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BLOOD DONORS AND BLOOD COLLECTION

TRANSFUSION

How to convert whole-blood donors to plasma donors: An investigation of the mechanisms of awareness of need for plasma and donors' perception of response efficacy

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Abstract

Background: Blood donation services need to increase plasma donations to match the rising demand. However, evidence on how to best recruit donors among whole-blood donors is limited. Therefore, this study evaluated the effectiveness of a conversion strategy based on two different mechanisms that drive donor behavior: (a) awareness of the need for plasma donation and (b) perception of response efficacy regarding plasma donation.

Study Design and Methods: An online experiment with 246 German Red Cross whole-blood donors (possibility of plasma donation, blood group AB) was conducted using a 2 × 2 factorial, between-subject setup, and a pre–post treatment measurement. The mechanisms varied and were addressed with experimental treatments and measured. Analyses of variance and hierarchical regression models were used to analyze the effects on intention and behavior.

Results: The intention to donate plasma was low, but increased with treatment (mean $\text{value}_{\text{overall}}$ of $\text{intention}_{\text{beforeTreatment}} = 2.63$, $SD = 1.73$ vs. $\text{intention}_{\text{afterTreatment}} = 3.28$, $SD = 1.92$). Furthermore, 31% of participants expressed willingness to be forwarded to the appointment-scheduling system of the blood donation service for further information. Only the mechanism of response efficacy was significantly associated with the intention to donate plasma ($\beta_{\text{Efficacy}} = .254$, $p = .001$; $\beta_{\text{Awareness of Need}} = .126$, $p = .070$).

Discussion: A conversion strategy based on making donors aware of their response efficacy is a promising way to optimize donor panels by shifting them to where they have the greatest impact. However, this study also substantiates the difficulty of such an effort. Blood donation services should invest in persuasion efforts and build personalized integrated marketing communications.

Abbreviations: α, Cronbach's alpha; ANOVA, analysis of variance; GRC, German Red Cross; OR, Odds ratio; SD, Standard deviation; SE, Standard error.

KEYWORDS

awareness of need, blood group AB, donor conversion, GRC Blood Donation Services North-East and Baden-Wuerttemberg-Hessia, mechanisms of giving, plasma, plasma donor recruitment, plasmapheresis, response efficacy, self-efficacy

1 | INTRODUCTION

Blood donation services worldwide need to increase the number of plasma donations to meet the mounting demand for blood plasma.[1–5] The standard recruitment procedure for plasma donors is to persuade those who have previously donated whole-blood to donate plasma.[1] However, recent studies have highlighted the difficulty in achieving this. Bagot et al.[6] (p. 189) mentioned that, "as may be expected, participants were more reluctant to change to plasmapheresis on request [...] and, regardless of willingness, voiced concerns about time constraints." Initial studies approaching this problem have examined barriers to conversion efforts or factors that drive their success, such as phone call versus a face-to-face communication.[7–10] Despite this, knowledge on what drives conversion of whole-blood donors to plasma donors is very limited.

The context of this study was the German Red Cross (GRC) Blood Donation Services, which is responsible for approximately 75% of the whole-blood collection in Germany and have an unremunerated whole-blood donor base. The GRC Blood Donation Services North-East and Baden-Wuerttemberg-Hessia are interested in learning about specific target groups for their conversion strategy. In the past, they periodically tried to convert donors with blood group AB into plasma donors because AB represents a universally transfusable blood group in the plasma context. In general, the GRC introduced communication activities to generate a higher awareness of different blood groups among whole-blood donors. On their website, for example, they display a "blood group barometer" that provides information on the blood-group-specific inventory levels (of whole-blood donations) updated on a daily basis.[11]

The goal of the present study was to investigate the effectiveness of the conversion strategy targeting AB-whole-blood donors, which is based on two mechanisms that drive plasma donor conversion: (a) awareness of the need for plasma donations and (b) perception of donors' own response efficacy regarding plasma donation.

1.1 | Mechanisms that drive conversion: awareness of need and perception of response efficacy

A conversion strategy with the goal of persuading whole-blood donors to start plasma donation will most likely first address a fundamental prerequisite for giving behavior, that is, an awareness of need.[12] Awareness can refer to different aspects of knowledge regarding needs. This study addressed the increasing need for plasma to meet the demands of modern health systems. Applying the reasoning of Bekkers and Wiepking, this is assumed to be a general driver of plasma conversion intention and behavior.[12] Accordingly, Bagot et al.[13] found that an awareness of the need for blood donations of a special type facilitates the change in donation type. Masser and Bagot recommended creating awareness of the possibility of donating plasma among donors.[10] Figure 1 illustrates the conceptualization of the mechanisms and anticipated associations regarding plasma conversion intention and behavior.

Persuading donors by educating them about their special suitability regarding one donation type because of their blood group addresses another key mechanism of giving behavior: the perception of one's own efficacy.[12] According to Bekkers and Wiepking, this "refers to the perception of donors that their contribution makes a difference to the cause they are supporting" (2011, p. 942).[12] Applied to the plasma conversion context, this means that the donors' intention to act, that is, to start plasma donation, is driven by their evaluation on how effective their donation is in achieving their goal: to give blood that helps others. This concept of perceived efficacy regarding the outcome is well known in health behavior research.[14–17] In this stream of the literature, different models include "response efficacy," which is associated with taking on a specific, health-related behavior. Response efficacy is defined as "the person's belief that a specific action will mitigate a health threat"[15] (Jayanti & Burns, 1998, p. 9). In the present study, perception of one's own response efficacy was represented by the knowledge about blood group AB and its particular value for plasma donation. This perception may drive an individual's conversion to plasma donation, which is supported by previous research. Bove et al.[18] suggested that donors can be converted after being informed about the suitability of their blood groups for plasma donation. Chamla et al.[19] highlight that sending personalized invitation letters featuring an individual's blood group positively affects the likelihood of a behavioral response.

This study argued that the stronger the awareness of need, the stronger the impact of the perception of one's own response efficacy on plasma donation intention and behavior. This interaction was substantiated in the

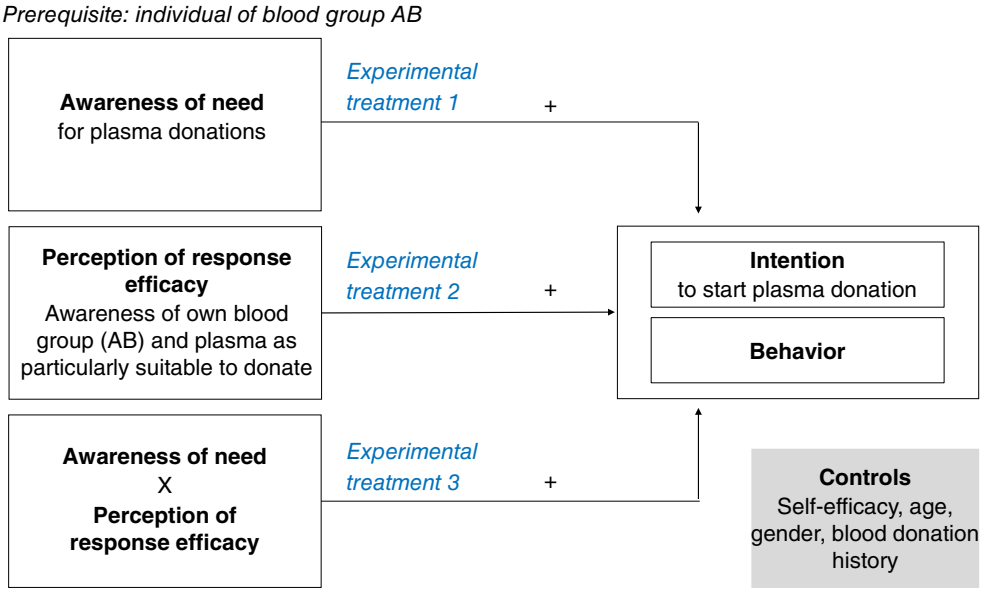

FIGURE 1 Conceptualization of mechanisms influencing plasma conversion. [Color figure can be viewed at wileyonlinelibrary.com]

charitable giving context by Warren and Walker, and mentioned by Bekkers and Wiepking.[12,20] In the context of health behaviors, Rogers (1983) proposed that response efficacy and the perception of severity of a health threat interact in influencing behavioral intention.[17]

Besides these two focal mechanisms and their interaction, which are assumed to be triggered as part of the AB blood group conversion approach, this study included self-efficacy as a general prerequisite for plasma donation intention. Giles et al. (2004, p. 383) defined self-efficacy as "a measure of the extent to which an individual believes he/she has the confidence/capability to give blood."[21] It therefore differs from the concept of response efficacy, which is more outcome-oriented. Self-efficacy was included as a control variable since this study focused on the potential increase in response efficacy by persuasion through the means of blood group education.

