Warming up Cooling Cooperators

Eamonn Ferguson (eamonn.ferguson@nottingham.ac.uk)
Nottingham https://orcid.org/0000-0002-7678-1451

Claire Lawrence
Lawernce Psych Advsiroy

Carley Gemelli
Australian Red Cross Lifeblood https://orcid.org/0000-0003-3030-5086

Amy Rozsa
Australin Res Cross Life Blood

Konrad Niekrasz
Australian Red Cross Lifeblood

Barbara Masser
University of Queensland

Tanya Davison
Australian Red Cross Lifeblood

Article

Keywords: warm-glow, cooperation, cooperation cools offs

Posted Date: October 14th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-87927/v1

Version of Record: A version of this preprint was published at Nature Human Behaviour on September 14th, 2023. See the published version at https://doi.org/10.1038/s41562-023-01687-6.

Abstract

The warm-glow of giving is one mechanism proposed to account for high levels of human cooperation. However, little is known about how warm-glow can be harnessed to sustain long-term cooperation to benefit wider society (vaccinations, blood donation). We argue that the power of warm-glow to sustain long-term cooperation cools offs over time but can be warmed-up with a simple intervention message. We test, and confirm this prediction, in a field-based experiment (n = 5,821) comparing warm-glow versus positive affect messages to predict long-term cooperation (blood donation) and confirm our findings in a subsequent implementation study comparing donation attendance in a 3 year pre-implementation period, prior to the warm-glow message being sent to all 1st time donors in Australia (Ns = 90,317, 93,430 & 89,606) to a 2 year post-implementation period (Ns = 81,766 & 88,551). Exogenously manipulated warm-glow can encourage long-term cooperation that benefits society. Wider societal implications are discussed.

Introduction

Human cooperation constitutes a behaviour that is costly to one individual (the actor) while beneficial to another (the recipient) [1-3]. The high levels of cooperation observed across human society are hard to explain from the perspective of natural selection [4-7]. Why would someone perform a behaviour that benefits another person, often a stranger, at a personal cost? To address this problem a number of ultimate ('why') explanations (e.g., kin selection), supported by a number of proximal ('how') mechanisms, have been proposed to account for both one off and repeated acts of human cooperation [5-18]. This paper focuses on one of these proximal mechanisms: the warm-glow of giving [10, 19-20]. We argue that warm-glow acts as a reinforcement mechanism helping to sustain repeated cooperation, but that with larger time intervals between acts of cooperation the initial power of warm-glow to support cooperation cools off, leading to unintentional free-riding. We test the hypothesis that a simple intervention message can reignite feelings of warm-glow to sustain long-term repeat cooperation.

Warm-glow And The Problem Of Cooling Cooperators

Andreoni [10, 19–20] proposed that people are impure altruists who cooperate, not only because they care about a cause, but also because they gain additional personal utility from the act of giving itself: warm-glow. This hypothesis is supported by a large number of lab and field based studies [21–39], with warm-glow: (i) increasing proportionally with the amount donated [22, 25], (ii) motivating increased effort [33], (iii) being experienced more strongly with property rights (when the person donates money they have earned rather than won) [36], (iv) observed cross-culturally [29], (v) identified as an individual rather than a group based experience [37], having a neural basis located in the reward centres of the brain [26] and (vi) sustainable over time with repeat acts of generosity [32].

However, while human cooperation is high it can still be undermined by the counter-force of free-riding [40–41]. A number of mechanisms such as punishment of free-riders [4], opt-out defaults [42–43] and

reputation management [12] have been proposed to ameliorate the free-rider problem. Warm-glow, or its absence, is another key mechanism to help explain why free-riding occurs and as such it should be possible to harness the power of warm-glow to reduce free-riding [44–45]. Specifically, we consider warm glow to be a mechanism that reinforces future cooperation [46]. That is, warm-glow is known to activate the brain's reward centres [26], not to habituate with repeat acts of cooperation [32] and act as a future expected reward [25]. However, this potential reinforcing effect may diminish over time if the time interval between acts of cooperation is large. This may be attributable to people forgetting or not being able to recall their initial warm-glow [47]. This can result in unintentional free-riding, where the person wants to help but does not due to memory failures [48]. Thus, as the warm-glow associated with an initial act of cooperation starts to fade and cool, the person may be less inclined to repeat their initial act of cooperation. Therefore, re-igniting feelings of warm-glow should act to encourage repeat acts of cooperation.

One way to reignite feelings of warm-glow would be with a simple message prompt that encourages people to recall the feelings of warm-glow they experienced for a specific act of cooperation. The literature on nostalgia and marketing is informative here. 'Nostalgic' memories boost current mood and esteem [49] and encourage charitable giving [50]. Nostalgia based campaigns can operate by anchoring the present in the feelings of the past [51]. Thus, while memories are reconstructive [47], having people recall the warm-glow they felt when initially cooperating, should reignite feelings of warm-glow linked to a specific act of cooperation, acting to reinforce future expectation of the reward from feeling warm-glow and subsequently enhance cooperation [46, 52].

Warm-glow, Repeat Blood Donation And Donor Identity

We test the above hypothesis using blood donation as our model of real world repeat long-term cooperation. Blood donation is an archetypal act of cooperation. The donor pays a *personal cost* to donate blood (time to donate, pain, loss of blood, the risk of finding they have an infection, fainting, and post-donation complications), which they donate to *benefit* a complete *stranger* (the recipient) in need. In most systems (other than family/replacement systems) the donor never meets or knows the recipient, and the recipient will never know who the donor is and is thus unable to repay the debt or express gratitude directly. Furthermore, blood donation is characterised by a large free-rider problem, with only 3–4% of the eligible population donating blood at any one time (97% free-ride) [53]. Thus, while everyone is able to receive blood, and blood products, if they wish to, the vast majority do not contribute. As such, it is a perfect real world analogue of the dictator and public goods games that constitute the lab based evidence for the role of warm-glow in cooperative behaviour [e.g., 19, 21–22, 25]. Indeed, compared to non-donors, donors are more likely to express 'impure altruistic' motivations concerning a future blood donation [54]. Furthermore, blood donors are more likely to display warm-glow preferences in lab based economic games [55]. Experienced donors are more likely to express warm-glow preferences than first-time or new donors [56–57] and expressed warm-glow predicts future donations [58].

A key finding from the work on warm-glow and blood donation is that warm-glow is a more salient predictor in those who identify with the role of being a blood donor (i.e., a cooperator), which normally emerges after the blood donor has made four donations [55–57, 59–60]. Thus, it has been argued that defining oneself as a blood donor – cooperative identity – catalyses the effects of warm-glow on future cooperation [56, 61]. That is, some people get a bigger warm-glow kick than others and this acts as a stronger reinforcement mechanism, with those experiencing the greatest kick likely to repeat their donation. Thus, if a warm-glow message is going to work to encourage donors who have made their first donation, their identity as a donor needs to be primed to kick-in earlier. Therefore, we predict that a warm-glow intervention will be maximally effective if also accompanied by an extra message that primes a blood donor (cooperative) identity from their first donation.

There is good evidence that general positive affect predicts future blood donation if experienced post blood donation, [62–63]. General positive affect is also associated with greater helping [64–65]. Thus, we test if it is the concept of warm-glow, specifically, or positive affect, generally, that predicts future cooperation, and in particular, when these are catalysed by priming cooperative identity as a blood donor..

Some donors may feel initial stronger warm-glow than others and this may lead to a selection effect, whereby those who felt greater warm-glow may be more willing to donate again in the absence of any external warm-glow intervention [56, 60–61]. In the blood donation system this may be operationalised as those who make an immediate appointment after their first donation to donate again, as opposed to those who do not. Thus, for those who do not make an immediate appointment warm-glow is potentially weaker and thus memories of the initial warm-glow of donation return to baseline quicker: these donors reach a cooling-off point off more quickly. Therefore, we predict that a warm-glow message should be more effective in reigniting feelings of warm-glow in those who do not make an initial appointment and warming them up sufficiently to donate again.

