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Blood, it runs in the family: Intergenerational transmission of blood-donor behaviour

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**Abstract**

Parents may, directly and indirectly, influence their children in developing prosocial behaviour. However, it is uncertain *to what extent* and *how* blood donor behaviour is transmitted from one generation to the next. We used linked data from the first wave of the Donor InSight Survey and the Dutch blood donor registry (n=23,037) to examine intergenerational transmission of blood-donor behaviour among blood donors in the Netherlands. We found that 38% of the Dutch donor population is part of a blood donor family (i.e., at least two generations of donors in the family). Additionally, our preregistered analyses revealed that three mechanisms are relevant for the transmission of donor behaviour from the parent to the child generation, namely parental blood-donor identity, the number of donations parents made, and the developmental period of the child during which parents donated. The outcomes of our study may be used by blood banks in designing their donor recruitment strategies towards families.

# **1. Background**

In many countries, demographic changes are challenging the fragile balance between blood supply and demand. Donor blood is an essential resource in healthcare as it is used for a large palette of medical treatments: transplant surgery, massive trauma intervention, severe anaemia etc. (World Health Organization, 2017). While previous research has extensively explored different aspects of blood donation such as motivations to donate, barriers to donation, and blood-donor behaviour (see the systematic review by Piersma et al., 2017), studies about how this behaviour is learned are lacking. Developing this area is relevant given the recent global demographic trends in longevity which directly impact the demand for blood donation. Older individuals are more prone to chronic diseases and age-related conditions that require blood transfusions compared to younger individuals (Ali, Auvinen & Rautonen, 2010; Greinacher et al., 2016). Additionally, an ageing population affects the availability of blood, as the overall ageing process results in a reduced pool of eligible donors (Greinacher et al., 2016). Thus, studying how people learn about blood donation is a crucial step in developing a long-term strategy for ensuring a stable and sufficient blood donor pool.

One way in which individuals might learn about blood donation is from their parents. Family is the earliest and most persistent factor that shapes the development of a person (Pratt & Hardy, 2015). Intergenerational transmission refers to the process in which certain behaviours and characteristics of the parents are passed down to their children (Branje et al., 2020). Previous work exploring the link between parents and children’s prosocial behaviour revealed significant positive relations between a child's current and their parent's past volunteering activity (Bekkers, 2007; Clary & Miller, 1986; Mustillo, Wilson & Lynch, 2004). This phenomenon has also been speculated in relation to blood donation. Some authors consider the existence of blood donors in the family an important element in influencing other members to become blood donors too (see Lee, Piliavin & Call. 1999; McCombie, 1991; Piliavin & Callero, 1991; Quéniart, 2013). For example, McCombie (1991)has uncovered that donors compared to non-donors are more likely to report having family or friends who donate blood, with family being more influential than friends. To our best knowledge, there is only one quantitative study exploring the mechanisms of intergenerational transmission of blood-donor behaviour: a nationwide study in Denmark by Pedersen et.al (2015) with monozygotic and dizygotic twins that decomposes the covariance in blood-donor behaviour into variance resulting from additive genetic factors (53% of the variance) and shared environment effects (28% of the variance). Yet, this study does not explore possible social and psychological mechanisms behind the transmission. There have been indeed qualitative studies that explore the social and psychological mechanisms behind this transmission such as the one conducted by Quéniart (2013). Quéniart (2013) distinguished between two categories of donor families: those in which blood donation is considered a family tradition, and those in which it is regarded as an individual choice. Nevertheless, the nature of the methodology employed in these qualitative studies constrains the generalizability of their findings.

The present paper contributes to the knowledge about the intergenerational transmission of blood-donor behaviour and the social and psychological mechanisms behind in two ways. Firstly, we determine the proportion of Dutch blood donors that come from a blood donor family, i.e., have parents and/or children that donate, too. Secondly, we will use a quantitative approach to analyse three mechanisms through which intergenerational transmission might occur derived from theories and research in social and developmental psychology. Parents may, directly and indirectly, influence their children in becoming donors. For example, learning to donate blood may be due to the direct influence of the parents promoting values, norms, and behaviours associated with this type of prosocial activity. Moreover, parents can influence their offspring indirectly too; the child learns through observation and imitation (social learning theory-see Bandura et al., 1961; Bandura, 1977). Finally, in certain periods such as childhood, adolescence and emerging adulthood, individuals could be more prone to be influenced by their parents than later in life. For our analysis, we will use data from the Donor InSight survey (Timmer et al., 2019) and the Dutch blood donor registry. We expect that the results will support blood banks in designing their recruitment strategies.