2 | MATERIALS AND METHODS

2.1 | Experimental design

This study employed an experimental design incorporated into an online survey. It featured a 2 × 2 factorial (manipulation of two mechanisms present/absent) between-subject design leading to four distinct experimental conditions. As outcome variables, the survey first included a pretest–posttest measurement of intention to start plasma donation. Second, it captured if a behavioral step was taken toward plasma donation. In addition, the study design enabled an introduction of the scales that measured the perception of the two main mechanisms. As stated in the preregistration, these serve, on the one hand, as a manipulation check, and, on the other hand, as the input for subsequent model analysis. See Figure 2 for an overview on experimental design, participants, and procedure.

The preregistration of this study in the Open Science Framework (OSF) is available at (10.17605/OSF.IO/79Q3C). This experimental design was approved by the persons responsible for donor research at the GRC, and was in accordance with the European Commission's RESPECT Code of Socio-Economic Research.[22]

2.2 | Participants

The data were collected in October 2022 and the final sample size comprised 246 whole-blood donors of the GRC Blood Donation Services North-East and Baden-Wuerttemberg-Hessia. For this, the GRC identified in their donor database a base population ($n = 11{,}850$) of eligible donors that matched the following criteria: (1) German whole-blood donor aged 18–73 years, (2) blood group AB (approximately 5% of the German population), (3) living close to a GRC plasma collection facility, (4) made at least one whole-blood donation in the past 36 months, but (5) never donated plasma before.

A total of 4218 individuals from this base population consented to be contacted for the study purposes. All of them were invited via postal mail by the GRC to participate in the online survey. The survey was initially conducted with 518 donors (response rate, 12%). Of these, 272 dropped out before answering the questions on the dependent variables or were screened out, for example, because of indication of previous plasma donation (see Appendix A). The sample is representative for the base population regarding gender and past donations.

Unfortunately, the final sample size fell short of the expectations targeted in the preregistration. However, the

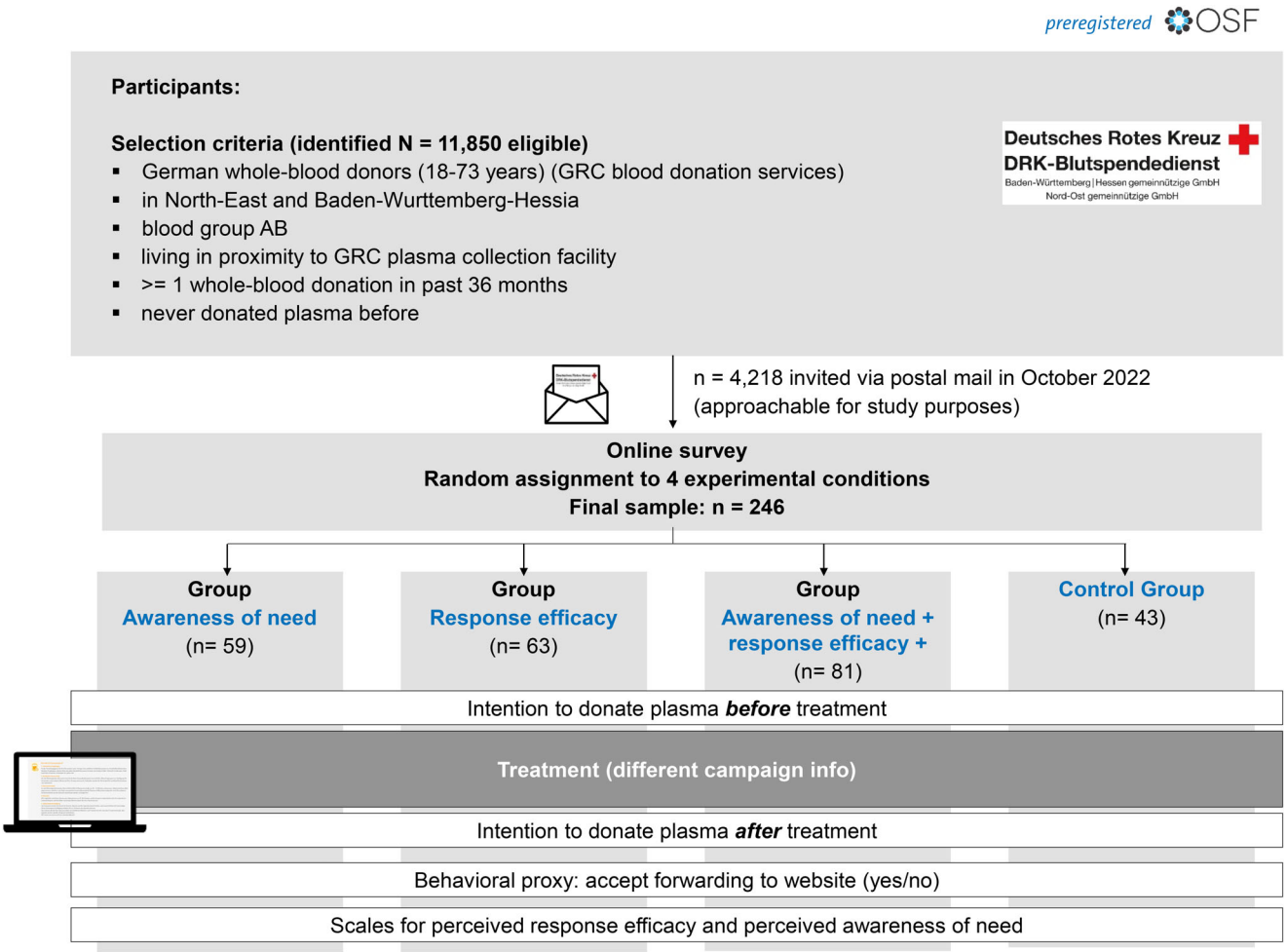

FIGURE 2 Experimental design, participants, and procedure. [Color figure can be viewed at wileyonlinelibrary.com]

general heuristic that requires approximately 30 participants in each experimental condition was still met and significance tests that took the sample size into account were applied.[23]

2.3 | Procedure and stimulus material

During the survey experiment, the four experimental conditions received different stimulus materials to manipulate the two focal mechanisms. The "awareness of need" group received a treatment dedicated to trigger this awareness of need for plasma donations. The "perception of response efficacy" group received a treatment that intended to raise the perception of the donor's response efficacy regarding plasma donation. The "awareness of need and perception of response efficacy" group received both treatments, and a control group received none of these two treatments.