The Current Studies

While there is extensive lab based experimental evidence revealing the presence of warm-glow preferences [e.g., 19, 21, 22, 25], as well as field based observations that warm-glow perceptions predict reported prosocial behaviours (e.g., environmental conservation: [27, 33, 35]), there are no experiments that exogenously manipulate individual warm-glow to predict real word costly future cooperation. In this paper we do just this. One study, however, has compared warm-glow messages to activate a new cooperative behaviour – donating refunds on used bottles to charity rather than keeping the money [66]. This study compared a warm-glow message (“Please donate your refund – think of the good feeling in helping others. Thank you for your donation.”), to norm based messages (e.g., “Many of our customers from this store regularly donate their refunds. Thank you for your donation”, or “Please donate your refund - We share an obligation to help those in need, Thank you for your donation”). These messages were manipulated at the level of organization displaying the message (supermarkets) and not used to directly influence an individual’s warm-glow. While the authors [66] report a significant effect on the amount donated in supermarkets displaying the warm-glow messages compared to normative ones, the

authors report no significant effects on the individual level behaviour they collected. Thus, due to the lack of randomization in this study [66] the authors cannot draw a causal link between warm-glow and individual behaviour. Furthermore, they did not compare their warm-glow message to another affective message – so cannot isolate if the effect is attributable to warm-glow per se or a sense of general positive affect. Thus, we explore, for the first time, the causal effect of a warm-glow intervention to reignite cooperation (blood donation) in individual donors (cooperators) who are cooling-off. We hypothesise that: (1) a warm-glow intervention combined with a prime for cooperative identity, will be more effective than a warm-glow message on its own, (2) a warm-glow intervention combined with cooperative identity prime, will be a stronger predictor than a general positive affect intervention (with and without a cooperative identity prime) and (3) that the most rapidly cooling cooperators (donors who have not made an immediate initial re-appointment to donate) will be the most likely to respond to the a warm-glow intervention combined with a cooperative identity prime.

We achieve this by randomly manipulating warm-glow messages at the individual level in a large scale field based experiment (n = 5,821 first time blood donors) to predict subsequent blood donor behaviour (attending to make a subsequent donation). Within this field-based experiment we further compare the relative efficacy of the warm-glow intervention, to a general positive affect-based intervention, to predict subsequent blood donor behaviour. We confirm the field based experimental findings in a large scale implementation study, where all new donors in Australia received the most effective warm-glow message. In the implementation trial we compared the return attendance rate, for a 2nd donation, in all new Australian donors in 3 one-year time windows *prior* to the warm-glow message being implemented (Ns = 90,317, 93,430, & 89,606), with the same attendance rates in all new Australian donors in 2 one-year time windows *after* the warm-glow message had been implemented (Ns = 81,766 & 88,551).

Results

Initially we present the results of the field-based experiment followed by the implementation analysis.

Field-Based Experiment of Warm-Glow and Positive Affect Messages

Demographics and Equivalence Across Arms: Information on age and sex across the arms is given in Fig. 2. With respect to the initial randomization of 5,821 donors, age did not vary significantly across conditions ($F_{(4, 5816)} = 0.725$, $p = 0.575$: $D_{Cohen} = 0.059$), nor did sex (χ^2 (4) = 3.542, $p = 0.472$: $D_{Cohen} = 0.050$). The majority of the sample had blood type O+ (45.9%), followed by A+ (36.9%), and O- (10.7%), A- (6.4%) and O (1%). The distribution of blood type did not vary by condition (χ^2 (16) = 18.16, $p = 0.314$: $D_{Cohen} = 0.112$). The percentage who rebooked immediately post-donation was 37.7% with 62.3% not rebooking while in the donor centre, and this did not vary by condition (χ^2 (4) = 4.163, $p = 0.384$: $D_{Cohen} = 0.054$).

After the 20 donors were excluded (Fig. 1), donor age still did not vary significantly by condition ($F_{(4, 796)} = 0.796$, $p = 0.527$: $D_{Cohen} = 0.059$), nor did sex (χ^2 (4) = 3.536, $p = 0.472$: $D_{Cohen} = 0.054$). The majority of the sample had blood group O+ (46%), followed by A+ (36.9%), and O- (10.7%), A- (6.4%). The distribution of blood type did not vary by condition (χ^2 (12) = 14.62, $p = 0.263$; $D_{Cohen} = 0.100$). The percentage who rebooked initially was 37.7% with 62.3% not initially rebooking and this did not vary by condition (χ^2 (4) = 4.198, $p = 0.380$: $D_{Cohen} = 0.054$). Thus, the randomization by arm remained intact after the exclusions.

Predicting 3 Month Donations: We conducted an intention to treat (ITT) analysis with assigned arm as the main predictor. A logistic regression (Table 1: columns 2–6) model with age, sex, blood group, arm, rebooked (Yes/No), and the interaction of arm by rebooked was used to predict attendance of all potential donors to donate 3 months later. As can be seen from Table 1, older new donors were more likely to return, as were those with an O- blood group (compared to those with O + blood group). Those exposed to the warm-glow plus identity message were 1.279 times more likely to return than the control group. None of the other messages had a significant effect. Those who rebooked were 3.242 times more likely to return than those who had not rebooked. Thus, initial rebooking is a powerful predictor of future cooperation. Importantly, rebooking status significantly interacted with condition and this was significant for the warm-glow plus identity message only.

To explore this interaction in detail we examined the effect of the warm-glow plus identity message versus the control arm (controlling for age, sex, blood group) in those who had rebooked and those who had not. In those who had rebooked there was no significant effect for the warm-glow plus identity message relative to the control arm ($p = 0.077$, OR = 0.772, 95% CI = 0.579, 1.029, n = 855, $R^2 = 0.068$: $D_{Cohen} = -0.143$). There was a significant positive effect in those who had not rebooked ($p = 0.025$, OR = 1.273, 95% CI = 1.031, 1.573, n = 1.464, $R^2 = 0.015$: $D_{Cohen} = 0.133$). Thus, those who did not initially rebook, which we argued were those less like to initially feel as much warm-glow and cool off (return to baseline) quicker, were more likely to be influenced by the warm-glow plus identity message and attend to donate. These findings support our hypothesis that warm-glow is maximally effective for cooperation when combined with a prime for the person’s cooperative identity.

Table 1
Predicting Return Behaviour at 3 months

				95%CI		
	B (se)	**p**	**OR**	**Lower**	**Upper**	**D_{Cohen}**
Sex (0 = male, 1 = female)	-0.03 (0.06)	0.598	0.971	0.896	1.084	-0.016
Age	**0.023 (0.002)**	**< 0.0001**	**1.023**	**1.019**	**1.028**	**0.012**
ABO (O + = reference category)		**0.022**				
A-	0.098 (0.115)	0.727	1.103	0.880	1.382	0.054
A+	-0.009(0.060)	0.838	0.991	0.880	1.116	-0.005
O-	**0.266 (0.093)**	**0.004**	**1.304**	**1.087**	**1.565**	**0.146**
Condition		0.120				
WG + I	**0.264 (0.108)**	**0.023**	**1.279**	**1.035**	**1.580**	**0.136**
WG	-0.010 (0.109)	0.928	0.990	0.800	1.226	-0.005
PA + I	0.105 (0.109)	0.334	1.111	0.898	1.374	0.058
PA	0.111 (0.109)	0.308	1.118	0.903	1.384	0.061
Rebooked (0 = No, 1 = Yes)	**1.176 (0.138)**	**< 0.0001**	**3.242**	**2.513**	**4.182**	**0.648**
Interactions		**0.004**				
Rebooked *WG + I	**-0.506 (0.180)**	**0.005**	**0.603**	**0.424**	**0.859**	**-0.279**
Rebooked *WG	0.097 (0.184)	0.596	1.102	0.768	1.581	0.053
Rebooked *PA + I	-0.335 (0.180)	0.064	0.715	0.502	1.019	-0.185
Rebooked *PA	-0.297 (0.180)	0.098	0.743	0.523	1.057	-0.164
Intercept	-1.263 (0.1189)	< 0.0001	0.283			
R^2	0.10					

Note. WG + I = Warm-Glow Plus Identity; WG = Warm-Glow Only; PA + I = Positive Affect Plus Identity; A = Positive Affect Only

Implementation Study

We compared the return attendance rates, for the second donation, in those who initially rebooked an appointment vs those who did not initially rebook across three pre-implementation time windows and two post-implementation time windows. The number of 1st time donors in each time window, the numbers

who rebooked in centre and those who did not, and attendance return rates can be found in Table S1 (Supplementary file).

