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To the memory of Danica Bućan.

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Abstract

In the first essay, I study the effects of reminders and frames designed to invoke higher levels of empathy and altruistic motives on the willingness to donate blood. I conduct a randomized field experiment with 3,236 blood donors from Bosnia and Herzegovina to test how effective frames are when used in letters soliciting blood donation. Further, I test the effectiveness of the letter itself, which served as a specific reminder, making the need for blood more salient. My baseline group did not receive any letter, while another seven groups received letters that differed in terms of goal framing; whether a specific "victim" was identified; and the gender of a "victim". I find that a reminder of the need for blood in the form of a simple letter increases the probability of donating blood by 6.44 percentage points (62%) relative to the baseline group, suggesting that reminder letters may serve as a cost-effective policy tool. At the same time, I find that the framing of the letter had relatively little effect.

The second essay provides the first evidence of the existence of gender-based favoritism in life-saving decisions to donate blood. In a field experiment with blood donors from Bosnia and Herzegovina, I exogenously manipulate the signal of a blood recipient's gender by adding his/her name and photograph to a letter soliciting blood donation. Motivated by the literature on identity, I test the influence on donation behavior of two dimensions of shared identity between donor and recipient – gender and age. I find that the probability of giving blood was 7.43 percentage points higher (at the 1% significance level) if the potential blood recipient was of the same gender, as compared to when the gender of the recipient was different. This result was mostly driven by male donors donating to a male recipient. Being of similar age to the blood recipient had relatively little

effect. By identifying an important factor that influences willingness to give blood, these results have implications for better targeting of campaigns to increase blood donations.

The third essay examines the phenomenon of demand for graduate education and postdoctoral training in the natural sciences remaining roughly constant despite dwindling academic career prospects. We investigate whether a reason for this phenomenon is that doctoral students hold excessively optimistic beliefs about the academic job market. We elicit the beliefs and career preferences of a sample of U.S. chemistry graduate students through a novel survey. Within the survey, we randomize respondents into a control and two information treatment groups and provide structured and non-structured information on the true state of the academic job market. We find that graduate students are excessively optimistic about academic prospects and publishing in top journals. Although providing both types of information did lead them to update their beliefs about the market, particularly those students with higher initial beliefs, we do not find an effect of the treatments on the likelihood of pursuing a postdoc, their satisfaction with undertaking PhD studies, or actual career outcomes two years after the intervention.

Abstrakt

V prvním článku práce zkoumám vliv upomínek a formulací použitých k vyvolání empatie a altruistických motivů na ochotu darovat krev. Provedla jsem randomizovaný experiment v reálném prostředí s 3236 dárci krve z Bosny a Hercegoviny a testovala efektivitu způsobu formulace dopisů žádajících o darování krve. Dále jsem testovala účinnost samotného dopisu, který sloužil jako upomínka důležitosti darovat krev. Základní skupina neobdržela žádný dopis. Dalších sedm skupin dostalo dopisy, které se lišily formulací cíle darovat krev – zda byla identifikována konkrétní „oběť" – a pohlavím „oběti". Zjistila jsem, že upomínka o potřebě darování krve v podobě jednoduchého dopisu zvyšuje pravděpodobnost darování krve o 6,44 procentního bodu (62 %) ve srovnání se základní skupinou, což naznačuje, že upomínky jsou nákladově efektivní nástroj. Zároveň jsem zjistila, že formulace dopisu má relativně malý účinek.

Druhý článek předkládá první důkaz existence genderově založeného zvýhodňování při dárcovství krve v situacích, kdy je v sázce lidský život. Provádím terénní experiment s dárci krve z Bosny a Hercegoviny. Při experimentu exogenně manipuluji se signalizací pohlaví příjemce krve přidáním jeho/jejího jména a fotografie k dopisu s žádostí o darování krve. Motivována publikacemi o identitě testuji vliv sdílené identity mezi dárcem a příjemcem na chování dárců ve dvou charakteristikách – pohlaví a věk. Zjišťuji, že pravděpodobnost darování krve je o 7,43 procentního bodu vyšší (na 1% hladině významnosti), pokud je potenciální příjemce stejného pohlaví. Tento výsledek je dán převážně mužskými dárci, kteří darují krev příjemcům mužského pohlaví. V kontrastu ke genderové identitě zjišťuji, že věk podobný příjemci krve má relativně malý vliv. Identifikací důležitých faktorů, které ovlivňují ochotu darovat krev, mají mé výsledky implikace pro lepší cílení kampaní, které mají za úkol zvýšit dárcovství krve.

Třetí článek zkoumá fenomén konstantní poptávky po postgraduálním a postdoktorandském vzdělávání v přírodních vědách, která zůstává přibližně neměnná navzdory zhoršujícím se kariérním vyhlídkám v akademické sféře. Zkoumáme, zda tento fenomén lze zdůvodnit přehnaným optimismem studentů doktorských programů ohledně akademického trhu práce. Zjišťujeme názory a kariérní preference výběru studentů doktorských programů chemie v USA skrze nové dotazníkové šetření. Součástí šetření je náhodné přiřazení respondentů do kontrolní skupiny nebo jedné ze dvou skupin, v rámci kterých jsou poskytnuty různé strukturované a nestrukturované informace o skutečném stavu akademického trhu práce. Zjišťujeme, že postgraduální studenti jsou přehnaně optimističtí ohledně svých vyhlídek uplatnění v akademii a publikování v top časopisech. Ačkoliv poskytnutí obou typů informací, strukturovaných i nestrukturovaných, je vedlo k přehodnocení svých názorů na trh práce, nenacházíme konkrétně u studentů s vysokými počátečními očekáváními vliv poskytnutých informací na pravděpodobnost usilování o postdoktorandskou pozici nebo jejich spokojenost s rozhodnutím studovat PhD a skutečnými kariérními výsledky dva roky po intervenci.

Introduction

Behavioral Economics takes insights from psychology and describes systematic deviations from the standard economic model with regard to preferences, beliefs, and decision-making (Kremer, Rao, & Schilbach, 2019). In particular, it studies (i) non-standard preferences, including the role of social preferences, identity, biases in time and risk preferences; (ii) non-standard beliefs, such as overconfidence; and (iii) non-standard decision-making, which centers on the role of limited attention, framing, and emotions (Rabin, 2002; DellaVigna, 2009). By systematically exploring the relevance of these concepts, Behavioral Economics aims to create better theories, predictions, and policy recommendations (Camerer & Loewenstein, 2003).

Numerous applications of behavioral approaches have provided valuable insights into better understanding consumer behavior (DellaVigna & Malmendier, 2004; Shapiro, 2005; Bertrand et al., 2010), improving health behavior (Volpp et al., 2008; Charness & Gneezy, 2009; Giné, Karlan, & Zinman, 2010), fostering charitable donations (Landry et al., 2006; Ariely, Bracha, & Meier, 2009; DellaVigna, List, & Malmendier, 2012; Chou & Murnighan, 2013), and optimizing educational choices (Nguyen, 2008; Fryer, Levitt, List, & Sadoff, 2012; Oreopoulos & Dunn, 2013).

Evidence from some of the above literature on charitable giving and educational choices suggests that subtle interventions, such as the provision of information or the framing of that information, can have an important influence on decision-making. In this dissertation,

I explore empirically the impacts of several different types of nudges and interventions, motivated by various concepts from Behavioral Economics. As outcomes, I focus on important decisions in the field – blood donations and graduate education decisions.

In the first essay, I test the effect of *two types of framing* applied to a blood soliciting letter: *goal framing* (Kahneman & Tversky, 1979; Chou & Murnighan, 2013) and *framing that contrasts the perception of an identified victim and statistical victims,* known as the *identifiable victim effect* (Schelling, 1968; Small & Loewenstein, 2003; Small, Loewenstein, & Slovic, 2007), on the decision to donate blood. In the second essay, I build on the literature on identity and test whether decreasing the social distance between a blood donor and a potential blood recipient, by making the gender *identity* of the latter salient, can foster the same outcome – the decision to donate blood. In the last essay, my co-authors and I focus on the issue of biased beliefs and document that graduate chemistry students are *overconfident* about their chances of succeeding in the academic job market. We study the effects of *information provision* of the true state of academic job market prospects on students' excessively optimistic beliefs. A unifying methodological approach of all three essays is the use of randomized field experiments as an empirical strategy. The third essay also combines a novel survey.

In the following paragraphs, I describe each essay in detail and explain its contribution to Behavioral Economics literature.

While the vast majority of studies investigates the effectiveness of different incentives that aim to invoke blood donors' selfish motives on their willingness to donate

blood (Mellström & Johannesson, 2008; Lacetera & Macis, 2010; Lacetera, Macis, & Slonim, 2014; Goette & Stutzer, 2020), the first essay of this dissertation explores incentives that aim to trigger blood donors' altruistic motives. In particular, I use two distinct frameworks: loss and gain framing (Kahneman & Tversky, 1979; Levin, Schneider, & Gaeth, 1998; Chou & Murnighan, 2013), and a framework that aims to invoke the identifiable victim effect (Schelling, 1968; Small & Loewenstein, 2003; Small, Loewenstein, & Slovic, 2007) in letters soliciting blood donation, in order to induce higher levels of empathy and altruistic behavior in blood donors. Letters soliciting blood donation served as a reminder, making the need for blood donations more salient. In contrast to the framing of the letter, which had relatively little effect, a reminder of the need for blood in the form of a simple letter increased the probability of coming to donate blood by 62% relative to the baseline. In addition to providing a policy recommendation to use reminder letters as a cost-effective policy tool, this essay contributes to the literature in Behavioral Economics by assesing both the short- and long-term effects of the above behavioral nudges that account for potential intertemporal substitution between future and present donations.

In the second essay, I examine the influence of decreasing social distance between a blood donor and a potential blood recipient on donation behavior. In particular, I match the donor's and the recipient's gender by exogenously manipulating the signal of the recipient's gender in letters soliciting blood donation. I show that being of the same gender as a potential blood recipient increases the probability of coming to donate blood by 7.43 percentage points relative to being of a different gender, thereby documenting that gender-based favoritism is

an important motive for donors. The contribution of this essay lies in complementing the existing laboratory evidence by testing, in a field setting where people make decisions that can have life-saving consequences, whether gender-based discrimination in altruism exists in high-stake environments.

The third essay, co-authored by Ina Ganguli and Patrick Gaulé, brings new insights to the continuing debate regarding the number of PhD graduates vastly exceeding the number of faculty openings in STEM fields (Freeman, Weinstein, Marincola, Rosenbaum, & Solomon, 2001; Cyranoski, Gilbert, Ledford, Nayar, & Yahia, 2011; Schillebeeckx, Maricque, & Lewis, 2013; Alberts, Kirschner, Tilghman, & Varmus, 2014; Sauermann & Roach, 2016). Principally, we show that STEM graduate students are excessively optimistic about their academic prospects. Although providing students with information on the actual state of academic job market prospects did influence changes in their beliefs, it did not influence the likelihood of pursuing a postdoc or a change in their preferences for different career paths. This study contributes to the literature by being the first study to investigate the existence of biased beliefs in the educational choice to pursue graduate studies, and postdoctoral studies in particular.

One of the key findings from this dissertation is that not all nudges reliably affect behavior in predicted directions. While a reminder in the form of a letter soliciting blood donation and making the blood recipient's gender identity salient were effective in fostering a decision to donate blood, framing was not. Similarly, information provision of the true state of the academic job market did not influence the likelihood of graduate chemistry students

to pursue a postdoc and to choose an academic career path. Therefore, the results of this dissertation suggest that researchers and policy-makers should not to take the effeciency of behaviorally-motivated interventions for granted. Specifically, the findings highlight the need for more empirical research to provide a clearer understanding of which nudges affect decision-making reliably, and in which contexts.

1. How Effective are Reminders and Frames in Incentivizing Blood Donations?

1.1. Introduction

> "However selfish man may be supposed, there are evidently some principles in his nature, which interest him in the fortune of others, and render their happiness necessary to him, though they derive nothing from it except the pleasure of seeing it". (Smith, 1969, p. 9)

Neoclassical economics assumes economic agents to be self-interested. However, there are numerous examples in everyday life, such as volunteering, charity donations, and medical donations, in which economic agents behave in an altruistic manner. According to Batson (2010), behavior that is not governed by self-interested motives, but rather aims to increase the welfare of another is defined as altruism. A textbook example of altruism is voluntary non-remunerated blood donation, in which a blood donor increases the welfare of blood recipients, in spite of incurring personal costs (such as pain, anxiety, iron depletion, etc.) that are not compensated by any kind of material reward (Bruhin, Goette, Haenni, & Jiang, 2015; Piliavin & Callero, 1991). However, most countries still face a risk of blood shortages, and benevolent blood donors remain the only source of blood for those in need. Therefore, there is high demand for the identification of cost-effective behavioral interventions to foster increases in the number of blood donations.

A substantial stream of work has investigated the effectiveness of different incentives that aim to invoke the *selfish motives* of donors[1]. However, fostering blood donors' selfish motives by offering material incentives, especially monetary, is considered ethically controversial and is not supported in a majority of countries. In addition, the World Health Organization (WHO) recommends that the mechanism of assuring a safe and sustainable blood supply should be based solely on voluntary non-remunerated blood donations (WHO, 1983)[2].

In light of the WHO's recommendation, I focus on incentives aimed to invoke solely *altruistic motives* among blood donors. In particular, I test the effectiveness of letters soliciting blood donations that aim to invoke higher levels of empathy and altruistic behavior.

Thus, building on previous research in Behavioral Economics, I examine the effects of subtle changes in letters soliciting blood donation on the likelihood of donors responding by giving blood. By making subtle changes in letters sent to different groups, I also test the incidence of framing effects and the identifiable victim effect when a one-month period is left for a donor to make their donation decision. Futher, I test the effect of sending the letter as a reminder of the need for blood donations. I also assess the short- and long-term effects

[1] Some incentives were: monetary incentives (Mellström & Johannesson, 2008; Lacetera & Macis, 2010; Lacetera, Macis, & Slonim, 2014), lottery tickets and free cholesterol tests (Goette & Stutzer, 2020), a paid day off work conditioned on making a blood donation (Lacetera & Macis, 2012).

[2] There are several studies that support the WHO's recommendation. There is a higher incidence of infectious diseases among donors who were recruited by monetary incentives (Eastlund, 1998; Van der Poel, Seifried, & Schaasberg, 2002). Similarly, excessively frequent blood donations motivated primarily by the monetary reward can have negative consequences on donors' own health.

of the above behavioral nudges used to motivate blood donations as well as the intertemporal substitution between future and present donations.

Invoking altruism by inducing empathy rests on Batson's (1987) Empathy-Altruism hypothesis, which describes empathy as the main driver of altruism. To induce different levels of empathy, and therefore more blood donations, I combine two distinct frameworks when framing letters soliciting blood donation.

The first framework contrasts the perception of loss and gain framing (goal framing) of the letters (Kahneman & Tversky, 1979). Chou and Murnighan (2013) find loss framing (prevent deaths) to be more effective than gain framing (save lives) when soliciting blood donations. They support their finding with an Empathy-Prospect model by Lee and Murnighan (2001), which explains that loss framing is more powerful than gain framing in inducing higher levels of empathy and therefore increases helping behavior. In contrast to Chou and Murnighan's (2013) three days, I allow a longer period (one month) for donors to make their donation decisions.

In addition, I combine goal framing with a framework that aims to invoke the identifiable victim effect (Schelling, 1968; Small & Loewenstein, 2003; Small, Loewenstein, & Slovic, 2007). The literature explains that the identifiable victim effect arises when contrasting the perception of an identified unfortunate person (identified victim) and the perception of unidentified unfortunate people (statistical victims). Kogut & Ritov (2005) assert that mentioning an identified single victim invokes more empathy than mentioning an unidentified group of victims, and that it generates an increase in helping behavior.

Finally, people in general might have certain altruistic goals, but need subtle nudges to fulfill them. Thus, letters soliciting blood donation might serve as a reminder of the ubiquitous need for blood. Here, I test *the effect of a reminder when promoting other-benefiting behaviors* as an extension to the literature, in which reminders have usually been tested in the case of promoting self-benefiting behaviors[3].

Lastly, the approach applied in this study is closely linked to the activities of many *Nudge Units* around the world[4]. *Nudge Units* focus on policy areas including safety, energy policy, employment, health, and crime prevention, in order to provide policy recommendations on the effectiveness of behaviorally informed interventions. They usually use randomized control trials to test the interventions before implementing them as a policy. I aim to provide policy recommendations to blood collection institutions on the effectiveness of reminder letters soliciting blood donations and on the effectiveness of different frames used to formulate such letters.

I conducted this study in the summer of 2014 in partnership with the Federal Institute of Transfusion Medicine in Bosnia and Herzegovina (henceforth, the Institute). A total of 3,236 randomly-chosen regular whole blood donors from the Institute's hand-collected database were first randomized into August and September waves, and then into control and

[3] Some examples where the effect of a reminder was tested in promoting self-benefiting behaviors are as follows: in commitment to one-off antimalarial treatment programs (Raifman, Lanthorn, Rokicki, & Fink, 2014; in adherence to a self-help sleep intervention (Horsch, Spruit, Lancee, van Eijk, Beun, Neerincx, & Brinkman, 2017); and in breast cancer screening (Vidal, Garcia, Benito, Milà, Binefa, & Moreno, 2014), among others.
[4] According to Afif, Islan, Calvo-Gonzalez, and Dalton (2018), Australia, Canada, Denmark, France, Germany, the Netherlands, Peru, Singapore, the UK and the US were the first countries to found Nudge Units and benefited from applying behavioral insights to public policy.

treatment groups, which received a letter requesting them to give blood in the corresponding month.

The first group was the *No letter group* and donors who were allocated into this group (baseline) did not receive any letter. Seven other randomly-chosen groups received different types of letters. The first of the seven treatment groups received a simple letter (*Simple letter group*) in which donors were given information about potential summer shortages accompanied by a request for blood donations. The second and third treatment groups received information on how many people – statistical "victims" in this setting – need blood and what kind of illnesses cause people to require blood on a regular basis, in addition to the notice of potential summer blood shortages. Specific people were not mentioned in the letter. The difference between the second and third treatment groups is that one received a letter framed using gain framing and the other using loss framing.

The last four groups received additional information that consisted of the name of a "victim", why he or she needed blood, and his or her picture. Again, these four letters differed in terms of how they were framed (loss or gain) and by the gender of the "victim".

I find that receiving a reminder of the need for blood in the form of a simple letter increased the probability of coming to donate blood by 62% within one month of receiving the letter, relative to the baseline group. Further, the effect of the reminder remained for a certain period. Specifically, donors were 20% more likely to donate at least once in the next 10 (9) months of receiving the simple blood soliciting letter in comparison to the donors who did not receive any letter. The number 10 or 9 depends on whether donors were sent the initial letter, or no letter in the case of the *No Letter Group* in the August wave or in the September

wave. Using a simple between-group comparison of the future turnout of blood donors who came within the first month, I show that those donors were not substituting their future arrivals with the arrival that was nudged by the reminder letter. Lastly, the cost of producing and sending the letter was only EUR 13 per additional donor. Therefore, this finding may serve as a policy recommendation for blood donation centers and other health-related services to utilize this cost-effective policy tool.

In addition, I find that the framing of the letter had relatively little effect when a one-month period was allowed for blood donors to make their donation decision. This period, which is longer than those used in the literature on testing framing effects, may have enabled activation of the controlled mode of generic function – System 2 – rather than the intuitive mode of System 1 (Kahneman, 2002; Kahneman & Frederick, 2002; Slovic, Finucane, Peters, & MacGregor, 2004). When System 2 prevails over System 1 in making a donation decision, it decreases the chances of making cognition biases such as the identifiable victim effect and framing effects. For example, Small, Loewenstein, and Slovic (2007) used a series of field experiments in which they explained the mechanism of identifiable victim effect to their experimental subjects, and by doing so, invoked their System 2, which resulted in discounted sympathy and fewer donations to identifiable victims.

Furthermore, with my findings I contribute to the claims by Piliavin and Calero (1991) and Mathew, King, Glynn, Dietz, Caswell, and Schreiber (2007) about blood donations having a different nature compared to charitable donations and volunteering. Specifically, blood donations are considered more costly as donors incur “personal costs”,

such as anxiety, fear, pain, and iron depletion (Piliavin & Calero, 1991). They are also more impersonal to the giver in relation to the receiver (Mathew, King, Glynn, Dietz, Caswell, & Schreiber, 2007) compared to charitable donations and volunteering.

The remainder of this study is structured as follows: In the next section, I briefly explain the conceptual background. In Section 3, I describe the empirical setup: the institutional background, the experimental design, the empirical strategy, and the descriptive statistics. Section 4 presents the results and the last section concludes.

1.2. Conceptual Background

Conceptually, manipulations of the letter that I used in this research are grounded in several streams of literature in Behavioral Economics, with the main focus on understanding the following terms: empathy-based altruism, framing effects (goal framing), identifiable victim effects, and reminders.

Inducing **altruism** in blood donors by invoking **empathy** rests on Batson's (1987) Empathy-Altruism hypothesis. Empathic concern (in short, empathy) is defined as an "other defined emotional response elicited by and congruent with the perceived welfare of someone in need" (Batson, 2011, p.11). According to the Empathy-Altruism hypothesis, the person in need is more likely to receive help if he or she invokes more empathy from the helper[5].

[5] The Empathy-Altruism hypothesis has already received empirical support. Batson (1999) found that people who felt more empathy toward others cooperated more in prisoner's dilemma games. Similarly, empathy has

Similarly, Singer and Fehr (2005) explain that "empathy renders our emotions other-regarding, which provides the motivational basis for other-regarding behavior" (p.2). To find the best type of nudge to induce the altruism of blood donors, my intention is to attempt to invoke different levels of empathy by applying different frames to letters soliciting blood donation.

Specifically, economic agents tend to answer inconsistently and incoherently if asked to respond to equivalent descriptions of the same problem described using different frames. This illustrates a cognitive bias known as **framing effects**. According to Kahneman and Tversky (1979), framing effects refer to changes in risk preferences with regard to how different choices are framed. Levin, Schneider, & Gaeth (1998) explain different types of framing, including *goal framing,* which I apply in this study. According to the authors, goal framing is used to identify the impact of two messages that differ in whether they stress the positive consequences of performing an act or the negative consequences of not performing the act. Thus, the potential donation in the letters I sent to blood donors was presented as an action taken to save lives or to prevent deaths (gain framing versus loss framing).

The effects of goal framing in the case of blood donation have already been tested by Chou and Murnighan (2013), who find that over 60% more donors arrived when blood donations were framed as death-preventing rather than life-saving. In contrast to Chou and Murnighan's (2013) three days, I allow for a longer period of one month for blood donors to

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induced students to share their class notes (Weiner, 1980) and to indicate that they would accept fewer monetary gains to benefit others (Lee & Murnighan, 2001).

make their donation decision. This enables me to check whether the incidence of framing effects in the case of blood donation is independent of the time period allowed to make a donation decision. Further, I combine goal framing with another type of framing that contrasts the perception of an identified victim and statistical victims.

By mentioning a single person in need of blood (*identified victim*) as opposed to mentioning unidentified people in need of blood (*statistical victims*) in the letters, I allow for the testing of the occurrence of another cognitive bias known as the **identifiable victim effect** (Schelling, 1968). Laboratory experiments have shown that an identifiable victim is more likely to evoke empathy and incentivize people to donate than statistical victims (Jenni, & Loewenstein, 1997; Small & Loewenstein, 2003; Kogut & Ritov, 2005). To my knowledge, the incidence of the identifiable victim effect has not yet been tested in the case of blood donations. Lee, Piliavin, & Call (1999) assert that the personal nature of what is given makes blood donations different from donating money to charity and volunteering. Thus, I test whether blood donors show inconsistencies in cognition, as other types of donors do.

Further, people might have certain altruistic goals, but need subtle nudges to fulfill them. The nudge that I employ in the experiment is a reminder in the form of a blood soliciting letter. Results from a survey conducted on 92,581 U.S. blood donors show that up to 63 percent of donors said they would be encouraged to donate blood after receiving a reminder from the blood bank (Glynn et al., 2002).

Moreover, the effectiveness of reminders has already been tested in numerous examples of promoting self-benefiting behaviors: increasing commitment to one-off antimalarial treatment programs (Raifman, Lanthorn, Rokicki, & Fink, 2014); increasing the

influenza vaccination rate (Maurer & Harris, 2014); fostering breast screening attendance Kerrison, Shukla, Cunningham, Oyebode, & Friedman, 2015), among others. However, evidence regarding the influence of reminders on promoting other-benefiting behaviors remains scarce. For example, a reminder in the form of a phone call has been shown to be effective in prompting college-age blood donors to fulfill their commitments (Ferrari, Barone, Jason, & Rose, 1985; Lipsitz, Kallmeyer, Ferguson, & Abas, 1989). Similarly, Grieco, Lacetera, Macis, & Martino (2018) document a strong effect of reminders on fostering cord blood donations. I contribute to the existing literature on the influence of reminders on other-benefiting behaviors by testing the influence of a reminder letter on blood donors' willingness to donate.

In addition, there is scarce evidence on the long-run effects of nudges used to increase the number of donors arriving to donate blood (Bruhin, Goette, Roethlisberger, Markovic, Buchli, & Frey, 2015). I therefore follow sampled donors in the ensuing 9 to 10 months after the experiment to assess the long-run effects of my interventions.

I choose regular voluntary blood donors to be in subject pool because, when asked about their main motive for giving blood, altruism was the most frequent answer (Drake, Finkelstein &, Sapolsky, 1982). Notably, this complies with my design and hypotheses to be tested. Further, according to Costa-Font, Jofre-Bonet, and Yen (2011), regular donors are essential for securing a constant supply of blood.

1.3. Empirical Setup

I conducted the randomized field experiment in August and September 2014. The target group consisted of pre-registered blood donors who had already been in contact with the Institute at least once. I excluded blood donors who were not eligible to donate due to the time that is required to elapse between donations (three months for men and four months for women). Further, I followed the donation behavior of sampled donors for 10 (9) months after the initial experiment to check for the long-run effects of my interventions as well as for potential intertemporal substitutions of their donations.

1.3.1. Institutional Context

Bosnia and Herzegovina is comprised of two autonomous entities: the Federation of Bosnia and Herzegovina, and Republika Srpska. The Brcko District is an additional entity, officially belonging to both Republika Srpska and the Federation of Bosnia and Herzegovina. The blood transfusion services in Bosnia and Herzegovina are decentralized and divided into three parts: the Federation of Bosnia and Herzegovina, Republika Srpska, and the Brcko District. Therefore, each entity has its own independent transfusion institute.

The Federal Institute of Transfusion Medicine in Bosnia and Herzegovina (the Institute) is a health institution that collects and supplies blood for use in transfusions. The Institute operates in the territory of the Federation of Bosnia and Herzegovina, and it

conforms to the Federation of Bosnia and Herzegovina's *Law on Blood and Blood Components*[6], which limits the age of donors to be between 18 and 65. Exceptionally, individuals aged 17 can donate blood if their parents provide written approval. Under the law, the frequency of blood donations is limited to four times a year for male donors, and three times a year for female donors. Notably, emergency replacement donations are minimal, and the blood collection process is based on 100 per cent voluntary non-remunerated blood donations.