Participants were randomly assigned to one of these groups, resulting in the following final group sizes: $\text{group}_{\text{Awareness of Need}}$ $n = 59$, $\text{group}_{\text{Response efficacy}}$ $n = 63$, $\text{group}_{\text{Awareness of need and response efficacy}}$ $n = 81$, and control group $n = 43$. Table 1 indicates that the randomization worked well with regard to different variables. To check for significant differences in these variables between the groups, Fisher's *t*-tests and univariate analysis of variance (ANOVA) were performed for categorical and continuous variables, respectively. Since none of these tests were significant, it can be assumed that the composition of the groups was sufficiently similar.

The sample comprised 39.8% women and 43.1% men (0.4% divers and 16.7% missing). The mean age was 45.9 years (SD = 13.5) and 50.4% had made more than 11 whole-blood donations. Overall, 82.9% of the respondents had a rough idea of what plasma donation was before taking the survey. A total of 83.3% had never been approached regarding plasma donation (Table 1).

During the survey, participants received manipulations through written stimulus material.[24] This information on plasma donation differed between groups (see Appendix B). The material was created from the content

TABLE 1 Sample characteristics.

Variable	Overall $n = 246$ *n* (%)	Group aware-ness of need $n = 59$ *n* (%)	Group response efficacy $n = 63$ *n* (%)	Group awareness of need + response efficacy $n = 81$ *n* (%)	Control group $n = 43$ *n* (%)	Fisher's *t*-test Exact Sig. (two-sided)	ANOVA *F* (*p*)
Gender[a]							
Female	98 (39.8)	26 (44.1)	26 (41.3)	28 (34.6)	18 (41.9)	.288	
Male	106 (43.1)	23 (39.0)	26 (41.3)	42 (51.9)	15 (34.9)		
Diverse	1 (0.4)	0 (0)	0 (0)	0 (0.0)	1 (2.3)		
Missing responses	41 (16.7)	10 (16.9)	11 (17.5)	11 (13.6)	9 (20.9)		
Age group[a]							
20–40	75 (30.5)	15 (25.4)	22 (34.9)	25 (30.9)	13 (30.2)	.569	
41–60	102 (41.5)	25 (42.4)	21 (33.3)	38 (46.9)	18 (41.9)		
61–73	28 (11.4)	9 (15.3)	9 (14.3)	7 (8.6)	3 (7.0)		
Missing responses	41 (16.7)	10 (16.9)	11 (17.5)	11 (13.6)	9 (20.9)		
Blood donation frequency in the past[a]							
1 time	7 (2.8)	2 (3.4)	1 (1.6)	2 (2.5)	2 (4.7)		.675 (.568)
2–3 times	20 (8.1)	5 (8.5)	5 (7.9)	5 (6.2)	5 (11.6)		
4–5 times	26 (10.6)	5 (8.5)	6 (9.5)	11 (13.6)	4 (9.3)		
6–10 times	28 (11.4)	7 (11.9)	8 (12.7)	8 (9.9)	5 (11.6)		
11–20 times	53 (21.5)	13 (22.0)	14 (22.2)	17 (21.0)	9 (20.9)		
More than 20 times	71 (28.9)	17 (28.8)	18 (28.6)	27 (33.3)	9 (20.9)		
Missing	41 (16.7)	10 (16.9)	11 (17.5)	11 (13.6)	9 (20.9)		
Previously approached regarding plasma[a] donation by GRC							
Yes	41 (16.7)	8 (13.6)	12 (19.0)	14 (17.3)	7 (16.3)	.884	
No	205 (83.3)	51 (86.4)	51 (81.0)	67 (82.7)	36 (83.7)		
Previous plasma knowledge[a]							
I've never heard of it.	12 (4.9)	1 (1.7)	5 (7.9)	5 (6.2)	1 (2.3)		.011 (.998)
I've heard or read about it before, but I'm not exactly sure what it is.	100 (40.7)	28 (47.5)	23 (36.5)	33 (40.7)	16 (37.2)		
I have a rough idea.	92 (37.4)	19 (32.2)	23 (36.5)	28 (34.6)	22 (51.2)		
I have a very good idea about it.	42 (17.1)	11 (18.6)	12 (19.0)	15 (18.5)	4 (9.3)		
Self-efficacy[b] (Summed score)							
Mean (Standard deviation)	4.80 (1.69)	4.74 (1.78)	4.86 (1.69)	4.94 (1.55)	4.53 (1.83)		.539 (.656)

Note: $^{*}p < .05$, $^{**}p < .001$.

[a]Data are reported as number (% of respective group).

[b]Items were measured on a 7-point Likert scale ("does not apply at all" to "applies fully").

of the GRC Blood Donation Services website and discussed with experts from the GRC to meet the demands of actual campaign texts to ensure a realistic invitation. All groups, including the control group, received basic information about the plasma donation procedure. For the condition of stimulated awareness of need or

TABLE 2 Manipulation checks (analysis of variance [ANOVA] and Dunnett's *t*-test).

	Group awareness of need $n = 59$	Group response efficacy $n = 63$	Group awareness of need + response efficacy $n = 81$	Control group $n = 43$	ANOVA F (p)
Awareness of need[a] (Summed score)					
Mean	5.78	5.81	5.68	5.38	.926 (.429)
SD	1.59	1.25	1.36	1.17	
Dunnett's-T (2-sided)[b]					
Mean difference to CG	.40	.43	.30		
SE	.28	.28	.27		
p	.333	.277	.503		
Perception of response efficacy[a] (Summed score)					
Mean	3.81	4.98	5.06	3.52	12.205 (.000)**
SD	1.72	1.72	1.51	1.66	
Dunnett's-T (two-sided)[b]					
Mean difference to CG	.29	1.46**	1.54**		
SE	.34	.34	.32		
p	.704	.000	.000		

Abbreviations: SD, standard deviation; SE, standard error.

Note: *$p < .05$. **$p < .001$.

[a]Items were measured on a 7-point Likert scale ("does not apply at all" to "applies fully").

[b]Dunnett's *t*-test: compares all groups against control group as reference category.

response efficacy, additional paragraphs were included. A paragraph on the pressing need for more plasma donations due to medical progress was generated to create higher awareness. A high perception of response efficacy was triggered by a paragraph explaining the special suitability of blood group AB with its universal applicability in the plasma context. Furthermore, the participants were reminded that they belonged to this specific blood group. The survey was pretested using a student blood-donor sample ($n = 15$) with regard to comprehensibility of the instructions and the formulation of questions. This led to minor reformulations.

2.3.1 | Manipulation checks

Manipulation checks of the treatment material were included to test whether the intended perception had been achieved.[24] Therefore, two scales, each with five items, were integrated into the questionnaire (see Appendix C). The items reflected the wording of the stimulus material. Awareness of need was measured with items such as "I believe that plasma donations will become more important in the future" or "...plasma donations are not available in sufficient quantities" (Cronbach's alpha (α) .934). Cronbach's alpha is an indicator for the internal consistency reliability of a construct. Scores above 0.8 are generally considered good, indicating that the items are sufficiently consistent. The perception of response efficacy was measured with items such as "I believe that my blood would be particularly suitable for plasma donation" or "...plasma donation is the optimal form of blood donation for me because of my blood group" (α .946). These two measurements, which reflected the extent to which the two mechanisms were present in respondents' minds, were also used later to evaluate the conceptualized model relationships.