The results are shown in Figure 1. As can be seen there is a significant ($Z = 8.52$, $p < 0.00001$: $D_{Cohen} = 0.04$) increase in the overall return rate (Figure 1). Set against this we observe a steep shift pre- to post-implementation in the return rates for those who did not rebook but not for those who did rebook.

To formally test this we compared the return rates for those who rebooked and those who did not rebook for the per-implementation period just prior to the implementation (16th April 2017 to the 15th April 2018) and the immediate post-implementation period (9th July 2018 to the 8th July 2019) and the 2nd post implementation time window (16th April 2019 to the 15th April 2020). The results (see Figure 5) show that for those who rebooked there was no change in the return rate pre and post-implementation for either comparison ($Z_{\text{pre vs immediate post}} = 0.675$, $p = 0.499$; $D_{Cohen} = 0.005$, and $Z_{\text{pre vs 2nd post}} = 1.512$, $p = 0.131$; $D_{Cohen} = 0.012$). However, for those who did not rebook there was a significant increase in return donations for both comparisons ($Z_{\text{pre vs immediate post}} = 22.876$ $p < 0.0001$; $D_{Cohen} = 0.146$ and $Z_{\text{pre vs 2nd post}} = 26.217$; $D_{Cohen} = 0.159$, $p < 0.0001$). Furthermore, the difference in return rates between those who rebooked and those who did not was also significantly different for the two comparisons ($Z = 13.272$ $p < 0.0001$, $D_{Cohen} = 0.065$ and $Z = 13.795$, $D_{Cohen} = 0.066$, $p < 0.0001$: Figure 2). Thus, those exposed to the warm-glow with identity message were significant more likely to return if they had not rebooked and this level of return was greater than for those who had rebooked.

On average there is a 6.73% increase in donations from those who did not rebook from the immediate pre-implementation period to the two post-implementation periods (6.42% [95% CI 5.869, 6.970] and 7.04% [95% CI 6.515, 7.566]), which is set against 1.93% and a -0.01% change in overall return rates. The 7.04% increase in those who did not rebook (the change from 16th April 2017 to the 15th April 2018 versus 9th July 2018 to the 8th July 2019) equates to an extra 3,253 donations attributable to the warm-glow intervention that had been implemented. For those who rebooked the increase over the same time period attributable to the warm-glow intervention was 78 donations. This gives a NNT (number needed to treat) of 16 indicating that for every 16 donors who did not rebook who were exposed to the intervention, 1 attended to donate. The 6.42% increase in those who did not book (the change from 16th April 2017 to the 15th April 2018 versus 16th April 2019 to the 15th April 2020.) equates to an extra 4,470 donations attributable to the warm-glow intervention that had been implemented. For those who rebooked the increase over the same time period attributable to the warm-glow intervention was 159 donations. This gives a NNT of 14.

Discussion

Our predictions about the effect of a warm-glow intervention on future cooperation were all supported. Exposure to a warm-glow message, in conjunction with a cooperative identity prime, was the most effective in warming-up cooling cooperators and enhancing the probability of attendance to donate.

Thus, a warm-glow message based intervention is an effective low cost approach to enhance long-term cooperative behaviour. This effect was specific to warm-glow and not just positive affect, as messages that focused on positive affect – even with an identity prime – were not effective in enhancing future cooperation. Furthermore, this effect was strongest for those cooperators who had cooled the most (new blood donors who had not rebooked).

Loss of warm-glow may be considered a mechanism that results in greater free-riding – probably unintentional free-riding – and these results show clearly that interventions to boost warm-glow may be an effective approach to sustain longer-term cooperation. In day-to-day social cooperative interactions, warm-glow may be continually reinforced through mechanisms such as reciprocity [6–7, 11–12] and as such sustained [32]. However, for more intermittent, yet important acts of sustained cooperation (blood donation, vaccination, social distancing during the COVID-19 pandemic), this may not be the case. Thus, messages to boost warm-glow in these contexts are likely to be beneficial. Warm-glow also may be a more fruitful mechanism to support cooperation and reduce free-riding than other mechanisms such as altruistic punishment [4], as this suffers from the problem of 2nd order free-riding and retaliation. Thus, encouraging people to reflect on the positive feelings they have from helping may be a positive way to enhance cooperation without these problems and the studies reported here show that this has potential..

These studies show the real power of warm-glow as a proximal mechanism to sustain cooperation beyond the lab. While extensively supported by evidence from lab based studies [21–37] experimental evidence that warm-glow is effective with respect to real world cooperation is lacking, and these studies fill these gaps. Further, these studies show not only that there is something special about the concept of warm-glow, compared to general positive affect, but also that this has long-term benefits is terms of sustaining cooperation.

We also highlight an important boundary condition for warm-glow to be effective: cooperative identity. That is, the effect of warm-glow is stronger when people are primed with a cooperative identity. This may serve to enhance any reinforcing effect of cooperation [46] by strengthening the salience of the link between warm-glow and the behaviour. This hypothesis about the moderating role of cooperative identity with respect to warm-glow is something that can be tested both in lab studies as well as other field based studies on cooperation (e.g., vaccination) and is a novel prediction arising from these field based experiments. We also propose that warm-glow messages re-activate memories or at least help develop positive reconstructive memories of an enjoyable past cooperative event. While plausible this exact mechanism needs to be explored in detail in future studies.

These findings also have important public health policy implications for blood transfusion. Repeat donors have a lower risk of experiencing vasovagal reactions (e.g., fainting) when donating and have a lower rate of discarded blood due to a lower incidence of transfusion-transmissible-infections (TTIs) [67–70]. Repeat donors, therefore, constitute a saving in terms of recruitment costs, improved donor safety and reduced waste from donated blood that cannot be used. Thus, improving conversion rates from first

to repeat donations is a key objective for transfusion services world-wide and warm-glow messages offers a simple, low cost and very effective means to help achieve this [6].

A number of other societal level behaviours are known to be motivated by other regarding preferences. For example, the altruism/prosocial vaccination hypotheses suggests that people are motivated to get vaccinated to protect others as well as themselves [71–72] and this is supported by a growing body of evidence [72–74 but see 75]. Similarly, behavioural restrictions introduced to combat COVID-19, such as social distancing and mask wearing, are likely motivated to some degree by concerns about protecting others as well as the self [76–78]. Thus, the idea of impure altruism seems relevant here also [10]. The work reported here suggests that emphasizing warm-glow can be added to self-other protective messages to emphasize, not only the protection of self and others but also, the personal warm-glow that the person may feel from helping others (e.g., “Get a vaccination to avoid getting and spreading the flu and feel the warm-glow that comes from helping those around”, or “Wear a mask and social distance to avoid getting and spreading COVID-19 and feel the warm-glow that comes from helping those around you”). Indeed, effective social distancing may be required to control the spread of viruses, such as SARS-Cov2and as such any ways to enhance the effectiveness of public health messages - such as a warm-glow message – should be considered [79].

Methods

Timeline for the Field-Based Experiment and Implementation Study

Figure 3 details the dates of the field-based experiment, the implementation of the best warm-glow message and the dates for the pre-post implementation analysis. The methodology of the field based experiment and implementation trial is detailed below.

