

Validation of a standardized donor health questionnaire across substances of human origin

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Vox Sanguinis

Abstract

Background and objectives A donor health questionnaire (DHQ) aims to ensure the safety of donors and recipients of transfusions or transplantations with blood components, plasma-derived medicinal products, tissues, haematopoietic stem cells and medically assisted reproduction (in short substances of human origin; SoHO). Currently, many different DHQs exist across countries and SoHO. TRANSPPOSE (TRANSfusion and transplantation PrOtection and SElection of donors) developed and validated a standardized DHQ to use across countries and SoHO. We tested whether participants understand the questions and provide honest answers.

Methods For the validation of the standardized DHQ, two demographically representative online surveys were conducted in Germany (N = 3329) and Austria (N = 3432). We surveyed whether participants understood each DHQ question and would answer the questions truthfully. We used experimental settings to test whether there is a difference between mode of administration (print vs. online), the order of the questions (subject vs. chronological order), and the positioning of the *general state of health* question (beginning vs. end) in the DHQ. Using regression models, we tested the DHQ's impact on participant mood after completion and on socially desirable response behaviour.

Results Participants understood the DHQ questions well and would answer them honestly. Nevertheless, the data show different levels of understanding and honesty when responding. Administration mode was the only characteristic that had a significant influence on mood, with the online version resulting in a more favourable mood in comparison to the printed version.

Conclusion The DHQ was well understood and had a low dishonest tendency. Our findings can serve as an impulse for further research on DHQ criteria across other SoHO and countries.

Key words: social desirability, donor health management, standardized questionnaire.

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Introduction

Donor and patient safety can be enhanced by improving strategies for donor pre-donation screening. Donor health questionnaires (DHQ) are important tools to assess whether an individual is suitable as a donor [1,2]. The European consortium project TRANSfusion and transplantation: PrOtection and SElection of donors (TRANSPPOSE, transposeproject.eu) aimed to harmonize donor selection and protection policies related to donations of SoHO (blood components, plasma-derived medicinal products, tissues, haematopoietic stem cells and medically assisted reproduction) within Europe. In TRANSPPOSE, a harmonized version of the DHQ has been assessed. Several different DHQs currently exist across different Substances of Human Origin (SoHO) within Europe but differ both in content (e.g. addressed risks) and form (e.g. number of questions) [3]. Therefore, it is of utmost importance to have better insight into the development and validation of DHQs regarding donors.

The validity of a DHQ depends on the answering behaviour of potential donors. Invalid answers occur when the question is not well understood or induces a risk of a dishonest answer. This is potentially due to a social desirability bias (e.g. risk behaviour), in which the given answers present the participant more favourably towards others [4]. Sensitivity to social desirability bias differs between individuals (e.g. varying notions of social norms) and within individuals (e.g. perceived sensitivity of different items) [5]. It involves conscious and willing dishonest behaviour from people weighing up the supposed external benefits and costs of said dishonest behaviour [6]. Particularly, participants may answer dishonestly to avoid threatening their self-esteem and to sustain a favourable self-image. However, regarding the DHQ, participants are often unaware of the risk such behaviour entails for the recipient and themselves. Thus, raising awareness of the consequences of such behaviour, as well as a proper way of presenting the questions is crucial. We study socially desirable response behaviour using the balanced inventory of desirable responding (BIDR) [4]. The BIDR stresses notably enhanced affirmations of positive cognitive characteristics. Individuals tend to resist negative self-assessments when they show a high degree of self-deception and thus want to pursue more positive self-assessments. Participants who overly give desirable answers achieve high scores [4].

The aim of our work is to validate and provide a DHQ by analysing whether participants understand the questions and whether they would answer them honestly (Study 1), as well as whether different characteristics of the DHQ (i.e. mode of administration, order of the questions and

positioning of the *general state of health* question) have an impact on the participants' mood and socially desirable response behaviour (Study 2). Due to the validation presented here, and further help from medical experts, a standard core version of the DHQ has been developed and proposed. This core version can be found in the appendix (Table S10) and is structured as a construction kit divided into 12 subject areas and consisting of a total of 58 questions. Subject areas include for example donor health, previous donations, and behaviours that might indicate a risk of blood-borne infections (i.e. risk behaviour).