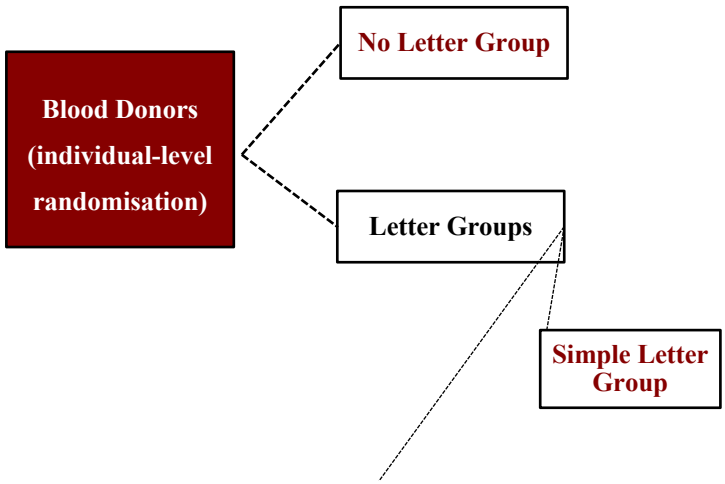
To recruit and retain blood donors, the Institute engages in promoting voluntary blood donation, organizing and conducting blood drives, and gathering and managing voluntary blood donors. Individuals who visit the Institute to donate blood are registered as a blood donor in the database. In the event of shortages of a certain type of blood, recruitment via phone calls is used. My experimental intervention extended the standard procedures conducted by the Institute to remind or motivate donors to donate blood, as sending letters soliciting blood donation had not been commonly used.

[6] Available at: http://www.fbihvlada.gov.ba/bosanski/zakoni/2010/zakoni/8bos.htm

1.3.2. Experimental Design

After being distributed into August and September waves, eligible donors were allocated to control and treatment groups. In total, I had eight groups of blood donors in each month. My experimental design is summarized in Figure 1.

Figure 1. Experimental Design



6 other letter groups

Framing which contrasts the perception of an identified victim and statistical victims

Goal framing			
	Statistical Victims/ Gain Framing Group	Identified Female Victim/ Gain Framing Group	Identified Male Victim/ Loss Framing Group
	Statistical Victims/ Loss Framing Group	Identified Female Victim/ Loss Framing Group	Identified Male Victim/ Gain Framing Group

The first group was a *No letter group* and donors who were randomized into the control group did not receive any letter.

Each treatment group received a letter soliciting blood donations of different content. Examples of the logo, letters, and their translation from Bosnian-Serbo-Croatian to English appear in Appendix A1.

The first treatment group – the *Simple letter group* – received a very simple letter with basic information about potential summer shortages accompanied by a request to come to donate blood. The second and third treatment groups received the same basic information as the first group, but in addition, they received information about the demand for blood and the types of illnesses that cause people to require blood on a regular basis. These groups received more information about statistical "victims" and there were no specified "victims" mentioned. The difference between the second and third treatment groups is that one of these two groups received a letter framed using gain framing, while the other one used loss framing.

Instead of receiving the letter with statistical "victims" mentioned, the last four groups received additional information about a specific "victim" who needs blood regularly (identified victim). Again, the last four letters differed in terms of how they were framed (either described using loss or gain framing) and by the gender of the "victim" mentioned. The "victims", Ruzdija (male) and Saliha (female), are real patients who agreed to participate in the study and to share the information about their health issues. Ruzdija and Saliha were identified using their name, surname and picture. They are of the same religion (Muslim), same nationality (Bosniak), similar age (50-60), and suffer from the same disease (myelodysplastic syndrome).

Importantly, blood donors were not aware that a study was being conducted, thus they did not feel scrutinized by the researcher (Levitt and List, 2008; List, 2008). Finally, the fact that the blood donation letters were mailed privately to the donors ensured that public image concern was excluded from this experiment.

1.3.3. Empirical Strategy

I use a linear probability model (LPM) since interaction effects cannot be readily interpreted using Probit models. I address the potential issue of heteroskedasticity using the standard heteroskedasticity-robust standard errors (Wooldridge, 2010). Further, I check if some of the OLS fitted values are not between zero and one. Finally, I check result robustness to model specification using a Probit model.

I estimate four types of effects. First, I test **the effectiveness of the simple letter** as a reminder of the need for blood. Here, I compare the arrival of donors sampled into the *No letter group* and the *Simple letter group*.

$$Presenting\_to\_Donate_i = \alpha_0 + \alpha_1 Simple\_Letter_i + \boldsymbol{\alpha^T X_i} + \varepsilon_i$$

The dependent variable $Presenting\_to\_Donate$ is a binary variable that is equal to 1 if the donor presented to donate blood, and 0 otherwise. Similarly, $Simple\_Letter$ is a binary variable equal to 1 if the letter soliciting blood donation was sent to a donor, and 0 otherwise. Further, $\boldsymbol{\alpha}$ is the vector of coefficients of the following covariates: gender, age, the number of times a person has donated blood before the experiment, dummy variables for each combination of ABO blood type and Rh status, dummy variables for education, and a

dummy variable for the proximity of a donor's home to the Institute where the blood is collected. $\boldsymbol{X_i}$ is the vector of the covariates, and ε_i is the error term.

Second, I test **the effectiveness of gain and loss framing** in the case of blood donations:

$$Presenting\_to\_Donate_i = \beta_0 + \beta_1 Loss_i + \boldsymbol{\beta^T X}_i + u_i$$

$Loss$ is a binary variable equal to 1 if the letter soliciting blood donation was formulated using loss framing, and 0 otherwise. $Gain$ is a baseline.

Third, in a similar manner to previous testing, I test **the incidence of the identifiable victim effect** in the case of blood donations.

Fourth, I test **the effects of combining different frameworks** in comparison to the *No letter group* using the LPM again:

$$Presenting\_to\_Donate_i = \gamma_0 + \gamma_1 Simple\_Letter_i + \gamma_2 Loss_i +$$

$$\gamma_3 Gain_i + \gamma_4 Identifiable_i + \gamma_5 Statistical_i + \gamma_6 Identifiable_i * Loss_i +$$

$$\gamma_7 Identifiable_i * Gain_i + \gamma_8 Statistical_i * Loss_i + \gamma_9 Statistical_i * Gain_i + \boldsymbol{\gamma^T X}_i + \omega_i$$

Last, I test **the long-run effects of my interventions** using the LPM. Thus, I again use the same model specified above, but I use $Presenting\_to\_Donate\_LR$ as the dependant variable, which is equal to 1 if the donor presented to donate blood at least once in the next 10 (9) months and 0 otherwise.

1.3.4. Descriptive Statistics

Several days before the beginning of each month, randomly chosen donors from seven treatment groups were sent a letter with a recommended period of one month to donate blood. In total, 1,654 (1,582) donors were sampled for the August (September) wave and the letter was sent to 1,246 (1,195) of them, with the remainder belonging to the *No letter group*. Table 1 gives an overview of the number of blood donors per treatment for both months together. Additional data about donors (i.e. gender, age, etc.) were collected using a simple questionnaire usually given prior to blood donation. Table A1.1. in Appendix A.1. shows the demographic characteristics of the blood donors sampled.

Table 1. Number of blood donors randomly sampled into groups

Treatment	Number of donors randomly sampled into groups	% of the whole sample
No letter group	795	24.57
Simple letter group	811	25.06
Identified Male Victim/ Gain Framing	221	6.83
Identified Female Victim/ Gain Framing	202	6.24
Identified Male Victim/ Loss Framing	200	6.18
Identified Female Victim/ Loss Framing	201	6.21
Statistical victims/Gain Framing	405	12.52
Statistical victims/Loss Framing	401	12.39
Total	3,236	100

Further, randomization checks were performed to verify that randomization had produced a balance of various characteristics across experimental groups (Tables A1.2. and A1.3. in Appendix A.1.). Considering that some of the differences in specific variables might

be statistically significant “by chance”, the equivalence of experimental groups was satisfied for most of the variables.

However, there is one exception: the variable for the B Positive blood type, which was not distributed equally across the experimental groups. Notably, Mutz & Pemantl (2011) argue that it is not necessary for experimental conditions to be identical in all possible respects. Further, Thye (2007) claims that important conditions are those that are potentially valuable in explaining the outcome variable. In this case, the B Positive distinction is not likely to play a significant role in explaining the outcome variable (see Table A1.4. in Appendix A.1.).

1.4. Results

Of the sampled blood donors, 13.29% came to donate blood in the time frame of this study. Although not everyone met the criteria for donation, everyone who came was counted as a donor. Prior to presenting the estimation results, I first show a raw comparison of the arrival of blood donors per group (Table 2).

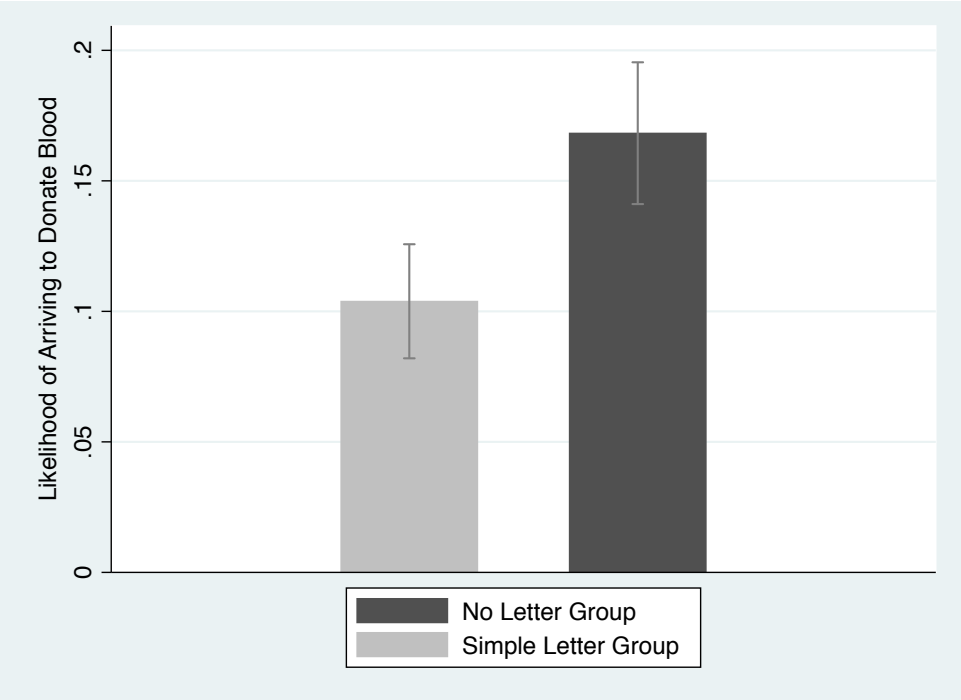
Due to changes of postal address, 5% of the blood donors who were invited to donate did not receive the letter. Further, 3% had given blood during the month before the experimental period began. The results that follow are not sensitive to the exclusion of these donors.

Table 2. The arrival of blood donors per group

Treatment	Number of donors randomly sampled into groups	Number of donors who presented to donate	% of all the donors in a corresponding group
No Letter Group	795	79	9.94
Simple Letter Group	811	127	15.66
Identified Male Victim/ Gain Framing	221	39	17.65
Identified Female Victim/ Gain Framing	202	26	12.87
Identified Male Victim/ Loss Framing	200	24	12.00
Identified Female Victim/ Loss Framing	201	24	11.94
Statistical victims/Gain Framing	405	55	13.58
Statistical victims/Loss Framing	401	56	13.97
Total	3,236	430	

The effect of a simple letter within one month of receiving it – the short run effect: I compared the arrival of the blood donors from the *No letter group* with the arrival of the blood donors from the *Simple letter group* (Figure 2 and the first two columns in Table 3).

Figure 2. The short-run effect of a simple letter



I estimated that receiving the simple blood soliciting letter led to a 6.44 percentage point increase (a 6.56 percentage point increase after including covariates) in the probability of presenting to donate blood relative to the baseline. In other words, receiving a reminder of the need for blood in the form of a simple letter increased the probability of presenting to donate blood by 62%.

Table 3. The short-run effect of a simple letter and the letter per se

VARIABLES	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)
Simple Letter Group	0.0644***	0.0656***		
	(0.0178)	(0.0174)		
Letter Groups			0.0478***	0.0483***
			(0.0135)	(0.0132)
No Letter Group	Reference category	Reference category	Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.104***	0.0597	0.104***	0.105**
	(0.0111)	(0.0513)	(0.0111)	(0.0413)
Observations	1,482	1,482	2,967	2,967
R-squared	0.009	0.061	0.004	0.059

Notes: The first two columns in Table 3. show the comparison of the *Simple Letter Group* with the *No Letter Group*. The third and fourth columns in Table 3 show the comparison of *all the groups which have received any type of letter* with the the *No Letter Group*. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before. Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

To ensure against heteroskedasticity, I use robust standard errors. Further, the estimation results from my linear probability models and Probit models provide qualitatively the same results for my data (see Table A1.5. in Appendix A.1.).

To assess the cost-effectiveness of a reminder in the form of a simple letter, I perform some back-of-the-envelope calculations (Table A1.6. in Appendix A.1.). When calculating the effect in the number of donors who presented after receiving a reminder in the form of a

simple letter, I compare the donors' arrival in the *No Letter Group* with the one in the *Simple Letter Group.* Randomization should have ensured that the two groups are equal on average based on all other characteristics apart from those generated by treatment.

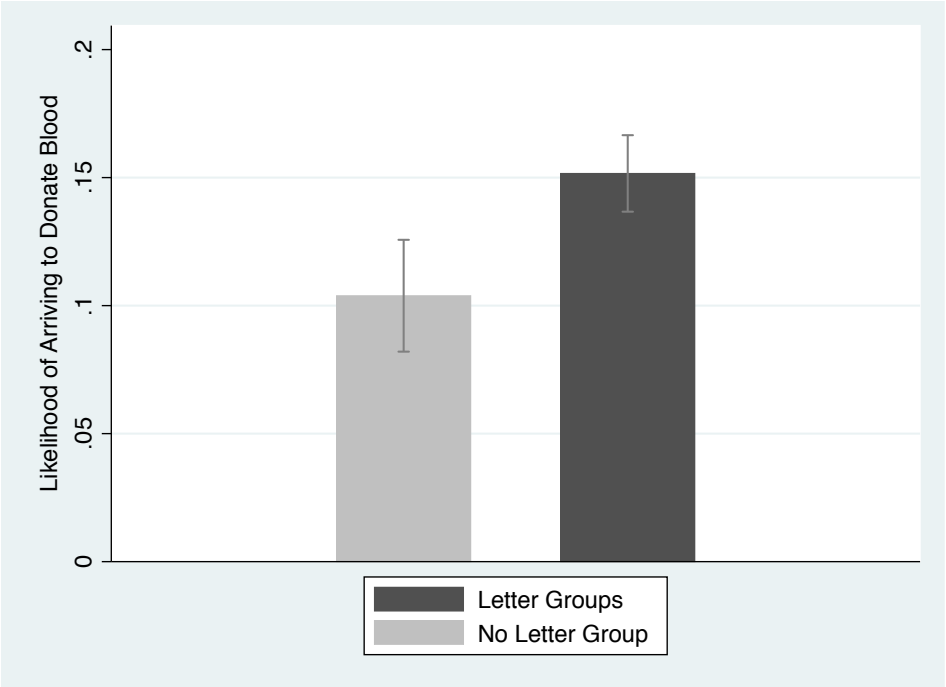
The cost of sending one letter was EUR 0.77 and each letter resulted in 0.0572 more donations. If I divide those two numbers, the cost of a letter per additional blood donation was EUR 13.46. This cost is smaller than other incentives that were shown to be effective in fostering blood donations. For example, a day-off incentive had a cost of around EUR 400 (Lacetera & Macis, 2012). Similarly, the cost of non-financial incentives such as T-shirts, mugs, and coupons per additional donation was calculated to be around USD 250 (Lacetera, Macis, & Slonim, 2011; Lacetera & Macis, 2012).

In addition, the cost of EUR 13.46 per additional donation is smaller than monetary remuneration in the form of an expense allowance to a blood donor, which is offered in some countries. For example, in the Czech Republic, a blood donor receives tax relief of EUR 50-70 annually, while donors in Germany and Austria receive an expense allowance of up to EUR 25 per donation (Kretschmer, et al., 2005; Abolghasemi, Hosseini-Divkalayi, & Seighali, 2010). Thus, this finding may serve as a policy recommendation for blood donation centers and other health-related service to use simple reminder letters as a cost-effective policy tool.

The effect of a letter within one month of receiving it – the short-run effect: When I merge all the groups that received any kind of letter and compare them to the *No Letter Group*, I find that receiving a letter led to an increase in the probability that the donor will

come to donate blood by 4.78 percentage points (4.83 after including covariates) relative to the baseline (Figure 3 and the last two columns in Table 3).

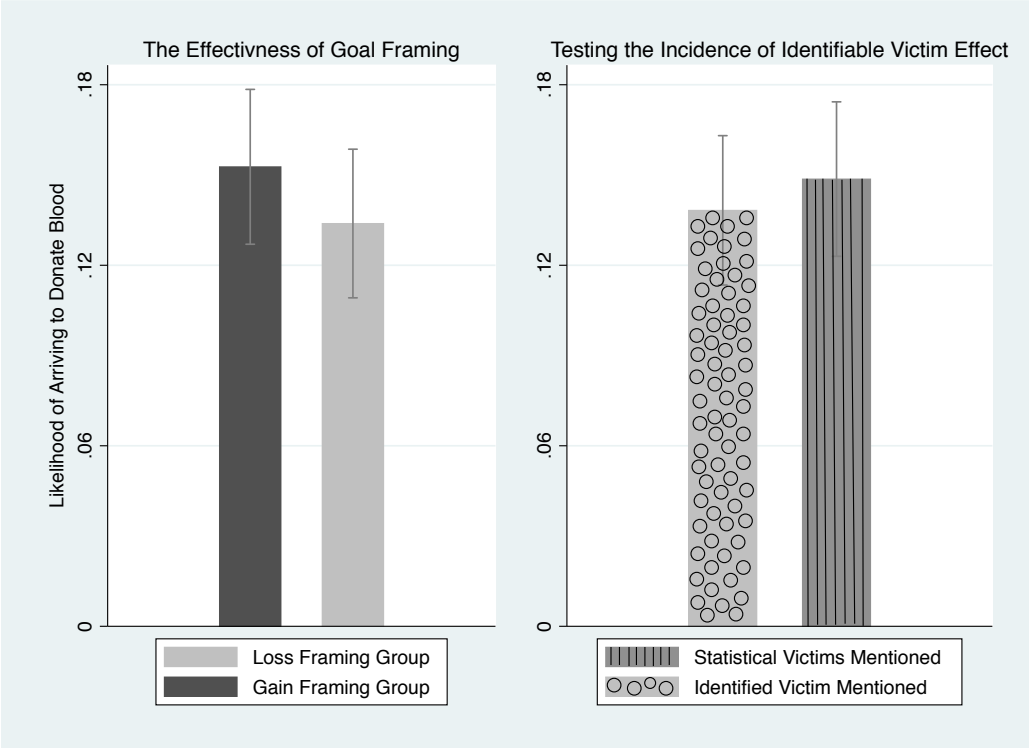
Figure 3. The short-run effect of the letter



The effectiveness of gain and loss framing within one month of receiving the letter – the short-run effect: The effectiveness of gain versus loss framing is shown in Figure 4 (left part) and in Table 4 (first two columns).

Loss framing was slightly less effective than gain framing. However, I find no significant difference in using gain or loss framing on the likelihood of donors responding by giving blood. My finding complements the assertion from DellaVigna and Pope (2016) about framing effects being context-specific. Thus, I provide evidence from a specific context in which previously-successful framing does not seem to have had an effect.

Figure 4: The effectiveness of goal framing (left part)/ Testing the incidence of the identifiable victim effect (right part) in the short run



Further, the difference in findings from Chou and Murnighan (2013) might be driven by the activation of a different generic mode of cognitive function when a longer time period has been allowed for making a blood donation decision. Kahneman & Frederick (2002) described two modes of cognitive function: System 1 (intuitive mode) and System 2 (controlled mode; reasoning), which are activated depending on the time available for deliberation (Slovic, Finucane, Peters, & MacGregor, 2004). Longer deliberation time activates System 2 rather than System 1. In contrast to Chou and Murnighan's (2013) three days, blood donors from my study had one month to make their donation decision. Testing

the effects of different time periods allowed for deliberation on the occurrence of cognition biases in the case of blood donation is left for further research[7].

Table 4. The effectiveness of goal framing in the short run

	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)
Loss Framing Group	-0.0188	-0.0235	0.0300*	0.0288*
	(0.0182)	(0.0178)	(0.0168)	(0.0164)
Gain Framing Group	Reference category	Reference category	0.0489***	0.0517***
			(0.0172)	(0.0168)
Simple Letter Group			0.0644***	0.0645***
			(0.0178)	(0.0174)
No Letter Group			Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.153***	0.221***	0.104***	0.102***
	(0.0131)	(0.0684)	(0.0111)	(0.0414)
Observations	1,485	1,485	2,967	2,967
R-squared	0.001	0.068	0.005	0.060

Notes: Columns (1) and (2) in Table 4. show the comparison of the *Loss Framing Group* with the *Gain Framing Group*. Columns (3) and (4) show the comparison of the *Loss Framing Group*, the *Gain Framing Group*, the *Simple Letter Group*, and the *No Letter Group*. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

[7] I conducted an additional analysis in which I tested the difference in the numbers of donations made within the first and within the other three weeks in which donors were asked to donate blood, by treatment (Table A1.7. in Appendix A.1.). I found no significant difference between treatments. However, this result cannot be conclusive regarding the role of System 1 and System 2 in making donation decisions, because donors in my sample knew that they could donate anytime within the month, which is different than allowing them to come to donate only within the next 3 days as in Chou and Murnighan (2013). Hypothetically, donors from my sample may have reacted promptly by deciding to donate, but planned the exact donation for later in the month.

The incidence of the identifiable victim effect within one month of receiving the letter – the short-run effect: Testing the incidence of the identifiable victim effect in the case of blood donation is shown in Figure 3 (right part) and in Table 7 (first and second columns). There was no significant difference between identifying a single "victim" or mentioning statistical "victims" on the likelihood of donors responding by giving blood.

Table 5. Testing the incidence of the identifiable victim effect

	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)
Identified Victim Mentioned	-0.0104	-0.00701	0.0344**	0.0365**
	(0.0182)	(0.0178)	(0.0169)	(0.0166)
Statistical Victims Mentioned	Reference category	Reference category	0.0448***	0.0443***
			(0.0172)	(0.0166)
Simple Letter Group			0.0644***	0.0645***
			(0.0178)	(0.0174)
No Letter Group			Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.149***	0.213***	0.104***	0.102***
	(0.0131)	(0.0679)	(0.0111)	(0.0414)
Observations	1,485	1,485	2,967	2,967
R-squared	0.000	0.067	0.005	0.060

Notes: Columns (1) and (2) in Table 5. show the comparison of the *Identified Victim Group* with the *Statistical Victims Group*. Columns (3) and (4) show the comparison of the *Identified Victim Group*, the *Statistical Victims Group*, the *Simple Letter Group*, and the *No Letter Group*. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. a Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times donor has donated blood before. Significance levels: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

In contrast to earlier findings from charitable donation literature (Small & Loewenstein, 2003; Kogut & Ritov, 2005), identifying a "victim" in need for blood might play a smaller role in motivating blood donors to come and donate blood. This difference might be driven by the different time that was allowed for participants to react to an incentive (as mentioned before, donor in my study had a one-month period to decide to come to donate blood, whereas in other studies the decision to donate to charity was prompt).

Further, the literature shows that blood donors tend to be different from charitable donors and volunteers. Specifically, Healy (2000) considers blood donation as a "perfect example of altruistic giving" that involves more than just money or time. Similarly, Lee, Piliavin, and Call (1999) find blood donation to be less similar to charitable donations and volunteering in the processes associated with giving. Moreover, Mathew, King, Glynn, Dietz, Caswell, and Schreiber (2007) find donating blood to be perceived as more impersonal for the giver in relation to the receiver, which could explain why mentioning the identified "victim" did not induce more empathy and altruistic behavior among the blood donors.

In addition, my findings complement the finding from the 2014 large-scale field experiment conducted by Lesner & Rasmussen. They show that mentioning an identifiable victim in a letter with a call to donate to charity does not elicit more donations than mentioning statistical victims. It could be that this is another case of imbalance between the findings on social preferences from laboratory and field experiments (DellaVigna, 2007).

The third and fourth columns of Table 5 show that a simple letter tends to be more effective than mentioning a single identified victim or mentioning statistical victims. However, the difference is not significant.

Lastly, Table 6 shows the comparison of all treatment groups (including manipulations with the gender of the victim) with the *Simple Letter Group*. Almost all the other treatments were less effective than a simple letter. Notably, loss framing significantly decreased (6.39 percentage points at the 5% significance level) the influence of the identified *female* victim on the likelihood of donors responding by giving blood.

In contrast to the strong overall impact of being reminded to donate blood, the specific content of the reminder seems to matter relatively little. This result coincides with Altmann and Traxler (2014), who studied the impact of reminder messages on preventative dental health and found that the number of patients who made a check-up appointment more than doubled one month after receiving a reminder. Further, including additional information about the benefits of preventative care and formulating the message using loss and gain framing did not significantly increase response rates relative to those from the neutral reminder.

An interesting open question would be to identify channels through which simple reminder letters affect donors' behavior. Behavioral economics literature suggests that limitations of donors' memory and attention, donors' present-biased preferences which lead to procrastination, or donors not being aware of blood shortages could be plausible channels. This paper was not designed to distinguish which channels were in place in the case of donors from my sample and the question remains to be explored in further research.

Table 6. Comparison of all treatments with the Simple Letter Group

VARIABLES	Donor presented to donate blood in the first month from intervention (=1)	Donor presented to donate blood in the first month from intervention (=1)
Ident. M. Vict. /Gain	0.0140	0.0165
	(0.0312)	(0.0309)
Ident. F. Vict. /Gain	-0.0331	-0.0294
	(0.0287)	(0.0283)
Ident. M. Vict. /Loss	-0.0392	-0.0327
	(0.0283)	(0.0279)
Ident. F. Vict. /Loss	-0.0639**	-0.0652**
	(0.0266)	(0.0263)
Stat. Vict. /Gain	-0.0220	-0.0173
	(0.0229)	(0.0223)
Stat. Vict. /Loss	-0.0172	-0.0229
	(0.0234)	(0.0226)
Simple Letter Group	Reference category	Reference category
Control variables[a]	Not included	Included
Constant	0.168***	0.202***
	(0.0139)	(0.0523)
Observations	2,216	2,216
R-squared	0.003	0.061

Notes: The estimates are from the LPM. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

However, when I compare all groups with the *No Letter Group* (Table 7), I find that the most effective in increasing the likelihood of blood donors presenting to give blood was the intervention in which I combined gain framing with an identified male "victim" in the letter. In comparsion to donors who did not receive any letter, donors who received the letter that combined gain framing with an identified male "victim" were 7.84 (7.98) percentage points (at the 1% significance level) more likely to come to give blood. Further, when compared to the *No Letter Group*, letters in which I combined gain framing with statistical

"victims" and loss framing with statistical "victims" were statistically significant in increasing blood donors' participation in donating blood.

Table 7. Comparison of all treatments with the No Letter Group

VARIABLES	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)
Ident. M. Vict. /Gain	0.0784***	0.0798***
	(0.0300)	(0.0296)
Ident. F. Vict. /Gain	0.0313	0.0343
	(0.0275)	(0.0271)
Ident. M. Vict. /Loss	0.0252	0.0311
	(0.0270)	(0.0266)
Ident. F. Vict. /Loss	0.000534	-0.00111
	(0.0253)	(0.0250)
Stat. Vict. /Gain	0.0424**	0.0460**
	(0.0214)	(0.0207)
Stat. Vict. /Loss	0.0472**	0.0427**
	(0.0219)	(0.0211)
Simple Letter Group	0.0644***	0.0645***
	(0.0178)	(0.0174)
No Letter Group	Reference category	Reference category
Control variables[a]	Not included	Included
Constant	0.104***	0.102**
	(0.0111)	(0.0415)
Observations	2,967	2,967
R-squared	0.006	0.061

Notes: The estimates are from the LPM. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

The effect of interventions within 10 (9) months – the long-run effect: Table 8 provides a raw group comparison of donors who presented to donate at least once in the 10 (9) months after the initial experiment (in which I sent different letters soliciting blood donation to the letter goups).