##  *Preaching blood donation*

Preaching is one of the main socializing practices used by parents in relation to their children (Eisenberg, Fabes & Spinrad, 2006).It consists of the parent verbally presenting to the child what should be done, for example, “ You should help others”, without the parent assisting the child in performing the behaviour (Eisenberg-Berg & Geisheker, 1979). What is being preached to the child is influenced by the parent’s life experience, values and identity (Parke & Buriel, 2006).Previous research by Rushton (1975) has shown that this practice is effective in influencing the child’s prosocial behaviour in the long term through internalization. Internalization refers to the process through which children incorporate the values, attitudes, behaviours and beliefs conveyed by their parents into their own cognitive and behavioural repertoires (Grusec & Goodnow, 1994). Thus we argue that the stronger the parent’s identity as a blood donor – i.e., when being a blood donor is seen as an important part of who you are – the more likely that they will incorporate the subject of blood donation in the discussions with their children, which in turn will influence the behaviour of their offspring in the long term, hence:

H1: Children whose parents have a stronger blood-donor identity are more likely to be blood donors than children of parents with weaker blood-donor identity.

##  *Children learn through repeated exposure*

According to the theory of social learning, one mechanism that fosters learning is *observation and imitation* (Bandura, 1977; Bandura, Ross & Ross, 1961). This type of learning is mostly unintentional and occurs in informal settings (Jarvis & Watts, 2012). Thus, the children could learn about blood donation when they see their parents donating blood or know that their parents are donating. The learning experience of the child can be enhanced by the fact that the modelled behaviour, blood donation, is done by a similar other, the parent. Moreover, being often exposed to this behaviour might lower the psychological distance, meaning the perceived separation between the child and the topic of blood donation. This lowered perceived separation might be prompting the child to support the cause later in life (see Baltatescu, 2014). For example, in her conclusions, Quéniart (2013) suggests that through repeated exposure to their parents’ blood donation behaviour, such as when the child comes to a blood drive with their parent, the children are likely to develop a familiarity towards the subject that later may prompt them to become blood donors themselves.

H2: Children whose parents donate blood more often are more likely to be blood donors than children whose parents donate less often.

##  *Transmission varies with the age of the child*

Family is one of the primary socializing factors in an individual's development. However, as a person matures, the influence of parents diminishes in favour of other elements. Childhood socialization is assumed to have a deep and lasting impact on the individual (Liable, Thompson & Froimson, 2015; Maccoby, 2015). During childhood (ages 3-11), the offspring is mostly dependent on the parent’s resources, and socialization occurs through modelling, parent-child discourse, family routines, reinforcements, rewards and punishments (Laible et al., 2015). Adolescence (ages 12-18) is a time of immense growth when the main challenge for the child is to develop one’s independence and sense of self (Erikson, 1968). As a result, during this stage the time spent with parents and the quality of the parent-child relationship declines, and the socialization influence of the peer group increases (Smetana, Robinson & Rote, 2015). During emerging adulthood (ages 19-22), individuals experience a transition from adolescence to adulthood (Arnett, 2000). In this period the influence of family further diminishes as other factors, such as education, romantic partners and work take precedence (Jensen Arnett, 2015; Luong, Rauers & Fingerman, 2015). However, especially when the young adult continues to co-reside with their family, parents may still exert some socializing influence (Aquilino, 1997; Fingerman et.al, 2012). An extended stay at home might provide parents with more opportunities to transmit their values, behaviours, and expectations - including those related to blood donations - to their children. Even though the power of parents as socializing factors decreases as an individual matures, it remains significant until the young adult leaves home (22.8 years in 2012 in the Netherlands; Centraal Bureau voor de Statistiek, 2019). We therefore hypothesize that:

H3: Children whose parents donated during their childhood, adolescence, or emerging adulthood are more likely to be blood donors than children whose parents donated at a later age.

# **2. Data & Methods**

## *2.1. Data & procedure*

We preregistered the study and our hypothesis on the OSF platform. The document can be accessed here: [URL omitted for a blind review]. We linked data from the Donor InSight Study (DIS; Timmer et al., 2019) and the Dutch blood donor registry. DIS is a large-scale cohort study among blood donors in the Netherlands and it consists of three waves (DIS-I, DIS-II and DIS-III). In the present study, we used information from the first wave, DIS-I. This survey wave suits the purposes of our study because the sample was similar to the general donor population in terms of general demographic and biological characteristics, such as age, BMI, haemoglobin levels or blood type, with the exception that the participants in the survey made more donations in the 2007-2009 period (Timmer et al., 2019). A full description of the methodological aspects and representativeness of the survey can be found in Timmer et al. (2019). The original questionnaires used for the DIS surveys can be accessed here: https://www.sanquin.org/research/donor-insight/measurements/index.