Materials and methods

Our work builds on the results of the proceeding work packages (WP) in TRANSPPOSE. All reports are available at the EU website [7]. First, an inventory of DHQs used in Europe was compiled. The questionnaires of each SoHO were then reviewed and revised in collaboration with medical experts to make a prototype of the DHQ available for validation. The medical content was based on a list of proposed donor selection criteria that had been assessed by a non-validated risk assessment method build on the Alliance of Blood Operators Risk Decision Making Framework [3]. The focus was to combine and update the different DHQs of the individual countries into one core DHQ covering all potential risks in an acceptable length. To develop this prototype, experts from Austria, Denmark, Germany, and the Netherlands were consulted in personal interviews. Moreover, input of experts from Germany, Finland, Portugal, Sweden, and the UK was obtained, ensuring that each SoHO was involved in the prototype.

Validation was conducted as two online studies in two countries (Germany and Austria), resulting in four data sets. Cultural differences were not included in the validation since research has shown that the variation in dishonesty within countries outweighs the variation between countries [8]. Two EU countries with the same language were used to avoid distortion by language differences during validation.

For our studies, we use the access panel of a German market research institute (i.e. respondi AG). Panel participants are generally recruited by *respondi* through campaigns and various marketing measures. Identity, plausibility, and response behaviour are regularly monitored by *respondi*. For participation in surveys, respondents are credited with points that can be redeemed for cash, vouchers or even a donation to charities. To obtain a demographically representative sample, study invitations were based on age (i.e. 18–75 years – the usual age range of most donor populations in Europe) and gender

(i.e. 50.0% women). We did not explicitly invite blood donors and candidate donors, so the distribution between the two groups occurred randomly. We excluded 1211 candidates based on their response time (processing time less than half of the average), as this eliminates participants who rush through the questionnaire, and based on their self-reported attention ('I fill out this survey carefully', 7-point Likert scale, at least 5 point marked) resulting in a total of 6,490 participants for analysis. Testing for non-responder bias analysis did not reveal substantial differences of our results (appendix, Table S3). All variables, the exact formulation, and answer options are presented in the appendix (Table S1).

Study 1

Research questions

The first study analysed (1) if participants understood each DHQ question and (2) if participants would answer the questions honestly. The following research questions (RQs) were addressed:

- RQ1: Do (potential) donors understand the questions in the DHQ?
- RQ2: How likely are they to respond to the questions honestly?
- RQ3: Which factors influence the level of understanding and honesty?

Study structure and variables

Regarding RQ1, the participants were directly asked per question 'How understandable is the question?' and regarding RQ2 'How honest would you answer the question?'. Each participant was randomly assigned to one of the five conditions (complies with the five SoHO) using a between-subject design. We averaged the responses across all SoHO and defined these as our dependent variables, measuring the overall level of understandability and honesty per respondent (7-point Likert scale, see appendix Table S4). Participants indicated their level of understanding and honesty towards each question; they were not requested to answer the questions.

For RQ3 we included the following variables in the study: Based on the PANAS scale (Positive And Negative Affect Schedule, 5-point Likert scale) we asked the participants about their mood directly before and after completing the DHQ [9]; the calculated difference (mood change = mood after – mood before) served as an influencing factor. After completing the DHQ and the stating their mood, we asked about intention to donate and the level of knowledge regarding blood donation (self-reported [10]). We focused on blood donation as this is the most common type of public donation [11]. Respondents

indicated where they get information about donations from (Table S1). Six information sources, such as media (e.g. websites of blood donation services or news sites), official leaflets, healthcare professionals, healthcare insurance, friends, and family could be selected (multiple selection was possible).

In addition, we controlled in this study for social desirability bias using the balanced inventory of desirable responding BIDR [4]. Accordingly, participants with a high score were excluded from the analysis as it could be assumed that they responded in a socially desirable manner and the response is therefore biased, resulting in nine candidates being excluded and 2463 being included in the analysis [4].