Table 2 shows the results of the ANOVA and Dunnett's *t*-tests as post hoc analyses. The latter compares the means (summed scale scores) of each group with the control group as the reference category. It showed that only the response efficacy stimulus achieved the intended effect. In the high response efficacy groups, the scale's mean was $m_{\text{Response efficacy}} = 4.98$ ($p < .01$) and $m_{\text{Response efficacy+awareness of need}} = 5.06$ ($p < .01$) compared with $m_{\text{Control group}} = 3.52$ in the control group. The low-efficacy group had no significant difference compared with the control group, $m_{\text{Awareness of need}} = 3.81$ ($p = .704$). The awareness of need stimulus did not raise special awareness in the groups as intended ($m_{\text{Awareness of need}} = 5.78$, $p < .333$; and $m_{\text{Awareness of need+response efficacy}} = 5.68$, $p < .503$ compared with m_{Control}

$_{group}$ = 5.38 in the control group). In all groups, awareness of the need was considerable after seeing the campaign material. This can be interpreted as follows: the information that plasma was needed was already conveyed by the basic information on plasma donation given to all groups and the fact that the GRC was addressing this issue.

In the following analyses, group differences regarding the intention and behavioral step taken toward plasma donation were still compared as the preregistered process envisaged. Owing to the failed manipulation of awareness of need, it was likely that no clear order of effectiveness could be established between groups. Since in every group, the participants' intention was measured before and after exposure to the campaign material, it could still be evaluated if the information given increased the individuals' intention to donate significantly. Differences compared with the control group were still possible, since additional information was displayed in the awareness of need group. Beyond that, following the preregistered process, the measurements of the two mechanisms were used in model analyses, where, based on the total sample, the association between these constructs and intention and behavior were evaluated.

2.4 | Measures

Before and after exposure to the stimulus, the survey measured the respondents' intention to donate plasma (see Appendix C). At both points, the three-item scale from Godin and Germain[25] was rated on a seven-point Likert scale ("does not apply at all" to "applies fully"): "I intend to/I will try to/I will...give plasma in the next 6 months." α of intention before and after were .922 and .977, respectively.

After showing the campaign material, a proxy for the actual behavior regarding the first plasma donation was operationalized by asking whether the person wished to be forwarded to the appointment reservation system of the GRC for further information after the survey, with a dichotomous response option (no/yes).

The study controlled for respondents' self-efficacy as explained in the introduction. The construct was surveyed on a seven-point Likert scale with three items, for example:[26] "If it were entirely up to me, I am confident I could donate plasma." The Cronbach's α was .872. Furthermore, it is accepted that sociodemographic characteristics and donation experience influence donation decisions. Accordingly, past studies have explored the effects of these variables in the context of conversion attempts.[25,27,28] Consequently, gender, age, and past donation frequency were included as control variables in this study.

For the sake of transparency, it is important to note that perceived behavioral control was measured in the survey as well. Due to the lack of discriminant validity regarding the operationalizations of this construct and self-efficacy, it was not included as another control variable, as initially intended.

2.5 | Data analysis

Two analytical steps were performed.

1. To assess the significance of group differences regarding (a) the intention to start plasma donation and (b) the behavior toward it, ANOVA and contingency analyses were performed. Regarding intention after manipulation, subsequent Dunnett's *t*-tests were used as a post hoc analysis to compare each group against the control group as a reference category. Within each experimental group, paired *t*-tests were used to test differences in intention before and after manipulation for significance. For the dichotomous behavioral proxy, a Chi-square test was applied to detect group effects.
2. Two hierarchical regression models delivered fine-grained insight into the assumed association between the two mechanisms and (a) intention, using a multiple linear regression with interaction, and (b) behavior, using a logistic regression with interaction. For these analyses, the measurements for awareness of need and perceived response efficacy were used as the independent variables. In both models, an interaction term between both was included. The models controlled for the effects of self-efficacy, age, sex, and donation history.

Analyses were performed with IBM SPSS Statistic software version 26.

3 | RESULTS

3.1 | Group differences in intention and behavior

The intention to start plasma donation was low across the sample, but increased significantly after exposure to the campaign material (mean value of $intention_{before} = 2.63$, $SD = 1.73$ vs. $intention_{after} = 3.28$, $SD = 1.92$) (see Table 3). The increase, however, was still below the scale's midpoint. It has to be interpreted against the background of a research setting with one single exposure with online marketing campaign material. Group-wise comparisons indicated no significant differences regarding intention after manipulation. Consequently, from these results, no statement can be made as to which campaign information

TABLE 3 Group differences regarding intention to donate plasma.

	Overall $N = 246$	Group awareness of need $n = 59$	Group response efficacy $n = 63$	Group awareness of need + response efficacy $n = 81$	Control group $n = 43$	ANOVA F (p)
Intention Before[a] (Summed score)						
Mean	2.63	2.48	2.67	2.55	2.95	.700 (.533)
SD	1.73	1.59	1.72	1.71	1.95	
Dunnett's-T (2-sided)[b]						
Mean difference to CG		−.47	−.27	−.40		
SE		.35	.34	.33		
p		.371	.735	.445		
Intention After[a] (Summed score)						
Mean	3.28	3.30	3.38	3.23	3.22	.090 (.966)
SD	1.92	2.03	1.92	1.87	1.91	
Dunnett's-T (two-sided)[b]						
Mean difference to CG		.08	.16	.01		
SE		.39	.38	.36		
p		.992	.946	1.000		
Difference intention before/after within group	.65**	.82**	.70**	.68**	.27	
Paired sample t-test: T (p)	8.14 (.000)	5.45 (.000)	3.86 (.000)	5.09 (.000)	1.62 (.114)	

Abbreviations: SD, standard deviation; SE, standard error.

Note: *$p < .05$, **$p < .001$.

[a]Items were measured on a seven-point Likert scale ("does not apply at all" to "applies fully").

[b]Dunnett's t-test: compares all groups against control group as reference category.

TABLE 4 Group differences regarding behavior.

	Overall $N = 246$ n (%)	Group awareness of need $n = 59$ n (%)	Group response efficacy $n = 63$ n (%)	Group awareness of need + response efficacy $n = 81$ n (%)	Control group $n = 43$ n (%)	Chi-square p
Behavioral proxy[a]						
Decline forwarding (1 = no)	170 (69.1)	41 (69.5)	41 (65.1)	59 (72.8)	29 (67.4)	.785
Agreement forwarding (2 = yes)	76 (30.9)	18 (30.5)	22 (34.9)	22 (27.2)	14 (32.6)	

Note: *$p < .05$, **$p < .001$.

[a]Would you like to be forwarded to the appointment-scheduling system of the GRC blood donation service for further information after completing the survey? (no/yes).

outperformed the others; the failed manipulation might deliver an explanation hereto. However, the paired sample t-test, which evaluated the before–after difference within one group, revealed a significant increase in intention in all three groups with manipulated mechanisms, but not in the control group, with mean differences of $G_{\text{Awareness of need}} = .82$ ($p < .001$), $G_{\text{Response efficacy}} = .70$ ($p < .001$), $G_{\text{Awareness of need+response efficacy}} = .68$ ($p < .001$), and $G_{\text{Control}} = .27$ ($p = .114$). These findings showed that the added information targeting the mechanisms were generally able to increase intention to donate plasma.

Regarding the behavioral steps taken toward plasma donation, despite the low intention to start plasma donation, 31% of participants expressed their willingness to be forwarded to the appointment-scheduling system of the blood donation service for further information (see Table 4). A Chi-

TABLE 5 Results of hierarchical multiple linear regression for intention to start plasma donation.