Table 8. Group comparions of blood donors who presented to donate in the 10 (9) months after receiving the letter

Treatment	Number of donors randomly sampled into groups	Number of donors who presented to donate at least once in the 10 (9) months after receiving the letter	% of all the donors in a corresponding group
No Letter Group	795	200	25.16
Simple Letter Group	811	230	28.36
Identified Male Victim/ Gain Framing	221	54	24.43
Identified Female Victim/ Gain Framing	202	43	21.29
Identified Male Victim/ Loss Framing	200	49	24.50
Identified Female Victim/ Loss Framing	201	45	22.39
Statistical victims/Gain Framing	405	102	25.19
Statistical victims/Loss Framing	401	103	25.69
Total	3,236	826	

The effect of a simple letter within 10 (9) months of receiving it – the long-run effect: Table 9 shows that the effect of the simple letter persisted in the following 10 (9) months. In particular, donors who received the simple letter in the initial period were 6.42 percentage points (at the 5% significance level) more prone to present to donate blood in the following 10 (9) months in comparison to the donors who did not receive any letter.

My results indicate that around 20% more donors arrived at least once, and 27% exactly once, in the above-mentioned period if they were sent the simple blood soliciting letter in the initial experiment in comparison to the baseline. This result is important given that in the 10-month period male donors are allowed to donate a maximum of three times, while female donors are allowed a maximum of two times.

When analyzing the intensive margin (Table A1.8. in Appendix A.1.), I do not find significant differences between the *No Letter* and *Simple Letter Groups* in the number of donations made 10 (9) months after receiving the letter. However, only 7% of donors made more than one donation in that period, so one should take this result with caution.

Table 9. The long-run letter effect - Donors' presenting to donate in the 10 (9) months after the initial experiment

VARIABLES	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)
Simple Letter Group	0.0462**	0.0442**	0.0471**	0.0449**
	(0.0228)	(0.0222)	(0.0207)	(0.0204)
No Letter Group	Reference category	Reference category	Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.239***	0.461***	0.176***	0.296***
	(0.0156)	(0.0678)	(0.0139)	(0.0647)
Observations	1,484	1,483	1,484	1,483
R-squared	0.003	0.076	0.003	0.045

Notes: Table 9. shows the comparison of the *Simple Letter Group* with the *No Letter Group*. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before, the month in which a donor donated blood the previous time. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

I argue that there was no intertemporal substitution between future and present donations of donors nudged by the reminder-letter. In particular, when restricting my sample only to donors from the *No Letter Group* and *Simple Letter Group* who presented to donate

in the initial experiment (one month after the interventions), I find that there was no statistically significant difference between thoses two groups in future arrivals in terms of presenting to donate at least once in the next 10 (9) months and in the total number of donations made during the same period (Table 10).

Table 10. Testing for potential intertemporal substitution between future and present donations of donors nudged by the reminder-letter

VARIABLES	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Number of times donor presented to donate blood in 10 (9) months after the initial experiment (=1)	Number of times donor presented to donate blood in 10 (9) months after the initial experiment (=1)
Simple Letter Group	-0.0585	-0.0607	-0.150	-0.152
	(0.0718)	(0.0697)	(0.115)	(0.109)
No Letter Group	Reference category	Reference category	Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.449***	0.460***	0.654***	0.841***
	(0.0566)	(0.131)	(0.0944)	(0.199)
Observations	201	201	201	201
R-squared	0.003	0.080	0.009	0.110

Notes: Table 10. shows the comparison of the *Simple Letter Group* with the *No Letter Group*. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, dummy variable for proximity to the Institute; the number of times a donor has donated blood before, the month in which a donor donated blood the previous time. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

The effectiveness of gain and loss framing – long-run effect: When observing blood donors' behavior in the 10 (9) months after the initial experiment, I find no significant difference in blood donors' arrival depending on receiving a blood soliciting letter framed using loss or gain framing (Table A1.9. in Appendix A.1.). However, when compared to

receiving the simple letter, donors who received letters framed using gain or loss framing were significantly less prone to come to donate blood within the next 10 (9) months (Table A1.10. in Appendix A.1.).

The incidence of the identifiable victim effect – long-run effect: Similar to my long-run goal framing results, there was no significant difference in blood donors' arrival depending on whether identified or statistical "victims" were mentioned in the blood soliciting letter (Table A1.11. in Appendix A.1.). Again, when compared to receiving the simple letter, donors who received letters that mentioned an identified victim or statistical victims were significantly less prone to come to donate blood within the next 10 (9) months (Table A1.12. in Appendix A.1.).

1.5. Conclusion

I investigate the effects of subtle changes in letters soliciting blood donation, and the effect of a reminder of the need for blood donations in the form of a simple letter, on the likelihood of donors responding by giving blood.

I find that receiving a reminder of the need for blood in the form of a simple letter increased the probability of coming to donate blood by 62%, relative to the baseline. Further, the positive effect remained in the year following the initial experiment; 20% more donors came to donate blood at least once (and 23% exactly once) in the next 10 (9) months if they received the simple letter in the initial experiment. Notably, donors were not substituting their future arrivals with the one nudged by the letter. Since the cost of a marginal donor coming to donate blood after receiving the letter was only around EUR 13, I recommend the use of this policy tool by blood donation centers and other health-related institutions.

Furthermore, I find that framing manipulations had relatively little effect. In our experiment, a relatively long period was allowed for donors to make their donation decision, as compared to some previous work (Small & Loewenstein, 2003; Chou & Murnighan, 2013). Thus, one possible interpretation is that the occurrence of cognition biases, such as framing effects and identifiable victim effects, might be influenced by time periods allowed for deliberation.

There are two ways to facilitate the attainment of sustainable blood reserves. The first concentrates on attracting and motivating new blood donors, and the second on the retention of donors who have already given blood. As my experiment studied the decision-making of

existing donors, it is open to question whether my finding of the effectiveness of a reminder of the need for blood in the form of a simple letter could be generalized to new donors.

Overall, my results indicate that the simple letter was effective, but a productive line of further research would be to investigate how to frame the most effective letter for eliciting concern and support among blood donors for people who need blood.

A.1. Appendix

Letter 1: Letter sent to the Simple Letter Group of blood donors in Bosnian/Croatian/Serbian (left) and translation to English (right)

Someone needs help urgently

Give blood

Dear blood donor,

The summer is known as a period of potential blood shortages that arise due to fewer donors donating blood during the summer holiday season.

Therefore, if you can and want to give blood in the summer period, please come to the Federal Institute of Transfusion Medicine.

By implementing a new recruitment strategy, we hope to manage sustainable blood reserves.

See you in August!

Federal Institute of Transfusion Medicine.

The other letters had the same main design and logo, but different wording. Below is the translation of the letters in which framing was combined with statistical "victims"

Letter 2: Gain Framing/Statistical Victims used in framing the letter	Letter 3: Loss Framing/Statistical Victims used in framing the letter
The title: Let life win! Dear blood donor, We would like to again ask you to **save lives** by donating blood. The summer period is known as a period of potential blood shortages that arise due to fewer donors donating blood during the summer holiday season. There is an average need of 60-80 doses per day for people who suffer from MDS, anemia, leukemia, etc. If you can and want to give blood in the summer period, and thereby **save lives**, please come to the Federal Institute of Transfusion Medicine. By implementing a new recruitment strategy, we would like **to ensure sustainable blood reserves for all the people who need blood.** See you in August (September[1])! Federal Institute of Transfusion Medicine	**The title:** Do not let death win! Dear blood donor, We would like to again ask you **to prevent deaths** by donating blood. The summer period is known as a period of potential blood shortages that arise due to fewer donors donating blood during the summer holiday season. There is an average need of 60-80 doses per day for people who suffer from MDS, anemia, leukemia, etc. If you can and want to give blood in the summer period, and thereby **prevent deaths**, please come to the Federal Institute of Transfusion Medicine. By implementing a new recruitment strategy, we would like **to prevent blood shortages and the situation in which people who need blood would not be able to get it.** See you in August (September)! Federal Institute of Transfusion Medicine

[1] The first wave was conducted in August and the second wave in September. The same letters were used with the difference in the corresponding month stated in the last sentence.

Letters that combined gained framing with an identified "victim" (female and male)

NEKIMA JE POMOĆ POTREBNA ODMAH

Da Salihin život pobijedi!

Poštovani darivaoče krvi,

htjeli bismo da Vas ponovo zamolimo da darujete krv.

Saliha boluje od mijelodisplastičnog sindroma (MDS) i ***živi uz pomoć dobročinstva darivalaca krvi****.*

Tokom ljetnog perioda moguće je smanjenje dostupnih doza krvi. Smanjenje nastaje uslijed manjeg broja darivalaca koji dolaze darivati krv u periodu raspusta i godišnjih odmora.

Ukoliko možete i želite da darujete krv u ljetnom periodu i pri tome ***spasite život osobama poput Salihe****, molimo Vas da dođete u Zavod za transfuzijsku medicinu Federacije BiH.*

Uvođenjem novog animacionog postupka želimo da obezbijedimo ***dovoljne količine dostupnih doza krvi za osobe poput Salihe****.*

Vidimo se u avgustu!

ZAVOD ZA TRANFUZIJSKU MEDICINU FEDERACIJE BIH
Čekaluša B6, Sarajevo
(u neposrednoj blizini Medicinskog fakulteta i Srednje Zubotehničke škole)
Telefon: 033 321 123

Radno vrijeme:
ponedjeljak - petak, od 8h do 19:30h / subota, od 8h do 15h.

NEKIMA JE POMOĆ POTREBNA ODMAH

Da Ruždijin život pobijedi!

Poštovani darivaoče krvi,

htjeli bismo da Vas ponovo zamolimo da darujete krv.

Ruždija boluje od mijelodisplastičnog sindroma (MDS) i ***živi uz pomoć dobročinstva darivalaca krvi****.*

Tokom ljetnog perioda moguće je smanjenje dostupnih doza krvi. Smanjenje nastaje uslijed manjeg broja darivalaca koji dolaze darivati krv u periodu raspusta i godišnjih odmora.

Ukoliko možete i želite da darujete krv u ljetnom periodu i pri tome ***spasite život osobama poput Ruždije****, molimo Vas da dođete u Zavod za transfuzijsku medicinu Federacije BiH.*

Uvođenjem novog animacionog postupka želimo da obezbijedimo ***dovoljne količine dostupnih doza krvi za osobe poput Ruždije****.*

Vidimo se u avgustu!

ZAVOD ZA TRANFUZIJSKU MEDICINU FEDERACIJE BIH
Čekaluša B6, Sarajevo
(u neposrednoj blizini Medicinskog fakulteta i Srednje Zubotehničke škole)
Telefon: 033 321 123

Radno vrijeme:
ponedjeljak - petak, od 8h do 19:30h / subota, od 8h do 15h.

Translation of the letters in which framing was combined with identified "victims"

Letter 4: Gain Framing/Identified Female Victim used in framing the letter	Letter 5: Loss Framing/Identified Female Victim used in framing the letter
The title: Let Saliha's life win! Dear blood donor, We would like to again ask you to donate blood. Saliha's picture Saliha suffers from myelodysplastic syndrome (MDS) and **she is alive thanks to blood donors' benevolence**. The summer period is known as a period of potential blood shortages that arise due to fewer donors donating blood during the summer holiday season. If you can and want to give blood in the summer period and thereby **save the lives of people like Saliha**, please come to the Federal Institute of Transfusion Medicine. By implementing a new recruitment strategy, we would like **to ensure sustainable blood reserves for people like Saliha.** See you in August (September)! Federal Institute of Transfusion Medicine	**The title:** Let Saliha beat death! Dear blood donor, We would like to again ask you to donate blood. Saliha's picture Saliha suffers from myelodysplastic syndrome (MDS) and **blood donors' benevolence prevents her from dying**. The summer period is known as a period of potential blood shortages that arise due to fewer donors donating blood during the summer holiday season. If you can and want to give blood in the summer period and thereby **prevent the deaths of people like Saliha**, please come to the Federal Institute of Transfusion Medicine. By implementing a new recruitment strategy, we would like **to prevent blood shortages and situations in which people like Saliha would not be able to get the blood needed.** See you in August (September)! Federal Institute of Transfusion Medicine

Letter number 6: Gain Framing/Identified Male Victim used in framing the letter	Letter number 7: Loss Framing/Identified Male Victim used in framing the letter
The title: Let Ruzdija's life win! Dear blood donor, We would like to again ask you to donate blood. Ruzdija' picture Ruzdija suffers from myelodysplastic syndrome (MDS) and **he is alive thanks to blood donors' benevolence**. The summer period is known as a period of potential blood shortages that arise due to fewer donors donating blood during the summer holiday season. If you can and want to give blood in the summer period and thereby **save the lives of people like Ruzdija**, please come to the Federal Institute of Transfusion Medicine. By implementing a new recruitment strategy, we would like **to ensure sustainable blood reserves for people like Ruzdija.** See you in August (September)! Federal Institute of Transfusion Medicine	**The title:** Let Ruzdija beat death! Dear blood donor, We would like to again ask you to donate blood. Ruzdija's picture Ruzdija suffers from myelodysplastic syndrome (MDS) and **blood donors' benevolence prevents him from dying**. The summer period is known as a period of potential blood shortages that arise due to fewer donors donating blood during the summer holiday season. If you can and want to give blood in the summer period and thereby **to prevent the deaths of people like Ruzdija**, please come to the Federal Institute of Transfusion Medicine. By implementing a new recruitment strategy, we would like to **prevent blood shortages and situations in which people like Ruzdija would not be able to get the blood needed.** See you in August (September)! Federal Institute of Transfusion Medicine

Table A1.1. Descriptive statistics

	Freq.	Percent
Gender		
Female	1,324	40.91
Male	1,912	59.09
Age Intervals		
18-25	1,664	51.44
26-35	752	23.25
36-45	432	13.35
46-55	270	8.35
56-	117	3.62
Education		
High school	577	17.84
University	90	2.78
In the process of obtaining a degree (students)	1,466	45.30
Blood type and RH factor		
0 Negative	172	6.37
0 Positive	850	31.48
A Negative	175	6.48
A Positive	874	32.37
B Negative	72	2.67
B Positive	384	14.22
AB Negative	35	1.30
AB Positive	138	5.11
Donation frequency		
1 donation	946	29.23
2-5 donations	1,053	32.54
6-20 donations	963	29.76
20 and more donations	274	8.47

Table A1.2. Randomization check: Demographic characteristics

VARIABLES	Gender	Age	Municipality	Number of Donations	High school	University	In the process of obtaining degree	Education Missing
Simple letter Group	-0.00436	-0.288	-0.0157	-0.516	0.0175	-0.0167**	0.0233	-0.0241
	(0.0245)	(0.560)	(0.111)	(0.607)	(0.0193)	(0.00808)	(0.0249)	(0.0236)
Ident. M. Vict. /Gain	-0.0170	2.349**	0.0320	1.179	0.0300	-0.00807	-0.0504	0.0284
	(0.0375)	(0.954)	(0.169)	(1.203)	(0.0303)	(0.0128)	(0.0373)	(0.0367)
Ident. F. Vict. / Gain	-0.00217	-0.348	-0.0521	-0.285	0.00463	0.0143	-0.0183	-0.000635
	(0.0387)	(0.893)	(0.174)	(0.925)	(0.0301)	(0.0166)	(0.0390)	(0.0375)
Ident. M. Vict. /Loss	-0.00623	-0.432	-0.0272	-1.169	-0.0136	-0.000220	0.0510	-0.0372
	(0.0389)	(0.927)	(0.175)	(1.009)	(0.0292)	(0.0146)	(0.0396)	(0.0369)
Ident. F. Vict. /Loss	-0.0141	-0.504	0.0598	0.957	-0.0492*	-0.000394	0.0286	0.0210
	(0.0389)	(0.902)	(0.173)	(1.316)	(0.0269)	(0.0145)	(0.0394)	(0.0380)
Stat. Vict. /Gain	0.00130	-0.169	-0.0311	-0.930	0.00666	-0.0204**	0.0449	-0.0311
	(0.0300)	(0.700)	(0.136)	(0.698)	(0.0234)	(0.00889)	(0.0305)	(0.0287)
Stat. Vict. /Loss	-0.0152	1.083	0.0663	0.504	0.00597	-0.00529	-0.0226	0.0219
	(0.0302)	(0.714)	(0.135)	(0.873)	(0.0234)	(0.0107)	(0.0303)	(0.0295)
No Letter Group	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category
Constant	0.596***	28.93***	4.547***	7.839***	0.174***	0.0352***	0.444***	0.347***
	(0.0174)	(0.401)	(0.0786)	(0.471)	(0.0134)	(0.00655)	(0.0176)	(0.0169)
Observations	3,236	3,236	3,236	3,232	3,236	3,236	3,236	3,236

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A1.3. Randomization check: ABO Blood type and Rh factor

VARIABLES	Onegative	Opositive	Anegative	Apositive	Bnegative	Bpositive	ABnegative	ABpositive	MissingBT
Simple letter	0.00890	0.0309	0.00887	0.00840	-0.000422	-0.0474***	0.00232	0.0127	-0.0243
	(0.0112)	(0.0220)	(0.0114)	(0.0221)	(0.00719)	(0.0166)	(0.00464)	(0.0107)	(0.0183)
Ident. M. Vict./Gain	-0.00381	0.0114	0.00398	0.000808	0.00577	-0.0469*	0.0106	-0.000785	0.0190
	(0.0160)	(0.0332)	(0.0171)	(0.0335)	(0.0121)	(0.0242)	(0.00949)	(0.0151)	(0.0296)
Ident. F. Vict./ Gain	0.0203	0.00593	0.00414	-0.00421	-0.00158	-0.0618***	0.0222*	-0.00191	0.0170
	(0.0195)	(0.0342)	(0.0178)	(0.0345)	(0.0111)	(0.0238)	(0.0123)	(0.0155)	(0.0306)
Ident. M. Vict./Loss	0.000943	0.0135	0.00469	0.0284	0.00362	-0.0659***	0.00745	-0.0115	0.0189
	(0.0172)	(0.0346)	(0.0179)	(0.0357)	(0.0122)	(0.0235)	(0.00914)	(0.0140)	(0.0308)
Ident. F. Vict./ Loss	0.000695	0.0669*	0.00441	-0.0278	-0.0164**	-0.00666	-0.00257	-0.0117	-0.00689
	(0.0172)	(0.0362)	(0.0178)	(0.0337)	(0.00715)	(0.0279)	(0.00584)	(0.0140)	(0.0294)
Stat. Vict./Gain	0.0102	-0.0416*	0.00154	0.0396	0.0132	-0.0225	-0.00261	-0.00941	0.0116
	(0.0140)	(0.0252)	(0.0135)	(0.0277)	(0.0104)	(0.0209)	(0.00465)	(0.0113)	(0.0234)
Stat. Vict./Loss	-0.00417	0.0602**	0.00205	0.0127	-0.00143	-0.0487**	0.00492	0.00587	-0.0314
	(0.0129)	(0.0277)	(0.0136)	(0.0272)	(0.00868)	(0.0198)	(0.00634)	(0.0128)	(0.0219)
No Letter Group	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category
Constant	0.0491***	0.247***	0.0503***	0.262***	0.0214***	0.151***	0.00755**	0.0415***	0.171***
	(0.00767)	(0.0153)	(0.00776)	(0.0156)	(0.00514)	(0.0127)	(0.00307)	(0.00708)	(0.0134)
Observations	3,236	3,236	3,236	3,236	3,236	3,236	3,236	3,236	3,236

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A1.4. The influence of having a certain blood type on the probability of coming to donate blood

	Donor presented to donate blood (=1)
O Negative	-0.115***
	(0.0432)
O Positive	-0.0602
	(0.0390)
A Negative	0.0465
	(0.0503)
A Positive	-0.0494
	(0.0391)
B Negative	-0.0191
	(0.0612)
B Positive	-0.00430
	(0.0427)
AB Negative	-0.0399
	(0.0775)
Blood Type Missing	-0.191***
	(0.0373)
AB Positive	Reference Category
Control variables	Not included
Constant	0.207***
	(0.0369)
Observations	2,967
R-squared	0.036

Notes: The estimates are form the linear probability model. Robust standard errors are in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A1.5. Marginal effects from probit estimates (main effects)

	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)	Donor presented to donate blood (=1)
Gain Framing		Reference category		
Loss Framing		-0.0189		
		(0.0182)		
Simple letter	0.0644***			Reference category
	(0.0178)			
Identified Vict.			-0.0104	
			(0.0182)	
Statistical Vict.			Reference category	
Ident. M. Vict. /Gain				0.0140
				(0.0312)
Ident. F. Vict. /Gain				-0.0331
				(0.0287)
Ident. M. Vict. /Loss				-0.0392
				(0.0283)
Ident. F. Vict. /Loss				-0.0639**
				(0.0266)
Stat. Vict. /Gain				-0.0220
				(0.0229)
Stat. Vict. /Loss				-0.0172
				(0.0234)
No Letter group	Reference category			
Observations	1,482	1,485	1,485	2,216

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A1.6. The cost of the reminder in the form of a simple letter

Costs	**Total**	**Number of letters**	**Per unit**	**Per unit**
Graphical solution	700.00 BAM[9]	2700	0.26 BAM	0.13 EUR
Printing letters and envelopes	950.00 BAM		0.35 BAM	0.18 EUR
Sending letters	2,430.00 BAM		0.90 BAM	0.46 EUR
Total	4,080.00 BAM		1.51 BAM	0.77 EUR
The cost of sending 795 letters				612.15 EUR
The cost of sending the letter per additional blood donation: **0.77 / 0.0572**				**13.46 EUR**

[9] BAM refers to the Bosnian Mark, the currency of Bosnia and Herzegovina (EUR 1 = BAM 1.95583).

Table A1.7. Difference in the donations made within the first and within the other three weeks after receiving the letter, by treatment

VARIABLES	Donor presented to donate blood within the first week after receiving blood soliciting letter (=1)	Donor presented to donate blood within the first week after receiving blood soliciting letter (=1)
Ident. M. Vict. /Gain	0.0648	0.0424
	(0.0872)	(0.0894)
Ident. F. Vict. /Gain	0.0877	0.0652
	(0.101)	(0.101)
Ident. M. Vict. /Loss	0.0994	0.0878
	(0.104)	(0.102)
Ident. F. Vict. /Loss	0.0709	0.0484
	(0.112)	(0.111)
Stat. Vict. /Gain	0.0441	0.0306
	(0.0733)	(0.0755)
Stat. Vict. /Loss	0.0804	0.0386
	(0.0756)	(0.0792)
Simple Letter Group	-0.0460	-0.0663
	(0.0554)	(0.0574)
No Letter Group	Reference category	Reference category
Control variables[a]	Not included	Included
Constant	0.192***	0.179
	(0.0451)	(0.128)
Observations	414	414
R-squared	0.017	0.049

Notes: The estimates are from the LPM. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A1.8. The long-run effect of letter – Intensive margin: the number of times donors presented to donate in the 10 (9) months after the initial experiment

VARIABLES	Number of times donor donated in in 10 (9) months after the initial experiment	Number of times donor donated in 10 (9) months after the initial experiment
Simple Letter Group	0.0427	0.0423
	(0.0321)	(0.0309)
No Letter Group	Reference category	Reference category
Control variables[a]	Not included	Included
Constant	0.312***	0.636***
	(0.0225)	(0.0991)
Observations	1,484	1,483
R-squared	0.001	0.081

Notes: Table A1.8. shows a comparison of the *Simple Letter Group* with the *No Letter Group*. The estimates are from the linear models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before, the month in which a donor donated blood the previous time. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A1.9. The long-run effect of Goal Framing (Comparison between Gain and Loss Framing Groups)

	Donors' arrival in the 10 (9) months after the initial experiment			
	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)
Gain Framing Group	-0.00813	-0.000270	-0.0168	-0.0108
	(0.0222)	(0.0215)	(0.0194)	(0.0192)
Loss Framing Group	Reference category	Reference category	Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.244***	0.372***	0.176***	0.176***
	(0.0159)	(0.0765)	(0.0141)	(0.0658)
Observations	1,487	1,486	1,487	1,486
R-squared	0.000	0.081	0.001	0.038

Notes: Table A1.9. shows the comparison of the *Gain Framing Group* with the *Loss Framing Group*. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before, the month in which a donor donated blood the previous time. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A1.10. The long-run effect of Goal Framing (Comparison of the Gain and Loss Framing, and the Simple Letter Group with the No Letter Group)

	Donors' arrival in the 10 (9) months after the initial experiment			
	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)
Gain Framing Group	-0.00329	-0.00434	-0.0164	-0.0121
	(0.0220)	(0.0209)	(0.0192)	(0.0188)
Loss Framing Group	-0.00484	-0.00392	-0.000457	-0.00199
	(0.0222)	(0.0216)	(0.0198)	(0.0195)
Simple Letter Group	0.0462**	0.0461**	0.0471**	0.0456**
	(0.0228)	(0.0221)	(0.0207)	(0.0204)
No Letter Group	Reference category	Reference category	Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.239***	0.408***	0.176***	0.237***
	(0.0156)	(0.0515)	(0.0139)	(0.0472)
Observations	2,971	2,969	2,971	2,969
R-squared	0.002	0.077	0.004	0.042

Notes: Table A1.10. shows a comparison of the *Gain Framing Group*, the *Loss Framing Group,* and the *Simple Letter Group* with the *No Letter Group*. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before, the month in which a donor donated blood the previous time. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A1.11. The long-run effect of mentioning the identified or statistical victims

(Comparison between Identified Victim Group and Statistical Victims Group)

	Donors' arrival in the 10 (9) months after the initial experiment			
	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)
Identified Victim Mentioned	-0.0245	-0.0201	-0.0267	-0.0231
	(0.0222)	(0.0214)	(0.0194)	(0.0191)
Statistical Victims Mentioned	Reference category	Reference category	Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.252***	0.381***	0.181***	0.182***
	(0.0160)	(0.0767)	(0.0141)	(0.0659)
Observations	1,487	1,486	1,487	1,486
R-squared	0.001	0.081	0.001	0.039

Notes: Table A1.11. shows the comparison of the *Identified Victim Group* with the *Statistical Victims Group*. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before, the month in which a donor donated blood the previous time. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A1.12. The long-run effect of mentioning identified versus statistical victims (Comparison of the Identified Victim Group, the Statistical Victims Group, and the Simple Letter Group with the No Letter Group)

Donors' arrival in the 10 (9) months after the initial experiment

	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)	Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)
Identified Victim Mentioned	-0.0115	-0.00514	-0.0214	-0.0176
	(0.0219)	(0.0211)	(0.0192)	(0.0188)
Statistical Victims Mentioned	0.0130	0.0135	0.00530	0.00349
	(0.0223)	(0.0214)	(0.0198)	(0.0194)
Simple Letter Group	0.0462**	0.0461**	0.0471**	0.0456**
	(0.0228)	(0.0221)	(0.0207)	(0.0204)
No Letter Group	Reference category	Reference category	Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.239***	0.408***	0.176***	0.237***
	(0.0156)	(0.0515)	(0.0139)	(0.0473)
Observations	2,971	2,969	2,971	2,969
R-squared	0.002	0.078	0.004	0.043

Notes: Table A1.12. shows a comparison of the Identified Victim *Group*, the *Statistical Victims Group,* and the *Simple Letter Group* with the *No Letter Group*. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times a donor has donated blood before, the month in which a donor donated blood the previous time. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

2. Gender-Based Favoritism in Blood Donations: Evidence from a Field Experiment

2.1. Introduction

Donating blood is a prime example of altruistic behavior as it directly benefits large numbers of individuals in need of transfusions by saving their lives. Therefore, ensuring sufficient supplies of this *gift of life*[1] is crucial for every country. Unfortunately, however, many countries still face blood shortages (Gao, 2018; Erickson, 2018), particularly during periods of decreased donor availability, such as in summer and early winter (Gilcher, & McCombs, 2005; McCarthy, 2007; Pitocco & Sexton, 2005; Goette, Stutzer, Yavuzcan, & Frey, 2009).