Impact of sociodemographics and information sources

To address differences in perception due to different knowledge or sources of information the impact of sociodemographics and use of information sources (0/1) was modelled on the overall level of understanding and honesty using a linear model (estimated via OLS). The means for both *understanding* and *honesty* were calculated jointly for all SoHO. We differentiated the two countries via the dummy variable *country*. We focused on the subject areas (a) risk behaviour, since the appearance of socially desirable response behaviour is most sensitive here [12], and (b) health, as it can be assumed that these questions are the most unclear due to the use of medical terms. The respective models for *understanding* and *honesty* were estimated individually for each subject area resulting in four different models.

$$\hat{Y}_{ij} = \beta_{0,ij} + \beta_{1,ij}x_{1,ij} + \beta_{2,ij}x_{2,ij} + \beta_{3,ij}x_{3,ij} + \beta_{4,ij}x_{4,ij} + \beta_{5,ij}x_{5,ij} \\ + \beta_{6,ij}x_{6,ij} + \beta_{7,ij}x_{7,ij} + \beta_{8,ij}x_{8,ij} + \beta_{9,ij}x_{9,ij} + \beta_{10,ij}x_{10,ij} \\ + \beta_{11,ij}x_{11,ij} + \beta_{12,ij}x_{12,ij} + \beta_{13,ij}x_{13,ij} + \varepsilon_{ij} \quad (1)$$

where i : 1 = honesty and 2 = understanding

j : 1 = risk behaviour and 2 = health

\hat{Y} = means of the dependent variable i for the subject area j

x_1 = gender (0 = female 1 = male)

x_2 = age

x_3 = donor (0 = no 1 = yes)

x_4 = country (0 = Austria 1 = Germany)

x_5 = mood change

x_6 = intention

x_7 = level of knowledge

x_8 = media as a source of information (0 = no 1 = yes)

x_9 = official leaflets as a source of information (0 = no 1 = yes)

x_{10} = healthcare professionals as a source of information (0 = no 1 = yes)

x_{11} = healthcare insurance as a source of information (0 = no 1 = yes)

x_{12} = friends as a source of information (0 = no 1 = yes)

x_{13} = family as a source of information (0 = no 1 = yes)

Study 2

Research questions

The aim of Study 2 was to analyse, based on experimental settings, whether different characteristics of the DHQ have an influence (a) on mood after completion and (b) on social response behaviour (all questions in this study referred to blood donations). This resulted in the following research questions being addressed:

- RQ4: Does the administration mode of the DHQ (print vs. online) influence (a) mood after completion of the DHQ or (b) socially desired response behaviour?
- RQ5: Does the question order (subject area vs. chronologically) influence (a) mood after completion of the DHQ or (b) socially desired response behaviour?
- RQ6: Does the positioning of the *general state of health* question (beginning vs. end) influence (a) mood after completion of the DHQ or (b) socially desired response behaviour?

Study structure and variables

RQ4: We varied the potential online version of the DHQ from the potential printed version. This means a printed version was included in an online environment as a scenario. The introductory text was adapted, and filters were set for age and gender such that some questions being omitted (e.g. about pregnancy) and fewer questions being displayed on one page for the online version.

RQ5: We manipulated the order in which the questions were displayed. The questions were either sorted by subject area (e.g. health, risk behaviour) or chronologically from the near to the far past (e.g. last week, last 4 weeks, ever).

RQ6: The manipulation of the *general state of health* question ('Do you feel fit and well enough to donate?') was based on the work by Shu et al. [13], who have shown that signing at the beginning of a form reduces

the probability of dishonesty within tax refund and insurance context. We applied this to the general health question as signing can be a means of awakening the focus on the self, therefore potentially increasing the honesty level [6]. Asking the question at the beginning may cause self-reflection on the donor's feelings regarding their own health status, whereas answering the question at the end may be influenced by previous responses to the DHQ.

Each participant was randomly assigned to one of eight experimental conditions (2 (print vs. online) \times 2 (subject area vs. chronologically) \times 2 (beginning vs. end) between-subject design). First, the DHQ was given to the participants to fill out truthfully. Then, candidates were asked about their mood directly before and after filling out the DHQ [9]. The mood after answering the DHQ served as the first dependent variable since the feelings after filling it out contributes to the overall experience of the donation process, which reciprocally can affect the return rate [14]. The second dependent variable was the socially desirable response behaviour measured by BIDR.

We obtained measures representing effort when filling out the DHQ, and the overall attitude towards the DHQ by measuring the following statements: 'It takes a lot of effort to fill out the DHQ', 'It is easy to fill out the DHQ', 'I felt good while filling out the donor questionnaire', and 'What is your general attitude towards the DHQ?'. The questions on attitude were analysed descriptively.