Field-Based Experiment of Warm-Glow and Positive Affect Messages

Sampling and sample: A sample of 5,821 of new whole blood donors with A-, A+, O- and O + blood types across Australia who made their first whole blood donation six weeks previously were recruited using the following criteria: (1) made their first whole blood donation six weeks ago, and (2) had not donated previously. For each week of the field-based experiment, all donors who met these eligibility criteria were selected and randomly allocated to conditions. Thus, the whole eligible population was sampled each week. This process continued until the pre-determined numbers per condition were achieved. Twenty donors were excluded: twelve due to email bounces and 8 due to being permanently deferred from donating blood after their initial donation (Fig. 4).
Procedure: New A-, A+, O- and O + donors were recruited to the trial when they made the first donation between the 16th of April 2018 to the 8th July 2018, with the first message issued from the 22nd of May

2018. These donors were randomly allocated (using simple randomization) to one of four active arms and a control arm. The control arm contained no message. All other communications from Lifeblood, including an SMS reminder at 12 weeks that the donor could donate whole blood again, were identical across the arms of the trial. Thus, the only difference was the warm-glow and positive affect messages with or without an identity prime. The four active arms crossed a warm-glow vs positive affect message with a prime ("… that's when you became a blood donor …") or no prime for cooperative identity (Fig. 5: Supplementary File S1 contains the full emails sent).

Measures: We collected the following data on the donors: (1) age, (2) sex (0 = male, 1 = female), (3) blood group (ABO: A-, A+, O-, O+, O) and (4) if they had rebooked to make their next donation immediately after their 1st donation (scored 1) or had not initially rebooked (scored 0)

Outcome: The main outcome was a verified attendance at the donor centre to make a donation (whole blood or plasma) three months after becoming eligible to donate. These data were collected using eProgesia. The data analysts who extracted the attendance data were blind to the experimental condition that the donor was assigned to. Attending to donate is a clear behavioural act of wishing to cooperate to help a stranger and the study is powered for attendance to donate as the outcome.

Power Analysis

Warm-glow has a small effect size with respect to predicting blood donor attendance [56, 58]. In a simple regression model with 8 predictors (e.g., arms, age, sex, blood group, rebooked and interaction of rebooked with arms) to achieve 80% power, with an alpha of 0.05 and a small effect size requires 757 donors per arm. Thus, we aimed for 1,000 new donors per arm to allow for any exploratory analyses.

Pre-Registration: The trial was pre-registered on the Open Science Framework prior to 'prior to data collection commencing' (OSF reference: https://osf.io/5m69k).

Consenting: All donors, when they attend to make a donation, sign an individual general declaration consenting to assist blood donor research.

Ethics: The field-based experiment was approved by the Australian Red Cross Lifeblood Ethics Committee on 7th May 2018, with the first randomized message sent out on the 22nd of May for those who had made a donation on the 16th of April (Reference: Davison 04052018).

Implementation Study

Design. When recruitment for the field-based experiment stopped, as the specified number of donors per arm had been achieved, the most effective message, based on marketing click through data (click to open) was selected to be rolled out nationally on the 9th of July 2018. Once the field-based experiment follow up data were collected and analysed it showed that the field-based experiment results confirmed the click rate choice. This correspondence allowed us to conduct the implementation study.

The implementation samples consisted of all new donors across Australia who were whole blood donors with autologous and therapeutic donors excluded. We collated aggregate data on whether or not they had attended to make a 2nd donation (WB or apheresis) within 3 months and whether or not they had initially rebooked in the centre or not. We compared the frequency of attending to make a second donation (whole blood or plasma) in a 3 year window prior to the message roll out to the frequency in the year after the message roll out, across two time windows. The pre-implementation period covered 3 time windows consisting of the 16th of April to the 15th of April for years (1) 2015-2016, (2) 2016-2017 and (3) 2017-2018 and the post-implementation period covered two slightly overlapping time windows: (1) the 9th of July 2018 to the 8th of July 2019 and (2) the 16th of April 2019 to the 15th of April 2020. The first post implementation time window covers the year from the moment the most effective warm-glow message went live across Australia and the second window covers the April to April window that is consistent with the April to April pre-implementation time window.

Ethics: As these data for the implementation analysis are aggregated at the population level, and all donors when they attend to make a donation sign a general declaration consenting to assist blood donor research, no specific additional ethical approval was needed for these analyses.

Statistical Analyses: Field Based Experiment and Implementation Data

All data were analysed using standard statistical packages (IBM SPSS v26, ZumStat, Psychometrica). All tests are two-tailed and effects sizes for all analyses are reported as Cohen's D. Cohen's D was derived for comparison across multiple group means using the procedures described in [80] and from Z scores using procedure described in [81], with both implemented in Psychometrica [82]. Odds Ratios are converted to D using procedures described in [83]. Comparison of percentage across groups, including interactions, used procedure detailed in [84–85].

Declarations

Data Accessibility: The authors declare that all data supporting the findings of this study are available within the paper and its supplementary information files.

Funding: Australian governments fund the Australian Red Cross Lifeblood to provide blood, blood products and services to the Australian community

Conflict of Interests: None of the authors has conflicts of interest to declare.

Authorship: All authors have read the content of the paper are happy with this and the order of authorship.

Author Contribution Statement: EF, CL, CNG, AR, KN, BM & TD designed the study protocol and materials. AR, KN & CNG conducted the day to day running of the trial. EF and CNG prepared the data files and did initial analysis on the main trial and EF analysed the main study and implementation study. EF drafted the initial manuscript and all the authors contributed to revising the manuscript over a number of iterations.

References

1. West, S.A., Griffin, A.S.A., & Gardner A. Social semantics: altruism, cooperation, mutualism, strong reciprocity and group selection. *J. Evol. Biol.* **20**, 415–432. (2007)
2. West, S.A., Mouden, C.E., & Gardner, A.. ixteen common misconceptions about the evolution of cooperation in humans. *Evol. Hum. Behav.* **32**, 231–262 (2011)
3. Pizzari, T., & Gardner, A. The sociobiology of sex: inclusive fitness consequences of inter-sexual interactions. *Philos. Trans. R. Soc. Lond. B. Biol. Sci.* **367**, 2314–2323. (2012)
4. Fehr, E., & Gächter, S. Altruistic punishment in humans. *Nature.* **415**, 137–140 (2002).
5. Scott-Phillips, T.C, Dickins, T.E, & West S.A. Evolutionary theory and the ultimate-proximate distinction in the human behavioral sciences. *Perspect. Psychol. Sci.* **6**, 38–47. (2011).
6. Nowak, M.A. Five rules for the evolution of cooperation. *Science.* **314**, 1560–1563 (2006).
7. Rand, D.G., &Nowak, M.A. Human cooperation. *Trends. Cogn. Sci.* **17**, 413–425. (2013).
8. Fischbacher, U., Gächter, S., & Fehr E. Are people conditionally cooperative? Evidence from a public goods game. *Econ. Letts.* **71**, 397–404. (2001).
9. Bradley, A., Lawrence, C., & Ferguson, E. Does Observability Effect Prosociality? A Meta Analytic Review. *Proc. Roy. Soc.* B. **285**: *20180116*. (2018).
10. Andreoni, J. mpure altruism and donations to public goods: A theory of warm glow giving. *Econ. J.* **100**, 464–487. (1990)
11. Nowak, M., & Sigmund, K.. Evolution of Indirect Reciprocity. *Nature*, **437**, 1291–1298 (2005)
12. Milinski, M.. Reputation, a universal currency for human social interaction. *Philos. Trans. R. Soc. Lond. Ser. B*, **371**, 20150100. (2016).
13. Zak, P.J., Stanton, A.A., & Ahmadi, S., (). Oxytocin increases generosity in humans. *Plos One*, **11** e1128 (2007).
14. Fehr, E., & Fischbacher, U. (). Third-party punishment and social norms. *Evol. Hum. Behav.* **25**, 63–87. (2004)
15. Fehr, E., & Schmidt, K. A theory of fairness, competition and cooperation. *Q. J. Econ.* **114**, 817–868. (1999).
16. de Waal, F.B.M.. Putting the Altruism Back into Altruism: The Evolution of Empathy. *Annu. Rev. Psychol.* **59**, 279–300. (2008)