To compute the prevalence of the blood donor families and how many generations of donors are in each donor family, we used all the DIS-I cases, N=3,338. We considered the DIS-I respondent as the “key respondent” (cf. Figure 1) and categorized them in one of the following four situations as shown in Figure 1: A) the respondent has a parent that donates or donated blood; B) the respondent has a child that donates or donated blood; C) the respondent has a parent *and* a child that donates or donated blood; D) the respondent has neither a parent nor a child that donates or donated blood.

Figure 1.DIS key respondents and their donor family network



To examine the mechanisms behind the intergenerational transmission, we selected the key respondent donors who reported having children over the age of 18, the minimum age for blood donation. Following Jakobsen et al. (2017), we scrutinized for missing data and we used case-wise deletion if the per cent of the missing data variable-wise was less than 5%. For example, 26 out of the 13,436 parents did not indicate their education level, the percent of missing variables was less than 5%, therefore, we excluded those 26 individuals from our analysis. Jakobsen et al.( 2017) also advised for the usage of case-wise deletion when we suspected that the data was not missing at random as it was the case of income. In total, we excluded 2,687 incomplete parent cases, leaving 10,775 parents for further analysis. We Winsorized the scores of continuous variables to prevent outliers from having a disproportionate influence on the results (see Blaine, 2018).

After these transformations, the data was transposed from a parent case organization to a child case; thus one child was represented per row and one parent could be associated with more than one child. As a result, the data had a multilevel structure. The new data set was cleaned by excluding children younger than 18, dead children, and abnormalities in the data, such as children older than parents, resulting in a total of 23,037 children of 10,546 parents. Finally, regarding the parent’s history of donations, we used the data from the Dutch donor registry and the previous blood donation records system. We considered all blood donations made until the year when the DIS questionnaire data was collected. The two data sets, i.e. the survey and the registry, were linked with a unique identifier attributed to each donor.

## *2.2.Measures*

*Multigenerational donor family.* This variable was determined by the composition of blood donors in the key respondent’s family. As shown in Figure 1, we distinguished: 3-, 2- and 1-generation blood donor families.

*Blood donor status of the child.*DIS-I offers information regarding the children of key respondents at the moment when the survey was answered. In order to determine the donor status of the child, we used information provided in two distinct questions in the survey. The first question was: “If you have children, please give their dates of birth and whether they are deceased”, and the second question was: “Please indicate which of your family members is a blood donor or has donated blood in the past. Include the year of birth of any of these family members.”. Thus if the respondent mentioned having a child in the first question we checked if the birth year provided in the first question matches the birth year mentioned in the second question about the history of blood donation in the family. If the birth year provided in the two questions matched then we considered that child as a donor. We considered both those children who donated in the past and those children that were donating at the time of the questionnaire as donors.

*Blood-donor identity of the parent.* Based on the DIS-I questionnaire, Schröder et al. (2021) constructed blood donor identity by considering the answers to the following questions evaluated on a 5-point Likert scale, where 1 signifies “completely disagree” and 5 “completely agree”:

“Being a blood/plasma donor is an important part of who I am.”

”Being a blood donor means more to me than just giving blood.”

”I would feel sorry if I could no longer give blood.”

The reliability of the construct was previously evaluated using composite reliability (CR)/McDonald's omega 0.69. Considering the cut-off point of 0.7, we assessed that the CR score obtained was satisfactory for the purposes of the present analysis. In order to obtain the score for this measurement, the individual values for each previously mentioned sentence as answered by the key respondent (parent) were summed.

*The number of blood donations done by the parent****.*** Based on the information we obtained from the Dutch blood donor registry we computed the number of donations the parents made during their blood donor careers.

*The child’s developmental period during which the parent was active as blood donor.* We extracted the birth years of the children of key respondents from DIS-I and we retrieved the years when the parents donated for the first and last time from the Dutch donor registry. By combining this information we can identify the age of the children when the parents began and ended their donor careers. To determine the developmental period of the children when their parents were active as donors we followed the guidelines formulated by Erikson (1950) and considered the new insights on adult development presented by Arnett (2000). Thus, if the parent donated when the child was between 3 and 11 years of age, we would say that the parent was donating during the childhood period of their offspring. If the parent donated when the child was between 12 and 18 years of age, we would say that the parent was donating during the adolescence period of their offspring. Finally, if the parent donated when the child was between 19 and 22 years of age, we would say that the parent was donating during the emerging adulthood period of their child.

*Control variables****.*** One reason why intergenerational transmission of behaviour occurs is because children inherit the social status and religiosity of their parents (Bekkers, 2007; Drollinger, 1997; Kuczynski et al., 1997). Thus in order to control for these aspects, in our statistical analysis, we included the following variables as covariates: parental income, parental religious affiliation, parental education, parental age, parental gender, the type of donor the parent is/was (plasma, whole blood, plasma & whole blood), marital status of the parent, the home situation of the parent, paid work in the case of the parent, if the parent was active as a volunteer and homeownership situation. As Veldhuizen and van Dongen (2012) and Thijsen et al. (2019) found differences in behaviour between plasma and whole blood donors, we also considered the type of donor that the parent was in our analysis.