	Dependent variable: Intention to start plasma donation (after treatment)[a]													
	Base model (controls)					**Model with mechanisms**					**Interaction model**				
Predictors	**B**	**SE (B)**	**β**	***t***	***p***	***B***	**SE (B)**	**β**	***t***	***p***	***B***	**SE (B)**	**β**	***t***	***p***
Step 1: Control variables															
Self-efficacy[a]	.531	.071	.464	7.448	.000**	.316	.084	.276	3.783	.000**	.338	.082	.295	4.124	.000**
Gender (1 = female, 2 = male)	−.503	.239	−.133	−2.099	.037*	−.314	.239	−.083	−1.317	.189	−.270	.234	−.072	−1.156	.249
Age	−.009	.010	−.066	−.920	.359	−.005	.010	−.035	−.510	.611	−.010	.010	−.070	−1.028	.305
Frequency of past donation	−.092	.094	−.072	−.981	.328	−.124	.091	−.096	−1.363	.175	−.108	.089	−.084	−1.216	.226
Step 2: Mechanisms															
Awareness of need[a]						.185	.101	.126	1.824	.070	−.319	.186	−.218	−1.716	.088
Perception of response efficacy[a]						.282	.081	.254	3.459	.001**	−.528	.265	−.476	−1.990	.048*
Step 3: Interaction															
Awareness of need × response efficacy											.135	.042	.932	3.199	.002*
Intercept	2.440	.669		3.650	.000**	.794	.860		.923	.357	3.698	1.237		2.989	.003*
R^2	.268					.336					.369				
ΔR^2						.067					.033				
F	18.234					16.591					16.349				
Sig. Model	<.001**					<.001**					<.001**				
ΔF^2						10.004					10.231				
Sig. F Change						<.001**					.002*				

Note: *$p < .05$, **$p < .001$. $n = 246$.

[a]Measured on a seven-point Likert scale (“does not apply at all” to “applies fully”).

TABLE 6 Results of hierarchical logistic regression for behavioral proxy.

	Dependent variable: behavioral proxy[a]					
	Base model (controls)		Model with mechanisms		Interaction model	
Predictors	**OR**	**Sig**	**OR**	**Sig**	**OR**	**Sig**
Step 1: Control variables						
Self-efficacy[b]	1.591	.000**	1.444	.004**	1.443	.004*
Gender (0 = male, 1 = female)	2.196	.018*	2.132	.029*	2.133	.029*
Age	1.014	.311	1.015	.288	1.016	.289
Frequency of past donation	.869	.279	.846	.205	.846	.205
Step 2: Mechanisms						
Awareness of nee[b]			.981	.906	1.002	.996
Perception of response efficacy[b]			1.214	.104	1.248	.637
Step 3: Interaction						
Awareness of need × response efficacy					.995	.952
Constant	.032	.000**	.026	.002*	.023	.111
Omnibus test (Sig.) Model	.000		.000		.000	
Omnibus test (Sig.) Block	.000		.246		.952	
Nagelkerke's R-quadrat	.180		.196		.196	
Hosmer–Lemeshow test (Sig.)	.025		.096		.098	

Abbreviation: OR, odds ratios.

Note: *$p < .05$, **$p < .001$. $n = 204$.

[a]Behavior proxy 1: declined forwarding (0), agreed forwarding (1).

[b]Measured on a seven-point Likert scale ("does not apply at all" to "applies fully").

square test indicated that behavior did not differ significantly between the groups.

3.2 | Hierarchical linear regression with interaction: intention to donate

The results of the bivariate Pearson correlations indicated a relationship between intention, the two mechanisms, and their interaction, as well as self-efficacy (see Appendix D). A weaker but significant association was revealed between intention and gender, age, and frequency of past donations.

Table 5 presents the results of the hierarchical linear regression analysis with the intention to donate plasma (after treatment) as the dependent variable. The procedure encompassed a stepwise introduction of the controls (base model), followed by the variables of the mechanisms (model with mechanisms), and finally, the interaction effect (interaction model). The initial R^2 value was .268, and adding the mechanisms improved the variance explanation by 6.7 pps. The interaction added another 3.3 pps ($R^2_{\text{interaction model}} = .369$). All models reached significance ($p < .001$). The second and third model steps yielded a significant change in the F value, which suggests a significant improvement in variance explanation by adding the mechanisms and their interaction. The base model revealed a significant positive association between self-efficacy and intention ($\beta_{\text{Self-efficacy}} = .464$, $p < .001$). Being female compared with male also had a positive association with intention ($\beta_{\text{Gender (1 = female, 2 = male)}} = -.133$, $p < .037$). No significant association was detected between the intention to start plasma donation and age or past donation frequency.

Introducing awareness of need and response efficacy reduced the effect of the two significant control influences. Regarding the mechanisms, only the perception of response efficacy was significantly associated with the intention to donate plasma ($\beta_{\text{Response efficacy}} = .254$, $p < .001$); awareness of need did not reach significance ($\beta_{\text{AwarenessofNeed}} = .126$, $p = .070$). This suggests that only the response efficacy mechanism supported intended engagement in plasma donations.

The final introduction of the interaction of awareness of need with response efficacy supported the existence of an interaction effect ($\beta_{\text{Interaction}} = .932$, $p = .002$). The use of this multiplicative term changes the way other regression coefficients are to be interpreted.[29] In the interaction model, the association between an independent and dependent variable is conditional on the other

relationships, that is, the main effects' coefficients in this model represent the effect if all other model effects equal zero.[29] Since this case is unobservable in the data, only the interaction effect should be interpreted. Cohen (1978) therefore advises to employ the hierarchical model procedure used to isolate the effect.[30]

3.3 | Hierarchical logistic regression with interaction: behavioral proxy

Table 6 shows the results of the hierarchical logistic regression analysis that estimated the behavioral response as a function of the control variables, mechanisms, and their interaction effect. The procedure encompassed a stepwise introduction of variables. The initial pseudo R^2 value was .180, which was only marginally improved (.196) by adding the mechanisms. The omnibus test revealed that no significant improvement of the model was achieved in the second and third steps. Only a significant effect of self-efficacy was detected in the base model; it increased the likelihood of agreeing with forwarding (odds ratio [OR] $\gamma_{\text{Self-efficacy}} = 1.591$, $p < .001$). Otherwise, the effect of gender (OR $\gamma_{\text{Gender}} = 2.196$, $p = .018$) was significant (male = 0, female = 1).

4 | DISCUSSION

4.1 | Research discussion

Understanding the successful persuasion of whole-blood donors to convert to plasma donors would help blood donation services match the rising demand for plasma, thereby supporting the endeavor for regional self-sufficiency regarding this strategically important resource of national health systems.[1,2,4] Based on experimental data, this study provides evidence that among the donors of the AB blood group, a low intention to convert prevails. Small but significant increases regarding the intention to start plasma donation are possible by targeting these donors with online marketing communication. The results of this study further reveal that, regardless of the experimental condition, nearly a third of the participants were willing to take the next step through the persuasion process and get further information on plasma donation. When interpreting these results, it has to be considered that the social desirability bias might even lead to an overestimation of the willingness to donate plasma; donors were approached by the GRC blood donation services and might have felt the obligation to answer more positively. Additionally, an intention–behavior gap that is broadly acknowledged in the blood donation literature must be taken into account; from the first step in the direction up until the final plasma donation, a non-negligible proportion of prospects would be lost.[31] On the contrary, the sample consisted of rather experienced whole-blood donors. Previous research has shown that the donor identity, which is developed in the course of the donor career, is likely to be connected to one form of donation, which can potentially negatively affect plasma donation intention.[7,26,28,32] This might decrease conversion intentions with progression in the donor career, leading to an underestimation of effects with the present study's sample. The findings revealed a negative correlation between donation frequency and intention. This might inspire future research in the optimal timing of conversion attempts along the donor career.

In general, the results suggest that it takes multiple touch points to elicit behavior. This is in line with previous research, which found that for starting plasma donation, individuals should have a need for multifaceted information and support from the blood donation services.[6] Moreover, different modes of interaction, such as conversations with staff members that follow the first contact with the promotional campaign, might foster intention, thereby improving conversion rates.[7] Charbonneau et al.[33] summarize that tailored approaches are necessary for conversion since donors differ from one another.