17. Cialdini, R.B., Brown, S.L., Lewis, B.P., Luce, C., & Neuberg, S.L.Reinterpreting the empathy-altruism relationship: when one into one equals oneness. *J. Pers. Soc. Psychol.* **73**, 481–494. (1997).
18. Batson, C. D. *The altruism question: Toward a social-psychological answer* (pp. 1–257). Hillsdale, NJ: Erlbaum. (1991)
19. Andreoni, J. (). Warm-glow versus cold-pickle: The effects of positive and negative framing on cooperation in experiments. *Q. J. Econ.* **60**, 1–21.(1995)
20. Andreoni, J. Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence *J. Pol. Econ.* **97** 1447–1458 (1989).
21. Crumpler, H., & Grossman, P.J. (). An experimental test of warm glow giving. *J. Pub. Econ.* **92**, 1011–1021 (2008).
22. Konow,. Mixed feelings: Theories of and evidence on giving. *J. Pub. Econ.* **94**, 3279–297. (2010).
23. Mayo, J. W., & Tinsley, C. H. Warm Glow and charitable living: Why the wealthy do not give more to charity? *J. Econ. Psychol.* **30**, 490–499 (2009).
24. Goeree, J. K., Holt, C. A., & Laury, S.K. Private costs and public benefits: Unraveling the effects of altruism and noisy behavior. *J. Pub. Econ.* **83**, 255–276. (2002).
25. Ferguson, E., & Flynn, N. (2016). Moral Relativism as a Disconnect Between Behavioural and Experienced Warm Glow. *J. Econ. Psychol.* **56**, 163–175. (2016).
26. Harbaugh, W.T., Mayr, U., & Burghart, D. R. Neural responses to taxation and voluntary giving reveal motives for charitable donations. *Science*, **316**, 1622–1625 (2007).
27. Menges, R., Schroeder, C. & Traub, S. Altruism, Warm Glow and the Willingness-to-Donate for Green Electricity: An Artefactual Field Experiment. *Environ. Resource. Econ.* **31**, 431–458 (2005).
28. Ferrara, I., & Missios, P. Trust, ability-to-pay, and charitable giving. *J. Pub. Econ. Theory.* **22**, 583–629. (2020).
29. Kuroishi, Y., & Sawada, Y. Motivations behind prosocial behavior: Evidence from the Philippines. *J. Asian Econ.* **64**,101127 (2019).
30. Gandullia., L. The price elasticity of warm-glow giving. *Econ. Letts*, **182**, 30–32. (2019).
31. Iweala, S., Spiller, A., & Meyerding, S. Buy good, feel good? The influence of the warm glow of giving on the evaluation of food items with ethical claims in the UK and Germany. *J. Clean. Product.* **215**, 315–328. (2019).
32. O'Brien, E., & Kassirer, S. People Are Slow to Adapt to the Warm Glow of Giving. *Psychol. Sci.* **30**, 193–204. (2019).
33. DellaVigna, S., & Devin Pope, D. What Motivates Effort? Evidence and Expert Forecasts, *Rev. Econ. Stud.* 85, 1029–1069 (2018).
34. van der Linden., S. Warm glow is associated with low- but not high-cost sustainable behaviour. *Nat. Sustain.* **1**, 28–30 (2018).
35. Hartmann, P, Eisend, M., Apaolaza, V., & D'Souza, C. Warm glow vs. altruistic values: How important is intrinsic emotional reward in proenvironmental behavior? J. *Environ. Psychol.* 52:43–55 (2017).

36. Luccasen, A. Warm-glow giving: earned money and the option to take. *Econ. Inq.* **55**, 996–1006. (2017).
37. Bischoff, I., & Krauskopf, T.. Warm glow of giving collectively – An experimental study. *J. Econ. Psychol.* **51**, 210–218. (2015).
38. Taufik, D., Bolderdijk, J. & Steg, L. Acting green elicits a literal warm glow. *Nat. Clim. Change* **5**, 37–40 (2015).
39. Tonin, M., & Vlassopoulos, M. An experimental investigation of intrinsic motivations for giving. *Theory. Decis.* **76**, 47–67 (2014).
40. Kollock, P. Social dilemmas: The anatomy of cooperation. *Ann. Rev. Sociol.* **24**, 183–214 (1998).
41. Andreoni. J. Why Free Ride - Strategies And Learning In Public-Goods Experiments. *J. Pub. Econ.* **37**, 291–304. (1988).
42. Johnson, E.J., & Goldstein, D.G. Do defaults save lives? *Science* **302**, 1338–1339. (2003).
43. Shepherd, L., O'Carroll, R.E., & Ferguson, E. An international comparison of deceased and living organ donation rates in opt-in and opt-out systems: a panel study. *BMC Med.* **12**, 131. (2014).
44. Andreoni, J., & Yildirim, H. Andreoni–McGuire algorithm and the limits of warm-glow giving. *J. Pub. Econ.* **114**: 101–107. (2014)
45. Allouch, N. A competitive equilibrium for a warm-glow economy. *Econ. Theory.* **53**, 269–282 (2013).
46. Weiss, R. F., Boyer, J. L., Lombardo, J. P., & Stich, M. H. Altruistic drive and altruistic reinforcement. *J. Pers. Soc. Psychol.* **25**, 390–400 (1973).
47. Schacter, D. L., & Addis, D. R. (). The cognitive neuroscience of constructive memory: remembering the past and imagining the future. *Philos. Trans. Roy. Soc. B.* **362**, 773–786. (2007).
48. Delton, A.W., Cosmides, L., Guemo, M., Robertson, T.E, & Tooby, J. The psychosemantics of free riding: dissecting the architecture of a moral concept. *J Pers Soc Psychol.***102**, 1252–1270. (2012).
49. Sedikides, C., Wildschut, T., Arndt, J., & Routledge, C. Nostalgia: Past, present, and future. *Curr. Dirs. Psychol. Sci. 17*, 304–307. (2008).
50. Merchant., A, Ford., J. B. & Rose G. How personal nostalgia influences giving to charity. *J. Bus. Res.* **64**, 610–616 (2011).
51. Hartmann B. J, & Brunk K. H. Nostalgia marketing and (re-)enchantment. International *J. Res. Market.* **36**, 669–686. (2019).
52. Balliet, D., Mulder, LB., & Van Lange PAM. (). Reward, punishment and cooperation: A meta-analysis. *Psychol. Bull.* **137**, 594–615 (2011).
53. Abasolo, I., & Tsuchiya, A. (). Blood donation as a public good: an empirical investigation of the free rider problem. *Euro. J. Health. Econ.* **15**, 313–321. (2014).
54. Evans, R., & Ferguson E. Defining and Measuring Blood Donor Altruism: A Theoretical Approach from Biology, Economics and Psychology. *Vox Sang.* **106**, *118 – 12* (2014).
55. Ferguson, E, Taylor, M., Keatley, D., Flynn, N., & Lawrence, C. Blood Donors' Helping Behavior is Driven by Warm Glow More Evidence For the Blood Donor Benevolence Hypothesis. *Transfusion*, **52**, 2189–

2200 (2012).