## *2.3.Statistical Analysis*

The statistical analyses were conducted using the SPSS 23 IBM software. We estimated descriptives and correlations for the variables used in the analysis. To determine the proportion of Dutch blood donors that come from a blood donor family we analysed the frequencies of the multigenerational donor family variable. For the analysis of the 3 mechanisms, because our dependent variable was dichotomous (being a donor or not) and the data has a multilevel structure, we use hierarchical logistic regression models. To account for the clustered structure, we added random intercepts. We built four models, starting with the parent's sociodemographic characteristics in the first model and then adding one mechanism in each subsequent model. Specifically, in model 2, we added the parent's donor identity; in model 3, we added the frequency of donations; and in model 4, we added the developmental period of the child when the parent was active as a blood donor. To check the robustness of the results we employed 4 different additional analyses: we run a mixed linear regression model, we run the model without covariates, we tested a randomly selected subsample of the DIS-I respondents, and we used data from the second wave of DIS (DIS-II) to control for the robustness of the donor identity variable.

## 3.Results*3.1.Descriptive Statistics*

With reference to the distribution of the Dutch blood donors in blood donor families, 37.7% of the respondents in the DIS-I survey were members of a blood donor family. More precisely, 36.0% of the respondents were members of a 2-generations blood donor family, and 1.7% of the respondents were members of a 3-generations family. As can be observed in Figure 2, 62.3% of the respondents had neither parents nor children that were blood donors.

Figure 2. DIS key respondents and their donor family network



Out of the 23,037 children, in our analysis, all aged 18+, 12.4% became blood donors themselves. Table 1 contains the descriptive statistics of their parent's characteristics. In Table 2 the correlation coefficients of the main independent variables and the dependent variable can be observed.

Table 1. Descriptive statistics of study measures

|  |  |
| --- | --- |
| Parent characteristic | Description (N=23,037) |
| Type of donor |  |
| Whole-blood donor | 18,104 (78.6%) |
| Plasma donor | 678 (2.9%) |
| Whole-blood & plasma donor | 4,255 (18.5%) |
| Age | 57 (±6.2) |
| Marital status |  |
| Married or in a registered partnership | 20,483 (88.9%) |
| Other (widows, never married or divorced) | 2,554 (11.1%) |
| Home situation |  |
| Lives with his/her partner/husband/wife | 11,937 (51.8%) |
| Lives with his/her partner/husband/wife and children | 8,822 (38.3%) |
| Other (e.g., lives alone or with friends) | 2,278 (9.9%) |
| Highest level of education achieved |  |
| None or primary school | 954 (4.1%) |
| Lower vocational education | 4,504 (19.6%) |
| Secondary education | 4,293 (18.6%) |
| Secondary vocational education | 5,022 (21.8%) |
| Higher secondary education | 1,689 (7.3%) |
| Higher vocational education | 5,196 (22.6%) |
| University | 1,379 (6%) |
| Paid employment |  |
| Yes | 16,396 (71.2%) |
| No | 6,641 (28.8%) |
| Housing status |  |
| Homeowner | 19,624 (85.2%) |
| Renting | 3,413 (14.8%) |
| Net monthly income |  |
| less than €500 | 1,750 (7.6%) |
| €501 - €1,000 | 3,184 (13.8%) |
| €1,001 - €1,500 | 4,165 (18.1%) |
| €1,501 - €2,000 | 5,504 (23.9%) |
| €2,001 - €2,500 | 4,114 (17.9%) |
| €2,501 - €3,000 | 2,032 (8.8%) |
| more than €3,000 | 2,285 (9.9%) |
| Volunteer in an organisation |  |
| Yes | 11,042 (47.9%) |
| No | 11,995 (52.1%) |
| Religious denomination |  |
| Roman Catholic | 7,886 (34.2%) |
| Dutch Reformed | 2,799 (12.2%) |
| Reformed | 1,946 (8.4%) |
| Protestant | 2,063 (9%) |
| Other religious affiliation | 927 (4%) |
| No religious affiliation | 7,416 (32.2%) |
| Gender |  |
| Man | 13,819 (60%) |
| Woman | 9,218 (40%) |
| Blood-donor identity | 11.48 (± 2.46) |
| Number of donations |  |
| Whole blood donor | 23.7 (± 14.9) |
| Plasma donor | 52.1 (± 39.2) |
| Whole-blood & plasma donor | 47.25 (± 27) |
| Parent active as donor during childhood of child (2y-11y) | 6,482 (28.1%) |
| Parent active as donor during adolescence of child (12y-18y) | 13,357 (58%) |
| Parent active as donor during emerging adulthood of child (19y-22 y) | 17,874 (68.9%) |