This study (1) theoretically conceptualizes and (2) provides evidence regarding the assumptions that transformation to plasma donation is driven by two mechanisms that are theorized to drive giving behavior: perception of one's own response efficacy and awareness of need, as well as the interplay of both.

The perception of one's own response efficacy is, in this case, evoked by affiliation with blood group AB and the knowledge about its particular value in the plasma context due to its universal applicability. The results reveal that it is positively associated with the intention to start plasma donation. This suggests that a personalized appeal including this information is effective. This is in line with previous research on plasma conversion. Bove et al. reported that informing donors about the suitability of their blood groups for plasma donation with a personal request can have positive effects on conversion.[18] Chamla et al.[19] highlighted that sending personalized invitation letters that feature the individual's blood group positively affects the likelihood of donor return. It can be concluded that education about blood groups seems to be a promising strategy for optimizing donor panels. The results show that online marketing communication following this strategy is the first step in delivering the message, but is not sufficient alone. Additional interactional modes like face-to-face conversations may yield optimal results.[7,9] More research is needed on what the optimal combination and order are, or what time intervals are important when designing the content of marketing communications for conversion.

The second mechanism tested in this study, awareness of need for plasma donations, plays a weaker role in conversion. Although the respondents did not know much about plasma donation in advance (even though they belonged to the more loyal whole-blood donor segment), awareness of need for plasma donations was already created by being approached regarding this topic by the GRC. Beyond that, the findings of the present study indicate that this driver is not strong enough on its own to significantly increase the intention to donate plasma. However, an interaction effect with response efficacy could be revealed, that is, response efficacy has a stronger impact when awareness for the need of plasma donations is present. This is consistent with the results of previous exploratory investigations by Bagot et al.[13] this study substantiates that the awareness of the need for special donation types facilitates donor conversion. However, awareness of need seems to represent a baseline factor that is more effective when paired with a personalized motivator to trigger behavior. Masser and Bagot argue that the creation of awareness alone might not suffice because the decision to start plasma donation is complex, and differences in donation procedures must be considered.[10] Future research needs to address the interplay of these and different mechanisms that drive plasma donation conversion, alongside the pursuit of a plasma donor career. These should be evaluated not only in the online recruitment method but also in the in-person approach.

Consistent with the findings that donors' beliefs that they are able to successfully exhibit a behavior drive conversion intentions, the present study found that self-efficacy contributes significantly to the prediction of intention to start plasma donation.[5,21,26] The focus of self-efficacy involves the individual's control over the behavior itself, in demarcation to the influence of factors outside the individual's control that might impair the behavior.[21,34] As Giles et al. (2004) show, underlying reasons that influence this self-efficiency include the fear of needles, lack of relevant experiences, perception of not having adequate health, or lack of necessary time resources.[21] Ferguson (1996) highlights that donors with varying degrees of experiences need different support systems to foster self-efficacy.[35] Giles et al. (2004) recommend different promotional activities to enhance self-efficacy at different levels of experience.[21] More research is needed as to which factors are important to foster self-efficiency in the plasma conversion context.

4.2 | Limitations

This study has some limitations. First, the experimental design included information as online marketing communication. Studies have shown that face-to-face communication is often more effective in persuading donors. Consequently, how the mechanisms work in different conversational modes or combinations thereof needs to be investigated. Second, only the selected mechanisms and covariates were included in this study. Future research should broaden this by including other mechanisms, for example, perceived behavioral control. Third, the high number of dropouts and eligible but not approachable people led to rather small sample sizes within the single experimental conditions. These might be the reason for the absence of significant differences between groups regarding the outcome variables. Additionally, a larger sample might have led to stronger effect sizes in the two models. Future research needs to anticipate these difficulties in recruiting participants from small base populations and create research designs that make effects more detectable. The use of only a behavioral proxy is also not optimal; in the future, larger field experiments and donation data should be used. Fourth, the research setting compensated for plasma donations. According to German legislation, plasma donations are compensated for up to 25€. This is not the case in several countries; therefore, caution should be taken regarding the generalizability of the results. Further research is needed on how the findings translate into other settings or differently organized national blood collection regimes.

4.3 | Managerial implications

The results have several strategic implications for blood services. Based on the finding that at best every third donor is willing to proceed in the conversion process, strategies and measures must be improved to increase the conversion rate.

Dare to communicate: Considering future plasma shortages, knowledge about plasma and awareness of its need must be triggered. This awareness alone is unlikely to substantially interfere with present whole-blood donations. A basic awareness of the different forms of donation will lay a foundation for more targeted conversion attempts.

Prioritize personalization: Personalized appeals have the potential to elicit a behavioral response. Education on blood groups is an adequate strategy regarding the content of communication, since it can foster the donors' belief that their donation has an impact. One example is the blood group barometer on the GRC website, which displays the inventory levels of different blood groups updated on a daily basis. Blood donation services should emphasize the impact of personal contribution in absolute and relative terms, for example, plasma is a product

that fewer people donate, and one blood group is particularly valuable because of its universal applicability.

Foster self-efficacy: Particularly important is the donors' confidence in their capabilities to make a specific donation. This is even more significant if the donation process is complex. Therefore, it is crucial that blood services improve the understanding of which factors are fostering or hindering these self-efficacy perceptions in the plasma context; for instance, the knowledge of donation requirements or trust in the safety of the procedure. They can familiarize donors with plasma donation, for example, by watching others, and should convince donors of the provision of excellent service quality.

CONFLICT OF INTEREST STATEMENT

The authors have disclosed no conflicts of interest.