56. Ferguson., E, & Lawrence C. Altruistic and Warm-Glow Motivations: Variation by Blood Donor Career. *Testing, Psychomets., Methodol. Appl. Psychol.* **29**, 639–651. (2019)
57. Ferguson, E., Atsma, F., de Kort, W., & Veldhuizen., I. Exploring the Pattern of Blood Donor Beliefs in First Time, Novice and Experienced Donors: Differentiating Reluctant Altruism, Pure Altruism, Impure Altruism and Warm-Glow *Transfusion*, **52**, **343**–**355**. (2012).
58. Ferguson,. E., Farrell., K, & Lawrence., C. Blood Donation is an act of Benevolence Rather Than Altruism. *Health Psychol.* **27**, 327–336. (2008).
59. Ferguson, E & Bibby PA. Predicting future blood donor returns: past behavior, intentions and observer effects. *Health Psychol.* **21**, 513–518 (2002)
60. Ferguson, E., & Chandler, S. A stage model of blood donor behaviour: Assessing voluntary behaviour. *J. Health Psychol.* **10**, 359–372 (2005)
61. Ferguson., E. Mechanisms of altruism approach to blood donor recruitment and retention: a review and future directions *Trans. Med.* **25**, 211–226. (2015).
62. Piliavin, J. A., Callero, P. L., & Evans, D. E. (). Addicted to altruism? Opponentprocess theory and habitual blood donation. *J. Pers. Soc. Psychol.* **43**, 1200–1213. (1982).
63. Piliavin, J. A., & Callero, P. L. (). Altruism: A review of recent theory and research. *Ann. Rev. Psychol.* **16**, 27–65. (1990).
64. Snippe, E., Jeronimus, B.F., Aan Het Rot, M., et al. The Reciprocity of Prosocial Behavior and Positive Affect in Daily Life. *J. Pers.* **86**, 139–146. (2018).
65. Ma, L., Tunney, R., & Ferguson, E. Does Gratitude Enhance Prosociality: A Meta-Analytic Review. *Psychol. Bull.* **143**, 601–635. (2017).
66. Neumann., R. The framing of charitable giving: A field experiment at bottle refund machines in Germany. *Rational. Soc.* **31**, 98–126. (2019).
67. Zou, S., Stramer, S.L., & Dodd, R.Y. Donor testing and risk: Current prevalence, incidence, and residual risk of transfusion-transmissible agents in US allogenic donations. *Transfus. Med. Rev.* **26**, 119–128. (2012).
68. Lucky, T.T.A., Seed, C.R., Keller, A., Lee, J., McDonald, A., Ismay, S., Wand, H., & Wilson, D.P. Trends in transfusion-transmissible infections among Australian blood donors from 2005 to 2010. *Transfusion.* **53**, 2751–2762.(2013).
69. Natachit, N., Robinson, V., Wongthanee, A., Kamtorn, N., Suriyanon, V., & Nelson K.E. Temporal trends in the prevalence of HIV and other transfusion-transmissible infections among blood donors in northern Thailand, 1990 through 2001. *Transfusion.* **43**, 730–735 (2002).
70. Schreiber, G.B., Sharma, U.K., Wright, D.J., Glynn, S.A., Ownby, H.E., Tu, Y., Garratty, G., Piliavin, J., Zuck, T., & Gitcher, R. First-year donation patterns predict long-term commitment for first time donors. *Vox Sang*, **88**: 114–121.(2005).

71. Brewer, N.T., Chapman, G.B., Rothman, A.J., Leask, J., Kempe, A. Increasing vaccination: Putting psychological science into action. *Psychol. Sci. Public. Interes.* **18**, 149–207. (2017).
72. Betsch, C., Böhm, R., & Korn, L. Inviting free-riders or appealing to prosocial behavior? game-theoretical reflections on communicating herd immunity in vaccine advocacy. *Heal. Psychol.* **32**, 978–985. (2013).
73. Betsch, C., Böhm, R., Korn, L.,& Holtmann, C. On the benefits of explaining herd immunity in vaccine advocacy. *Nat. Hum. Behav.* **1**, 0056. (2017).
74. Li, M., Taylor, E.G., Atkins, K.E., Chapman, G.B., & Galvani, A.P. Stimulating influenza vaccination via prosocial motives. *PLoS One.* **11**, e0159780.(2016).
75. Isler, O., Isler, B., Kopsacheilis, O., Ferguson, E. Limits of the social-benefit motive among high-risk patients: a field experiment on influenza vaccination behaviour. *BMC Pub.Heal.* **20**, 240 (2020).
76. Jordan, J.J., Yoeli, E., Rand, D.G, et al. Don't Get It or Don't Spread It? Comparing Self-interested Versus Prosocial Motivations for COVID-19 Prevention Behaviors PsyArXiv, 3 Apr. 2020. Web.
77. Campos-Mercade, P., Meier, A.,Schneider, F., and Wengström, E. Prosociality Predicts Health Behaviors during the COVID-19 Pandemic (May 17, 2020). University of Zurich, Department of Economics, Working Paper No. 346, 2020, Available at SSRN: https://ssrn.com/abstract=3604094 or http://dx.doi.org/10.2139/ssrn.3604094
78. Luttrell, A., & Petty, R. E. Evaluations of Self-Focused Versus Other-Focused Arguments for Social Distancing: An Extension of Moral Matching Effects. *Soc. Psychol. Pers. Sci*. (2020)
79. Block, P., Hoffman, M., Raabe, I.J. *et al.* Social network-based distancing strategies to flatten the COVID-19 curve in a post-lockdown world. *Nat. Hum. Behav.* **4**, 588–596 (2020).
80. Cohen J. Statistical Power Analysis for the Behavioral Sciences. New York, NY: Routledge Academic. (1988).
81. Fritz CO, Morris PE, Richler JJ.(2012). Effect size estimates: current use, calculations, and interpretation [published *J. Exp. Psychol. Gen*. **141**, 2–18. (2012).
82. Lenhard., W. & Lenhard., A. *Calculation of Effect Sizes*. Retrieved from: https://www.psychometrica.de/effect_size.html. Dettelbach (Germany): Psychometrica. DOI: 10.13140/RG.2.2.17823.92329 (2016).
83. Borenstein, M., Hedges, L. V., Higgins, J. P. T., & Rothstein, H. R. *Introduction to Meta-Analysis*. Chichester, West Sussex, UK: Wiley (2009).
84. Agresti., A. An Introduction to Categorical Data Analysis: New York: Wiley & S Sons. (1996).
85. Rosenthal, R., & Rosnow., R.L. Contrast analysis. Focused companions in the analysis of variance. Cambridge, England Cambridge University Press. (1985).

Figures

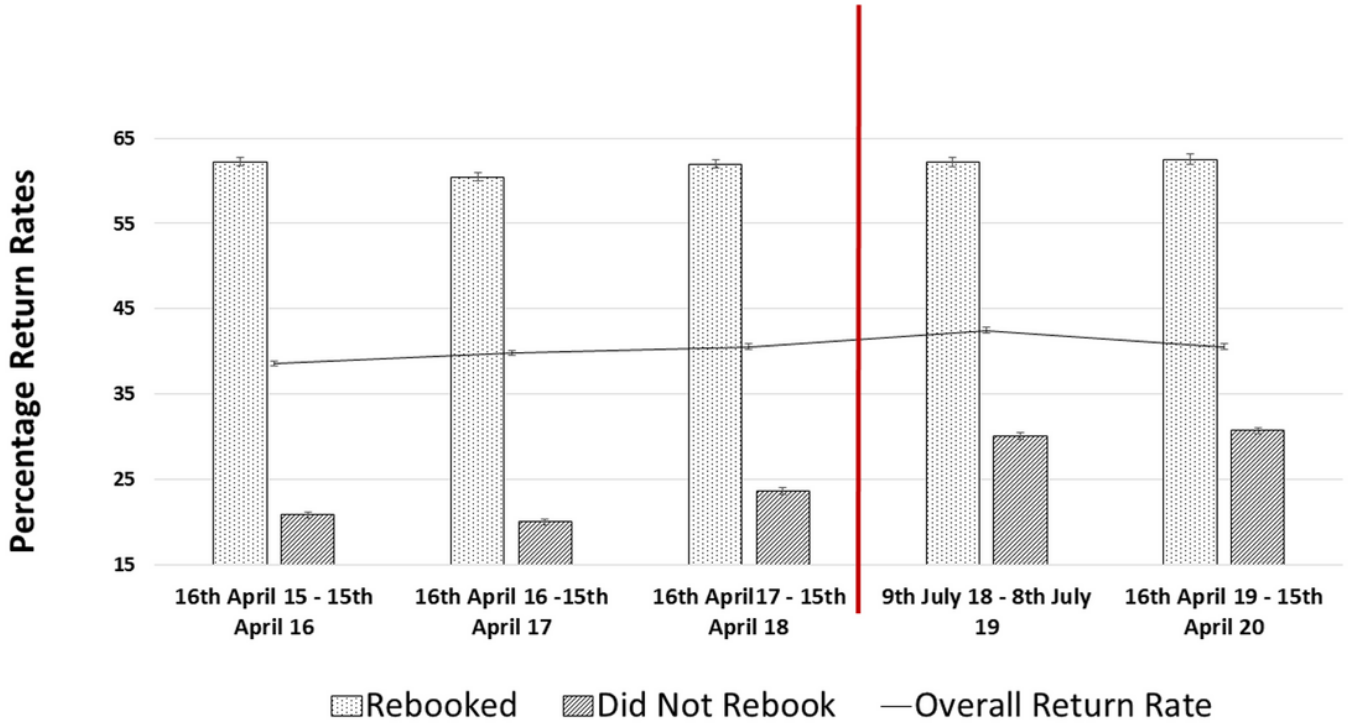

Figure 1

Return rates pre- and post-implementation of the Warm-Glow plus Identity Message In new donors as a function of initial rebooking status (rebooked or did not). Upward trend for overall return rate ($Z = 8.52$, $p <= 0.00001$ comparing 16th April 2015 to the 15th April 2016. To 16th April 2019 to the 15th April 2020). Error Bars are 95% CIs