Participants had the opportunity to make remarks about the DHQ in an open text field (an overview is provided in Table S5 in the appendix). In total, 12.6% of participants expressed criticism, particularly of the questions regarding men having sex with other men (MSM). Since no other question received so many comments, we decided to code a binary variable *MSM* (=1 if criticized, 0 else) and included it in the subsequent analyses (equations (2), predicting mood after filling in the DHQ, and (3) predicting social desirability and answering behaviour). Finally, we measured participants' intention to donate.

Impact of DHQ characteristics

We estimated two linear models to test the impact of different DHQ characteristics on both the mood afterwards (equation 2) and social desirability (BIDR, equation 3).

$$\hat{Y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \beta_{11} x_{11} + \varepsilon \quad (2)$$

where \hat{Y} = mood afterwards

x_1 = mode of administration (0 = online 1 = print)

x_2 = question order (0 = subject 1 = chronological)

x_3 = position of the general state of health questions
 (0 = end 1 = beginning)
 x_4 = gender (0 = female 1 = male)
 x_5 = age
 x_6 = donor (0 = no 1 = yes)
 x_7 = intention
 x_8 = MSM (0 = no 1 = yes)
 x_9 = country (0 = Austria 1 = Germany)
 x_{10} = mood before
 x_{11} = BIDR

$$\hat{Y} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7 + \beta_8 x_8 + \beta_9 x_9 + \beta_{10} x_{10} + \varepsilon \quad (3)$$

where = \hat{Y} BIDR

x_1 = mode of administration (0 = online 1 = print)
 x_2 = question order (0 = subject 1 = chronological)
 x_3 = position of the general state of health questions
 (0 = end 1 = beginning)
 x_4 = gender (0 = female 1 = male)
 x_5 = age
 x_6 = donor (0 = no 1 = yes)
 x_7 = intention
 x_8 = MSM (0 = no 1 = yes)
 x_9 = country (0 = Austria 1 = Germany)
 x_{10} = mood before.

Results

The sociodemographic characteristics of both studies in the two countries are shown in Table 1.

Study 1

Finalizing the DHQ

We analysed the means and standard deviations of each question in the DHQ for each SoHO (see appendix, Table S4). The questions with the lowest means for understanding were reconsidered and revised with the help of medical experts, resulting in the standard core version of the DHQ. Apart from the time periods, questions were therefore split if they contained too many different aspects or reformulated if it was not clear enough before (e.g. 'Have you consulted a healthcare professional or have you had an illness (such as fever and diarrhoea) in the last four weeks?' was reformulated into two separated questions: 'Have you consulted a healthcare professional in the last 3 months?' and 'Have you experienced fever, diarrhoea or vomiting in the last 2 weeks?', all changes can be found in the appendix, Table S7). This was done during on-site meetings within

Table 1 Sociodemographic characteristics.

| | Study 1 | | | | | | Study 2 | | | | | |
|----------------|--------------------|------------|--------------------|------------|---------------------------|------------|--------------------|------------|--------------------|------------|---------------------------|------------|
| | Germany (n = 1223) | | Austria (n = 1240) | | Both Countries (n = 2463) | | Germany (n = 2016) | | Austria (n = 2002) | | Both Countries (n = 4018) | |
| | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage | Number | Percentage |
| Age (in years) | | | | | | | | | | | | |
| 18-29 | 132 | 10.8 | 408 | 32.9 | 540 | 21.9 | 229 | 11.4 | 496 | 24.8 | 725 | 18.0 |
| 30-39 | 179 | 14.6 | 272 | 22.9 | 451 | 18.3 | 319 | 15.8 | 417 | 20.8 | 736 | 18.3 |
| 40-49 | 261 | 21.3 | 202 | 16.3 | 463 | 18.8 | 421 | 20.9 | 399 | 19.9 | 820 | 20.4 |
| 50-59 | 358 | 29.3 | 205 | 16.5 | 563 | 22.9 | 555 | 27.5 | 438 | 21.9 | 993 | 24.7 |
| >=60 | 293 | 24.0 | 153 | 12.3 | 446 | 18.1 | 492 | 24.4 | 252 | 12.6 | 744 | 18.5 |
| Gender | | | | | | | | | | | | |
| Male | 549 | 44.9 | 431 | 34.8 | 980 | 39.8 | 988 | 49.0 | 792 | 39.6 | 1780 | 44.3 |
| Female | 674 | 55.1 | 809 | 65.2 | 1483 | 60.2 | 1028 | 51.0 | 1210 | 60.4 | 2238 | 55.7 |
| Blood Donor | | | | | | | | | | | | |
| Yes | 605 | 49.5 | 710 | 42.7 | 1315 | 53.4 | 954 | 47.8 | 1209 | 60.4 | 2173 | 54.1 |
| No | 618 | 50.5 | 530 | 57.3 | 1148 | 46.6 | 1052 | 52.2 | 793 | 39.6 | 1845 | 45.9 |

