surprising that the demand to donate appears inelastic when compared to standard consumer theory contexts. Similarly, a decrease in wait time by one standard deviation (62.5% decrease in wait time) corresponds to an expected increase in donations by 9% and results in an estimated elasticity of −0.14. Our estimated elasticities are similar in magnitude to the elasticities estimated in Karlan and List (2007) and Eckel and Grossman (2008). Karlan and List (2007) vary the size of a matching donation in the field and estimate a price elasticity of giving at −0.30. Eckel and Grossman (2008) study the effects of rebates and matches on charitable donations to the National Public Radio and estimate elasticities of giving between −0.35 and −1.03.

One potential concern in calculating the effect of wait time on the whole blood supply is the possibility that donors are substituting away from whole blood and into another blood product, like plasma, after a long wait for whole blood. However, Supplemental Table S14 shows that waiting for whole blood delayed returns to both plasma and whole blood. Moreover, not only are whole blood donors delaying their return

Table 8 Social Cost of Waiting, Whole Blood Donors Only

	Total 330,290	75% (3+/yr)	50% (1–3/yr)	25% (0–1/yr)
No. of donors	330,290	27,666	182,596	120,028
No. of donations, average wait	663,950	92,643	429,984	141,323
No. of donations, +20 min wait	599,560	90,162	401,491	107,907
No. of lost donations	64,391	2,482	28,493	33,416
Days donation delayed		3	11	96

Total donations lost 64,391
Estimated elasticity −0.27
Minutes lost to waiting 12,000,000

in response to a long wait, but they are also less likely to convert to plasma. Column (2) of Table 7 estimates a probit model in which the dependent variable takes a value of 1 if the whole blood donor returned to give plasma on his subsequent donation and 0 otherwise. Our estimates suggest that an additional 20-minute wait reduces the likelihood of converting to plasma by 1.6 percentage points. This suggests that our estimate of the effect of wait time on the whole blood supply may underestimate the total effect on the supply of blood products: not only are whole blood donors delaying their return to whole blood, but they are less likely to convert to plasma.[34]

Longer wait times not only reduce the expected number of donations per year, but the time spent waiting is also valuable as it could be allocated to alternative activities. In fact, the main insights of Becker (1965) apply; the social cost of requiring a donor to wait 20 minutes longer per donation on average has two components—a loss in future donations and a loss of about 12 million minutes of time (equivalent to about 97 years of full time work).

4. Additional Findings

In this section, we briefly discuss additional findings including the differential effects of wait time on returning to donate whole blood versus plasma, and wait time's heterogeneous effects across gender and past donation experience.

4.1. Competing Risks

After making a whole blood donation, donors are eligible to give another whole blood donation 12 weeks later or a plasma donation 3 weeks later. Table 4 did not separately analyze the return to whole blood versus the return to plasma. To do this, we estimate a

[33] An alternative econometric approach to examine the social cost is to run an OLS or Poisson regression of wait time on total donations, which leads to a significantly less conservative estimate on the effect of wait time on the whole blood supply. We present this analysis in Supplemental Table S13 and find that an increase in the average wait time by 20 minutes corresponds to a 20% reduction in donations. To obtain this estimate, we must assume that donors experience a permanent increase in wait time over the next 48 months and so the average donor who would have made 1.35 donations per year now makes 1.08 donations per year. Our empirical approach taken here in the text results in a more conservative and defensible estimate given that our parametric hazard model accounts for nonlinearity in return behavior. Moreover, our hazard specification that estimates time until a donor returns (rather than total donations) reflects our theoretical model that assumes each time a donor donates he experiences a new wait time that affects his subsequent donation.

[34] A full assessment of the benefits of a wait time reduction for the Blood Service requires knowledge of the Blood Service's cost structure. It is unclear whether a reduction in wait time would require the hiring of additional staff, which would clearly come at a financial cost to the Blood Service, or streamlining of the current process. Without full knowledge of the Blood Service's costs, it is not possible to move beyond speculation.

competing risks model, where at any time t a donor is "at risk" to return to give plasma or return to give whole blood. This allows for the estimated baseline hazard to vary depending on the type of return the donor experiences. In this specification, each donor has two observations, one for each potential type of return, but can only return to donate either whole blood or plasma. For this reason, we cluster the standard errors at the donor level.