Blood donation services typically follow the World Health Organization's recommendation (WHO, 1983) to ensure a safe and sustainable blood supply based solely on voluntary non-remunerated blood donations (Misje, Bosnes, Gåsdal, & Heier, 2005; Goette & Stutzer, 2020). Thus, these services rely on the effectiveness of different donor recruitment interventions[2]. Since non-remunerated donors' decisions to donate blood depend largely on their

[1] Blood started to be an *alienable* commodity after developments in transfusion medicine enabled civilians to donate blood to injured soldiers in World War II. At that time, blood donation was promoted among civilians as an opportunity to give *the gift of life* (Charbonneau, & Smith, 2015).

[2] The most commonly used recruitment strategies are phone calls, SMS messages, letters, or blood drives in donors' neighborhoods or office spaces, and they usually differ in how the call for blood donation is framed; whether it invokes donors' altruistic motives, boosts their self-esteem, reminds them of the personal health benefits of blood donation, or similar.

prosocial motivations, it is important to understand what types of interventions may encourage their participation rates, and whether these should be tailored to specific donor characteristics, such as gender or age.

In the framework of *Identity Theory* (Akerlof & Kranton, 2000), gender is one of the social categories people belong to and identify with. It is also among the first characteristics we observe when we see another person (Niederle, 2014). There are numerous studies showing that social categorization motivates in-group favoritism, defined as the tendency to favor members of one's own group over those in other groups (Tajfel, 1969; Tajfel, Billig, Bundy, & Flament, 1971; Hogg, Turner, Nascimento-Schulze, & Spriggs, 1986; Everett, Faber, & Crockett, 2015). In-group favoritism has been tested in different contexts, including altruistic behavior. For example, when the dictator game was implemented on Serbs, Croats, and Muslims in postwar Bosnia and Herzegovina, participants exercised preferential in-group treatment to people of the same ethnicity (Whitt & Wilson, 2007). Further, Chen and Li (2009) demonstrated that participants in a laboratory experiment evinced an increase in charitable concerns when matched with an in-, as opposed to an out-group member. In other words, participants were more altruistic towards an in-group match. Moreover, in Eckel & Grossman's (2001) study, when matched with another woman, women were less likely to reject the offer in an ultimatum game.

In this paper, I address the question of whether gender is deeply rooted in one's identity when it comes to prosocial behavior, in particular when donating blood. By making the recipient's gender salient in a letter soliciting blood donation, I examine the influence of decreased social

distance between a donor and a recipient on blood donation behavior[3]. My main contribution is to complement the existing laboratory evidence by testing, in an important field setting where people make decisions that can have life-saving consequences, whether gender-based discrimination in altruism exists in high-stake environments.

Motivated by the literature on group identity and in-group favoritism (Akerlof & Kranton, 2000, 2005, 2010; Tajfel, 1969; Tajfel, Billig, Bundy, & Flament, 1971), I exogenously manipulate the signal of a blood recipient's gender in letters soliciting blood donation. In particular, I ask sampled donors to come to donate blood for someone like Ruzdija (a potential male recipient) or Saliha (a potential female recipient)[4] in a one-month period. Ruzdija and Saliha are real people who receive blood on a weekly basis and who agreed to take part in this study by allowing their name, photograph, and anamnesis to be used when framing the letter soliciting blood donation. In essence, I was interested in whether donors are more willing to come to donate blood to someone with whom they share the same gender. To additionally vary the social distance between donor and recipient, I study another category of identity – age (Ruzdija and Saliha are between 50 and 60 years old). Thus, I designed the experiment to test whether being more similar to the recipient in terms of gender and age influences donors' participation rates.

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[3] My design is related to Jurajda and Janhuba (2018), who used random assignment of advisors to clients, and varied advisers' gender, in one financial institution to study the effects of advisor gender on the probability of mortgage issuance. They find that male advisors issue more mortgages to arguably riskier male clients than female advisors. Similarly to Jurajda and Janhuba (2018), I use a random assignment of blood donors, while varying the gender of blood recipients; however, I apply this approach to study social behavior.

[4] In addition to recruiting real people in need of blood to be part of my study, I ensured that no deception was used in this experiment by asking donors to donate to someone like Saliha and Ruzdija, knowing that the donor could not be sure that his/her blood would be compatible with Saliha's or Ruzdija's blood.

I conducted this field experiment in the summer of 2014 in partnership with the Federal Institute of Transfusion Medicine in Bosnia and Herzegovina. I sent letters soliciting blood donation to seven hundred and forty-six randomly chosen whole blood donors from the Institute's database. I decided to sample pre-registered donors, based on recommendations from the literature concerning the quality of the blood collected and the smaller incidence of deferrals (Costa-Font, Jofre-Bonet, and Yen, 2011; Reikvam, Svendheim, Røsvik, & Hervig, 2012). Pre-registered donors are those who have donated blood at least once in their life. An additional benefit of sampling pre-registered donors, instead of first-time donors, is the ability to perform a heterogeneity analysis on the influence of my treatments, depending on the individual's donation frequency. It is also interesting to identify whether in-group bias will be more prominent among donors who have just started donating blood, and who may need to be motivated to continue to do so, or among more experienced donors.

My results show that donors prefer donating to the same gender. In particular, male donors were eighty-five percent more likely to donate when the potential blood recipient was also male, rather than female. The effect was strongest in the case of young male donors. For female donors, I find a qualitatively similar pattern, i.e. favoritism of female donors for a female recipient, but the effect is smaller in magnitude (51%) and not statistically significant. I further show that decreasing social distance in terms of the donor's and recipient's age does not seem to have any significant effect.

By documenting the presence of gender-based favoritism in the decision to donate blood, my results should help in understanding who gives blood and what influences their behavior. This understanding may prove helpful in targeting more effective campaigns to increase blood

donations. Additionaly, studying the various motivations behind blood donations can be useful for understanding a wider class of prosocial behaviors (Bruhin, Goette, Haenni, & Jiang, 2015).

This paper relates to the literature on altruism, charitable giving, and the provision of public goods (Andreoni, 1990; Bolton, & Katok, 1995). Ours is the first study to exogenously manipulate the signal of a blood recipient's gender in letters soliciting blood donation, thereby documenting that gender-based favoritism is an important motive for donors. Previous work has focused on other types of incentives to donate blood, including financial incentives (Lacetera & Macis, 2010; Lacetera, Macis, & Slonim, 2014), lottery tickets (Goette & Stutzer, 2020), a paid day off work conditioned on making a blood donation (Lacetera & Macis, 2012), and similar. There are, however, numerous blood donation services which are required by law[5] to collect donations solely from voluntary and non-remunerated blood donors. As such, these blood donation services can only use motivational nudges that are not considered to be remunerative. Non-remunerative nudges that have been shown to be effective in motivating blood donors include a reminder of the need for blood in the form of letters soliciting blood donation (Essay 1), sending blood donors a text message when their donation was used to help a patient (Fosgaard et al., 2019) and publication in the local newspaper of the names of repeat donors who received a medal after making a certain number of donations (Lacetera & Macis, 2008). In my study, I suggest that bringing potential blood recipients closer to the donor using their gender identities can also serve as a nudge for increasing donors' participation rates.

[5] For example, under the Federation of Bosnia and Herzegovina's Law on Blood and Blood Components, all blood collections in the Federation of Bosnia and Herzegovina should be based on 100 per cent voluntary non-remunerated blood donations (http://www.fbihvlada.gov.ba/bosanski/zakoni/2010/zakoni/8bos.htm).

My treatments are motivated by *Identity Theory* (Akerlof, & Kranton, 2000, 2010), which explains that an individual's identity can influence choices, behaviors, and economic outcomes. By dividing oneself and others into social categories, people tend to behave differently depending on which particular social category they belong to. There are several studies that have applied identity models to explain different aspects of behavior. For example, Akerlof & Kranton (2005) argued that sharing a military identity allows lower wages to be paid in military organizations, with wages being traded off against military identity. According to the same authors, similar reasoning can be applied to any kind of work environment – if an employee identifies herself as part of the organization she works for, less monetary remuneration will be needed to perform her job well. Similarly, *Gender Identity*, defined as a personal perception of oneself as male or female (Howard, 2000), has been shown to play an important role in decision-making (Akerlof & Kranton, 2010). For example, it has been shown to motivate decisions about labor force participation, allocation of work within the household, and marriage formation in the case of aversion to a wife earning more than her husband (see, e.g., Fortin, 2015; Bertrand, 2011; Bertrand, Kamenica, & Pan, 2015; Cadsby, Servátka, & Song, 2013). I build on the above evidence by testing the importance of gender identity in altruistic behavior, in particular in the case of blood donations.

2.2. Empirical Setup

The randomized field experiment was conducted in August and September 2014 in cooperation with the Federal Institute of Transfusion Medicine in Bosnia and Herzegovina (henceforth, the Institute). The Institute collects and supplies blood for use in transfusions in the Federation of Bosnia and Herzegovina and conforms to the country's Law on Blood and Blood Components, which restricts people younger than 18 and older than 65 from donating blood and limits the frequency of blood donations to four times a year for male donors, and three times a year for female donors. The Institute collects blood from 100 per cent voluntary non-remunerated blood donations[6], and the most common manner for recruiting regular blood donors is a phone call. The person who will receive the blood is not usually identified during the recruitment phone call.

2.2.1. Experimental Design

The target group consisted of blood donors who had already given blood at least once at the Institute[7]. The data used in this study is a subset of data collected in a large-scale field experiment that tested the effectiveness of a reminder in the form of a letter soliciting blood donation, and the influence of frames used to invoke higher levels of empathy and altruistic motives on the willingness to donate blood (Essay 1). In this study, donors were randomly sampled

[6] Note that there is an exception in the case of emergency replacements, which are minimal. Further, according to the Federation of Bosnia and Herzegovina's Law on Blood and Blood Components, blood donors are eligible for a paid day off in exchange for donation; however, most of the donors do not use this benefit (e.g., their employer does not allow for it, they are students, and similar).

[7] I excluded blood donors who were not eligible to donate due to the time that has to elapse between two donations defined in the Federation of Bosnia and Herzegovina's Law on Blood and Blood Components.

into 8 groups – a control group and seven treatment groups, which received letters differing in terms of goal framing, whether a potential blood recipient was identified or not, and when identified – in the gender of a potential blood recipient.

This present study concentrates on the random sample of blood donors who received the letter soliciting blood donations that identify a potential blood recipient. This sample was randomly divided into two groups - the first received a letter describing a potential female blood recipient, while the second received a letter identifying a potential male recipient. The letters and their translation from Bosnian-Serbo-Croatian to English are in Appendix A.2. The potential blood recipients identified in the letters, Ruzdija (male) and Saliha (female), agreed to participate in the study and to share the information about their health issues. Thus, the letter contained Ruzdija's and Saliha's names, surnames, photographs, and short stories about their health issues, revealing why they need blood on a regular basis. I ensured that Ruzdija and Saliha were as similar as possible regarding other characteristics that might influence donor decisions, such as religion (both were Muslim), nationality (Bosniaks), age (50-60), and the disease they suffer from (myelodysplastic syndrome)[8].

Importantly, the blood donors were not aware that a study was being conducted. If they had been aware that they were receiving different recruitment interventions, they might have changed their behavior (Levitt and List, 2008; List, 2008). Finally, the fact that the blood donation

[8] According to Ma, Does, Raza, & Mayne (2007), the distribution of myelodysplastic syndrome is more prevalent among men in comparison to women (4.5 vs 2.7 per 100,000 people per year). However, I believe that Bosnian donors are not aware of these findings and this should not bias my results.

letters were mailed privately to the donors ensured that public image concerns were excluded from this experiment.

Several days before the beginning of each month, randomly chosen donors from two treatment groups were sent a letter with a recommended period of one month to donate blood. 824 donors were sampled, of which 746 received the letter. The difference in the numbers is due to changes of postal address (some donors who were invited did not receive the letter) and because some donors gave blood during the month in which the experiment was in preparation. The results are not sensitive to the exclusion of these donors.

Additional data about donors (gender, age, etc.) were collected using a simple questionnaire that is usually given prior to blood donation. Table A2.1. in Appendix A.2. shows the demographic characteristics of the blood donors sampled, and Table A2.2. in Appendix A.2. shows descriptive statistics.

Further checks were performed to verify that randomization had produced a balance of other various characteristics across experimental groups; namely balance t-tests of baseline observables (See Tables A2.3. and A2.4. in Appendix A.2.) and an F test for joint orthogonality (Table A2.5. in Appendix A.2.). The equivalence of experimental groups was not satisfied in the case of certain blood types, such as: 0 negative, 0 positive, and B positive blood types. In the case of this study, the blood types distinction is not likely to play a significant role in explaining the outcome variable. Further, my results are robust to controlling for blood types.

2.2.2. Empirical Strategy

Since the dependent variable of interest is a binary variable ($Presenting\_to\_Donate$)[9], I use linear probability models (LPM) to test my hypotheses. One of the main reasons I have chosen LPM models over Probit models is the latter's inconvenience when interpreting interaction effects. Further, I use standard heteroskedasticity-robust standard errors to address the potential issue of heteroskedasticity (Wooldridge, 2010). Likewise, I examine if some of the OLS fitted values are not between zero and one to address another potential shortfall of the LPM. Finally, I check the robustness of the results to the model specification using a Probit model.

I test if being of the same gender as the recipient will induce more male donors to donate blood with the model below:

$$Presenting\_to\_donate_i = \alpha_0 + \alpha_1 MaleDonor_i + \alpha_2 MaleRecipient_i +$$

$$\alpha_3 MaleDonor_i * MaleRecipient_i + \boldsymbol{\alpha^T X_i} + \varepsilon_i$$

$Presenting\_to\_donate$ is a binary variable that is equal to 1 if the donor came to donate blood within a one month period, and 0 otherwise. Similarly, $MaleDonor$ is a binary variable equal to 1 if the donor's gender is male and 0 if female, while $MaleRecipient$ is equal to 1 if the potential blood recipient identified in the letter soliciting blood donation is male, and 0 for female. α_3, the coefficient in front of the interaction term, is my coefficient of interest, capturing the gender-based favoritism. Further, $\boldsymbol{\alpha}$ is the vector of coefficients of the following covariates: age, the number of times a person has donated blood, dummy variables for each combination of ABO

[9] Note that I use *Presenting to donate* when naming my dependent variable due to the fact that although not every donor will meet the criteria for donation, his or her willingness to give blood will be counted.

blood type and Rh status, and a dummy variable for proximity to the Institute. $\boldsymbol{X_i}$ is the vector of the covariates and ε_i is the error term.

Further, I test if being more similar to a potential recipient in terms of both gender and age will foster male donors' participation rates.

$$
\begin{aligned}
&Presenting\_to\_Donate_i \\
&= \beta_0 + \beta_1 MaleDonor_i + \beta_2 MaleRecipient_i \\
&+ \quad \beta_3 SimialarAge_i + \beta_4 MaleDonor_i * MaleRecipient_i \\
&+ \quad \beta_5 MaleDonor_i * SimilarAge_i + \beta_6 MaleRecipient_i * SimilarAge_i \\
&+ \quad \beta_7 MaleDonor_i * MaleRecipient_i * SimilarAge_i + \boldsymbol{\beta^T X_i} + \eta_i
\end{aligned}
$$

$SimilarAge$ is a binary variable equal to 1 if both donor and recipient were 50 to 60 years old, and 0 otherwise. In contrast to gender, the age of the potential blood recipient was not experimentally manipulated. Both potential recipients were between 50 and 60 years old. Since my donor pool consisted of donors older than 18 and younger than 67, I was able to match donors of a similar age to the potential blood recipient. Further, I conducted robustness checks, using different age intervals when checking the influence of decreased social distance in terms of donor and recipient age on donation behavior. $\beta_3 + \beta_5 MaleDonor_i + \beta_6 MaleRecipient_i + \beta_7 MaleDonor_i * MaleRecipient_i$ should yield the average effect of the donor and recipient being of similar age on the probability of presenting to donate blood. Coefficient β_7, the coefficient of the three-way interaction term from the equation above is the coefficient of interest. It should tell if being of similar age, in addition to sharing a gender identity with the potential blood recipient has a significantly different influence on presenting to donate blood than being of different age but still sharing a gender identity. In other words, it represents an additive effect of donors sharing

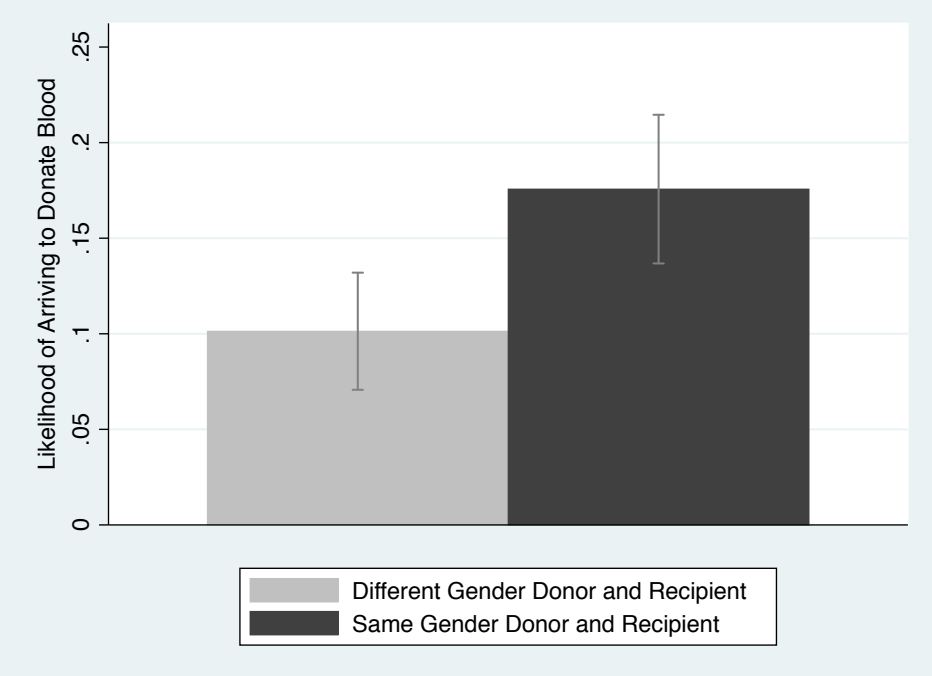
both age and gender identity with a potential blood recipient. Further, $\boldsymbol{\beta}$ is the vector of coefficients of the following covariates: age, the number of times a person has donated blood, dummy variables for each combination of ABO blood type and Rh status, and a dummy variable for proximity to the Institute. Lastly, η_i = error term.

2.3.Results

On average, the response rate for arriving to donate blood after receiving the letter soliciting blood donation mentioning either a male or female blood recipient was 13.83%. Further, of those who presented, 63% were donors whose gender was matched with the recipient's gender.

Donors were 7.43 percentage points (73%) more likely to come to donate blood to a same-gender, rather than an opposite-gender recipient within a one month period of receiving the letter (see Figure 1. and the first two columns in Table 1.). This relationship was statistically significant at the 1% level.

Figure 1. Gender-based favoritism



Note that this *gender-match effect* is larger in size than the effect obtained in Essay 1, where donors were 6.44 percentage points more likely to come to donate blood after receiving the simple reminder letter soliciting blood donation. A more comprehensive review on the effect sizes from different incentives that were shown to be effective in increasing blood donations can be found in Table A2.6. in Appendix A.2.

Table 1. Likelihood of donor arrivals depending on the recipient's gender

	(1) Donor presented to donate blood (=1)	(2) Donor presented to donate blood (=1)	(3) Donor presented to donate blood (=1)	(4) Donor presented to donate blood (=1)	(5) Donor presented to donate blood (=1)
Same gender donor and recipient	0.0743***	0.0788***			
	(0.0252)	(0.0249)			
Male donor			0.0450*	-0.0255	-0.0219
			(0.0251)	(0.0352)	(0.0312)
Male recipient			0.0366	-0.0454	-0.0360
			(0.0253)	(0.0363)	(0.0302)
Interaction (Male donor x Male recipient)				0.139***	0.116***
				(0.0500)	(0.0429)
Control variables [a]	Not included	Included	Not included	Not included	Included
Constant	0.101***	0.177	0.0931***	0.135***	0.199**
	(0.0156)	(0.108)	(0.0234)	(0.0282)	(0.0999)
Observations	745	745	745	745	745
R-squared	0.012	0.085	0.007	0.017	0.305

Notes: The first two columns in Table 1. show donor presenting after being nudged with the letter soliciting blood donation mentioning a blood recipient of the same or different gender. Columns 3-5 show donor arrivals after being nudged with the letter soliciting blood donation mentioning a male blood recipient. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: age; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times the donor has donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Both male and female donors preferred to donate to a recipient of the same gender; however, the difference between arriving to donate to the same in comparison to the opposite gender was significant (and larger) in the case of male donors (Figure 2., the last 3 columns in Table 1., and table A2.7. in Appendix A.2.).

This *gender-match effect* among donors may be contributed to the salience; perhaps donors pay more attention to information on a person of the same gender. Another possible explanation

would be that donors believe that their donation may have a better outcome if it is given to a recipient of the same gender, as in the case of gender matches in transplant outcomes (Zeier, Döhler, Opelz, & Ritz, 2002; Lai, et al.,2018).

Figure 2. Likelihood of donors' arrival depending on the recipient's gender

The results are robust to using alternative estimators. Probit models are presented in Tables A2.8., A2.9., and A2.10. in Appendix 2.A. In the subsequent paragraphs, I provide a more nuanced presentation of these results.

By adding *Male donor* (a dummy variable which is equal to 1 for male donors), and *Male recipient* (a dummy variable which is equal to 1 for male recipients) to the model (column 3 in Table 1.), I found that more male donors came to donate blood in the reporting period. Pointedly,

the variable *Male donor* was significant at the 10% significance level with a positive sign. This result is not surprising as it is usually the case that men give blood more frequently than women, due to women's medical limitations. In particular, on average, women have lower levels of iron and lower body weight than men, making them more likely to defer (Davey, 2004; Bianco et al., 2002). Further, women experience more difficulties when their blood is drawn than men, such as fatigue and arm discomfort (Newman, Pichette, Pichette, & Dzaka, 2003), and they are more susceptible to vasovagal reactions[10] (Madrona, Herrera, Jiménez, Giraldo, & Campos, 2014). Moreover, pregnancy and breastfeeding restrict women from donating.

Further, when the interaction term of interest (interacting *Male donor* and *Male recipient)* was added (column 4, Table 1.), the variable *Male donor* becomes insignificant. Thus, in this case the prevalence of male donors coming to donate was mostly driven by gender-based favoritism – coming to donate to the male recipient. Similarly, Table A2.7. in Appendix A.2. illustrates that male donors were 9.31 (9.89 when including covariates) percentage points more likely to come to donate blood when the male recipient was described in the letter, as opposed to the female recipient. This relationship was statistically significant at the 1% level.

A review of behavioral economics literature shows that men demonstrating favoritism towards other men is not specific to blood donors. A correspondence study by Erlandsson (2019) confirmed the existence of pro-male bias on the Swedish labor market. Male recruiters contacted male applicants more often than female applicants. Similarly, in their field experiment, Coffman, Exley, & Niederle (2017) showed that when women were making a hiring decision, women were

[10] A vasovagal reaction is sudden dizziness or loss of consciousness that can be triggered by pain, fright, or trauma.

hired 50 percent of the time, yet when men were making a hiring decision, women had only a 40 percent chance of being hired.

There are several concerns that should be addressed before continuing with the interpretation of other results. One concern is that the photograph enclosed in the letter soliciting blood donation might have signaled more than just the gender of the recipient. For example, one could argue that more male donors presented to donate to the male blood recipient (Ruzdija) because his poor medical condition was more transparent in his photograph than that of the female blood recipient (Saliha). If that were the case, then logically more of both female and male donors should have presented to donate to Ruzdija, which we do not see. In the third model in Table 1., a positive, yet insignificant coefficient in front of the *Male recipient* variable shows that this was not the case, as when pooling together male and female donors, we can see that together they were not more prone to donate blood to Ruzdija.

Another concern is that Ruzdija's appearance indicated that he is in more need of blood than Saliha. Further, the fact that more donors did not arrive in the first week to donate to Ruzdija (Table 2.) serves as evidence that they did not perceive that Ruzdija was experiencing a greater need for blood than Saliha.[11]

[11] It is noteworthy that Cable & Edgren (2017) argue that receiving a transfusion from a donor who was pregnant, compared with a male donor or a female donor who was not pregnant, is associated with an increased risk of death among male recipients of transfusions but not among female recipients. However, these findings were published in 2017 and my experiment was conducted in 2014.

Table 2. Perception of one recipient experiencing a greater need for blood than the other

	(1) Donor presented to donate blood within the first week (=1)	(2) Donor presented to donate blood within the first week (=1)
Male recipient	-0.00154	-0.00679
	(0.0895)	(0.0856)
Female recipient	Reference category	Reference category
Control variables[a]	Not included	Included
Constant	0.273***	0.125
	(0.0678)	(0.212)
Observations	103	103
R-squared	0.000	0.244

Notes: Table 2. shows the comparison of donor arrivals within the first week from receiving the letter soliciting blood donation, with the arrivals in subsequent weeks conditional on the donor coming to donate in the experimental period. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: age; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute, and the number of times the donor had donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

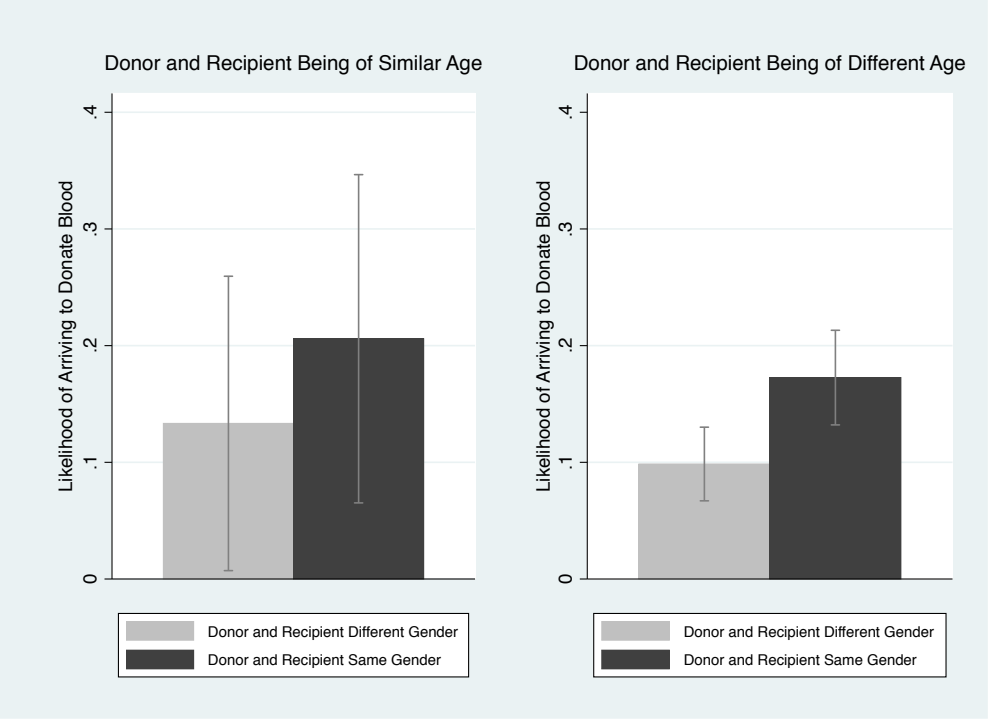
An easy back-of-the-envelope calculation shows that if all, rather than only a random subsample of male donors from my sample, had received the letter soliciting blood donation mentioning a male blood recipient, around 30% more donations would have been given by male donors (89 instead of 69).