the TRANSPOSE project as well as by personal communication with medical experts and involved several phases of revision and adjustment until full consensus among participants. The added and revised questions were then tested again for understanding in a survey ($N = 27$; see appendix, Table S8). Overall, the respondents understood the new questions very well ('I understand the question totally', mean 6.40, SD 1.09) and perceived them as easy to answer ('The question is easy to answer', mean 6.61, SD 0.49).

Research questions

Overall, participants *understood* the questions across all SoHO very well (RQ1, overall mean 6.23, SD 1.25). The means indicated that health-related questions are less well understood due to the use of medical terms (see appendix, Table S6). It must be noted though, that the differences were small and that the mean levels were nevertheless high. To verify the reasons for the lowest mean values in the original questions, a validation test was conducted (Appendix, Table S9). This survey revealed that 67% of the respondents did not know what the medical terms meant. However, individuals having a specific health problem are, due to learning effects, generally more likely to be familiar with the associated medical terminology.

Analysing the *honesty* of the questions, we found lower values for risk behaviour (appendix, Table S6). Generally, the values indicated that participants answered the questions truthfully (RQ2, overall mean 6.44, SD 1.11).

Comparing participants' sociodemographic characteristics there were significant differences in the level of *understanding* and *honesty* (RQ3). First, females (Mean 6.35, SD 1.14) had a higher level of understanding than males (Mean 6.05, SD 1.39), $t(2461) = 6.072$, $p < 0.001$. Second, younger participants (Mean 6.32, SD 1.11) have a higher level of understanding than older ones (Mean 6.15, SD 1.37), $t(2461) = 3.477$, $p = 0.001$. There were no significant differences between donors and non-donors. Third, the analysis showed that female participants (Mean 6.53, SD 0.998) would answer the questions more honestly than males (Mean 6.31, SD 1.25), $t(2461) = 4.863$, $p < 0.001$. In terms of age and previous donations, there was no significant difference in the level of honest answers.

The results of the estimated regression (Table 2) support the univariate findings. *Gender* effects indicate that women have a higher level of understanding and honesty than men. This applies to questions about risk behaviour, as well as to questions about health. *Age* had a significant negative effect on the level of understanding. For both risk behaviour and health questions, it seemed that the older the participants were, the less they understood the questions. However, age had no significant effect on the level of honesty. *Country* had no significant influence on

questions of risk behaviour, neither in terms of understanding nor honesty. Contrary to this was the effect related to health questions. These were significantly understood better by participants in Austria than in Germany. However, we did not find any effects on *honesty*.

The level of knowledge was positively related to the level of understanding concerning questions about health. Addressing the questions on risk behaviour, we found that the level of knowledge had a significant positive effect on the level of honesty, but not on the level of understanding. The more participants knew about blood donation, the more honest they responded. Although, the level of understanding remained unchanged. The classification as blood donor (or not) had no influence on *honesty* and *understanding*. This suggested that the DHQ questions are understood and answered honestly by both potential and experienced donors.

Participants understood the questions better, both on risk behaviour and health, when they obtained their information through the media and answered both types of questions more honestly. Official leaflets also helped the participants to better understand questions about health and risk behaviour. Moreover, they encouraged participants to answer questions about health more honestly. In contrast, receiving information through a health insurance company was the only source that had a significant negative impact. For both risk behaviour and health-related questions, receiving information from a health insurance company was associated with a lower level of understanding and honesty.