Table 2. Correlations between the main study variables

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Donor status of the child | Childhood | Adolescence | Emerging adulthood | Blood donor identity | Donation frequency |
| Donor status of the child | 1 |  |  |  |  |  |
| Childhood | 0.009 | 1 |  |  |  |  |
| Adolescence | .017\* | .531\*\* | 1 |  |  |  |
| Emerging adulthood | -.022\*\* | .233\*\* | .562\*\* | 1 |  |  |
| Blood donor identity | .048\*\* | .087\*\* | .081\*\* | .049\*\* | 1 |  |
| Donation frequency | .032\*\* | -.253\*\* | -.251\*\* | -.243\*\* | .082\*\* | 1 |

*\*\*. Correlation is significant at the 0.01 level (2-tailed).*

*\*. Correlation is significant at the 0.05 level (2-tailed).*

## *3.2.Control variables*

We began our analysis with model 1 where we included the sociodemographic and donor characteristics control variables. We maintained these variables in all subsequent models. The model results for the sociodemographic and donor characteristics control variables, included in models 1-4, can be seen in the Appendix.

Table 3. Model Results Summary

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Model 2 | Model 3 | Model 4 |  |
|  | B | SE | Sig. | B | SE | Sig. | B | SE | Sig. |
| Parent's Donor Identity | 0.056 | 0.010 | <.001 | 0.051 | 0.010 | <.001 | 0.051 | 0.010 | <.001 |
| Frequency of blood donation |  |  |  | 0.008 | 0.001 | <.001 | 0.007 | 0.001 | <.001 |
| The parent donated during the child’s childhood period (3y-11y) |  |  |  |  |  |  | 0.049 | 0.065 | 0.448 |
| The parent donated during the child’s adolescence period (12y-18y) |  |  |  |  |  |  | -0.226 | 0.065 | 0.001 |
| The parent donated during the child’s emerging adulthood period (19y-22y) |  |  |  |  |  |  | 0.316 | 0.061 | <.001 |
| Constant | -3.627 | 0.376 | <.001 | -3.565 | 0.3761 | <.001 | -3.650 | 0.411 | <.001 |

\* the models include the control variables, for the coefficients and significance levels of the control variables see the Appendix

## *3.3. Parent’s donor identity*

In model 2, in addition to the control variables from model 1 (sociodemographic and donor characteristics of the parent), we included the parent’s donor identity in order to test for its association with the likelihood of the child to be a blood donor. As depicted in Table 3 we found a positive statistical effect of parent donor identity on the donor status of the child, with B=0.056 (SE=0.01) and p<0.001. Thus, for every 1-point increase in the score of the blood-donor identity of the parent ,the probability of the child to be a donor increases by 5.1% points.

Additionally, when controlled for the number of blood donations, the regression coefficient lowered, B=0.051 (SE=0.01 ; p<0.001), indicating a possible mediation between the 2 variables. The coefficient remained stable when inserting the developmental period of the child variable in the last model.

## *3.4. Number of blood donations*

In the third model, we inserted the number of blood or plasma donations made by the parent. Our prediction, as described in H2, was that this association will be positive. The obtained coefficient for this variable was B=0.007 (SE=0.001) with a p<0.001. The values of the coefficient did not modify in the fourth model. Thus, for every new blood or plasma donation by the parent, the probability of the child to be a blood donor raise by 0.7% points.

## *3.5. Developmental stage of the child*

In the fourth model, we added the developmental stage of the child in which the parent was active as a blood donor. A significant negative association was found when parents donated blood during the child’s adolescence compared to those parents who donated when the child was not in one of the three developmental periods considered in the study (childhood, adolescence and emerging adulthood), B=-0.226 (SE=0.065, p=0.001). Thus, children whose parents donated during their adolescence compared to those whose parents donated when their children were younger than 3 or older than 22 had 22.6% lower probability of being blood donors. Moreover, we found a positive association in the case of parents who donated during the child’s emerging adulthood compared to the parents who donated when the child was not in one of the three developmental periods, B=0.316 (SE=0.061; p<0.001). This means that, children whose parents donated during their emerging adulthood compared to those whose parents donated when their children were younger than 3 or older than 22 had 31.6% higher probability of being blood donors.