The calculated duration for each donor takes into account the differences in eligibility of the two types of return. For example, if a donor returns to give whole blood 14 weeks after his initial donation then he had been eligible to give plasma for 11 weeks and had been eligible to give whole blood for 2 weeks. On the other hand, if a donor returns to give plasma after 4 weeks, then he had been eligible to give plasma for 1 week, but was never eligible to give whole blood. In this case, the donor will not have an observation that tracks his duration of time for whole blood since he was never "at risk" to give whole blood.

In Supplemental Table S14, we present results from the competing risks model. In general, we find that wait time has a significant negative effect on a whole blood donor's return to either whole blood or plasma (p-value < 0.05). We can not reject the null hypothesis that the effect of wait time on returning to give plasma is equal to the effect of wait time on the return to give whole blood (p-value $= 0.39$). When we allow the regressors to vary by the type of return (plasma or whole blood), we find that past donation experience (measured by average yearly donation rates) and gender have the same effect on return behavior to plasma as on return behavior to whole blood. On the other hand, older donors return more quickly to whole blood and less quickly to plasma. There are also interesting differences in return behaviors across blood types. AB positive donors (whose whole blood donations can only be given to other AB positive donors) return more quickly to make a plasma than whole blood donation (p-value $= 0.03$). On the other hand, O negative donors (whose blood can be given to anyone) return more quickly to make a whole blood than plasma donation (p-value $= 0.12$). These behaviors most likely reflect the Blood Service's efforts to direct O negative donors to give whole blood and AB positive donors to give plasma rather than any inherent differences in preferences between donors with different blood types.

Next, we examine gender differences in the responsiveness to time costs, the results of which are presented in Supplemental Table S15. We find that both men and women are less satisfied by longer waits and longer waits reduce their intention to donate. In fact, our estimates suggest that women experience more dissatisfaction from longer wait times than men (p-value $= 0.12$).

However, consistent with laboratory (Andreoni and Vesterlund 2001), empirical (Andreoni et al. 2003), and field evidence (Conlin et al. 2003), which finds that females are less responsive to price changes in altruistic settings, we find that men are significantly more elastic in their response to time costs than women. Our estimates suggest that a 38% increase in the time cost of donation corresponds to a 20% reduction in the number of whole blood donations made by men (p-value < 0.01), resulting in an elasticity of -0.51. In contrast, the estimates indicate that we cannot reject that women are perfectly inelastic (p-value $= 0.71$); women do not change the number of whole blood donations in response to the change in time cost.[35] However, given the extant literature that sometimes finds men more sensitive (Niederle 2016) and sometimes females more sensitive (Cox and Deck 2006, DellaVigna et al. 2013), more work to understand when and why men and women respond differentially will be a valuable direction for future research.

We further extend our gender analysis to estimate the competing risk model presented in Section 4.1. We find that both men and women are responsive to time costs, but along different dimensions. In response to longer waits, male whole blood donors significantly delay their return to donate whole blood (p-value $<$ 0.01) and do not significantly alter their return to plasma (p-value $= 0.56$). In contrast, female whole blood donors do not significantly delay their return to whole blood (p-value $= 0.54$), but respond to the longer waits by reducing their propensity to convert to plasma (see Supplemental Table S15) and, upon conversion, delaying their return to a plasma donation (p-value < 0.05).[36] In summary, we find that men are more responsive to wait time regarding their delay until returning to donate whole blood again, while women are more responsive to wait time regarding their conversion to plasma.[37]

Heterogeneity in time cost sensitivities is a potentially important factor for organizations to consider. If two consumers are of equal value to the firm (e.g., men and women) but have different time cost sensitivities, then the firm can encourage the more elastic consumer by lessening the time cost. On the other

[35] This result does not identify the particular mechanism behind the different elasticities. One possible mechanism is a difference in opportunity costs of time due to differences in employment patterns for men and women. Unfortunately, our data do not allow us to confirm or deny such a mechanism.

[36] In the All Donors sample, the return to plasma is not significant for women.

[37] Supplemental Table S16 shows that increased waiting times cause women to be less likely to convert to plasma, whereas it does not significantly affect conversion rates for men in the survey sample.

hand, if two consumers are not of equal value to the firm (e.g., O negative versus AB positive blood types) but have the same time sensitivities, then adjusting time costs to encourage the more valuable consumer to return may be a viable strategy.[38]

4.2. Effect of Experience

This section explores heterogeneity in wait time effects across donors with varying donation frequencies. If donors update their expectation about costs according to Bayes rule, then a frequent donor's expectation about a future wait time will be affected less by a single wait time. In this case, we would expect frequent donors to be less responsive to the current wait time since the current wait time is only one of many.[39]

We define a frequent lifetime donor as a donor who is in the top quartile (75th percentile) in terms of lifetime number of donations (more than 13 donations). In Supplemental Table S17 we present our findings using both the Survey Donors and All Donors. Using the all donors sample, we find that more experienced donors are significantly less sensitive to longer waiting times (p-value < 0.1).[40] We also examine whether longer waiting times have a greater effect on new donors who may update their expectations the most. The estimates using either the Survey Donors or All Donors suggest that new donors are not more sensitive to waiting time than repeat donors on average. In summary, we find that frequent lifetime donors are less responsive to longer waiting times than less frequent donors, but we cannot reject that new donors are equally sensitive to longer waiting times than repeat donors.