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APPENDIX A

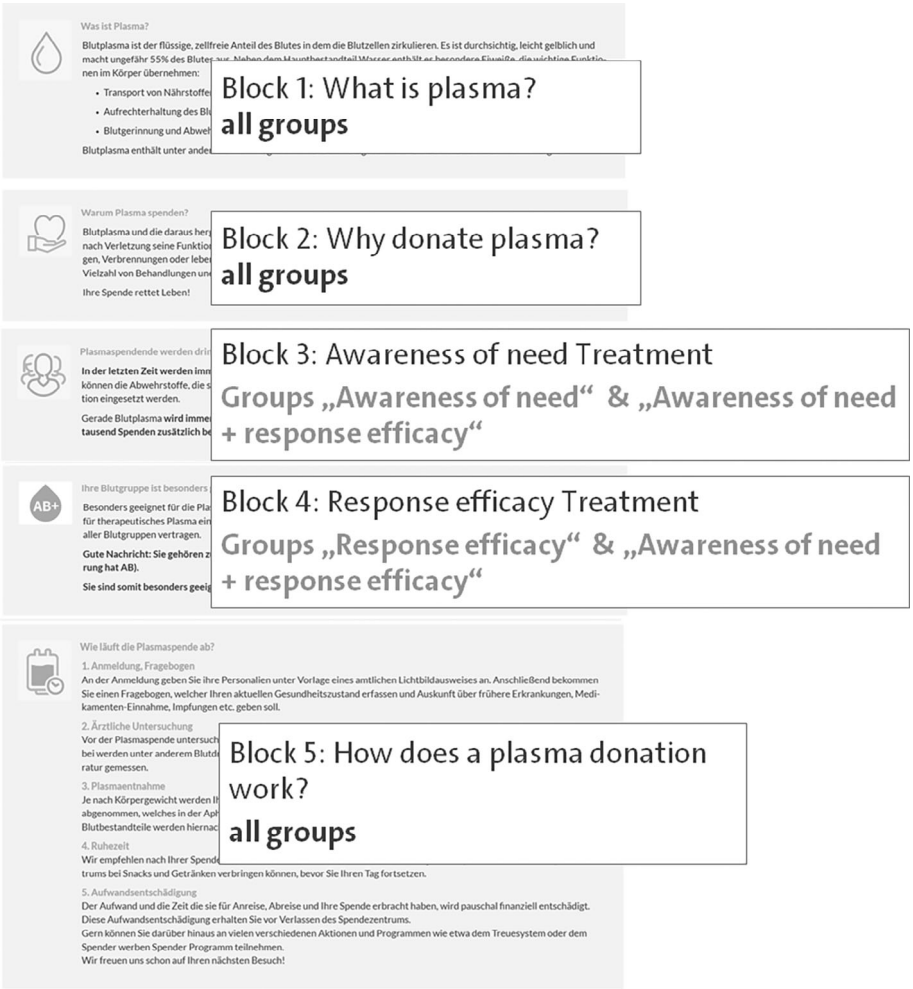
ANALYSIS OF DROPOUTS

	Overall	Group awareness of need	Group response efficacy	Group awareness of need + response efficacy	Control group
Raw data	518				
Just opened the start page, then left	−158				
Just answered the data protection policy agreement, then left	−31				
Screening questions					
Did not agree with the data protection policies	−6				
Mentioned they never donated blood before	−5				
Mentioned they did not donate during past 3 years	−13				
Mentioned they donated plasma before (elsewhere not GRC)	−27				
Further dropped out before randomization	−6				
Randomization	272	65	67	87	53
Drop out after randomization at dependent variable (scale of intention after)	−26	−6	−4	−6	−10
Final sample	246	59	63	81	43

APPENDIX B

EXPERIMENTAL STIMULI

Composition: All groups (including the control group) received basic information (blocks 1,2,5). In the experimental groups, the treatment paragraphs (awareness of need and/or response efficacy) appeared before block 5.



1. Awareness of need treatment (block 3)

Text translated.

Plasma donors are urgently needed!

Recently, an increasing number of therapies and drugs have been developed based on blood plasma. For example, the antibodies found in this blood component can be used as therapy for severe COVID-19. In particular, blood plasma is becoming increasingly important for societal health care. This means that thousands of additional donations are required every year.

Text original German.

Plasmaspendende werden dringend gebraucht!

In der letzten Zeit werden immer mehr Therapien und Medikamente entwickelt, die auf Blutplasma basieren. Beispielweise können die Abwehrstoffe, die sich in diesem Bestandteil des Blutes befinden, als Therapie bei einer schweren COVID-19-Infektion eingesetzt werden. Gerade Blutplasma wird immer wichtiger für die gesundheitliche Versorgung der Gesellschaft. Das heißt, dass jährlich viele tausend Spenden zusätzlich benötigt werden!

Layout.

2. Perceived response efficacy treatment (block 4)

Text translated.

Your blood type is particularly suitable!

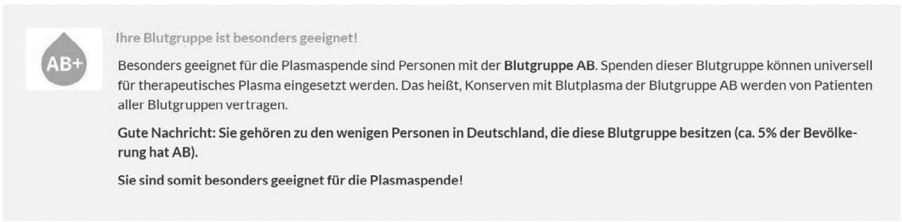
Individuals with blood group AB are exceptionally suitable for donating plasma. Donations of this blood group can be used universally for plasma treatment. This means that blood type AB blood plasma is tolerated by all patients. Good news: You are one of the few people in Germany who have this blood type (approximately 5% of the population has AB). Therefore, you are particularly suitable for plasma donation.

Text original German.

Ihre Blutgruppe ist besonders geeignet!

Besonders geeignet für die Plasmaspende sind Personen mit der Blutgruppe AB. Spenden dieser Blutgruppe können universell für therapeutisches Plasma eingesetzt werden. Das heißt, Konserven mit Blutplasma der Blutgruppe AB werden von Patienten aller Blutgruppen vertragen. Gute Nachricht: Sie gehören zu den wenigen Personen in Deutschland, die diese Blutgruppe besitzen (ca. 5% der Bevölkerung hat AB). Sie sind somit besonders geeignet für die Plasmaspende!

Layout.



3. Basic information (received by all experimental groups including control)

Text translated.

What is plasma? (block 1).

Blood plasma is the liquid, cell-free part of the blood in which blood cells circulate. It is clear, slightly yellowish, and comprises approximately 55% of the blood. In addition to its main component, water, it contains special proteins that perform important functions in the body:

- Transport of nutrients, antibodies, and hormones.
- Maintenance of blood pressure.
- Blood clotting and defense against disease.

Blood plasma contains, among other things, coagulation factors and immunoglobulins for the defense against pathogens.

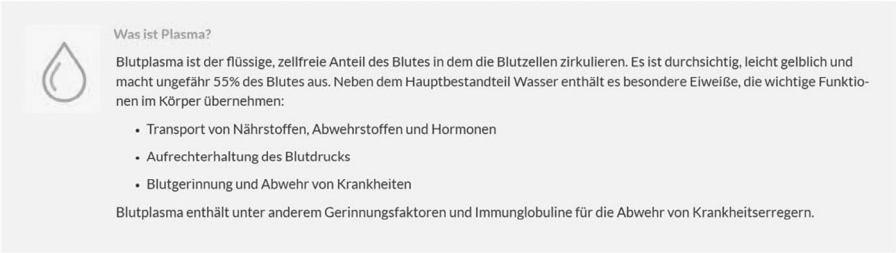
Text original German.

Was ist Plasma?

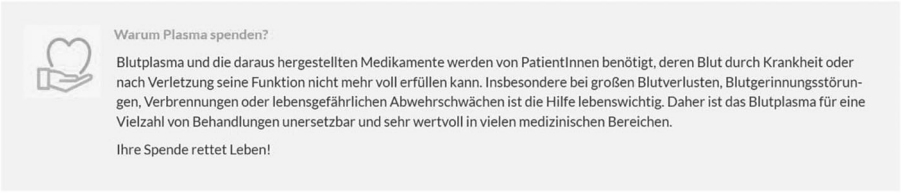
Blutplasma ist der flüssige, zellfreie Anteil des Blutes in dem die Blutzellen zirkulieren. Es ist durchsichtig, leicht gelblich und macht ungefähr 55% des Blutes aus. Neben dem Hauptbestandteil Wasser enthält es besondere Eiweiße, die wichtige Funktionen im Körper übernehmen:

- Transport von Nährstoffen, Abwehrstoffen und Hormonen.
- Aufrechterhaltung des Blutdrucks.
- Blutgerinnung und Abwehr von Krankheiten.

Blutplasma enthält unter anderem Gerinnungsfaktoren und Immunglobuline für die Abwehr von Krankheitserregern.
Layout.



Text translated.
Why donate plasma? (block 2).
Blood plasma and the medicines made from it are needed by patients whose blood can no longer fully perform its function due to illness or injury. Help is vital, particularly in the event of major blood loss, blood-clotting disorders, burns, or life-threatening immune deficiencies. Therefore, blood plasma is irreplaceable for various treatments and is valuable in many medical fields.
Your donation saves lives!
Text original German.
Warum Plasma spenden?
Blutplasma und die daraus hergestellten Medikamente werden von PatientInnen benötigt, deren Blut durch Krankheit oder nach Verletzung seine Funktion nicht mehr voll erfüllen kann. Insbesondere bei großen Blutverlusten, Blutgerinnungsstörungen, Verbrennungen oder lebensgefährlichen Abwehrschwächen ist die Hilfe lebenswichtig. Daher ist das Blutplasma für eine Vielzahl von Behandlungen unersetzbar und sehr wertvoll in vielen medizinischen Bereichen.
Ihre Spende rettet Leben!
Layout.