Study 2

Overall, the general attitude towards the DHQ was fairly positive (Mean 5.81, SD 1.26) and it did not require much effort to fill out the DHQ (Mean 2.07, SD 1.44). The donors found it easy to answer the DHQ (Mean 6.21, SD 1.29) and felt rather good while doing so (Mean 5.62, SD 1.51).

The online version leads to a more favourable mood after completion than the printed version (RQ4, Table 3). However, this had no significant effect on the socially desirable response behaviour.

Neither the order of the questions (RQ5) and the positioning of the *general state of health* question (RQ6) had a significant effect on mood after filling out the DHQ, nor on the socially desirable response behaviour.

In Model 1 (Table 3), donation intention had a significant positive effect on the mood after completing the DHQ. The variable whether participants complained about the MSM question had a significant negative influence on the mood. Furthermore, gender had a significant influence on the mood afterwards such that males felt worse

Table 2 Results estimated regression Study 1.

| | Model 1 (DV: Understanding – Risk Behaviour, $R^2 = 0.028$) | | Model 2 (DV: Honesty – Risk Behaviour, $R^2 = 0.017$) | | Model 3 (DV: Understanding – Health, $R^2 = 0.042$) | | Model 4 (DV: Honesty – Health, $R^2 = 0.022$) | |
|--|--|--------------|--|--------------|--|--------------|--|--------------|
| | Regression Coefficient (SE) | Significance | Regression Coefficient (SE) | Significance | Regression Coefficient (SE) | Significance | Regression Coefficient (SE) | Significance |
| Constant | 6.362 (0.165) | 0.000 | 5.787 (0.157) | 0.000 | 5.967 (0.143) | 0.000 | 6.472 (0.128) | 0.000 |
| Age | -0.009 (0.003) | 0.001 | 0.003 (0.003) | 0.252 | -0.005 (0.002) | 0.042 | -0.003 (0.002) | 0.142 |
| Gender (0 = female 1 = male) | -0.266 (0.069) | 0.000 | -0.289 (0.069) | 0.000 | -0.282 (0.060) | 0.000 | -0.234 (0.054) | 0.000 |
| Blood Donor (0 = no 1 = yes) | 0.045 (0.078) | 0.559 | -0.050 (0.076) | 0.520 | -0.004 (0.067) | 0.951 | -0.030 (0.060) | 0.613 |
| Country (0 = Austria 1 = Germany) | -0.058 (0.070) | 0.405 | -0.072 (0.070) | 0.304 | -0.192 (0.060) | 0.002 | -0.042 (0.054) | 0.434 |
| Mood change | 0.074 (0.119) | 0.534 | 0.097 (0.118) | 0.412 | 0.108 (0.103) | 0.291 | 0.049 (0.092) | 0.594 |
| Intention | 0.008 (0.018) | 0.671 | 0.017 (0.018) | 0.348 | -0.009 (0.016) | 0.554 | 0.006 (0.014) | 0.644 |
| Knowledge | 0.031 (0.023) | 0.174 | 0.052 (0.023) | 0.021 | 0.071 (0.020) | 0.000 | 0.015 (0.017) | 0.402 |
| Media (0 = no 1 = yes) | 0.263 (0.070) | 0.000 | 0.185 (0.070) | 0.008 | 0.233 (0.061) | 0.000 | 0.166 (0.054) | 0.002 |
| Official leaflets (0 = no 1 = yes) | 0.122 (0.068) | 0.072 | 0.023 (0.068) | 0.737 | 0.189 (0.059) | 0.001 | 0.099 (0.052) | 0.057 |
| Healthcare professionals (0 = no 1 = yes) | -0.028 (0.076) | 0.718 | 0.109 (0.077) | 0.177 | -0.049 (0.066) | 0.463 | 0.008 (0.059) | 0.890 |
| Healthcare insurance (0 = no 1 = yes) | -0.291 (0.109) | 0.008 | -0.109 (0.109) | 0.044 | -0.305 (0.095) | 0.001 | -0.210 (0.084) | 0.013 |
| Friends (0 = no 1 = yes) | 0.043 (0.079) | 0.589 | 0.079 (0.079) | 0.599 | 0.077 (0.068) | 0.260 | 0.078 (0.061) | 0.202 |
| Family (0 = no 1 = yes) | -0.071 (0.083) | 0.393 | -0.083 (0.083) | 0.453 | -0.105 (0.072) | 0.145 | -0.084 (0.064) | 0.193 |
| F(13) | 5.445 | 0.000 | 3.179 | 0.000 | 8.279 | 0.000 | 4.195 | 0.000 |

Significant results are marked in bold.