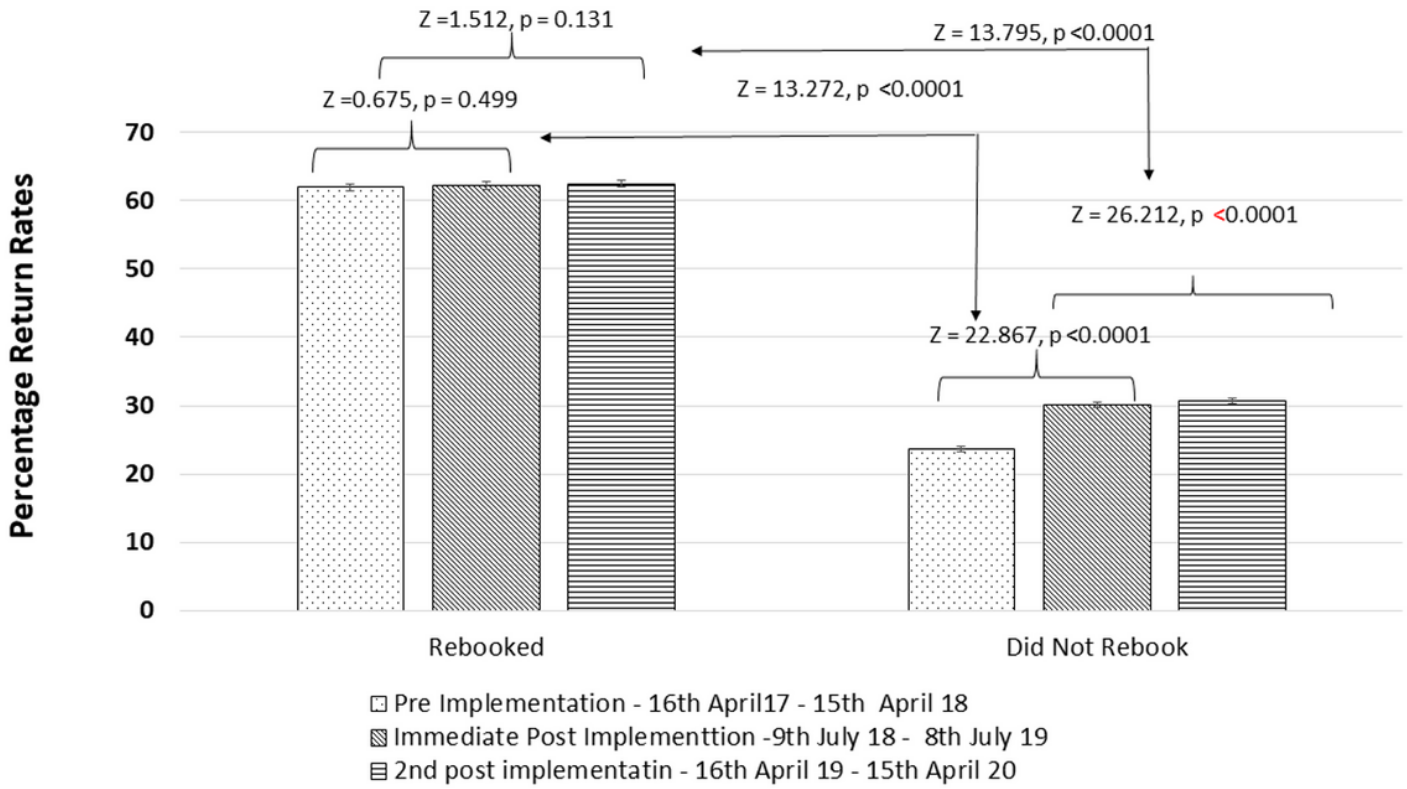

Figure 2

Comparison of Pre- and Post-Implementation Periods. Error Bars = 95% CIs.