I follow sampled donors in the next 10 (9) months to understand whether the gender-based favouritism I observed in the short run (one month after the intervention) persists in the long run (9 to 10 months after the intervention). Blood donors who were sent the letter with a potential blood recipient of the same gender were slightly more likely to come to donate exactly once in the next 10 (9) months period (see Table A2.11. in Appendix A.2.) In comparison to the short run, gender-based favouritism was not more pronounced in the case of male donors 10 (9) months after the intervention (Table A2.12. in Appendix A.2). More male donors came, but this could be

attributed to the frequency allowed by the Federation of Bosnia and Herzegovina's Law on Blood and Blood Components, under which male donors can donate 4 times a year and female only three.

In contrast to gender identity, age identity appears to have relatively little effect on increasing donors' participation rates (Figure 3. and Table 3.).

Figure 3. Likelihood of donor arrivals depending on whether or not they were in a similar age[12] group to the blood recipient



In other words, being of a similar age to a potential blood recipient did not seem to have a significant effect on arriving to donate blood. Here, it is important to mention one caveat of this result. Since the age of the potential blood recipient was not experimentally manipulated – both

[12] Here, similar group means donors and recipients being 50 to 60 years old.

recipients were of similar age (50 to 60 years old), this analysis essentially represents a comparison of responses across cohorts of donors. Therefore, I advise the reader to perceive the estimates of age identity as more tentative.

In addition, decreasing the social distance between the donor and recipient by interacting both gender and age of the donor and recipient did not seem to have an additive effect.

Table 3. Donor arrivals depending on whether or not they were of the same gender and in a similar age group to the blood recipient

VARIABLES	(1) Donor presented to donate blood (=1)	(2) Donor presented to donate blood (=1)
Similar age donor and recipient	-0.0107	-0.0108
	(0.121)	(0.134)
Male donor	-0.0302	-0.0460
	(0.0364)	(0.0358)
Male recipient	-0.0467	-0.0425
	(0.0375)	(0.0360)
Male donor x Male recipient	0.140***	0.152***
	(0.0521)	(0.0509)
Male donor x Similar age donor and recipient	0.0552	0.0411
	(0.147)	(0.159)
Male recipient x Similar age donor and recipient	0.0217	0.0344
	(0.156)	(0.165)
Male donor x Male recipient x Similar age donor and recipient	-0.0344	-0.0679
	(0.197)	(0.203)
Control variables[a]	Not included	Included
Constant	0.136***	0.242**
	(0.0291)	(0.104)
Observations	745	745
R-squared	0.017	0.088

Notes: Table 3. shows donor arrivals after being nudged with the letter soliciting blood donation mentioning either a male or female blood recipient. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute, and the number of times the donor had donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Further, the probability of arriving to donate blood to the male blood recipient decreased with the male donor's age when accounting for other differences among donors (Table A2.13. in Appendix A.2.).

Thus, younger male donors were the main drivers of the gender-based favoritism in blood donations (Table 4.).

Table 4. Male donor arrivals depending on their age

	(1) 18-21 years old	(2) 22-34 years old	(3) older than 35
Male recipient	0.0987*	0.165**	0.0141
	(0.0534)	(0.0636)	(0.0628)
Female recipient	Reference category	Reference category	Reference category
Control variables	Not included	Not included	Not included
Constant	0.0441*	0.115***	0.167***
	(0.0251)	(0.0364)	(0.0462)
Observations	124	153	149
R-squared	0.030	0.043	0.000

Notes: Dependent variable=1 if a male donor presented to donate blood. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Speculatively, it might be the case that younger donors' exposure to the war in Bosnia and Herzegovina (April 1992 - December 1995), which took 250,000 lives, during the sensitive phase of their social-emotional development[13] had influenced their bias to donate to someone with whom they share the same identity.

[13] Social-emotional development relates to intrapersonal and interpersonal capacities and experiences in childhood that form the foundation for subsequent personal behaviors and social interactions (Stepka & Callahan, 2016).

It has been shown that prosocial motivations develop during childhood (Fehr, Bernhard, & Rockenbach, 2008; Bauer, Chytilová, & Pertold-Gebicka, 2014). Further, war can have an effect on prosocial behavior towards the same identity group (Bauer, Cassar, Chytilová, & Henrich, 2014; Bauer, Blattman, Chytilová, Henrich, Miguel, & Mitts, 2016). The 22-year-old donors were born when the war started and the 34-years-old donors were 12 years old at that time (see 2nd column in Table 4.). Thus, I can speculate that they could have internalized much of their social behavior during their wartime childhood.

As a robustness check, I used different age intervals in the analysis (see Table A2.14. in Appendix A.2.). In addition to donors who experienced war during the sensitive phase of their social-emotional development, the influence of gender-based favoritism on the decision to donate was present among the youngest donors, who were 18 and 19 when this study was conducted. This may provide further evidence of in-group favoritism being pronounced in the teenage years (Fehr, Glätzle-Rützler, & Sutter, 2013).

Lastly, the presence of gender bias in blood donations was the most pronounced in the case of male donors with the highest donation frequency – those who had donated more than 10 times in their life time (Table 5). I control for the age of a donor, since there is an age limit that prevents donors from donating when they are younger than 18. Thus, in comparison to older donors, someone who is younger has not had equal opportunities of time span to donate blood a similar number of times.

Table 5. Donor arrivals to donate to the same gender recipient depending on donation frequency

	Male donor			Female donor		
VARIABLES	Rare donor presented to donate blood (=1)	Occasional donor presented to donate blood (=1)	Frequent donor presented to donate blood (=1)	Rare donor presented to donate blood (=1)	Occasional donor presented to donate blood (=1)	Frequent donor presented to donate blood (=1)
Male recipient	0.0911**	0.0618	0.146*			
	(0.0406)	(0.0641)	(0.0752)			
Female recipient				0.0317	0.0221	0.136
				(0.0463)	(0.0629)	(0.128)
Age	-0.00121	-0.00110	-0.00619*	-0.000511	-0.00283	-0.00383
	(0.00136)	(0.00297)	(0.00325)	(0.00365)	(0.00259)	(0.00565)
Constant	0.0511	0.195*	0.407***	0.0922	0.183*	0.273
	(0.0323)	(0.0996)	(0.142)	(0.0848)	(0.0999)	(0.224)
Observations	161	157	123	166	102	36
R-squared	0.033	0.007	0.052	0.003	0.011	0.047

Notes: In my categorization, 'rare donor' represents a donor who had donated blood fewer than 3 times in his/her lifetime. Similarly, 'occasional donor' is a donor who had donated blood more than 3 times and less than 10 times in his/her lifetime. Lastly, 'frequent donor' refers to a donor who had donated blood more than 10 times in his/her lifetime. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

2.4. Conclusion

This paper establishes strong evidence of in-group favoritism based on gender. Further, it provides support for the view that gender identity plays an important role in people's decisions, including those with high stakes, such as a lifesaving decision to donate blood.

I conducted a field experiment with 746 blood donors from Bosnia and Herzegovina in which I exogenously manipulated the signal of the blood recipient's gender by disclosing the recipient's name and photograph, as well as the history of his/her disease in letters soliciting blood donation.

Donors were seventy-three percent more likely to donate if they received a letter indicating a blood recipient of the same gender. Favoritism towards the donor's own gender was more pronounced among male donors. At the same time, decreasing the social distance in terms of the donor's and recipient's age did not seem to have a significant effect.

Although it is important to know how to motivate established donors to give blood in order to maintain a wide base of willing donors (Goette & Stutzer, 2020), a natural open question is whether these findings can be generalized to first-time donors. It is also noteworthy that this study was implemented in a post-war country, and my results might be country-specific if war strengthens narrow group identities. Thus, it would be interesting to investigate whether my results could be replicated in another country, particularly in one that had not recently been exposed to a war.

In many countries that are in compliance with the World Health Organization (WHO) recommendation on how to ensure a safe and sustainable blood supply (WHO, 1983), the supply

of blood is reliant solely on non-remunerated blood donors. In addition to blood donation being perishable, it is difficult to predict blood demands. Thus, transfusion services in those countries are in need of finding effective recruitment strategies and nudges that are not considered to be remuneration for blood given, yet would motivate blood donors to come to donate. I demonstrate that male and female donors behaved differently to a nudge in the form of a letter that contained a request to donate blood to a specific person. For both male and female donors, matching their gender with the potential blood recipient induced more blood donations. In identifying that gender-based favoritism has an influence on the decision to give blood, my results have implications for designing better recruitment strategies to increase blood donors' participation rates. A policy recommendation for blood donation centers would be to take into account donor group attributes when designing recruitment campaigns.

A.2. Appendix

Examples of letters

Letter number 1: Female Blood Recipient

NEKOME JE POMOĆ POTREBNA ODMAH

Da Salihin život pobijedi!

Poštovani darivaoče krvi,

htjeli bismo da Vas ponovo zamolimo da darujete krv.

Saliha boluje od mijelodisplastičnog sindroma (MDS) i ***živi uz pomoć dobročinstva darivalaca krvi****.*

Tokom ljetnog perioda moguće je smanjenje dostupnih doza krvi. Smanjenje nastaje usljed manjeg broja darivalaca koji dolaze darivati krv u periodu raspusta i godišnjih odmora.

Ukoliko možete i želite da darujete krv u ljetnom periodu i pri tome ***spasite život osobama poput Salihe****, molimo Vas da dođete u Zavod za transfuzijsku medicinu Federacije BiH.*

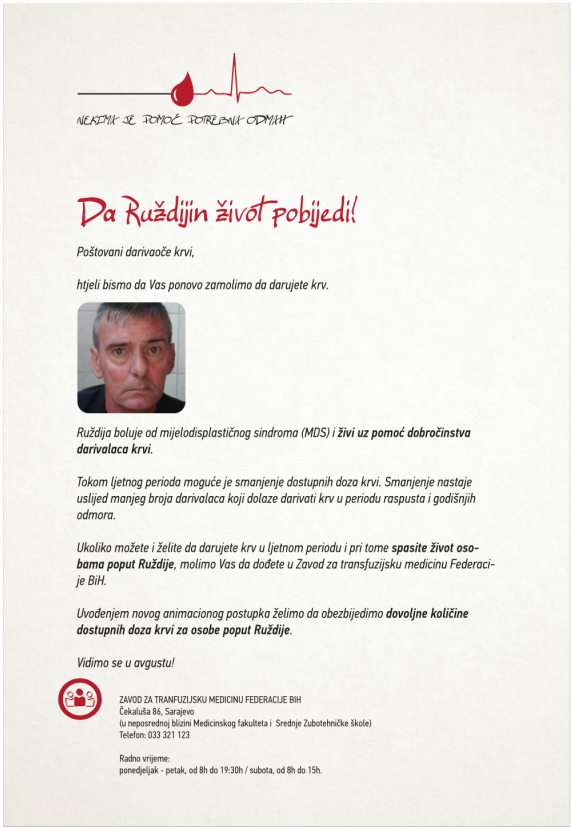
Uvođenjem novog animacionog postupka želimo da obezbijedimo ***dovoljne količine dostupnih doza krvi za osobe poput Salihe****.*

Vidimo se u avgustu!

ZAVOD ZA TRANFUZIJSKU MEDICINU FEDERACIJE BIH
Čekaluša 86, Sarajevo
(u neposrednoj blizini Medicinskog fakulteta i Srednje Zubotehničke škole)
Telefon: 033 321 123

Radno vrijeme:
ponedjeljak – petak, od 8h do 19:30h / subota, od 8h do 15h.

Letter number 2: Male Blood Recipient



NEKOME JE POMOĆ POTREBNA ODMAH

Da Ruždijin život pobijedi!

Poštovani darivaoče krvi,

htjeli bismo da Vas ponovo zamolimo da darujete krv.

Ruždija boluje od mijelodisplastičnog sindroma (MDS) i ***živi uz pomoć dobročinstva darivalaca krvi****.*

Tokom ljetnog perioda moguće je smanjenje dostupnih doza krvi. Smanjenje nastaje usljed manjeg broja darivalaca koji dolaze darivati krv u periodu raspusta i godišnjih odmora.

Ukoliko možete i želite da darujete krv u ljetnom periodu i pri tome ***spasite život osobama poput Ruždije****, molimo Vas da dođete u Zavod za transfuzijsku medicinu Federacije BiH.*

Uvođenjem novog animacionog postupka želimo da obezbijedimo ***dovoljne količine dostupnih doza krvi za osobe poput Ruždije****.*

Vidimo se u avgustu!

ZAVOD ZA TRANFUZIJSKU MEDICINU FEDERACIJE BIH
Čekaluša 86, Sarajevo
(u neposrednoj blizini Medicinskog fakulteta i Srednje Zubotehničke škole)
Telefon: 033 321 123

Radno vrijeme:
ponedjeljak – petak, od 8h do 19:30h / subota, od 8h do 15h.

Translation of letters from Bosnian/Croatian/Serbian to English (both letters had the same main design and logo, but different wording):

Letter number 1: Female Blood Recipient	Letter number 2: Male Blood Recipient
The title: Let Saliha's life win!	**The title:** Let Ruzdija's life win!
Dear blood donor,	Dear blood donor,
We would like to again ask you to donate blood.	We would like to again ask you to donate blood.
Saliha's photograph	Ruzdija' photograph
Saliha suffers from myelodysplastic syndrome (MDS) and **she is alive thanks to blood donors' benevolence**.	Ruzdija suffers from myelodysplastic syndrome (MDS) and **he is alive thanks to blood donors' benevolence**.
The summer period is known as a period of potential blood shortages that arise due to fewer donors donating blood during the summer holiday season.	The summer period is known as a period of potential blood shortages that arise due to fewer donors donating blood during the summer holiday season.
If you can and want to give blood in the summer period and thereby **save the lives of people like Saliha**, please come to the Federal Institute of Transfusion Medicine.	If you can and want to give blood in the summer period and thereby **save the lives of people like Ruzdija**, please come to the Federal Institute of Transfusion Medicine.
By implementing a new recruitment strategy, we would like **to ensure sustainable blood reserves for people like Saliha.**	By implementing a new recruitment strategy, we would like **to ensure sustainable blood reserves for people like Ruzdija.**
See you in August (September)!	See you in August (September)!
Federal Institute of Transfusion Medicine	Federal Institute of Transfusion Medicine

Table A2.1. Donors' demographic characteristics

Variable	N	Percent
Gender		
Female	341	41.38
Male	483	58.62
Age Intervals		
18-19	233	28.28
20-31	316	38.35
32-	275	33.37
Blood type and RH factor		
0 negative	44	5.34
0 positive	223	27.06
A negative	45	5.46
A positive	215	26.09
B negative	16	1.94
B positive	87	10.56
AB negative	14	1.7
AB positive	29	3.52
Missing	151	18.33
Donation Frequency		
Rare Donors (up to 3 donations)	357	43.33
Occasional Donors (3-10 donations)	292	35.44
Frequent Donors (more than 10 donations)	175	21.24

Notes: Variable age interval is constructed in a way that ensures a similar number of donors per group.

Table A2.2. Descriptive Statistics

VARIABLES	Mean	Standard deviation	Min	Max	N
Presenting	0.137	0.344	0	1	824
Male donor	0.586	0.493	0	1	824
Male recipient	0.511	0.500	0	1	824
Age	29.24	11.97	18	67	824
Proximity	0.723	0.448	0	1	824
NMBDonations	8.034	14.73	0	155	823

Notes: Presenting is a binary variable that is equal to 1 if the donor presented to donate blood and 0 otherwise. *Male donor* is a binary variable equal to 1 if the donor's gender is male and 0 if female, while *Male recipient* is equal to 1 if the potential blood recipient from the letter soliciting blood donation is male, and 0 if female.

Table A2.3. Randomization check: ABO Blood Types and RH Factor

Blood types	0 negative	0 positive	A negative	A positive	B negative	B positive	AB negative	AB positive	Missing
Same gender donor and recipient	-0.0340**	-0.0413	-0.00243	0.0218	0.00485	-0.0121	0.0146	0.00728	0.0413
	(0.0156)	(0.0310)	(0.0159)	(0.0306)	(0.00962)	(0.0214)	(0.00900)	(0.0129)	(0.0269)
Different gender donor and recipient	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category
Constant	0.0704***	0.291***	0.0558***	0.250***	0.0170***	0.112***	0.00971**	0.0316***	0.163***
	(0.0126)	(0.0224)	(0.0113)	(0.0214)	(0.00637)	(0.0155)	(0.00484)	(0.00862)	(0.0182)
Observations	824	824	824	824	824	824	824	824	824

Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2.4. Randomization check: Demographic Characteristics

Demographic Characteristics	Gender	Age	Number of Donations	Worker	Student	Missing Occupation
Same gender donor and recipient	0.0218 (0.0343)	0.0534 (0.0546)	-0.0292 (1.027)	0.0121 (0.0309)	-0.0170 (0.0348)	0.00485 (0.0310)
Different gender donor and recipient	Reference category	Reference category	Reference category	Reference category	Reference category	Reference category
Constant	0.575*** (0.0244)	1.024*** (0.0390)	8.049*** (0.720)	0.262*** (0.0217)	0.468*** (0.0246)	0.269*** (0.0219)
Observations	824	824	823	824	824	824

Robust standard errors in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2.5. Randomization check: Test for joint orthogonality

Dependent variable=1 if the blood donor and blood recipient were of the same gender

VARIABLES	Donor and recipient are of same gender (=1)
Male donor	0.0257
	(0.0366)
Age	0.0459
	(0.0351)
Number of previous donations	-0.000310
	(0.00131)
Worker	0.00940
	(0.0475)
Student	0.0142
	(0.0576)
0 negative blood type	-0.249***
	(0.0878)
0 positive blood type	-0.123**
	(0.0562)
A negative blood type	-0.0976
	(0.0877)
A positive blood type	-0.0626
	(0.0558)
B negative blood type	0.00469
	(0.132)
B positive blood type	-0.117*
	(0.0701)
AB negative blood type	0.137
	(0.141)
AB positive blood type	-0.0230
	(0.102)
Constant	0.510***
	(0.0749)
Observations	823
R-squared	0.018
F-test	1.161
Prob > F	0.304

Notes: Robust standard errors are in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2.6. Overview of effective interventions from field experiments with blood donors

Study	Country	Treatment (Incentive)	Effects
Lacetera, Macis, and Slonim (2011)	The United States	Rewards in the amount of 5 USD, 10 USD, or 15 USD	$5 dollar rewards increased the number of donations by 3.5 (0.06) percentage points, the $10 rewards increased donations by 6.9 (0.14) percentage points, and the $15 rewards increased donations by 9.5 (0.37) percentage points, for individuals with past history at the sites (no prior history at the sites).
Lacetera and Macis (2012)	Italy	One-day paid leave of absence to blood donors for giving blood	Employed donors made, on average, one extra blood donation per year, an increase of around 40 percent annually.
Lacetera, Macis, and Slonim (2012)	The United States	T-shirt, Coupon, Cedar Point Ticket (raffle), Cooler, Sweatshirt, Umbrella, Hat, 6-pack Cooler, Blanket, Scarf, Mug, Music Download Card, Jacket, Miscellaneous items	Offering material incentives led to 15–20 percent more donors presenting at the blood drive.
Iajya, Lacetera, Macis, and Slonim (2012)	Argentina	Supermarket vouchers of AR$60 and AR$100	Supermarket vouchers of AR$60 and AR$100 increased undirected donations to 0.5 and 1.1 percent, respectively, from a baseline of no undirected donations in the no-reward condition.
Leipnitz, Vries, Clement, and Mazar (2018)	Germany	Comprehensive blood health check	The health check treatment increased the probability of attending a donation by 33 percent compared to the standard invitation.
Goette and Stutzer (2020)	Switzerland	Lottery ticket from the Swiss State Lottery (value of lottery ticket = 5 CHF)	Lottery ticket increased donations by 5 percentage points (baseline donation rate was 42 percent).

Table A2.7. Likelihood of female vs. male donor arrivals depending on recipient gender

	(1) Male donor presented to donate blood (=1)	(2) Male donor presented to donate blood (=1)	(3) Female donor presented to donate blood (=1)	(4) Female donor presented to donate blood (=1)
Male recipient	0.0931***	0.0989***	-0.0369	-0.0342
	(0.0343)	(0.0350)	(0.0306)	(0.0283)
Female recipient	Reference category	Reference category	Reference category	Reference category
Control variables	Not included	Included	Not included	Included
Constant	0.110***	0.189	0.0946***	0.0177
	(0.0212)	(0.132)	(0.0241)	(0.0559)
Observations	441	441	304	304
R-squared	0.016	0.114	0.005	0.083

Notes: Table A2.7. shows female versus male donor arrivals after being nudged with the letter soliciting blood donation mentioning either a male or female blood recipient. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: age; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times the donor had donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1

Table A2.8. Marginal effects from probit estimates (main effects)

Gender-based favoritism

	(1) Donor presented to donate blood (=1)	(2) Donor presented to donate blood (=1)
Same gender donor and recipient	0.0744***	0.0794***
	(0.0253)	(0.0241)
Different gender donor and recipient	Reference category	Reference category
Control variables [a]	Not included	Included
Observations	745	745

Notes: Table A2.8. shows donor arrivals after being nudged with the letter soliciting blood donation mentioning the blood recipient of the same or different gender. Robust standard errors are reported in parentheses. [a] Control variables include: gender; age; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times the donor had donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2.9. Marginal effects from probit estimates (main effects)

Likelihood of male vs. female donor arrivals to donate to the male blood recipient

	(1) Male donor presented to donate blood (=1)	(2) Female donor presented to donate blood (=1)
Male recipient	0.0933***	-0.0453
	(0.0344)	(0.0363)
Female recipient	Reference category	Reference category
Control variables [a]	Not included	Not included
Observations	441	304

Notes: The first column in Table A2.9. shows male donor arrivals after being nudged with the letter soliciting blood donation mentioning a male blood recipient. The second column shows female donor arrivals after being nudged with the letter soliciting blood donation mentioning a male blood recipient. Robust standard errors are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2.10. Marginal effects from probit estimates (main effects)

Likelihood of donor arrivals depending on recipient gender

	(1) Donor presented to donate blood (=1)	(2) Donor presented to donate blood (=1)	(3) Donor presented to donate blood (=1)
Male donor	0.0445*	-0.0273	-0.0448
	(0.0261)	(0.0371)	(0.0356)
Male recipient	0.0350	-0.0519	-0.0441
	(0.0252)	(0.0414)	(0.0393)
Interaction (Male donor x Male recipient)		0.138***	0.143***
		(0.0522)	(0.0497)
Control variables[a]	Not included	Included	Included
Observations	745	745	745

Notes: Table A2.10. shows donor arrivals after being nudged with the letter soliciting blood donation mentioning either a male or female blood recipient. Robust standard errors are reported in parentheses. [a] Control variables include: gender; age; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times the donor had donated blood before. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2.11. The long run letter effect - Donors' presenting to donate in the 10 (9) months after the initial experiment

VARIABLES	(1) Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	(2) Donor presented to donate blood at least once in 10 (9) months after the initial experiment (=1)	(3) Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)	(4) Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)
Same gender donor and recipient	0.0299	0.0404	0.0423	0.0472*
	(0.0308)	(0.0300)	(0.0265)	(0.0263)
Different gender donor and recipient	Reference category	Reference category	Reference category	Reference category
Control variables[a]	Not included	Included	Not included	Included
Constant	0.213***	0.316**	0.133***	0.199*
	(0.0212)	(0.123)	(0.0176)	(0.109)
Observations	745	745	745	745
R-squared	0.001	0.077	0.003	0.038

Notes: Table A2.11. shows donor presenting to donate in the 10 (9) months after being nudged with the letter soliciting blood donation mentioning a blood recipient of the same or different gender. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times the donor had donated blood before, the month in which the donor donated blood the previous time. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2.12. The long run letter effect – Male donors' presenting to donate in the 10 (9) months after the initial experiment

	(1) Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)	(2) Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)	(3) Donor presented to donate blood exactly once in 10 (9) months after the initial experiment (=1)
Male donor	0.0555**	0.0177	0.00316
	(0.0262)	(0.0365)	(0.0375)
Male recipient	0.0309	-0.0130	-0.0123
	(0.0264)	(0.0377)	(0.0373)
Interaction (Male donor x Male recipient)		0.0741	0.0769
		(0.0523)	(0.0521)
Control variables [a]	Not included	Not included	Included
Constant	0.106***	0.128***	0.202*
	(0.0235)	(0.0276)	(0.111)
Observations	745	745	745
R-squared	0.007	0.010	0.049

Notes: Table A2.12. shows male donor presenting to donate in 10 (9) months period after being nudged with the letter soliciting blood donation mentioning a blood recipient of the same or different gender. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. [a] Control variables include: gender, age, four dummy variables for education (high school, university, in the process of obtaining a degree, and for missing data); nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; the number of times the donor had donated blood before, the month in which the donor donated blood the previous time. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2.13. Male donors' presenting to donate blood depending on their age

	(1) Donor presented to donate blood (=1)	(2) Donor presented to donate blood (=1)	(3) Donor presented to donate blood (=1)
Male recipient	0.0907***	0.196**	0.240***
	(0.0347)	(0.0879)	(0.0881)
Age	0.00127	0.00305*	0.00317*
	(0.00136)	(0.00182)	(0.00184)
Interaction (Male recipient x Age)		-0.00339	-0.00450*
		(0.00270)	(0.00270)
Control variables	Not included	Not included	Included
Constant	0.0711*	0.0172	0.110
	(0.0428)	(0.0532)	(0.137)
Observations	441	441	441
R-squared	0.018	0.022	0.120

Notes: The estimates are from the linear probability models. Robust standard errors in parentheses. [a] control variables: age; nine dummy variables for each combination of ABO blood type and Rh factor, and for missing data; dummy variable for proximity to the Institute; average number of donations. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

Table A2.14. Male donors' presenting to donate blood depending on their age – using different age intervals

VARIABLES	(1) 18 and 19 years old	(2) 20-24 years old	(3) 25-31 years old	(4) 32-41 years old	(5) 42- years old
Male recipient	0.108**	0.0864	0.188**	0.0738	0.0148
	(0.0528)	(0.0957)	(0.0829)	(0.0807)	(0.0783)
Female recipient	Reference category	Reference category	Reference category	Reference category	Reference category
Constant	0.0192	0.171***	0.0870**	0.118**	0.174***
	(0.0192)	(0.0596)	(0.0420)	(0.0560)	(0.0565)
Control variables	Not included	Not included	Not included	Not included	Not included
Observations	99	76	86	81	99
R-squared	0.045	0.011	0.061	0.010	0.000

Notes: Dependent variable=1 if the male donor presented to donate blood. The estimates are from the linear probability models. Robust standard errors are reported in parentheses. Significance levels: *** p<0.01, ** p<0.05, * p<0.1.