Table 3 Results estimated regression Study 2

| | Model 1 (DV: PANAS After, $R^2 = 0.753$) | | Model 2 (DV: BIDR, $R^2 = 0.116$) | |
|---------------------------------------|--|--------------|---------------------------------------|--------------|
| | Regression Coefficient (SE) | Significance | Regression Coefficient (SE) | Significance |
| Constant | 0.520 (0.034) | 0.000 | 35.085 (1.489) | 0.000 |
| Online (0) – Print (1) | -0.018 (0.008) | 0.030 | -0.405 (0.383) | 0.290 |
| Subject (0) – Chronological Order (1) | -0.002 (0.008) | 0.761 | -0.211 (0.383) | 0.582 |
| End (0) – Beginning (1) | 0.000 (0.008) | 0.992 | 0.290 (0.383) | 0.448 |
| Intention | 0.021 (0.002) | 0.000 | 0.193 (0.109) | 0.076 |
| MSM (0 = no 1 = yes) | -0.089 (0.032) | 0.006 | -0.520 (1.512) | 0.731 |
| Age | 0.001 (0.000) | 0.034 | 0.198 (0.015) | 0.000 |
| Gender (0 = female 1 = male) | -0.026 (0.008) | 0.002 | -0.194 (0.395) | 0.624 |
| Blood Donor (0 = no 1 = yes) | -0.001 (0.009) | 0.939 | -1.465 (.443) | 0.001 |
| Country (0 = Austria 1 = Germany) | -0.011 (0.009) | 0.198 | -0.898 (0.399) | 0.024 |
| PANAS before | 0.816 (0.008) | 0.000 | 6.196 (0.363) | 0.000 |
| BIDR | 0.001 (0.000) | 0.000 | / | / |
| F(10) | / | / | 52.557 | 0.000 |
| F(11) | 11080.394 | 0.000 | / | / |

Significant results are marked in bold.

than females. The results show that the DHQ did not deteriorate the mood. The better one felt before, the better one felt after completing the DHQ. The mood after filling out the DHQ was also affected by the socially desired response behaviour (BIDR). Although this effect was highly significant ($p < 0.001$), the effect size was very small ($\beta = 0.001$, $SE = 0.000$), meaning that the mood only slightly improved when participants gave more desirable answers.

In Model 2 (Table 3) we find that donation intention had a significant positive effect on the socially desirable response behaviour. An increase of donation intention leads to an increase in desirable answers. The participants' age had a significant positive influence on socially desirable response behaviour. Being a blood donor additionally had a significant negative influence on the socially desirable response behaviour. Thus, blood donors do not tend to give desirable answers nor defend themselves against negative self-assessments. *Country* had a significant effect as well. Participants from Austria tended to answer more desirably than those from Germany. The prior mood of the participants exerts a significant positive influence on the socially desired response behaviour as well.

Discussion

Validation of the DHQ is of utmost importance to make sure that both regular and candidate donors understand the questions, answer honestly, and to ensure the safety of both donors and recipients [15–17].

Previous literature has focused on current donors or individuals who have already arrived at the blood donation centre [15,18], but ignored the large number of potential new donors. This is crucial since attitudes and behaviour of individuals who have not been confronted with donation yet is also essential. Therefore, we studied both donors and candidate donors and can provide broader insights. Additionally, and unlike previous research, we considered five SoHO and not only one type of donation [15,16,18]. Furthermore, we extended traditional evaluation methods which were either focus groups [15,19], cognitive interviews [15] or paper surveys [17,18,20], by running two large online studies to generate a representative sample from two countries, firstly and secondly, to test three new manipulations regarding different variants of the DHQ.