5. Conclusion

This paper estimates the effect of wait time on the satisfaction, intention to donate, and actual return behavior of blood donors. We estimate that an increase in wait time by one standard deviation reduces the probability of return on any subsequent day by 10%, resulting in a loss of 64,000 whole blood donations per year. In other words, a 38% increase in wait time results in a 10% decrease in whole blood donations.[41] Thus, longer wait times entail substantial social costs.

The estimates that we have presented were only possible due to our unique context: the Blood Service's monopoly on blood collection allows us to precisely track and measure individual donation behavior without worrying about donors substituting across alternative blood collection organizations. This means that we are able to go beyond measures of satisfaction and intention to estimate the effect of wait time on subsequent donations.

We show that while the duration of the wait time negatively affects return behavior, emotions play no significant role in predicting return behavior. Conversely, emotions about the wait experience, and not the duration of the wait, drive satisfaction and stated intention at the time of donation. This discrepancy is consistent with a hot-cold empathy gap: return decisions are made several weeks or months after the wait experience when emotions have dissipated and the decision is a cold cost calculation.

Although we find longer waiting times significantly delay return behavior, we suspect that the highly prosocial context we have examined likely underestimates (possibly substantially) the effects of waiting time costs in more general consumer contexts. First, donors likely have fewer close substitutes than consumers in other contexts. Second, donors may also receive some benefits (e.g., status and warm glow) while waiting that would diminish the negative costs of waiting, which would not exist in a nonprosocial context. Finally, donors in our context have to wait several weeks before they can donate again, diminishing the effects of negative emotions experienced while waiting. If subsequent choices occurred sooner (e.g., in the context of routine shopping), emotional reactions might play a stronger role.

Our results also contribute to the literature on the extrinsic motivations for prosocial behavior. While the literature has mainly focused on the effects of a change in benefits, we examine the effect of a change in costs. Our results suggest that the management of

[38] We cannot reject the null that AB positive and O negative blood types have the same sensitivity to waiting times (p-value > 0.66)

[39] Alternatively, expectations about wait times might be a weighted average of all previous wait experiences, but the most current wait time is weighted more heavily, while previous wait experiences are substantially discounted or forgotten (consistent with recency bias). Recency can be attributed to either discounting past information or events or limited memory. Our data do not permit an exploration of the mechanism, but Fudenberg and Levine (2014) show that, under certain conditions, there is an equivalence between learning models with limited memory and those with information discounting. This observation is consistent with an adaptive learning model where the weight on past observations is negligibly small. Using laboratory data, Erev and Roth (1998) fit a learning model to interactive play and find that the model that best fits the data places 90% of the weight on the most recent event, and 10% on past expectation.

[40] We cannot reject the null hypothesis that the wait time has no effect on the time until the most frequent donors return ($p > 0.37$).

[41] Of course, it is also possible that donors with longer wait times are substituting toward alternative prosocial activities. While this would not affect our estimated effects on the blood supply, it would indicate that we are overestimating the effect on overall prosociality. However, relative to the extant literature, we believe the extent to which we overestimate effects is substantially lower given the Blood Service's monopoly on all blood product collections and the lack of close substitutes in terms of the unique donation (e.g., time and discomfort) and product being provided.

the costs of prosocial behavior, in addition to the benefits, may be an additional or alternative tool for policy makers and organizations.

We have focused on wait time as an important cost that volunteers incur when donating blood products. There are, however, many other costs associated with volunteering that deserve attention in future research. In the context of blood products, reducing the distance donors have to travel and lowering discomfort and (perceived) safety risks may be viable approaches to encourage blood donation. Moving beyond blood donation and examining the effects of costs in other contexts would also be a fruitful avenue to further our understanding of prosocial motivations.

Supplemental Material

Supplemental material to this paper is available at http://dx.doi.org/10.1287/mnsc.2016.2504.

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