3. Biased Beliefs and the Academic Labor Market

3.1. Introduction

Pursuing a PhD and post-doctoral training are major human capital investments involving years of effort and considerable foregone earnings during the training period. The main benefit of these investments lies in subsequent career opportunities. A tenure-track faculty position - a job that comes with considerable non-monetary attributes in terms of prestige, autonomy and flexibility, if not with greater pay - requires a PhD, and in the case of natural and physical sciences, additional postdoctoral training.

However, starting an academic career, particularly in the natural sciences in the United States, has become difficult. In 2016, approximately 2,700 students graduated with a PhD degree in chemistry, yet there were only 152 advertised openings for chemistry faculty positions in U.S. research-intensive universities[1]. The share of PhD chemistry graduates that become faculty in a research-intensive university is around 5% or lower (Gaule & Piacentini, 2018). Similar patterns can be observed in physics and biology. Despite the low likelihood of ever becoming faculty, many graduate students pursue one or multiple postdocs after earning their doctorates.

The fact that the number of PhD graduates vastly exceeds the number of faculty openings in many STEM fields has not escaped the attention of the science policy community and has been the subject of recurring debates (e.g. Romer, 2000; Freeman, Weinstein, Marincola, Rosenbaum,

[1] Chemistry faculty positions are not advertised on a central platform. Instead, we rely on the results of a community effort to help applicants by identifying all relevant positions (see http://chemjobber.blogspot.com/).

& Solomon, 2001; Cyranoski, Gilbert, Ledford, Nayar, & Yahia, 2011; Schillebeeckx, Maricque, & Lewis, 2013; Alberts, Kirschner, Tilghman, & Varmus, 2014; Sauermann & Roach, 2016).

Why do young scientists keep choosing to pursue PhD and postdoctoral training despite the dwindling academic career prospects? One possibility is that postdoctoral training improves industry career prospects enough to be worthwhile even in the absence of academic career options[2]. Alternatively, the experience of training itself may be appealing to graduate students, as scientists are drawn to the puzzle-solving nature of doing science (Merton, 1973; Partha & David, 1994; Stern, 2004; Sauermann & Roach, 2012). Meanwhile, for foreigners, visa considerations may steer individuals not only towards graduate study, but also towards postdoctoral training, as universities are not subject to the same H1-B restrictions as private sector firms, which allows them to more easily remain in the U.S. (Stephan & Ma, 2005; Ganguli & Gaule, 2000; Amuedo-Dorantes & Delia-Furtado, 2019).

In this paper, we consider another factor that may contribute to the observed postdoctoral training choices: perhaps graduate students are not well informed about the state of the academic job market, and these incorrect beliefs play a role in their career decisions, particularly decisions to pursue postdoctoral training. Sauermann and Roach (2016) provide compelling survey evidence that individuals already in postdoc positions were indeed overly confident about their likelihood of getting an academic job, and that junior scientists who had already advanced beyond the PhD lacked information about non-academic career options. Yet whether providing information to graduate students would have a causal impact on subsequent career choices and preferences remains an open question.

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[2] For example, having completed postdoctoral training may have signaling or certification value on the labor market. Further, the knowledge gained through training may be applicable – and indeed highly valued - for working in industry (Aghion, Dewatripont, & Stein, 2008; Sauermann & Stephan, 2010; Sauermann & Roach, 2016).

In very different contexts, the economics literature has established that biased beliefs can drive human capital investment decisions and that providing information can causally impact subsequent educational choices (e.g. Jensen, 2010; Oreopoulos & Dunn 2013; Dinkelman & Martinez 2014; Wiswall & Zafar, 2015). In these studies, individuals typically underestimate the returns to education and thus underinvest in education or make sub-optimal education choices.

We consider whether, for advanced degrees in the natural and physical sciences, students are overly optimistic about their chances of becoming faculty, and whether providing objective information about these probabilities can have a causal impact on career aspirations, in particular preferences to do a postdoc and pursuing an academic career. We investigate these possibilities and their consequences among a sample of U.S. chemistry doctoral students at the top 54 U.S. Chemistry departments using an original survey combined with a field experiment[3]. In the baseline survey, we first elicit beliefs about the academic market and publishing, as well as career preferences for different types of post-graduation jobs, such as postdocs, industry, or teaching positions. At the end of the survey, a random subsample of respondents received a message with a link to a custom-built website providing information on actual historical placement records by institution (Treatment 1). Another subsample received a message with a link to a webpage from the American Chemical Society, the main professional society for chemists, listing profiles of professional scientists in both academic and industry occupations (Treatment 2). The last randomly drawn subsample, the control group, did not receive any message. One year after the baseline survey, we conducted a follow-up survey with the respondents of the baseline survey. In order to

[3] We focus on chemistry as this is a discipline where we are able to observe academic placements on a systematic and accurate basis thanks to the availability of a faculty directory (the ACS directory of graduate research). No comparable data exists for biology or physics. However, tight academic labor markets and long postdoctoral training are prevalent across the life and hard sciences.

track how beliefs changed over time and whether the information interventions caused differential adjustments in beliefs, we asked respondents the same questions about their expectations about the academic job market.

Our first result is that doctoral students in our sample are excessively optimistic, both about the state of the academic market in their field and about publishing in top journals. When we ask respondents to state their beliefs about the share of peers from their program eventually obtaining a tenure-track position in a U.S. research-intensive university, only a third of respondents have beliefs in the correct range, with the rest being either mildly or widely overoptimistic. Being overly optimistic in turn correlates with stated preferences for doing a postdoc and academic careers more generally.

Interestingly, respondents were more optimistic about their peers' chances of obtaining a tenure-track position in a research-intensive university than about their own chances. Similar to Sauermann and Roach (2016), who show that graduate students in older cohorts are less likely to plan on doing a postdoc and are less interested in academic careers, we find students further along in their programs are less likely to hold overoptimistic beliefs about their chances on the academic job market. Female students are more optimistic about the prospects of their peers, but not about their own chances of becoming faculty.

Turning to the experiment, we estimate the causal impact of each information intervention on beliefs and preferences for different careers. We find that the intervention using historical placement information led to a downward adjustment in beliefs about respondents' own chances of becoming faculty. Nevertheless, we observe no significant impact of either type of information on beliefs about the share of graduates from their program who will eventually become faculty.

We also examined impacts of the interventions on satisfaction with doing a PhD. We do not observe an effect of the historical information treatment (Treatment 1) on satisfaction with pursuing a PhD, but the ACS treatment (Tretament 2) did lead to small decline in satisfaction. Interestingly, we do find that the historical information treatment led to an increase in the perceived attractiveness of an academic career. To the extent that the historical placement information made respondents realize that becoming a faculty member is more difficult than they expected, this may have reinforced the perceived attractiveness of academic careers. The ACS treatment, meanwhile, increased the perceived attractiveness of government research and development positions and reduced the preference for doing a postdoc, suggesting that exposure to non-academic career options can impact career preferences.

We also examine longer-run outcomes by collecting data on actual placements for the subsample of students who completed their PhD after the baseline survey two years later. For this sample, we do not see any significant effects in their actual career choices, including doing a postdoc after the PhD.

In sum, we find that the beliefs of graduate students are often biased, and providing historically accurate information leads to an adjustment in their beliefs, especially among those who initially had higher beliefs. Moreover, providing less structured information about non-academic careers impacts preferences for those careers. Yet, these changes in beliefs lead to limited changes in career aspirations in the longer run, and we do not detect impacts on actual career outcomes. Taken together, the results raise further questions about the role of information in post-graduate human capital investments.

There are several possible reasons for the limited estimated effects on stated career aspirations and actual outcomes. First, it could be that other preferences known to drive scientists'

behavior (e.g. the puzzle-solving nature of science, or matters of prestige) are already quite strong at this point in training, so that there was minimal impact of the information on actual career preferences and choices. Second, given the sequential nature of educational choices, and that these are individuals who are already far along in their training trajectory with little option value, switching costs may be high (Stange, 2012). Third, the experience of going through postdoctoral training may be enjoyable in itself or may be desirable for visa or dual-career considerations. Finally, postdoctoral training is still valued in many industry and government positions.

While we cannot differentiate between these explanations in the current study, our findings nonetheless suggest that there is a strong rationale for departments to provide better career information, about both academic and non-academic careers, to prospective and actual students, and there seems to be demand for such information (Sauermann and Roach, 2016). Providing better information would ensure that the choices are made with full knowledge of what they imply, and the costs of collecting and sharing information on placements are low.

This paper also contributes to the growing literature on biased beliefs and overconfidence. Overconfidence has been documented to lead to hazardous decisions contributing to market bubbles, business failures, and even wars (Levy, 1983; March & Shapira, 1987; Camerer, Lovallo, 1999; Scheinkman & Xiong, 2003; Johnson & Fowler, 2011). The existence of biased beliefs has been documented across many domains, such as labor supply (Mueller, Spinnewijn, & Topa, 2018), the housing market (Armona, Fuster, & Zafar, 2016), risky behavior (Dupas, 2005), and returns to schooling (Bleemer & Zafar, 2018; Wiswall & Zafar, 2015; Loyalka et al., 2013). Notably, ours is the first study that investigates the existence of biased beliefs in the educational choice to pursue graduate studies, postdoctoral studies in particular, and estimates how these beliefs are impacted by the provision of objective information about the labor market.

The paper proceeds as follows. Section 2 explains the institutional context. Section 3 describes methodology and data. Section 4 presents the results, and we end with the discussion in Section 5.

3.2. Institutional Context

In this section, we discuss entry into scientific careers with a specific focus on chemistry and academic careers in the U.S. The entry into scientific careers is characterized by long periods of training; a PhD degree typically takes six years and is often followed by one or several postdocs[4]. The chemical and pharmaceutical industry, as well as the government, are major employers of chemistry PhD graduates, and graduates can enter industry positions before or after postdoctoral training. Despite these human capital investments into becoming a professional researcher, many doctoral degree holders employed in industry do not actually conduct research in their jobs (Lautz et al., 2018).

A necessary condition for becoming a tenure-track professor in chemistry at a research-intensive U.S university is earning a doctoral degree. However, in chemistry and other natural sciences, postdoctoral training has become a *de facto* additional pre-requisite, with direct transitions from obtaining a PhD degree to a tenure-track position essentially unheard of. In other words, to be a competitive candidate for faculty positions, postdoctoral training is crucial. As post-docs, junior scientists build their publication portfolio, apply for grants, and gain additional scientific and professional skills. Yet, the vast majority of postdocs do not become tenure-track

[4] In the extreme case, a small but significant proportion of postdocs end up as 'permadocs', undertaking several subsequent postdoctoral training streams without ever advancing to another level (Powell, 2015).

faculty members. Around a third of graduate students pursue postdocs, but less than 10% of chemistry graduate students are in a tenure-track position in a research-intensive U.S university five years after graduation (Gaule & Piacentini, 2018). Such low odds have been documented in other disciplines and countries (Stephan, 2012b).

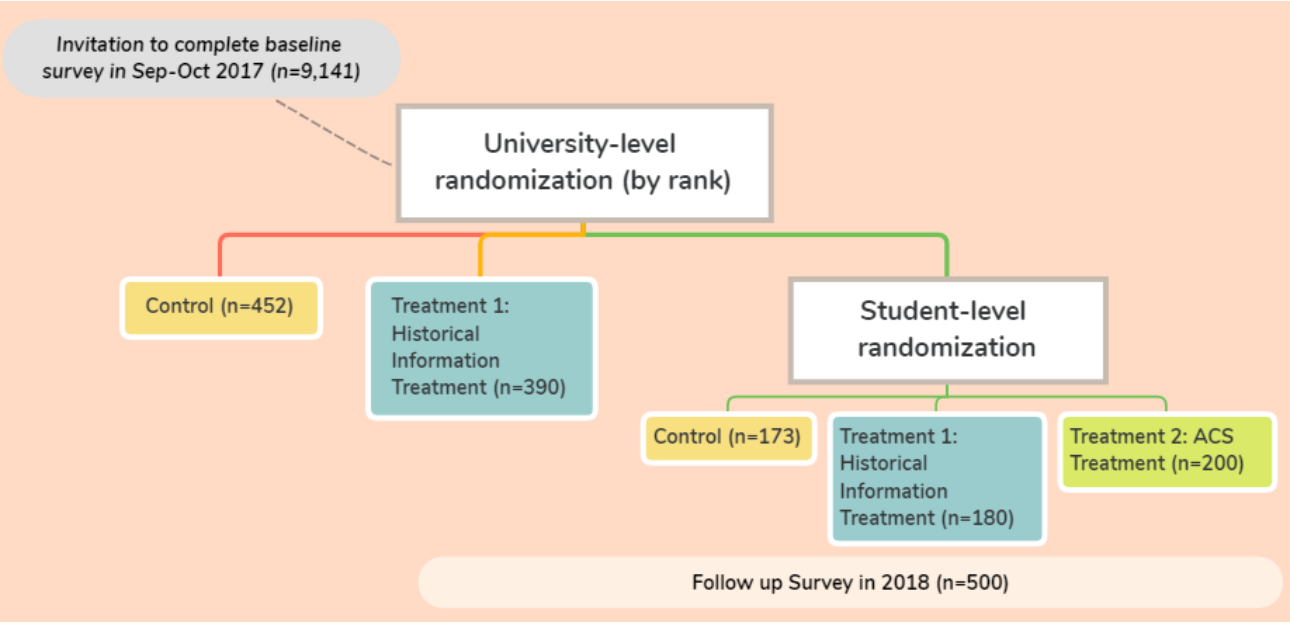
Postdocs receive comparatively low levels of compensation during their postdoctoral training. For example, postdocs on average receive a 31% lower hourly wage than an average U.S. worker regardless of the education level (Stephan, 2013). The opportunity cost of choosing a three-year postdoc instead of working in industry was estimated to be around $60,000 in 2012 (Stephan, 2012a). In biomedicine, compared with peers who started working outside academia immediately after finishing their graduate studies, those who finish a postdoc earn less when they actually start to work (Kahn & Ginther, 2017). According to the same authors, postdocs forgo about one-fifth of their earnings potential in the first 15 years after finishing their doctorates, which amounts to more than $200,000.

While information on career prospects for scientists is often available from professional associations and other sources, departments generally provide relatively little career information to prospective and current graduate students. Prior to the launch of this study, we visited the websites of 56 chemistry departments in our sampling frame (see Appendix B) looking for their graduate degree holders' placement information. For 70% of departments, we could find no placement information at all. The remainder typically provided examples of institutions that have hired their graduates or aggregate data on placement by broad industry categories. One notable exception was the Princeton chemistry department, which provided list of graduates and their placements at the conclusion of PhD. See Appendix C for more details on placement information available from departmental websites.

3.3. Data and Experimental Design

We combine two surveys of chemistry graduate students with a field experiment, linked to the data on individual publications and career choices. The surveys provide rich descriptive data on respondents' beliefs and aspirations and how they evolve over time. To overcome potential hypothetical bias, we combine the data on hypothetical job preferences with real job preferences from hand-collected placement data of the survey respondents who finished their PhD after the baseline survey. We also leverage data from faculty directories, PhD theses and publications from an ongoing project on the production of knowledge in chemistry (see Gaule, 2014; Gaule & Piacentini, 2018; Catalini, Fons-Rosen, & Gaule, forthcoming). Our research design and data collection approach are summarized in Figure 1.

Figure 1. Empirical Design



Our analysis is primarily based upon a survey we conducted in Fall 2017 (hereafter 'baseline survey'). To construct the sampling frame, we first identified the set of 54 research-intensive U.S. universities that rank highest in the Academic Ranking of World Universities

(Shanghai Ranking) in its Chemistry subject ranking. We gathered the names and emails of all individuals (n=9,141) that were listed as graduate students in the chemistry departments of these universities, either on graduate student directory websites or on individual laboratory websites. We then sent them email invites to complete a survey using the Qualtrics online survey platform[5].

We received a total of 1,330 responses corresponding to a response rate of 15%[6]. The baseline survey included a set of basic demographic questions, as well as questions on undergraduate education, year of enrolment in the PhD program, progress in the PhD program and field of specialization. We asked about career preferences using both standard Likert-scale measures and counterfactual choice questions. Regarding beliefs, we asked respondents to rate their chance of publishing in *Nature* or *Science*, to rate their chance of becoming a tenure-track faculty in a research-intensive university, and the share of students in their program they believe eventually become tenure-track faculty in a research-intensive university (see Appendix D for the exact survey questions). Finally, we asked respondents whether they would agree to be contacted in a follow up survey and if so, if they could provide us with a permanent email address that we could use to contact them again. Table A3.1. in Appendix A.3. shows means and standard deviations for several key variables from the baseline survey.

We combined the baseline survey with an information provision experiment. After completing the baseline survey, respondents were randomly selected into either two treatment or one control group. Treatment groups received one of the two versions of a thank-you message via

[5] To increase the response rate, we sent two reminder emails and offered a lottery with the possibility of winning one of ten Amazon gift certificates worth $100 each. The choice of using this type of lottery was informed by Sauermann and Rauch (2013).

[6] One issue we encountered was that some of the individuals we contacted reported having already graduated, presumably reflecting the fact that some online directories and websites were not entirely up to date. We excluded such responses from our analysis sample. Adjusted for the presence of students who already graduated among the people we contacted, our response rate was around 18%.

email with information related to the labor market, while the control group received no message at all.

One of the messages contained more structured information (Treatment 1), which linked to a custom-built website providing information on historical actual academic placement rates by graduate institution[7]. These placement rates were well below 10% for all institutions, so the information communicated was mainly an update on the difficulty of becoming a tenure-track faculty member in a research department. The second message included less-structured information (Treatment 2), which linked to a real webpage from the American Chemical Society (ACS), the main professional society for chemistry, called "Chemists in the Real World". This website lists the profiles of professional scientists in both academic and industry occupations (see Appendix F for the illustration of both websites used in this study)[8]. Not all respondents clicked on the links embedded in either message. While we did not track individual usage, we estimated that roughly 35% of survey respondents who received the link visited the custom-built website, versus around 1% of respondents in the control group (we could not track cliks to the ACS website, see Appendix G for details).

The randomization procedure combined block-randomization with individual-level randomization. The block-randomization was stratified based upon a department's Shanghai Ranking. We created triads of departments of similar ranks and within each triad assigned one

[7] The historical placement records were based on previously collected data from Proquest Dissertations and Abstracts and the ACS directory of graduate research (Gaule & Piacentini, 2018). Specifically, we collected data on students graduating from U.S. chemistry graduate programs between 2008 and 2010 and matched their names to a 2015 list of chemistry faculty in research-intensive universities. We then computed the share of graduating students who had become faculty by 2015, by graduating department. For more information, see Appendix E. We published this data, along with a detailed explanation of how the data was constructed, on a custom-built website https://chemistryplacementdata.com/. The website was not advertised in any way. Web analytics confirm that the overwhelming majority of visits to the website originated from the survey emails.

[8] Available at: https://www.acs.org/content/acs/en/careers/college-to-career/chemists.html

department to Treatment 1, one to the control, and one to individual randomization. Thus, one university of three in the block was randomly chosen as Treatment 1, so that all respondents to the baseline survey at this university received the first message with historical placement rate information. For the second university, respondents were in the control group. In the final university, survey respondents were individually randomized into one of the three groups (Treatment 1, Treatment 2, or control). An advantage of this design is that for Treatment 1, we have both: individuals whose peers were also treated, and individuals whose peers were not treated. This randomization design should enable us to measure potential spillovers from the treatment if the treated individuals share information with their peers.

To measure the impact of the intervention on respondents' beliefs and plans, we contacted our respondents again, asking them to fill in a follow-up survey roughly one year after the baseline survey[9]. In the follow-up survey, we repeated several questions from the baseline survey. We again incentivized responses by sending two reminder e-mails and offering a lottery to win a $100 Amazon gift certificate upon completing the survey. We obtained 500 complete responses, roughly 38% of the initial survey respondents. Table A3.2. in Appendix A.3. reports means and standard deviations for several variables from the follow-up survey. We complemented the follow-up survey with manually-collected information on the current position of baseline survey respondents, including whether they were doing a postdoc or working in industry (for descriptive statistics, see table A3.3. in Appendix A.3.). This information was collected in the summer of 2019, roughly two years after the baseline survey. We collected this information irrespective of whether individuals answered the second survey, but only students who were expecting to graduate in 2017, 2018 or 2019 at the time when they were filling in the baseline survey.

[9] We excluded those who requested in the first survey not to be contacted again.

Table A3.4. in Appendix A.3. shows differences in the characteristics of respondents to our follow-up survey to those who completed the baseline survey only. We do see that there are some differences by observable characteristic. Students from higher-ranked programs, foreign students, and students further along in the program are less likely to respond to the follow-up compared to those earlier in the program. We estimate all regressions including these controls. Importantly, we do not see differential attrition in the Treatment 1 group (the group that received the historical placement information). We do see a small decline in the Treatment 2 group (the group that received the link to the webpage from the American Chemical Society). However, for the actual outcomes collected, we have information for all baseline survey respondents, and therefore attrition is not a concern.

3.4. Results

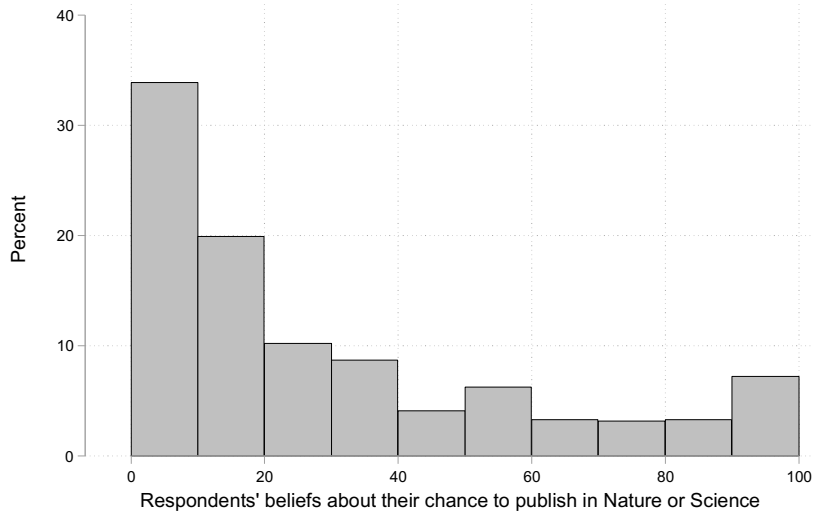
3.4.1. Prevalence of Optimistic Beliefs

Do graduate students know how difficult it is to publish in the most prestigious scientific journals, and to become a tenure-track faculty member in a research-intensive university? Are individuals overconfident about their own ability, and in particular, do they overestimate their position in the ability distribution?

One way we measure biased beliefs is by eliciting respondents' beliefs about their chances of publishing as a first author in *Nature* or *Science* before the end of their PhD. When testing the survey, we had been warned that this is a very rare event. Indeed, historically, only one in 200

chemistry PhD students reaches this milestone[10]. A group of 1,301 students would thus be expected to collectively generate six or seven first-authored *Nature* or *Science* publications. Yet, by aggregating the beliefs of the respondents, we find that they expect to collectively produce 310 first-authored *Nature* or *Science* publications. Figure 2 plots the distribution of the respondents' beliefs about their chances of publishing in *Nature* or *Science* by the end of their PhD studies.

Figure 2. Respondents beliefs about their own chance to publish in Nature or Science

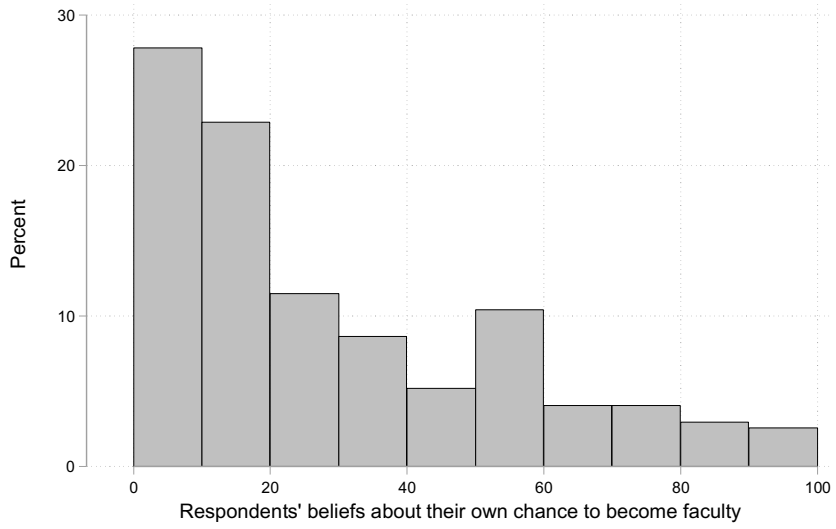


We also asked respondents to rate their own chances of becoming a tenure-track faculty member in a research-intensive U.S. university. The distribution of those beliefs is displayed in Figure 3. In recent years, the share of chemistry PhD students becoming faculty members was around 5%. For instance, in 2016, a listing of chemistry faculty openings listed 152 tenure-track positions in research-intensive U.S. universities, while 2,700 students graduated in this same year. Our own calculations, which are based on matching names from comprehensive lists of PhD graduates and faculty members in Chemistry departments, suggest a similar rate. Again, the

[10] Authors' calculations based upon chemistry PhD graduates listed in Proquest and Nature/Science bibliometric data.

respondents collectively display optimistic beliefs, although to a lesser degree than for *Science*/*Nature* publications. Specifically, if all the beliefs of the respondents were correct, 320 students in our group would become tenure-track faculty members in a research-intensive university, while only 66 of them would actually become faculty in Chemistry departments based on historical averages.

Figure 3. Respondents' beliefs about their own chance to become faculty



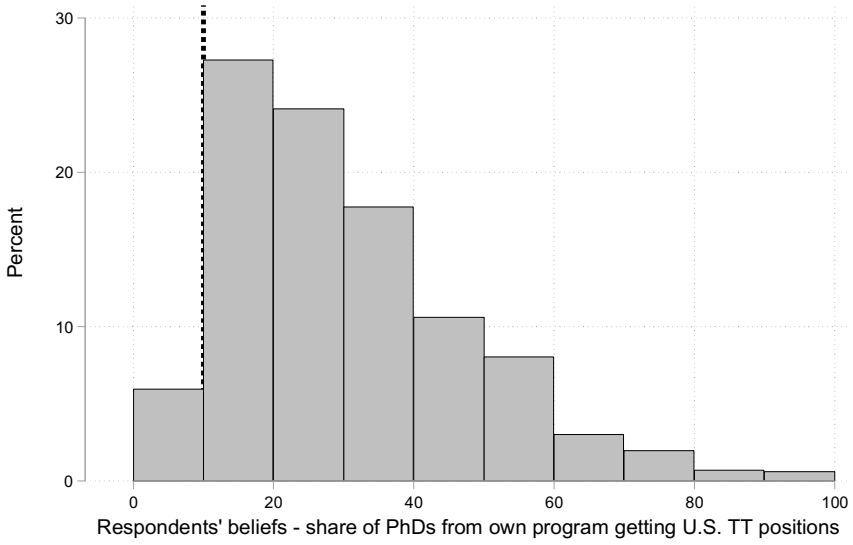
We also asked respondents about their *peer* beliefs, i.e. their beliefs on what share of PhD students in their programs will become faculty members. By asking about others in their program, we focus on whether beliefs are biased only about oneself or also about the aggregate market. By contrast, the beliefs about one's own chance to become faculty also incorporates beliefs about one's own ability as well as preferences for the academic career.