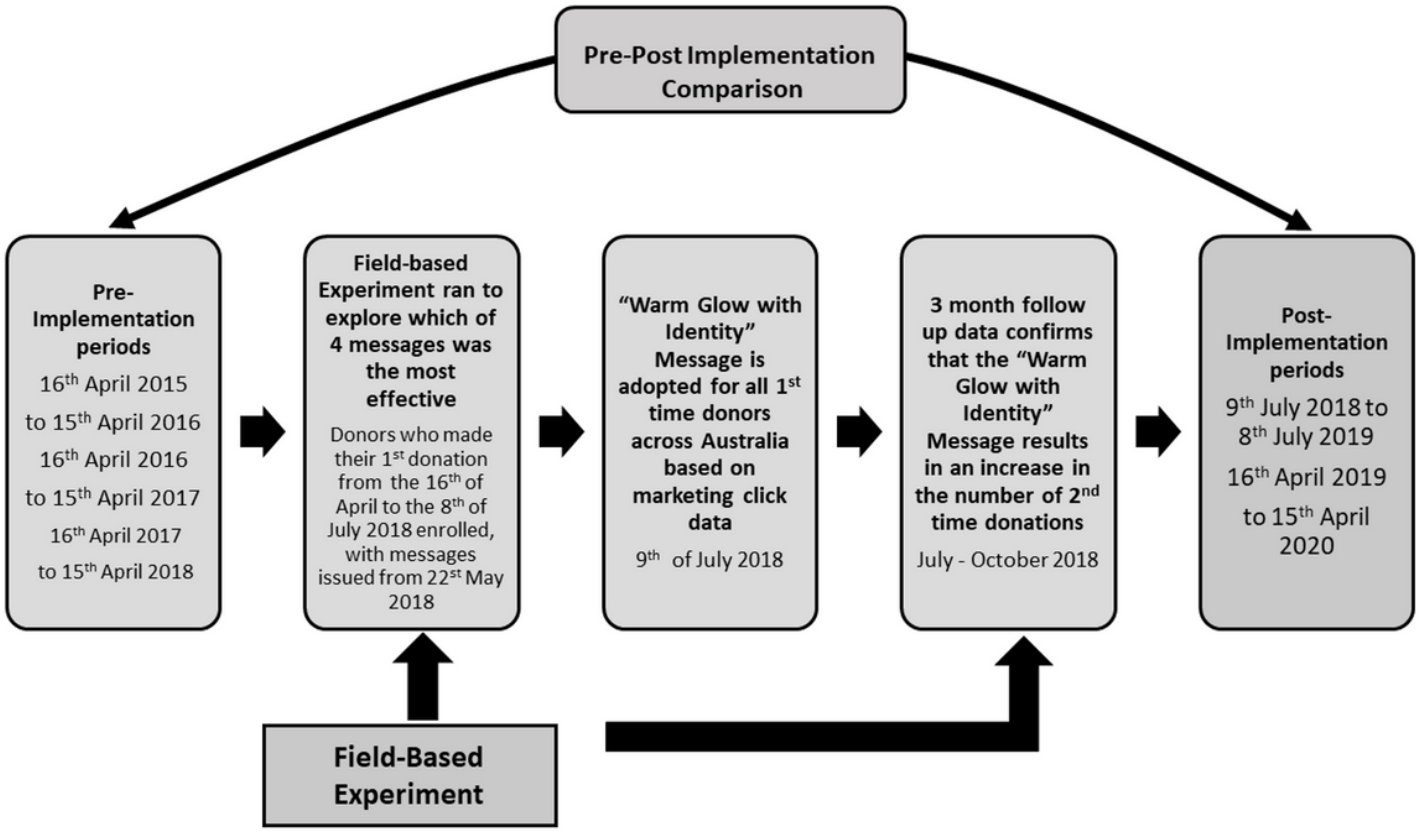

Figure 3

Time Lines for Field Experiment and Implementation Analysis

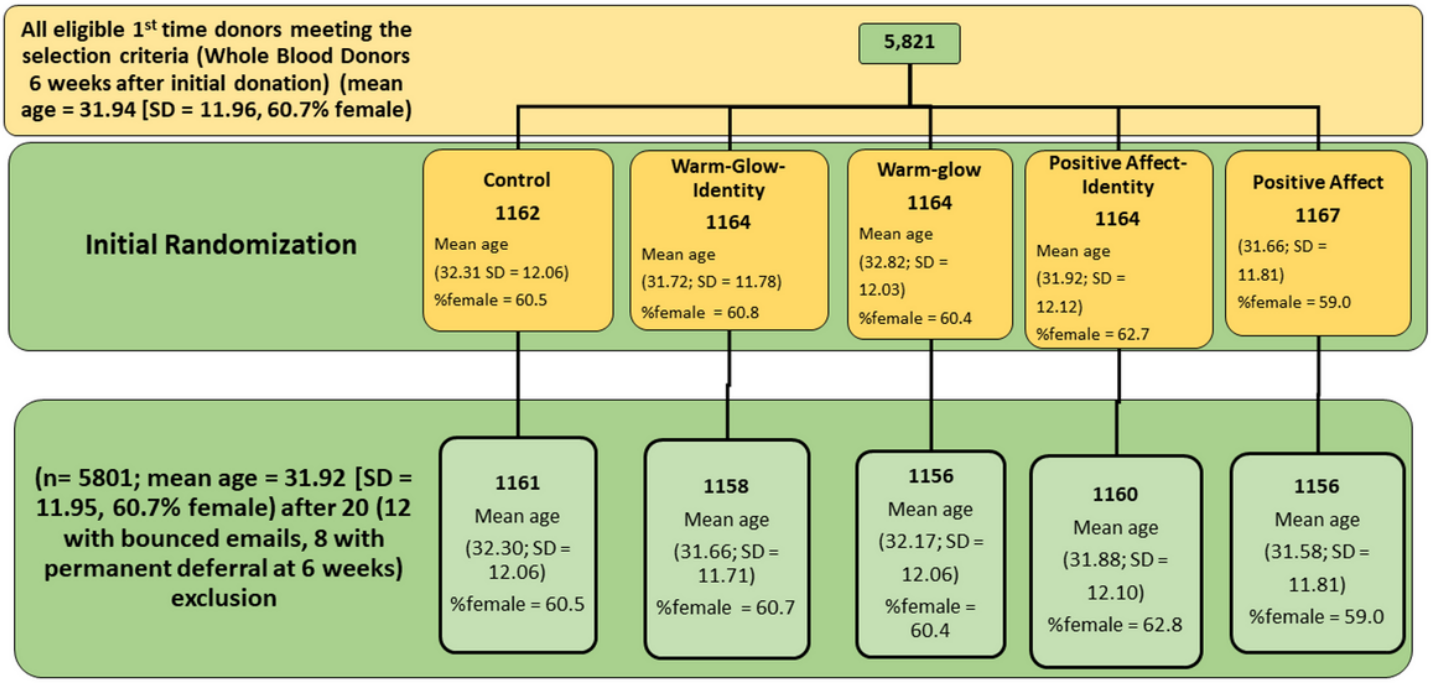

Figure 4

Design and sampling for the Field-Based Experiment

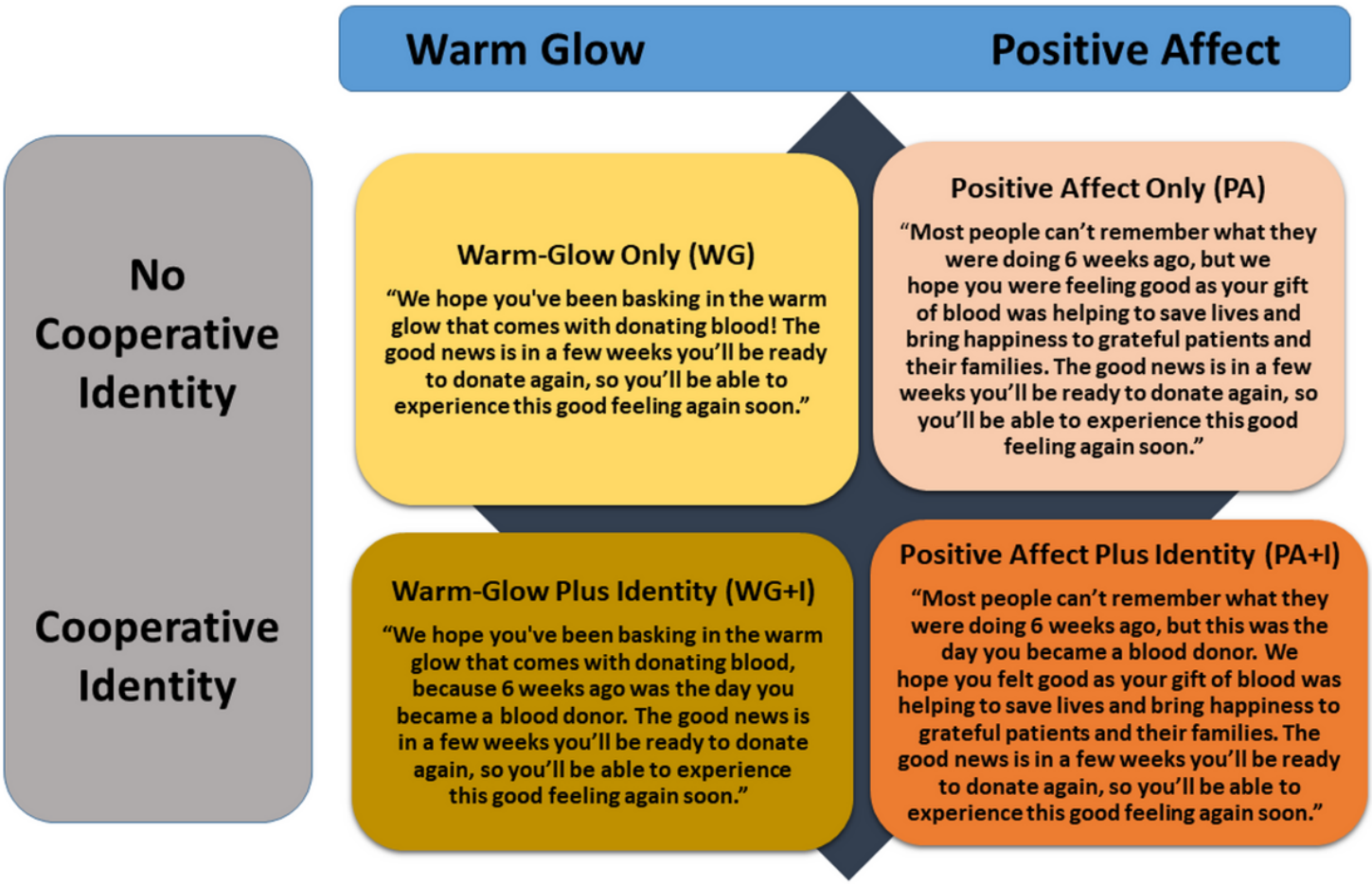

Figure 5

Active intervention arms

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- SupplementrayFileWarmGlowRCT.docx
- FieldBasedExperimentWarmingupCooperators.csv