Text translated.
How does a plasma donation work? (block 5).
1. Registration, questionnaire
When registering, provide your personal details and present an official photo ID. You will then receive a questionnaire that records your current state of health and provides information about previous illnesses, medication intake, vaccinations, and so on.
2. Medical examination
Before plasma donation, a doctor will examine your state of health and will be happy to answer any questions you may have. Blood pressure, pulse, and breathing rate will be examined. Body weight and temperature will also be measured.
3. Plasma collection

Depending on your body weight, 650–850 mL of plasma will be taken from you within 30–45 min. Blood is taken from you and is divided into its components (plasma and blood cells) in the apheresis machine. Cellular blood components are then returned to the body.

4. Rest Period

We recommend a rest period of approximately 15–30 min after your donation, which you are welcome to spend in the donor area of your donation center with snacks and drinks before continuing your day.

5. Expense allowance

The effort and time you have spent on the way back and forth, and your donation itself, will be financially compensated as a lump sum. You will receive this compensation before leaving the donation center.

You are also welcome to take part in many different campaigns and programs, such as the loyalty system or donors' recruit-donor program.

We look forward to your next visit!

Text original German.

Wie läuft die Plasmaspende ab?

1. Anmeldung, Fragebogen

An der Anmeldung geben Sie ihre Personalien unter Vorlage eines amtlichen Lichtbildausweises an. Anschließend bekommen Sie einen Fragebogen, welcher Ihren aktuellen Gesundheitszustand erfassen und Auskunft über frühere Erkrankungen, Medikamenten-Einnahme, Impfungen etc. geben soll.

2. Ärztliche Untersuchung

Vor der Plasmaspende untersucht ein/e ÄrztIn Ihren Gesundheitszustand und steht für offene Fragen gern zur Verfügung. Dabei werden unter anderem Blutdruck, Puls, Atmung untersucht. Außerdem werden Ihr Körpergewicht und Ihre Körpertemperatur gemessen.

3. Plasmaentnahme

Je nach Körpergewicht werden Ihnen 650 bis 850 mL Plasma innerhalb von 30–45 Minuten entnommen. Dabei wird Ihnen Blut abgenommen, welches in der Apheresemaschine in seine Bestandteile (Plasma und Blutzellen) aufgeteilt wird. Die zellularen Blutbestandteile werden hiernach dem Körper wieder zurückgeführt.

4. Ruhezeit

Wir empfehlen nach Ihrer Spende eine Ruhezeit von ca. 15–30 Minuten, welche Sie gern im Spenderbereich Ihres Spendezentrums bei Snacks und Getränken verbringen können, bevor Sie Ihren Tag fortsetzen.

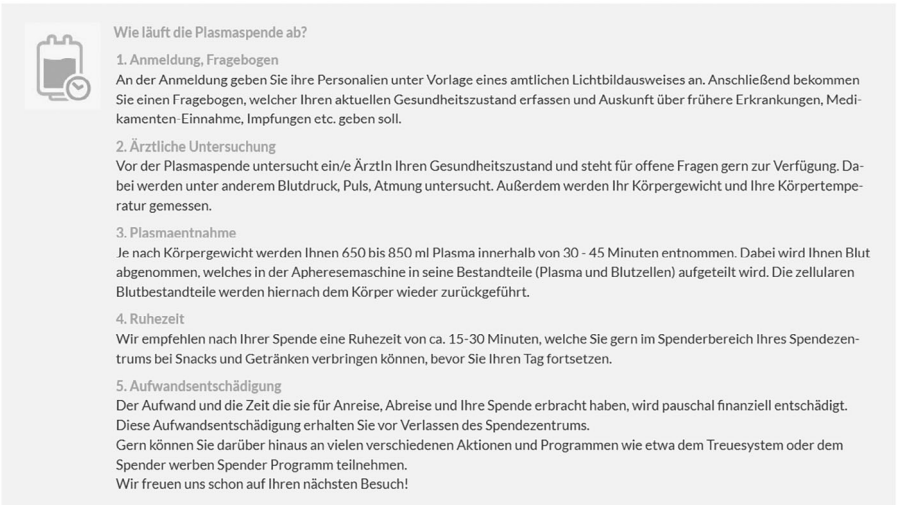
5. Aufwandsentschädigung

Der Aufwand und die Zeit die sie für Anreise, Abreise und Ihre Spende erbracht haben, wird pauschal finanziell entschädigt. Diese Aufwandsentschädigung erhalten Sie vor Verlassen des Spendezentrums.

Gern können Sie darüber hinaus an vielen verschiedenen Aktionen und Programmen wie etwa dem Treuesystem oder dem Spender werben Spender Programm teilnehmen.

Wir freuen uns schon auf Ihren nächsten Besuch!

Layout.



APPENDIX C

DESCRIPTION OF SCALES AND MEASUREMENT QUALITY

	Mean	SD	α
Awareness of need[a]			
I believe that...			
Plasma donations are important.	5.93	1.46	.934
Plasma donations are not available in sufficient quantities.	5.60	1.56	
There are many people who depend on plasma donations.	5.85	1.49	
Plasma donations will become more important in the future.	5.55	1.57	
More and more drugs and therapies will be developed that are based on plasma donations.	5.48	1.55	
Perception of response efficacy[a]			
I believe that...			
I could donate plasma better than other people.	4.11	2.02	.946
My blood would be particularly suitable for plasma donation.	4.65	1.97	
My plasma donation would be particularly effective.	4.46	1.88	
My plasma donation would make a particularly large contribution.	4.58	1.89	
Plasma donation is the optimal form of blood donation for me because of my blood group.	4.50	1.96	
Intention Before[a] (Godin & Germain 2013)			
I intend to give plasma in the next 6 months	2.78	1.95	.922
I will try to give plasma in the next 6 months	2.60	1.83	
I will give plasma in the next 6 months	2.52	1.78	
Intention After[a] (Godin & Germain 2013)			
I intend to give plasma in the next 6 months	3.36	2.02	.977
I will try to give plasma in the next 6 months	3.35	1.97	
I will give plasma in the next 6 months	3.14	1.88	
Self-Efficacy[a] (Bagot et al.[26])			
If it were entirely up to me, I am confident I could donate plasma.	4.71	1.93	.872
I believe I have the ability to make a plasma donation.	5.00	1.90	
If I wanted to, it would be easy for me to make a plasma donation.	4.69	1.85	

Note: α = Cronbach's alpha. $n = 246$.

[a] Items were measured on a 7-point Likert scale ("does not apply at all" to "applies fully").

APPENDIX D

PEARSON CORRELATIONS

Variable	1	2	3	4	5	6	7	8
1 Intention to start plasma donation (after)[a]	1	.416**	.465**	.527**	.507**	−.152*	−.216*	−.170*
2 Awareness of need[a]	–	1	.442**	.693**	.433**	−.274**	−.205*	−.167*
3 Perception of response efficacy[a]	–	–	1	.927**	.568**	−.032	−.149*	.024
4 Interaction: Awareness of need × perception of response efficacy	–	–	–	1	.571**	−.140*	−.158*	−.039
5 Self-Efficacy[a]	–	–	–	–	1	.015	−.219*	−.055
6 Gender (1 = female, 2 = male)	–	–	–	–	–	1	.085	.284**
7 Age	–	–	–	–	–	–	1	.500**
8 Frequency of past donation (#)	–	–	–	–	–	–	–	1

Note: *$p < .05$, **$p < .001$. $n = 246$.

[a] Measured on a seven7-point Likert scale (“does not apply at all” to “applies fully”).