## *3.6. Robustness analyses*

To check the robustness of the results we developed different additional analyses. First, we re-ran model four with a mixed linear regression model, which has been argued to better perform than logistic regression (see Gomila, 2021). In this model, all the previously mentioned variables are significant, and the coefficients maintain their direction. Second, we used the method of subsampling and we randomly selected a subsample of the original data set (50%) and run the statistical analysis once again. All the variables previously declared significant remained significant and kept their direction of influence (positive or negative). Third, approximately 70% of the participants that participated in the first wave (DIS-I: 2007-2009) of the DIS survey, answered the same questions a few years later in the second wave (DIS-II: 2012-2013). Thus, we measured the robustness of parent's donor identity as a predictor for the likelihood of the child to be a blood donor by assessing the association between the parent's blood-donor identity score at the time of DIS-I and the likelihood of the child to be a blood donor at the time of the DIS-II. The analysis rendered that the variable remained a significant predictor having a B=0.040, SE=0.009 and p<.001. Finally, in the list of best practices aimed at preventing false-positive results described by Simmons, Nelson and Simons (2011), it is advised to report the results of the statistical analysis without the covariates. As it can be observed in Table 4, the coefficients maintained their direction and significance with small variations in their value.

Table 4. Statistics results analysis without control variables

|  |  |  |  |
| --- | --- | --- | --- |
|  | B | SE | Sig |
| Parent's Donor Identity | 0.056 | 0.001 | <.001 |
| Frequency of blood donation | 0.004 | 0.001 | .001 |
| The parent donated during the child’s childhood period (3y-11y) | 0.001 | 0.061 | .984 |
| The parent donated during the child’s adolescence period (12y-18y) | -0.277 | 0.062 | <.001 |
| The parent donated during the child’s emerging adulthood period (19y-22y) | 0.304 | 0.059 | <.001 |
| Constant | -2.881 | 0.127 | <.001 |

# **4. Discussions**

## *4.1. Findings*

Previous research has revealed significant relations between a child’s current prosocial behaviour and their parent’s past prosocial behaviour (Bekkers, 2007; Clary & Miller, 1986; Mustillo et al., 2004). However, in the field of blood donation, only one quantitative study has been conducted on intergenerational transmission, focusing on genetic and environmental factors in the case of Danish twins (Pedersen et Al., 2015). There has been a qualitative study by Quéniart (2013) however due to methodological reasons, the findings cannot be generalized. Our study extends this line of research by determining intergenerational transmission and by exploring three psycho-social mechanisms that may facilitate this process in a large representative sample of Dutch blood donors. We uncovered that 37.7% of the Dutch blood donor population is part of a blood donor family, indicating that intergenerational transmission of blood-donor behaviour is an important phenomenon in the Netherlands. Moreover, the results suggest that a parent’s donor identity, the parent’s number of donations and the developmental stage of the child in which the parent was active as a blood donor play a role in determining intergenerational transmission and the likelihood of the child to be a blood donor themselves.

Our analyses revealed that the stronger the blood-donor identity of the parent the higher the probability of the child to be a blood donor. We hypothesized that parents having a stronger blood-donor identity would be more likely to talk to their children about blood donation compared to parents with weaker blood-donor identities. As a result of these family discussions, the children might internalize values and attitudes related to blood donation that might influence their behaviour in the future. Regarding the number of donations, we uncovered a positive, statistically significant, association between the number of donations and the donor status of the child. We speculated that as the child is more exposed to successful donations by the parent through observations or hearing about it from the parent, the offspring may become acquainted with the behaviour.

Concerning the age of the child at which the parent was active as a blood donor, the periods of adolescence and emerging adulthood proved to be significant. The results indicate that the probability of the child to be a blood donor decrease if the parent was donating during the child’s adolescence and increases if one was donating during the child’s emerging adulthood. A possible explanation for this dynamic is the change in the relationship between children and parents during adolescence, when the influence of the family diminishes in favour of peers (Smetana et al., 2015). Numerous previous studies report a decline in the quality of the relationship between children and parents during this period, a trend that tends to stabilize during young adulthood (see Tsai et al., 2013) and thus the positive association that corresponds to the later developmental period. Additionally, McCombie (1991) concludes in his study that a suggestion by another to donate might be more influential for non-donors compared to merely knowing about others’ donation behaviour. Thus, given that the minimum age of donation in the Netherlands is 18, it is possible that for children at younger ages, the process of transmission is rather indirect: with parent-child discussions centring on altruistic practices and values, rather than directly endorsing blood donation (Quéniart, 2013).

## *4.2. Limitations & Implications*

Although the DIS-I sample proved to be representative of the Dutch blood donor population at the moment of data collection, the demographic and psycho-social characteristics of the donor pool and implicitly donor families might have changed in the past 10 years; and thus also the functioning of the transmission mechanisms. We should also consider several other factors that could influence the passing down of behaviour from one generation to the next. These factors include the quality of the parent-child relationship, the parenting style used, how children perceive the values that the parents desire to transmit, and even genetic influences (see Fortuna & Knafo, 2014; Padila-Walker, 2014). Moreover, it is also crucial to note that our findings are influenced by cultural context, as family dynamics and roles vary significantly from country to country (Ferguson et al., 2018). This means that our results, while applicable to the Dutch context, may not hold true in other cultural settings. Finally, in determining the conditions of transmission, only information about the parents was used; however, the process is bidirectional, and the children play an active role in socialization (Kuczynski, 1997).