Interestingly, the mean beliefs about the share of students becoming faculty (24.5%) are actually slightly higher than the mean beliefs about one's own chance to become faculty (24%).[11]

[11] As discussed earlier, both aggregate evidence and historical placement data suggest that this share is around 5%.

Thus, what looked like an above-average effect might be incorrect beliefs about the market as a whole. The distribution of beliefs on the share of peers becoming faculty in research-intensive universities is displayed in Figure 4. While there was some variation across programs, no program had a share higher than 10% in the historic placement data. Slightly less than 30% of the respondents answered between 0 and 10%, and thus essentially had correct beliefs about the state of the market. A further 25% of respondents were mildly optimistic, answering that between 11% and 20% of peers will become faculty. The remainder – 45% of respondents – were wildly optimistic with answers far above the observed average.

Figure 4: Respondents' beliefs about the share of PhDs from their program becoming faculty



In summary, these descriptive statistics suggest that over-optimistic beliefs about publishing and placement are widespread among graduate students. However, we also observe heterogeneity in beliefs: some individuals have correct beliefs, some have biased beliefs and are biased to various extents.

3.4.2. Who Holds Optimistic Beliefs?

We now explore descriptively whether the heterogeneity in beliefs can be related to observable characteristics. For this, we regress each of the three types of beliefs on student gender, foreign status, time since enrollment in the program, and a dummy variable for the top 10 program (based on the Shanghai Ranking). Table 1 displays the results.

Table 1. Who holds overoptimistic beliefs?

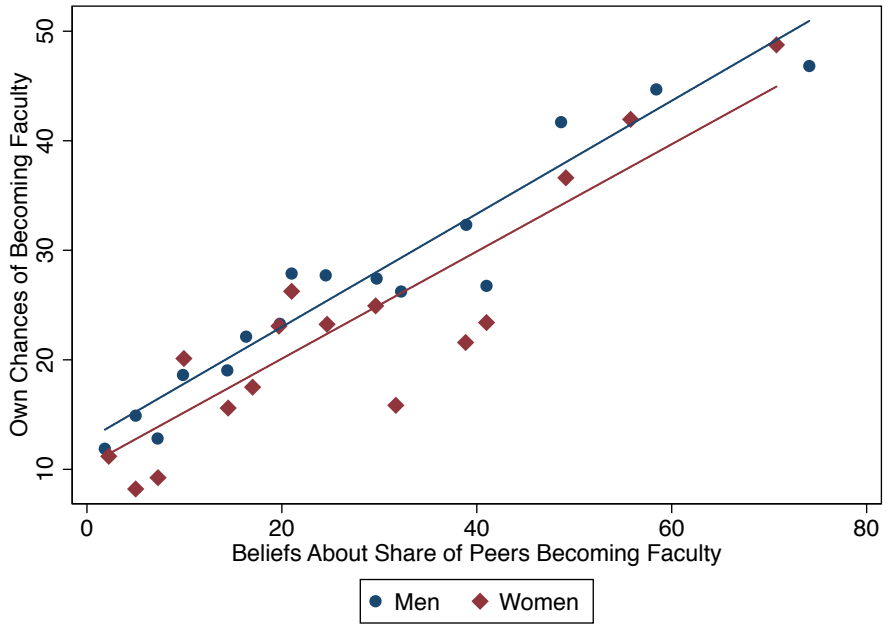
	(1)	(2)	(3)
	Respondents' beliefs		
	Own chance to publish in Nature/Science;	Own chance to become faculty	Percentage of students becoming faculty
Female	0.359	-1.155	2.396**
	(1.616)	(1.380)	(0.971)
Foreign student	9.400***	8.343***	3.798***
	(1.914)	(1.587)	(1.120)
Top 10 school	-1.897	-2.625	-1.349
	(1.969)	(1.679)	(1.181)
First year student	17.753***	9.789***	7.355***
	(2.233)	(1.890)	(1.331)
Second year student	9.512***	6.713***	4.558***
	(2.152)	(1.829)	(1.287)
Third year student	0.767	1.522	1.414
	(2.200)	(1.874)	(1.319)
Obs.	1301	1333	1330
Mean of D.V.	24.907	23.953	24.472
R2	0.073	0.048	0.039

The dependent variables are the respondents' beliefs regarding (1) their chance to publish in Nature or Science as a first author by the end of their PhD, (2) their chance to become tenure-track faculty in a U.S. research-intensive universe university, and (3) the percentage of students becoming tenure-track faculty in a research-intensive U.S. university. All the beliefs are expressed on a scale from 0 to 100. The omitted category for time in the program is fourth year and above. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Foreign students are considerably more optimistic about publishing and placement (Table 1, columns 1 and 2). Foreign students may be more able, on average, due to tougher selection to be admitted into U.S. PhD programs (Gaule & Piacentini, 2013). However, they also seem to be less informed about the tightness of the U.S. academic market (Table 1, column 3). Another explanation for foreign students being more optimistic might be that they were also considering the possibility of landing tenure-track positions abroad when replying to the questions posed, which we did not directly ask about in the questionnaire.

While the literature has documented gender differences in overconfidence (e.g. Murciano-Goroff, 2019; Niederle and Vesterlund, 2007), we find few gender differences in beliefs in our sample. We find that female and male students are equally likely to hold optimistic beliefs about their chances to publish in Nature or Science. Female students are slightly more optimistic about the aggregate state of the academic market, i.e. their peers' chances of getting a tenure track job (see Figure 5 and Figure A3.1. in Appendix A.3.), but we observe no gender differences in beliefs about one's own chances.

Figure 5. Beliefs by Gender



Time since enrollment in the PhD program is a strong predictor of holding optimistic beliefs: Students in their first year or second year of study are the most optimistic, though there is no statistical difference between students in their third year and subsequent years. The results are consistent with Stephan and Ma (2005) Sauermann and Roach (2012), Sauermann and Roach (2016), and Gibbs, McGready, and Griffin (2015).

We also investigate whether holding optimistic beliefs about the share of students becoming faculty is associated with preferences for academic careers (Table 2). We measure these preferences by asking how likely respondents are to do a postdoc or to choose a prestigious postdoc over an industry research job or a teaching position in a counterfactual choice question. We find that respondents' beliefs about the share of students becoming faculty is strongly correlated with preferences for continuing with an academic path. This holds despite the fact that we control for key observable correlates of holding optimistic beliefs, such as being a foreign student or being in the first or second year of study.

Table 2: Optimistic beliefs and preferences for academia

	(1) Likelihood of doing a postdoc	(2) Choosing postdoc among 3 options
Respondents' beliefs - share of students becoming faculty	0.205***	0.086**
	(0.050)	(0.038)
Female	-2.102	-2.559*
	(1.743)	(1.350)
Foreign student	12.085***	10.575***
	(2.012)	(1.586)
Top 10 school	-1.219	1.747
	(2.139)	(1.640)
First year student	6.000**	5.779***
	(2.401)	(1.878)
Second year student	3.566	3.599**
	(2.298)	(1.801)
Third year student	1.897	-1.419
	(2.383)	(1.832)
Obs.	1271	1312
Mean of D.V.	54.155	25.524
R2	0.055	0.056

The dependent variables are: (1) the likelihood of doing a postdoc as reported in the baseline survey (percentage out of one hundred), and (2) the likelihood (out of 100) of choosing the postdoc when offered a counterfactual choice between a postdoc, research position in industry, or a teaching position (see Appendix D.). The variable of interest is the respondents' beliefs on the share of students becoming faculty (also out of one hundred). The omitted category for time in the program is fourth year and above. Robust standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

As discussed earlier, in this discipline, moving directly from doctoral studies to tenure-track positions is virtually impossible. However, by choosing postdoctoral training, a scientist keeps open the possibility of subsequently landing a tenure-track faculty position, a job that she often perceives to be highly desirable. The option to access this career path, while uncertain and risky, is part of the returns to doing a postdoc. Students who underestimate how difficult it is to

obtain a tenure-track faculty position should thus be expected to find the postdoctoral option more attractive, which is exactly what we find.

However, as in previous studies that have documented over-optimism among scientists (e.g. Sauermann & Roach, 2016), these results are descriptive in nature. We cannot rule out that students who have optimistic or biased beliefs may also have other characteristics that drive preferences for doing a postdoc. It is thus unclear whether exogenously inducing updates in the beliefs could lead to changes in career preferences. The next section describes the results of the intervention in which we provided information to a random sample of the baseline survey respondents, and then followed up with them one year later.

3.4.3. Effects of the Intervention

Our experimental design combined block-randomization at the university level with individual-level randomization for a subset of universities. Accordingly, survey respondents were assigned to one of the following five groups[12]:

(1) Treatment 1 – Block Randomization: students received the email linking to the historical information on graduates' placement, along with all other survey respondents from the same university receiving the same link.

(2) Control - Block Randomization: students did not receive any email along with other survey respondents from the same university not receiving any email.

[12] Alternatively, we could pool treatment 1- block randomization and treatment 1 – individual randomization into a single variable. Results from the alternative specification are presented in table A5. The results are qualitatively similar with this alternative specification except for the changes of the beliefs on one's own chance to become a faculty member, where the effect of the historical placement intervention is just outside the significant region (p-value-0.11 instead of 0.02 in the preferred specification) but the effect of the ACS profiles intervention is significant.

(3) Treatment 1 – Individual Randomization: students received the email linking to the historical information on graduates' placement along with only some of the respondents from the same university receiving the same link.

(4) Treatment 2 – Individual Randomization: students received the email linking to the ACS profiles website along with only some respondents from the same university receiving the same link.

(5) Control (Some peers treated) – Individual Randomization: students did not receive an email, but some other survey respondents from the same university received the other types of emails (Treatment 1 or 2).

We use the second group – those that did not receive any email with other survey respondents from the same university not receiving any email – as the control group and the omitted category in all specifications[13]. Our variables of interest are indicator variables for each of the other categories, or treatments, and we present specifications both with and without controls.

We first consider the effect of the intervention on beliefs using the sample of students who answered both the initial and final survey. As in the descriptive analysis, we observe two types of beliefs: the beliefs about peers (which share of students in their program become faculty members) and the self-beliefs (one's own chance of becoming a faculty member). Since we asked the exact same questions on beliefs in the initial and final survey, we can track the evolution of beliefs over time and whether they were impacted by the treatment.

[13] We also estimate the treatment effects of the historical placement information when pooling the block randomized and individually randomized groups. See Table A3.5. in the Appendix.

Table 3 and 4 show the effect of the intervention on the changes in beliefs between the two surveys (final minus initial beliefs). Note that the mean change in either type of beliefs is negative, suggesting that students become more pessimistic over time.

Table 3. Effect of the interventions on beliefs regarding the share of students becoming faculty members

	(1)	(2)	(3)
	Change in beliefs on the share of students becoming faculty		
Historical placement info	0.008	0.612	-0.416
treatment (block)	(1.664)	(1.619)	(1.394)
ACS profiles treatment	0.938	0.373	0.263
	(2.182)	(2.583)	(2.052)
Historical placement	1.184	1.000	0.154
info treatment (individual)	(2.346)	(2.469)	(2.343)
Some peers treated	1.004	0.239	-0.630
	(2.249)	(2.416)	(1.867)
Obs.	500	500	500
Controls	None	Demographics, field	Demographics, field + Initial beliefs
Mean of D.V.	-3.520	-3.520	-3.520
R2	0.001	0.081	0.374

These regressions are run on the sample of survey respondents who answered both the initial and follow-up survey. The dependent variable is the change in beliefs on the percentage of students who will become faculty (belief in the final survey minus belief in the initial survey). The coefficients reported correspond to 4 different indicators for each treatment status (see main text for description). The omitted group is the group of survey respondents who did not receive a thank-you message in universities where other respondents also did not receive a thank-you message. The specification (1) does not include any controls. The specification (2) includes controls for gender, foreign status, time in the program and university rank. In specification (3) we additionally control for the initial level of beliefs. Clustered standard errors in parentheses. The cluster is a group of three universities of similar rank which was used to stratify the block-randomization. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

The point estimates for the effect of all treatments on beliefs about the share of peers becoming faculty are small and statistically insignificant. However, both the block-randomized historical placement information treatment (Tretament 1) and individual ACS treatment (Treatment 2) had a statistically significant effect on the changes in beliefs on one's own chances of becoming a

faculty member, where receiving the information lowered beliefs about obtaining a tenure-track faculty position (Table 4). The magnitude of the effect is similar in magnitude to the mean of the dependent variable, suggesting that individuals who received the information became less optimistic about their chances to become faculty members at a faster rate than those who did not. The coefficients on both the individually-randomized historical information treatment and the 'some peers treated' group are smaller in magnitude than for the block-randomized historical information treatment. This is consistent with the effects of the historical placement information being amplified when all peers received the information, rather than only a small subset of individuals, likely by creating more opportunities for discussions that made the information more salient.

Table 4. Effect of the interventions on beliefs regarding own chance to become faculty

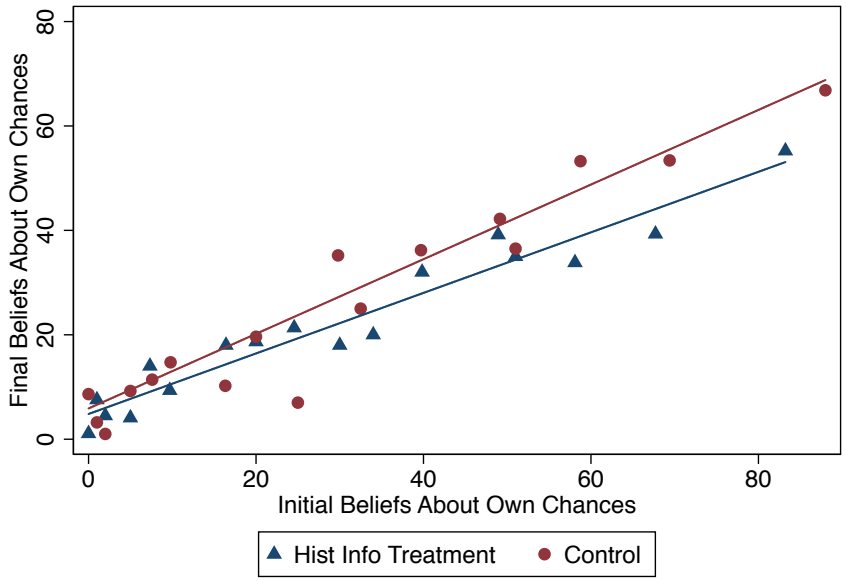
	(1)	(2)	(3)
	Changes in beliefs on own chance to become faculty		
Historical placement info	-5.995***	-5.002**	-3.071**
treatment (block)	(1.625)	(1.807)	(1.428)
ACS profiles treatment	-5.083*	-6.888**	-5.982**
	(2.624)	(2.655)	(2.213)
Historical placement	-2.882	-3.194	-2.015
info treatment (individual)	(2.402)	(2.559)	(2.959)
Some peers treated	-2.144	-3.540	-2.689
	(2.743)	(2.957)	(2.787)
Obs.	500	500	500
Mean of D.V.	-3.736	-3.736	-3.736
R2	0.015	0.092	0.273

These regressions are run on the sample of survey respondents who answered both the initial and follow-up survey. The dependent variable is the change in beliefs on the respondents' own chance to become faculty (belief in the final survey minus belief in the initial survey). The coefficients reported correspond to 4 different indicators for each treatment status (see main text for description). The omitted group is the survey respondents who did not receive a thank-you message in universities where other respondents also did not receive a thank-you message. The specification (1) does not include any controls. The specification (2) includes controls for gender, foreign status, time in the program and university rank. In specification (3) we additionally control for the initial level of beliefs. Clustered standard errors in parentheses. The cluster is a group of three universities of similar rank which was used to stratify the block-randomization. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

It is puzzling that we find an effect of the intervention on self-beliefs but not on beliefs about peers. Prior to the intervention, we had expected that the intervention might impact both types of beliefs and that if anything, the effect might be weaker for the beliefs on one's own chances.

We next examine whether there was differential response to the treatments in who updated their beliefs. Figure 6 shows that it appears that those with higher initial self-beliefs (those who most over-estimated their own chances of becoming faculty members) were more likely to update their beliefs in response to the historical information treatment. Table A3.6. in Appendix A.3. shows that for both information treatments, the higher the baseline beliefs, the greater the decline in subsequent beliefs. In Table A3.7. in Appendix A.3., we estimate heterogeneity in response to the treatment by our main covariates: gender, foreign status, and a dummy variable for the top 10 program. Here, we see that there are not many significant differences, apart from a larger negative effect of both treatments on the beliefs about peers among foreign students.

Figure 6. Initial vs. Post-Treatment Beliefs



Now that we have established that the information treatment did impact beliefs about one's own chances of becoming a faculty member, we proceed to investigate whether the information interventions impacted career preferences and actual career choices. For the latter, we can also include baseline survey respondents who did not complete the final survey, as we code career choices using publicly available information.

Table 5. Effect of the interventions on post-PhD career choice

	(1)	(2)	(3)
	Started a postdoc after PhD		
Historical placement info treatment (block)	0.008	0.018	0.029
	(0.030)	(0.032)	(0.028)
ACS profiles treatment	-0.066	-0.032	-0.026
	(0.045)	(0.042)	(0.041)
Historical placement info treatment (individual)	-0.054	-0.003	-0.007
	(0.047)	(0.043)	(0.050)
Some peers treated	-0.043	-0.007	0.008
	(0.048)	(0.053)	(0.057)
Obs.	574	574	574
Mean of D.V.	0.181	0.181	0.181
R2	0.006	0.118	0.231

These regressions are run on the sample of survey respondents who were, at the time of filling in the baseline survey, expecting to graduate in 2017, 2018 and 2019, irrespective of whether they answered the final survey afterwards. The dependent variable is whether the person actually started a postdoc as determined by manual searches. The coefficients reported correspond to 4 different indicators for each treatment status (see main text for description). The omitted group is the survey respondents who did not receive a thank-you message in universities where other respondents also did not receive a thank-you message. The specification (1) does not include any controls. The specification (2) includes controls for gender, foreign status, time in the program and university rank. In specification (3) we additionally control for the initial level of beliefs. Clustered standard errors in parentheses. The cluster is a group of three universities of similar rank which was used to stratify the block-randomization. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Given that the historical placement information intervention led to a downward adjustment in the beliefs on their own chance of becoming a faculty member, we would expect postdocs to become less desirable in the treatment group (relative to the controls), and fewer people actually

choosing postdocs. However, as Table 5 shows, we find no effect of the historical placement information intervention on postdoc plans.[14]

Finally, we consider the effect of the interventions on two additional outcomes: satisfaction with the PhD as a career choice and perceived attractiveness of a faculty position.

Table 6: Effect of the interventions on satisfaction with the PhD as a career choice

	(1)	(2)	(3)
	Changes in satisfaction with the PhD as a career choice		
Historical placement info treatment (block)	0.281	0.024	0.031
	(0.311)	(0.358)	(0.348)
ACS profiles treatment	-0.648	-0.774	-0.814*
	(0.374)	(0.455)	(0.442)
Historical placement info treatment (individual)	0.006	-0.075	-0.068
	(0.535)	(0.583)	(0.535)
Some peers treated	0.714**	0.410	0.351
	(0.333)	(0.326)	(0.288)
N	496	496	496
Mean of D.V.	2.613	2.613	2.613
R2	0.016	0.084	0.106

These regressions are run on the sample of survey respondents who answered both the initial and follow-up survey. The dependent variable is the change in respondents' satisfaction with choosing a PhD as career track (satisfaction reported in the final survey – satisfaction in reported in the baseline survey). The coefficients reported correspond to 4 different indicators for each treatment status (see main text for description). The omitted group is the survey respondents who did not receive a thank-you message in universities where other respondents also did not receive a thank-you message. The specification (1) does not include any controls. The specification (2) includes controls for gender, foreign status, time in the program and university rank. In specification (3) we additionally control for the initial level of beliefs. Clustered standard errors in parentheses. The cluster is a group of three universities of similar rank which was used to stratify the block-randomization. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Surprisingly, we do not see an effect of either intervention on satisfaction with doing a PhD as a career choice (Table 6). However, the historical placement information did significantly increase the perceived attractiveness of an academic faculty position (Table 7). To the extent that

[14] This finding echoes Sauermann and Roach (2016) who found – in a descriptive analysis – no systematic evidence of a relationship between perceived demand for jobs in academia and the choice of postdoctoral training,

the historical placement information made respondents realize that becoming a faculty member is more difficult than they expected, this may have reinforced the perceived attractiveness of academic careers.

Table 7. Effect of the interventions on perceived attractiveness of faculty position

	(1)	(2)	(3)
	Changes in the attractiveness of faculty positions		
Historical placement info treatment (block)	0.237***	0.298***	0.298***
	(0.077)	(0.094)	(0.088)
ACS profiles treatment	0.102	0.129	0.132
	(0.166)	(0.181)	(0.188)
Historical placement info treatment (individual)	0.196*	0.216*	0.214*
	(0.111)	(0.110)	(0.111)
Some peers treated	0.081	0.151	0.154
	(0.190)	(0.204)	(0.210)
N	500	500	500
Mean of D.V.	-0.288	-0.288	-0.288
R2	0.009	0.089	0.096

These regressions are run on the sample of survey respondents who answered both the initial and follow-up survey. The dependent variable is the change in perceived attractiveness of faculty positions (reported attractiveness in the final survey minus reported attractiveness in the initial survey). The coefficients reported correspond to 4 different indicators for each treatment status (see main text for description). The omitted group is the survey respondents who did not receive a thank-you message in universities where other respondents also did not receive a thank-you message. The specification (1) does not include any controls. The specification (2) includes controls for gender, foreign status, time in the program and university rank. In specification (3) we additionally control for the initial level of beliefs. Clustered standard errors in parentheses. The cluster is a group of three universities of similar rank which was used to stratify the block-randomization. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

3.5. Discussion

This paper studies the beliefs of science PhD students regarding the academic job market and how these beliefs impact their preferences for different types of careers and their decisions upon graduating. We use descriptive analysis based on a novel survey of chemistry graduate students combined with randomized information interventions.

We find considerable evidence that graduate students are excessively optimistic regarding the state of the academic job market, their chances to become faculty members, and their chances to publish in the very best scientific journals. Students early in the program, and foreigners, are more likely to hold excessively optimistic beliefs. Holding such beliefs is in turn associated with intentions to engage in postdoctoral training after completing a PhD.

Providing information on historical placement rates appears to influence beliefs, with treated individuals adjusting their perceived chance of becoming faculty members. However, we do not observe an effect of the intervention on actual career choices after the PhD, or on satisfaction with choosing the PhD as a career choice.

Taken together, these results provide us with more puzzles. On one hand, the beliefs of graduate students are often biased and providing historically accurate information leads to an adjustment. On the other hand, the change in beliefs we induced experimentally do not lead to changes in actions we can observe. Perhaps a stronger intervention on the beliefs would lead to observable changes in actions. Only a minority of individuals who received the link to the information actually acquired the information, and it seems that our information intervention did not come with the same credibility as information provided directly by the American Chemical

Society or the department. Additionally, our sample size was relatively limited, and having more statistical power might have revealed an effect of interventions.

Alternatively, it may be that other preferences known to drive scientists' behavior (e.g. the puzzle-solving nature of doing science or prestige) are already quite strong at this point in training, so that the effects of the information on actual changes in career preferences and choices had a minimal impact. Moreover, given that these are individuals who are already far along in their training trajectory, switching costs may be high. In additon, the experience of going through postdoctoral training may be enjoyable in itself or may be desirable for visa or dual-career considerations. Finally, postdoctoral training is still valued in many industry positions.

While we cannot differentiate between these explanations, and despite the lack of evidence of a causal effect of biased beliefs on graduate students' actual career choices, our findings nonetheless suggest that there is a strong rationale for departments to provide better career information to prospective and current students, both about academic and non-academic careers, as there seems to be demand for such information (Sauermann and Roach, 2016). Given that the costs of collecting and sharing information on placements are low, little effort is needed to help graduate students make better decsions.

A.3. Appendix

Appendix A: Descriptive Statistics and Covariate Balance

Table A3.1. Descriptive statistics on baseline survey respondents (n=1,330)

	Mean	S.D.
Chances of publishing in Nature/Science	24.91	29.90
Chance of becoming TT faculty in a U.S. research intensive university	24.47	17.76
Share of students becoming faculty in U.S. research-intensive university	23.95	25.38
Likelihood of doing a postdoc	54.13	31.32
Likelihood of choosing postdoc among three options	25.52	24.75
Female	0.42	0.49
Foreign	0.28	0.45
Top 10 school	0.20	0.40
Year in doctoral program:		
First year	0.19	0.39
Second year	0.21	0.40
Third year	0.19	0.40
Field of study:		
Analytical Chemistry	0.11	0.32
Biological/Biochemistry	0.18	0.38
Inorganic Chemistry	0.16	0.37
Medical/Clinical/Pharmaceutical Chemistry	0.01	0.12
Organic Chemistry	0.18	0.38
Physical Chemistry	0.16	0.36
Polymer Chemistry	0.04	0.20
Theoretical/Computational Chemistry	0.07	0.25
Other	0.09	0.28
Obs.	1330	

Table A3.2. Descriptive statistics on final survey respondents (n=500)

	Mean	S.D.
Change in beliefs on the share of students becoming faculty	-3.52	15.70
Changes in beliefs on own chance to become faculty	-3.74	20.28
Historical placement info treatment (block)	0.31	0.46
ACS profiles treatment	0.12	0.33
Historical placement info treatment (individual)	0.12	0.33
Some peers treated	0.12	0.33
Female	0.47	0.50
Foreign	0.17	0.38
Top 10 school	0.25	0.43
Year in doctoral program:		
First year	0.21	0.40
Second year	0.28	0.45
Third year	0.22	0.41
Field of study:		
Analytical Chemistry	0.11	0.32
Biological/Biochemistry	0.17	0.38
Inorganic Chemistry	0.17	0.37
Medical/Clinical/Pharmaceutical Chemistry	0.01	0.12
Organic Chemistry	0.17	0.38
Physical Chemistry	0.17	0.38
Polymer Chemistry	0.04	0.20
Theoretical/Computational Chemistry	0.07	0.26
Other	0.07	0.26
Obs.	500	

Table A3.3. Descriptive statistics on sample with actual placement data (n=574)

	Mean	S.D.
Started a postdoc	0.18	0.39
Change in beliefs on the share of students becoming faculty	0.29	0.45
Changes in beliefs on own chance to become faculty	0.16	0.36
Historical placement info treatment (block)	0.12	0.32
ACS profiles treatment	0.13	0.34
Female	0.44	0.50
Foreign	0.26	0.44
Top 10 school	0.20	0.40
Year in doctoral program:		
First year	0.01	0.10
Second year	0.04	0.20
Third year	0.38	0.49
Field of study:		
Analytical Chemistry	0.11	0.32
Biological/Biochemistry	0.17	0.38
Inorganic Chemistry	0.18	0.38
Medical/Clinical/Pharmaceutical Chemistry	0.02	0.12
Organic Chemistry	0.17	0.38
Physical Chemistry	0.14	0.35
Polymer Chemistry	0.06	0.23
Theoretical/Computational Chemistry	0.07	0.25
Other	0.08	0.27
Obs.	574	

Table A3.4. Is there differential selection into the follow-up survey?