In Study 1, we found that both regular and candidate donors, understood the DHQ well and would answer honestly. Our results are consistent with previous studies in other countries [20,21]. However, a distinction needs to be made between the reasons for the non-understanding. It may be due to the medical terminology and thus the content of the question (i.e. questions regarding health) [21] or participants may not understand the necessity of the question and why an honest answer is important (i.e. questions regarding risk behaviour) [21,22]. Hence, it is not only important that the content is properly clarified, but also that the participants are informed of the reason for certain questions [21,22]. Our results show that the level of knowledge significantly influenced the level of honesty of the questions on risk behaviour, highlighting

the need for careful information of the donors from the donation establishments. Previous studies have shown that although the screening educational materials are read by the donors, they are often skimmed or not read with sufficient concentration to actually understand the risks that can arise from dishonest answers [21,23,24]. A suitable alternative could be short information videos on the donation service website, which can either be viewed as preparation at home or at the collection centre [21,23]. The latter has already been implemented in Sweden [21].

Although participants who felt better informed have a higher level of understanding, this only concerned questions about health. The cause for this might be that participants with higher levels of information are more familiar with the medical terminology of the questions and thus understand these questions better. In contrast, questions on risk behaviour contained almost no medical terminology so the level of information was not associated with the level of understanding. However, the level of information did influence the level of honesty regarding risk behaviour questions. This could be justified by the notion that participants with a higher level of knowledge are more likely to know why these questions are asked, and why it is important that these types of questions are answered honestly. Previous research has also stated that additional explanations about the reason of certain questions can boost donor's motivation to answer honestly [21]. The level of information had no influence on the level of honesty on questions concerning health. This was probably because participants knew why these questions are important and why they needed to be answered honestly regardless of their information level. Our results also confirmed previous findings [21] that information of the procedures and possible risks in the donation process are important to both regular and candidate donors.

Furthermore, we were also able to show that the use of media has the strongest positive influence – among different sources of information – on honesty and understanding. These results clearly encourage the use of media to strengthen honesty and understanding and to further enhance donor and patient safety.

In Study 2 we showed that participants who completed the online DHQ version were in a more favourable mood afterwards than participants who answered the printed version. Since the DHQ is an essential part of the overall donation experience, and this experience is an important driver for the return rate [14], it is crucial that the DHQ experience is favourable and that the donors finish the DHQ feeling good. The stated mood in our study is based on a hypothetical scenario and rules out other influences

from a real donation experience (e.g. nervousness and excitement before a real donation, interaction with staff). Thus, the reported mood is directly related to the DHQ. Interestingly, our data also show that there is no difference in socially desirable response behaviour and mood when the questions are sorted by subject area or chronologically, nor when the question on general health is asked at the beginning or at the end. Previous research has stated that both subject area and chronological sorting are possible as a logical order [22] but this was not clear from our analysis. Further research should investigate this matter.

However, both studies are based on hypothetical and not on real donation situations. This poses a new and unusual scenario, especially for candidate donors and they may respond differently in a real donation situation. In our analysis, we further rely on self-stated and not on assessed knowledge. Future research should therefore include verified and assessed answers to gain deeper insights. We directly asked whether participants understood and would honestly answer the question. No further validation tests of whether they indeed did understand the questions or answered honestly were performed. We could demonstrate, though, with a small sample that for most medical terms there is a lower level of understanding, which is in line with previous research [21].

Overall, the self-reported data reflects the general degree of understanding and honesty. Nevertheless, we note the limitations that we cannot directly report the exact level and reasons of misunderstanding or dishonesty. The issue of blood donation and social desirability is addressed in the literature [25], but much more research is needed, especially on the effect of a confidential environment on the honesty of answers. While, based on previous research [8,20,21], we have not focused on culturally different countries, deviating results in other countries cannot be excluded and a generalization of our results needs to be further investigated.

Conclusion

Our analysis revealed underlying factors that may influence understanding and honesty. This made it possible to develop a donor health questionnaire that is well received by (potential) donors and can be completed without major difficulty. Questions concerning risk behaviour remains an issue which requires a higher level of information to ensure honest answers. Donations establishments should carefully include this in their donor assessment to ensure the best effect of their DHQ.

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Conflicts of interest

The authors declare no conflicts of interest.

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Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1

Table S1 Variables & Scales.

Table S2 Classification of Quotas.

Table S3 Non-responder analysis.

Table S4 Means of all Questions.

Table S5 All remarks categorized.

Table S6 Questions with lowest values.

Table S7 Revised and added questions.

Table S8 Mean values and standard deviations of the revised and added questions.

Table S9 Validation test medical terms.

Table S10 Standard core version of the DHQ.