Nonetheless, the results are relevant for blood banks in designing their recruitment strategies. Given that a large segment of the donor population is part of a blood donor family, blood banks may design interventions to engage the families of current donors in conversations about blood donation or design campaigns in which they are encouraged to bring a family member as a donor. Thus, by supporting the transfer of the blood-donor behaviour from one generation of donors to another, blood banks may be able to ensure the long-term stability of the blood supply. This approach may be most relevant for blood banks whose strategy focuses on maintaining the loyalty of the existent donors rather than recruiting new donors as children can replace their parents in the donor pool and being a member of a donor network (family) is positively associated with blood donation (Schröder et. al., 2021).

## *4.3. Future Research*

We recommend that future research focuses on the relationship between parent and offspring as well as child characteristics; these elements proved significant in previous studies but we could not consider in the present research. For example, it would be valuable if forthcoming papers would explore the strategies and discourses blood-donor parents use when talking with their children about this type of prosocial behaviour. For this purpose, a qualitative study may bring the necessary details that would offer a more complete picture. Moreover, in future quantitative research, it is advised that information on both parents' and children's social status and donation behaviour is collected, as well as the quality of the relation existent between them. Finally, when analysing this area, scientists are advised to consider the larger context of transmission. By this, we are referring to the embedding of the blood donor family in a larger donor network (e.g. the existence of other donor relatives, friend; see Piliavin & Callero, 1991) or situational factors that may influence one’s behaviour such as certain life events (Piersma et al., 2019) or proximity to a blood donation centre (Piersma et al., 2021).