	(1) Responded follow-up survey	
Historical placement info treatment (block)	-0.044	(0.034)
ACS profiles treatment	-0.094**	(0.042)
Historical placement info treatment (individual)	-0.044	(0.045)
Some peers treated	-0.058	(0.044)
Foreign student	-0.147***	(0.031)
Female	0.022	(0.027)
Top 10 school	0.091***	(0.033)
First year student	0.127***	(0.036)
Second year student	0.194***	(0.035)
Third year student	0.128***	(0.036)
Field study:		
Analytical Chemistry	0.020	(0.050)
Biological/Biochemistry	0.006	(0.044)
Inorganic Chemistry	0.007	(0.044)
Medical/Clinical/Pharmaceutical Chemistry	0.022	(0.113)
Physical Chemistry	0.044	(0.045)
Polymer Chemistry	-0.012	(0.070)
Theoretical/Computational Chemistry	0.043	(0.058)
Other	-0.042	(0.054)
Constant	0.322***	(0.043)
Obs.	1330	
Mean of D.V.	0.375	

Organic chemistry excluded. Standard errors in parentheses. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A3.5. Effects of the interventions pooling the historical placement info treatment into one variable

	(1)	(2)	(3)	(4)	(5)
	Change in beliefs on the share of students becoming faculty	Changes in beliefs on own chance to become faculty	Started a postdoc after PhD	Changes in satisfaction with the PhD as a career choice	Changes in the attractiveness of faculty positions
Historical placement info treatment (block + individual)	-0.245	-2.761	0.018	-0.081	0.261***
	(1.453)	(1.663)	(0.028)	(0.347)	(0.056)
ACS profiles treatment	0.254	-6.012**	-0.025	-0.710	0.133
	(2.045)	(2.194)	(0.041)	(0.410)	(0.184)
Some peers treated	-0.640	-2.712	0.009	0.333	0.145
	(1.862)	(2.750)	0.056	(0.248)	(0.189)
Obs.	500	500	574	496	500
Controls	Demographics, field + Initial beliefs	Demographics, field + Initial beliefs	Demographics, field + Initial beliefs	Demographics, field + Initial beliefs	Demographics, field + Initial beliefs
Mean of D.V.	-3.520	-3.736	0.181	2.613	-0.288
R2	0.374	0.273	0.230	0.171	0.129

These regressions correspond to the column of tables 3-7 except that Historical placement info treatment (block) and Historical placement info treatment (individual) are pooled instead of being entered separately. The omitted group is the group of survey respondents who did not receive a thank-you message in universities where other respondents also did not receive a thank-you message. All specifications control for gender, foreign status, time in the program, university rank and the initial level of beliefs. Clustered standard errors in parentheses. The cluster is a group of three universities of similar rank which was used to stratify the block-randomization. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Table A3.6. Heterogeneity: effects of the interventions on peer and own beliefs by baseline beliefs

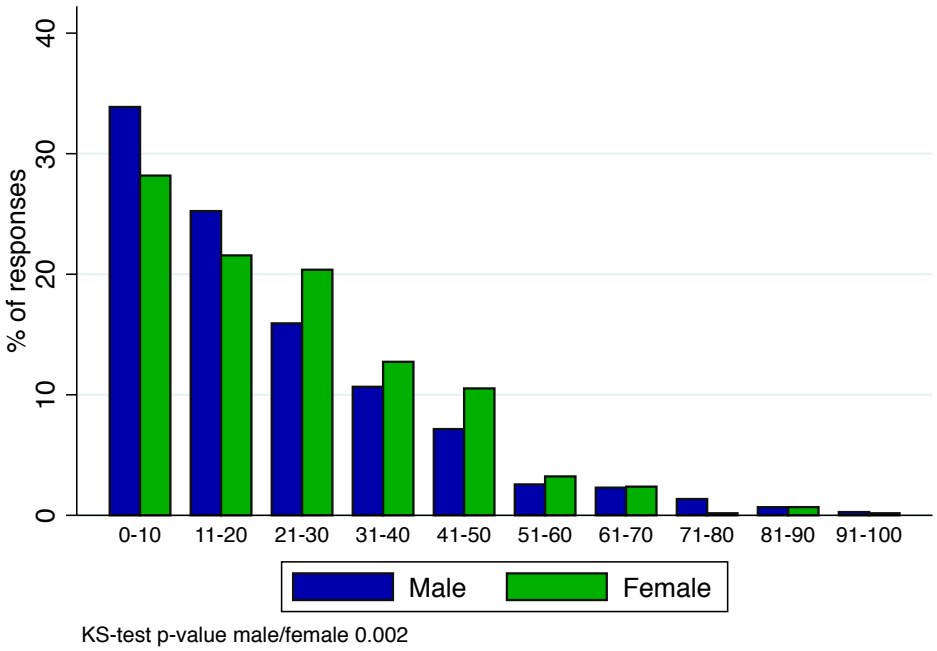
	(1) Change in beliefs of the share of students becoming faculty	(2) Changes in beliefs of own chance to become faculty
Historical placement info treatment (block)	3.498	-0.049
	(3.075)	(2.092)
ACS profiles treatment	-2.419	-0.781
	(2.805)	(2.650)
Historical placement info treatment (individual)	5.823	-3.320
	(4.352)	(3.164)
Some peers treated	6.758**	-3.037
	(2.823)	(2.838)
Historical placement info treatment (block) x Baseline beliefs	-0.161	-0.153*
	(0.157)	(0.081)
ACS profiles treatment x Baseline beliefs	0.117	-0.233**
	(0.118)	(0.089)
Historical placement info treatment (individual) x Baseline beliefs	-0.205	0.028
	(0.170)	(0.072)
Some peers treated x Baseline beliefs	-0.272*	0.023
	(0.146)	(0.114)
N	500	500
Mean of D.V.	-3.520	-3.736
r2	0.351	0.263

All specifications control for gender, foreign status, time in the program, university rank and the initial level of beliefs. Clustered standard errors in parentheses. The cluster is a group of three universities of similar rank which was used to stratify the block-randomization. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table A3.7. Heterogeneity: effects of the interventions on peer and own beliefs

	(1)	(2)	(3)	(4)	(5)	(6)
	Change in beliefs on the share of students becoming faculty			Changes in beliefs on own chance to become faculty		
Covariate →	**Female**	**Foreign**	**Top Univ.**	**Female**	**Foreign**	**Top Univ.**
Historical placement	0.951	2.127	1.796	-7.061***	-4.784**	-1.857
info treatment (block)	(1.967)	(1.409)	(3.872)	(1.438)	(1.698)	(2.928)
ACS profiles treatment	1.891	1.297	1.886	-2.481	-6.478**	-5.600
	(2.520)	(2.805)	(5.928)	(2.981)	(2.672)	(4.711)
Historical placement	-2.088	1.498	-2.837	-2.272	-2.273	5.261
info treatment (individual)	(3.429)	(2.756)	(4.154)	(5.055)	(2.481)	(3.582)
Some peers treated	0.119	3.870*	1.166	-1.200	-2.286	-0.792
	(2.861)	(2.118)	(3.159)	(2.810)	(4.038)	(2.549)
Historical placement	-0.416	-7.759*	-1.444	4.495	-1.516	-3.991
info treatment (block) x Covariate	(3.858)	(3.948)	(4.176)	(3.522)	(7.078)	(3.995)
ACS profiles treatment	-4.322	-7.278**	-2.823	-9.201	-0.387	-2.144
x Covariate	(3.752)	(3.006)	(6.441)	(5.585)	(5.730)	(5.593)
Historical placement	6.212	-0.155	4.921	-1.655	-7.616	-11.503**
info treatment (individual) x Covariate	(5.117)	(16.610)	(5.047)	(7.842)	(9.300)	(4.304)
Some peers treated x Covariate	2.337	-12.565	0.163	-5.043	-5.137	-4.173
	(4.722)	(7.954)	(4.256)	(6.729)	(9.168)	(5.328)
N	500	500	500	500	500	500
Mean of D.V.	-3.520	-3.520	-3.520	-3.736	-3.736	-3.736
r2	0.067	0.071	0.064	0.098	0.088	0.096

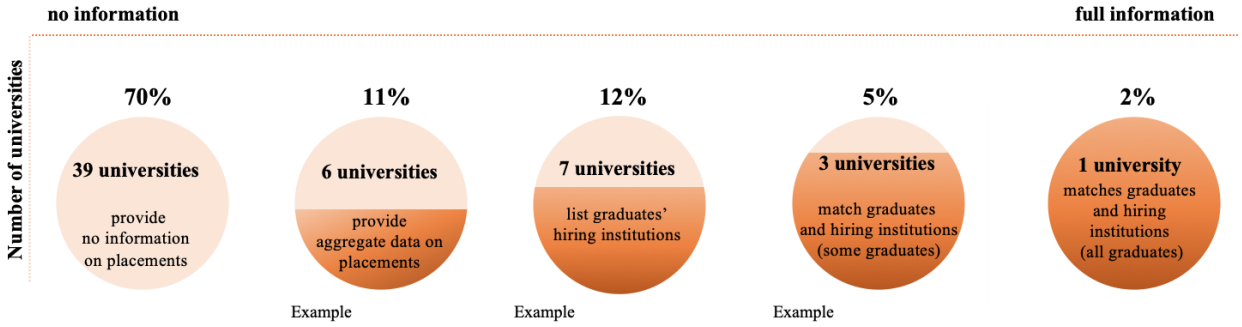
Figure A3.1. Gender differences in beliefs about the share of PhDs from their program becoming faculty



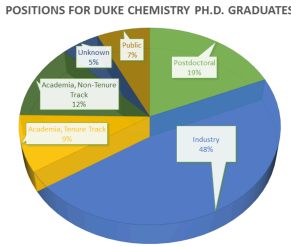
Appendix B: Universities Included in the Sampling Frame

Arizona State University
California Institute of Technology
Carnegie Mellon University
Colorado State University
Columbia University
Cornell University
Duke University
Emory University
Georgia Institute of Technology
Harvard University
Indiana University
Iowa State University
Johns Hopkins University
Massachusetts Institute of Technology
North Carolina State University
Northwestern University
Princeton University
Purdue University
Rice University
Stanford University
State University of New York at Buffalo
Texas A&M University
The Ohio State University
The Pennsylvania State University
The University of Texas at Austin
University of California, Berkeley
University of California, Davis
University of California, Irvine
University of California, Los Angeles
University of California, Riverside
University of California, San Diego
University of California, Santa Barbara
University of Chicago
University of Colorado
University of Delaware
University of Florida
University of Houston
University of Illinois at Urbana-Champaign
University of Maryland, College Park
University of Massachusetts Amherst
University of Michigan
University of Minnesota
University of North Carolina at Chapel Hill
University of Pennsylvania
University of Pittsburgh
University of South Florida
University of Southern California
University of Utah
University of Virginia
University of Washington
University of Wisconsin-Madison
Washington State University
Washington University in St. Louis
Yale University

Appendix C: Information on Graduates' Placements from University Webpages [15]

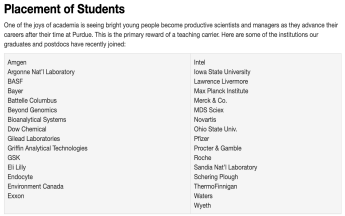


Example



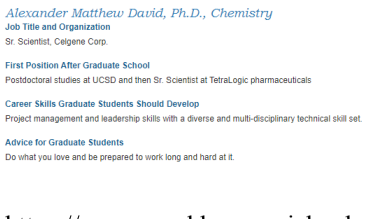
chem.duke.edu/graduate/placements

Example



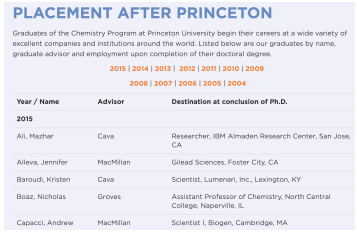
www.chem.purdue.edu/Analytical/placement.php

Example



https://secure.rackham.umich.edu/_graduate-student-success/alumni-profiles/

Example



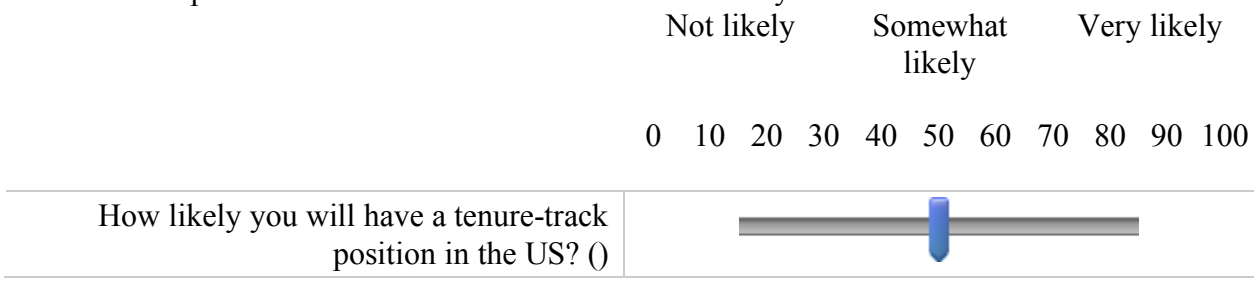
chemistry.princeton.edu/graduate/after-princeton

[15] We visited the websites of 56 U.S. chemistry research-intensive universities in our search for the information they publish on their graduates' placements. We looked through their graduate studies' main pages, graduate student handbooks, career pages, alumni profiles, and news section.

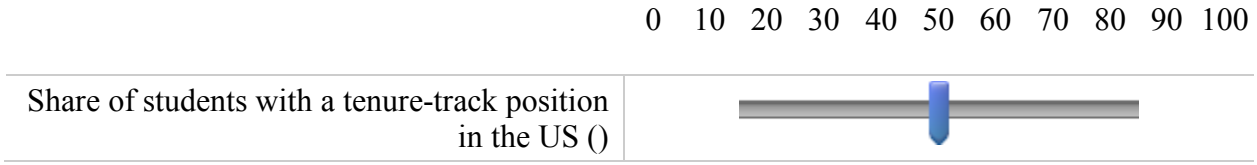
Appendix D: Selected Survey Questions

Measuring beliefs about the academic job market

Q. What do you think is the percent chance (or chances out of 100) that you will eventually have a tenure-track position in a U.S. research-intensive university?

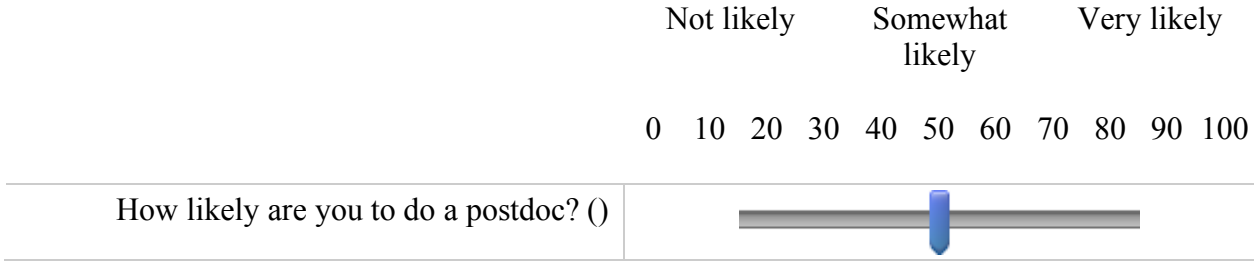


Q. Approximately what share of PhD graduates from your PhD program do you think eventually obtain a tenure-track position in a US research-intensive university? (0 means "None" and 100 means "All").



Measuring beliefs about postdoctoral training

Q. What do you think is the percent chance (or chances out of 100) that you will do a postdoc after your PhD?



Measuring career preferences – counterfactual choice question

Q. Now we want to ask you to do some simple evaluations of potential job offers. Imagine that you have just completed your dissertation and are looking for **a full-time position**.
First, suppose you have the following job offers and you need to choose between them. Please rate how likely you are to accept one of them rather than the other. For each job offer, choose the percent chance (out of 100) of choosing each one. **The total chances given to each offer should add up to 100.**

_____ **Job Offer #1:** Research Scientist/Engineer at Private Sector Firm (e.g. DuPont, Novartis) **Annual Salary:** $90,000 (1)

_____ **Job Offer #2:** Postdoctoral Research Fellow at Top U.S. university (e.g. Berkeley, MIT) **Annual Salary:** $50,000 (2)

_____ **Job Offer #3:** Assistant Professor at top liberal arts college (e.g. Swarthmore College) **Annual Salary:** $70,000 (3)

Q. Putting job availability aside, how attractive do you personally find each of the following careers?

	Not at all attractive (1)	Mostly not attractive (2)	Neutral (3)	Mostly attractive (4)	Very attractive (5)
Academic faculty with an emphasis on research (1)	○	○	○	○	○
Academic faculty with an emphasis on teaching (2)	○	○	○	○	○
Government research and development position (3)	○	○	○	○	○
Government (other) (6)	○	○	○	○	○
Industry position with an emphasis on research and development (4)	○	○	○	○	○
Industry (other) (5)	○	○	○	○	○

Appendix E: Measuring Historical Placement Rates

Overview

The objective of this data collection effort was to understand what share of PhD graduates from U.S. chemistry departments become faculty members themselves (in research-intensive universities), and differences across schools. To reach this objective, we collected data on students graduating from U.S. chemistry graduate programs between 2008 and 2010, and matched their names to a 2015 list of chemistry faculty in research-intensive universities. We then computed the share of graduating students who had become faculty by 2015, by graduating department.

Data sources

The database "Proquest Dissertations and Abstracts" was used to obtain the list of chemistry dissertations completed between 2008 and 2010. Proquest Dissertations and Abstracts includes the names of students, the year and university of graduation as well as a subject classification for the thesis, among other information. While the database itself is generally thought to be quite comprehensive, it does not clearly indicate from which department the student graduated. This implies that one must deduce whether it was a chemistry dissertation from the subject classification.

For lists of chemistry faculty, we relied on the "ACS Directory of Graduate Research" available online at dgr.rints.com. This resource, meant to help prospective graduate students choose a graduate program, has an extensive listing of faculty members in U.S. PhD-granting chemistry, chemical engineering and biochemistry programs. The ACS Directory of Graduate Research was used to create a list of faculty members in U.S. research intensive universities, where research intensive is defined as "R1" or "R2" in the Carnegie classification.

An important limitation is that it does not list faculty members outside the U.S. as well as in non-chemistry departments where PhD chemistry graduates may find employment as university faculty with a focus on research.

Matching

The list of graduate students was matched to the list of faculty using last names, initials, first names, year of graduation and university of graduation. The matching algorithm is robust enough to handle cases of variations in spelling of first names, inconsistent reporting of middle names or individuals changing last names.

Limitations of the placement data

The placement data presented here have several important limitations.

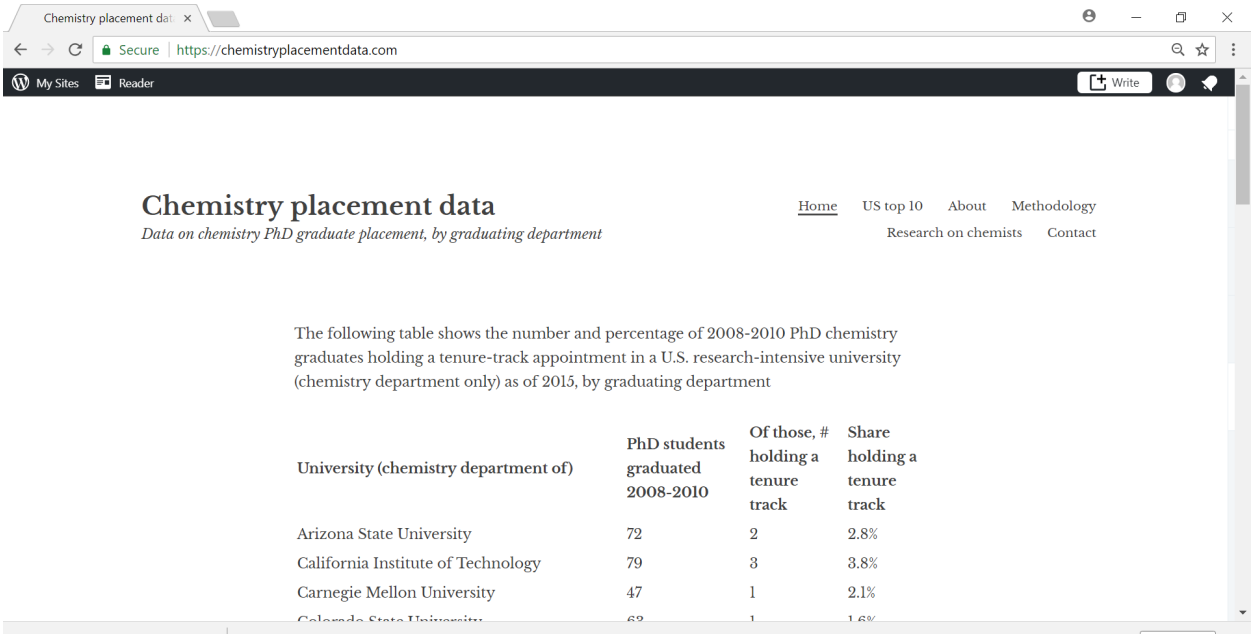
First, some truncation bias arises from the fact that faculty placements are observed as of 2015, while the list of students includes students who graduated relatively recently (e.g. 2010) and may have obtained a faculty position in 2016 or 2017, or may obtain a faculty position in the future.

Second, the placement data fails to capture placement in non-chemistry departments that may employ chemistry PhD students, as well as placements outside the U.S.

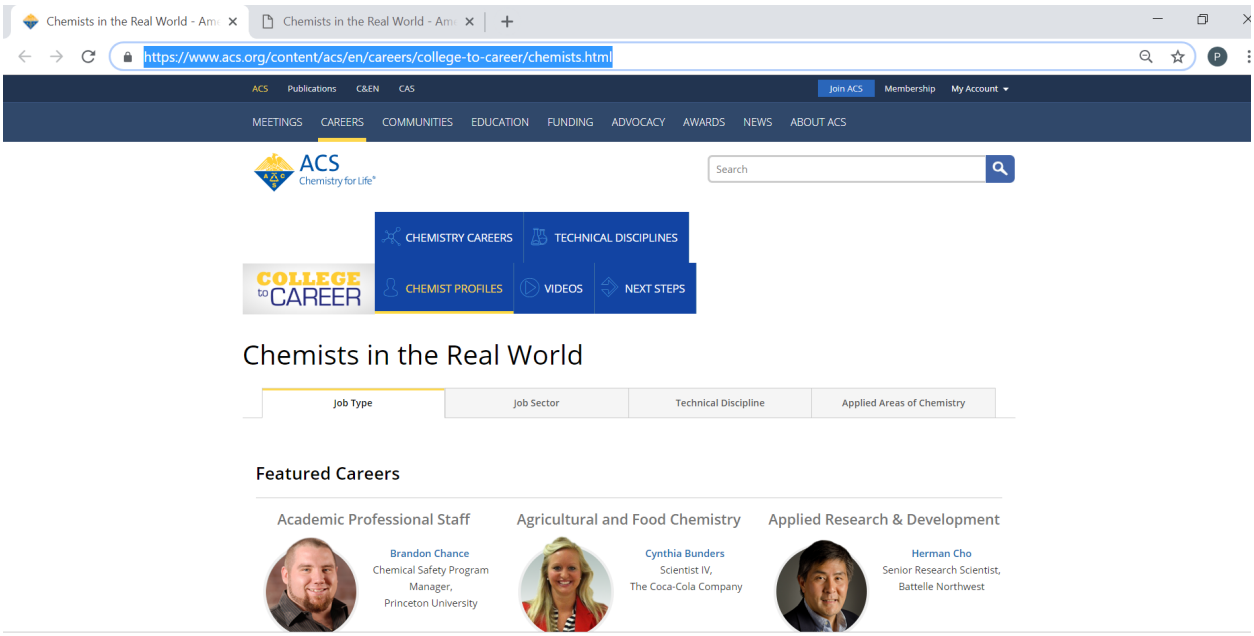
Third, students outside chemistry departments may be mistakenly assigned to the chemistry department if the subject classification of their thesis is close to chemistry, thus potentially impacting the placement measures.

Appendix F: Websites Linked in the Thank You Emails

Custom-built website with historical placement information



American Chemical Society "Chemists in the Real World" website listing profiles of professional scientists in both academic and industry occupations



Appendix G: Historical Placement Information Web Analytics

Figure 1G: Source through which the website: http://chemistryplacementdata.com was assessed

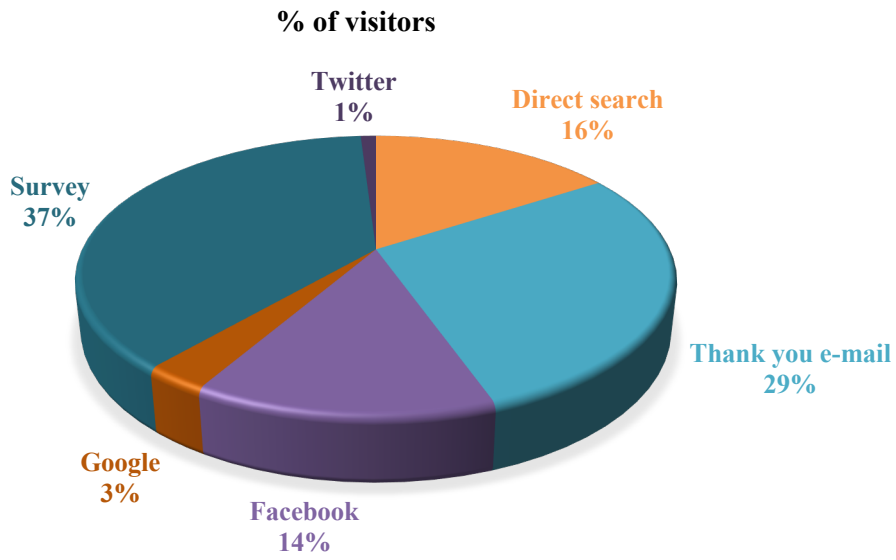
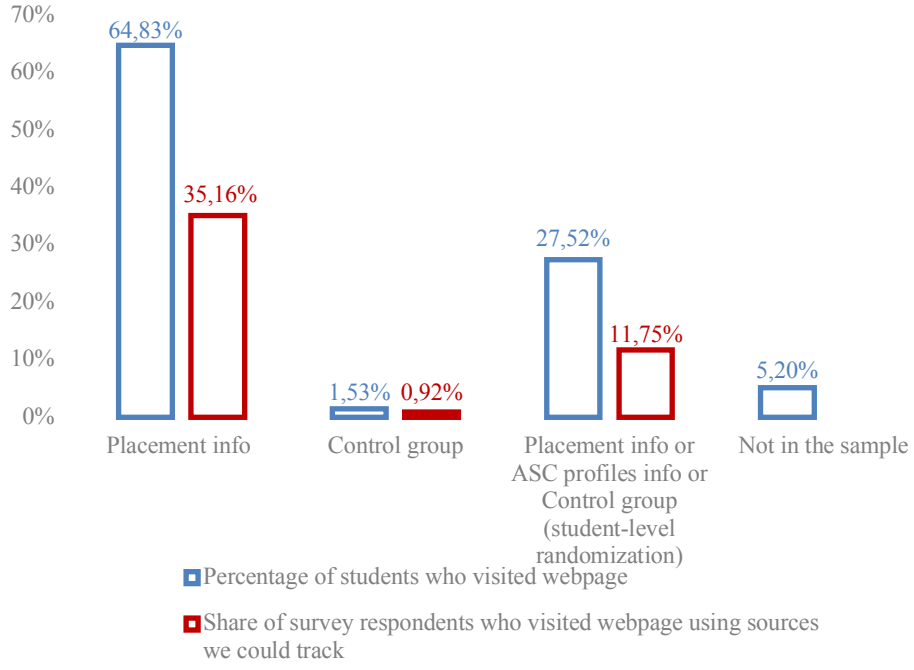


Figure 2G: Share of respondents who visited website according to treatment status



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