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**Appendix**

Complete model results

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Model 1 | Model 2 | Model 3 | Model 4 |
|  | B | S.E. | B | S.E. | Sig. | B | S.E. | Sig. | Sig. | B | S.E. | Sig. |
| Unmarried/ never married/divorced/widow | -0.273 | 0.193 | -0.284 | 0.194 | 0.143 | -0.277 | 0.195 | 0.154 | 0.157 | -0.287 | 0.193 | 0.138 |
| The respondent (parent) lives with his/her partner/ husband/ wife and children |  |  |  |  |  |  |  |  |  |  |  |  |
| The parent is in a different home situation than the other 2 categories  | 0.214 | 0.207 | 0.218 | 0.208 | 0.293 | 0.183 | 0.209 | 0.381 | 0.302 | 0.216 | 0.207 | 0.297 |
| Parent lives with his/her partner/husband/wife | 0.109 | 0.063 | 0.113 | 0.063 | 0.072 | 0.067 | 0.064 | 0.295 | 0.082 | 0.108 | 0.063 | 0.085 |
| Parent education highest level attained: university |  |  |  |  |  |  |  |  |  |  |  |  |
| The parent has followed no education or he/she completed only primary school | -0.095 | 0.170 | -0.204 | 0.172 | 0.235 | -0.227 | 0.173 | 0.190 | 0.575 | -0.210 | 0.172 | 0.221 |
| Parent education highest level attained: lower vocational education | 0.054 | 0.129 | -0.036 | 0.131 | 0.785 | -0.058 | 0.132 | 0.659 | 0.674 | -0.049 | 0.131 | 0.710 |
| Parent education highest level attained: secondary education | 0.012 | 0.127 | -0.073 | 0.128 | 0.567 | -0.089 | 0.129 | 0.491 | 0.922 | -0.076 | 0.128 | 0.552 |
| Parent education highest level attained: secondary vocational education | 0.191 | 0.123 | 0.115 | 0.124 | 0.356 | 0.100 | 0.125 | 0.426 | 0.120 | 0.109 | 0.124 | 0.381 |
| Parent education highest level attained: higher secondary education | 0.027 | 0.142 | -0.031 | 0.143 | 0.825 | -0.034 | 0.143 | 0.810 | 0.850 | -0.032 | 0.142 | 0.822 |
| Parent education highest level attained: higher vocational education | 0.157 | 0.117 | 0.122 | 0.118 | 0.303 | 0.112 | 0.119 | 0.347 | 0.182 | 0.116 | 0.118 | 0.324 |
| Parent is in paid employment | -0.095 | 0.170 | 0.097 | 0.067 | 0.143 | 0.071 | 0.067 | 0.288 | 0.575 | 0.102 | 0.066 | 0.123 |
| Net monthly income of the parent > €3,000.00 |  |  |  |  |  |  |  |  |  |  |  |  |
| Net monthly income of the parent: less than €500.00 | 0.098 | 0.139 | 0.068 | 0.139 | 0.626 | 0.060 | 0.140 | 0.669 | 0.479 | 0.067 | 0.139 | 0.632 |
| Net monthly income of the parent: €501.00 - €1,000.00 | 0.101 | 0.125 | 0.073 | 0.125 | 0.561 | 0.084 | 0.125 | 0.506 | 0.415 | 0.069 | 0.125 | 0.582 |
| Net monthly income of the parent: €1,001.00 - €1,500.00 | -0.016 | 0.112 | -0.031 | 0.113 | 0.780 | -0.033 | 0.113 | 0.768 | 0.888 | -0.040 | 0.112 | 0.721 |
| Net monthly income of the parent: €1,501.00 - €2,000.00 | -0.007 | 0.100 | -0.031 | 0.101 | 0.761 | -0.031 | 0.101 | 0.759 | 0.942 | -0.024 | 0.100 | 0.808 |
| Net monthly income of the parent: €2,001.00 - €2,500.00 | -0.123 | 0.101 | -0.143 | 0.101 | 0.158 | -0.147 | 0.102 | 0.147 | 0.222 | -0.135 | 0.101 | 0.180 |
| Net monthly income of the parent: €2,501.00 - €3,000.00 | -0.084 | 0.114 | -0.102 | 0.114 | 0.373 | -0.103 | 0.115 | 0.368 | 0.460 | -0.096 | 0.114 | 0.399 |
| If the parent is active as a volunteer in an organisation | 0.129 | 0.049 | 0.128 | 0.050 | 0.010 | 0.131 | 0.050 | 0.009 | 0.009 | 0.124 | 0.050 | 0.013 |
| If the parent is a homeowner | -0.007 | 0.070 | 0.020 | 0.070 | 0.773 | 0.025 | 0.071 | 0.721 | 0.916 | 0.007 | 0.070 | 0.918 |
| No religious affiliation |  |  |  |  |  |  |  |  |  |  |  |  |
| Religious affiliation Roman Catholic | 0.063 | 0.060 | 0.050 | 0.060 | 0.405 | 0.048 | 0.060 | 0.420 | 0.291 | 0.041 | 0.060 | 0.487 |
| Religious affiliation Dutch Reformed | 0.201 | 0.080 | 0.194 | 0.080 | 0.015 | 0.191 | 0.080 | 0.017 | 0.011 | 0.178 | 0.080 | 0.026 |
| Religious affiliation Reformed | -0.060 | 0.098 | -0.050 | 0.100 | 0.615 | -0.053 | 0.099 | 0.591 | 0.541 | -0.078 | 0.098 | 0.428 |
| Religious affiliation Protestant  | 0.117 | 0.090 | 0.106 | 0.095 | 0.240 | 0.103 | 0.091 | 0.258 | 0.195 | 0.098 | 0.090 | 0.280 |
| Other religious affiliation  | -0.113 | 0.133 | -0.106 | 0.133 | 0.426 | -0.102 | 0.134 | 0.445 | 0.395 | -0.126 | 0.133 | 0.343 |
| Donor parent father | -0.327 | 0.071 | -0.411 | 0.072 | >.001 | -0.389 | 0.073 | >.001 | 0.000 | -0.332 | 0.071 | 0.000 |
| Age of the parent when the questionnaire was filled in | 0.017 | 0.006 | 0.013 | 0.006 | 0.027 | 0.005 | 0.006 | 0.392 | 0.002 | 0.016 | 0.006 | 0.006 |
| Parent was a whole blood donor |  |  |  |  |  |  |  |  |  |  |  |  |
| Parent was a plasma donor | 0.055 | 0.061 | -0.143 | 0.070 | 0.038 | -0.131 | 0.070 | 0.061 | 0.364 | 0.035 | 0.061 | 0.564 |
| Parent was a plasma donor & whole blood donor | 0.194 | 0.136 | -0.041 | 0.142 | 0.771 | -0.008 | 0.145 | 0.958 | 0.152 | 0.184 | 0.136 | 0.176 |
| Parent's donor identity |  |  |  | 0.056 | 0.010 | <.001 | 0.051 | 0.010 | <.001 | 0.051 | 0.010 | <.001 |
| Frequency of blood donation |  |  |  |  |  |  | 0.008 | 0.001 | <.001 | 0.007 | 0.001 | <.001 |
| The parent donated during the child’s childhood period (3y-11y) |  |  |  |  |  |  |  |  |  | 0.049 | 0.065 | 0.448 |
| The parent donated during the child’s adolescence period (12y-18y) |  |  |  |  |  |  |  |  |  | -0.226 | 0.065 | 0.001 |
| The parent donated during the child’s emerging adulthood period (19y-22y) |  |  |  |  |  |  |  |  |  | 0.316 | 0.061 | <.001 |
| Constant | -3.192 | 0.367 | -3.565 | 0.376 | >.001 | -3.068 | 0.420 | >.001 | >.001 | -3.627 | 0.376 | >.001 |