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Respondent-Driven Sampling with Probability-Based Seeds: Recruitment, Super-Seeds, and Non-Compliance

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Abstract

This paper evaluates the feasibility of using respondent-driven sampling (RDS) with probability-based seeds to recruit young adults. Previous research suggests young adults may be suited to RDS because they are willing to recruit peers, while online peer-to-peer recruitment aligns with their communication habits. Using seeds drawn from the probability-based NatCen Opinion Panel, we investigate RDS-based recruitment among young adults aged 18-24. We examine recruitment dynamics, willingness to recruit, predictors of recruitment cooperation, homophily, seed productivity, including super-seed chains, and non-compliance.

A total of 820 seeds were issued, of which 317 participated (38.7%) and 183 agreed to recruit peers. 2,229 productive respondents were recruited over ten waves, averaging 1.1 recruits per participant. Recruitment showed substantial attrition but became increasingly self-sustaining after initial waves. However, recruitment was concentrated, with three super-seed chains accounting for 91.8% of all recruited participants. Homophily was evident across several socio-demographic characteristics, particularly ethnicity and region, while non-compliance included age discrepancies and eligibility violations.

The findings suggest that RDS can be integrated into probability-based survey infrastructure, but recruitment success depends on network structure and is vulnerable to concentration effects and protocol deviations. Further methodological development is needed before RDS can be recommended for implementation in probability-based surveys.

Keywords: Respondent-driven sampling, probability-based seeds, super-seeds, under-represented sub-groups, protocol non-compliance

Introduction

Achieving adequate representativeness of all population sub-groups and ensuring inclusivity for general population surveys are paramount for robust survey research but also remain the most important challenges in survey practice. Despite advances in sampling and data collection methods, including non-response follow-up efforts, general population probability-based surveys frequently struggle to recruit sufficient numbers of respondents from some population sub-groups. Young adults, especially young males, ethnic minority groups, recent migrants, and other harder-to-survey population sub-groups are consistently under-represented in high-quality social surveys due to a combination of lower response propensities associated with weaker survey engagement and potentially greater barriers to participation (Lynn, 2024; Domarchi et al., 2026). Their under-representation may reduce the precision of sub-group estimates and introduce bias if these groups differ systematically from the general population on the key survey outcomes. Consequently, understanding the causes and consequences of differential participation among harder-to-survey population sub-groups remains a key priority in survey methodology.

Traditional approaches to improving inclusivity and representativeness typically involve over-sampling of these groups, targeted procedures, differential incentives, or adaptive survey designs (Lohr, 2021, Sladka and Lynn, 2025; Groves and Heeringa, 2006; Schouten et al., 2013; Gaia et al., 2026). While these approaches have achieved varying degrees of success, they are often expensive and operationally demanding, particularly when the target sub-group constitutes only a small proportion of the overall sample. For example, the use of convenience samples may not provide sufficient level of quality for social surveys, while over-sampling from the Postcode Address File (PAF) and/or screening may be prohibitively expensive or unfeasible in a self-completion mode. Alternative recruitment strategies that can complement probability-based designs, therefore, continue to receive considerable attention.

Respondent-driven sampling (RDS), which was first introduced by Heckathorn (1997), represents one such promising alternative. RDS is a chain-referral sampling methodology originally developed to study hidden or hard-to-reach populations for which no sampling frame exists (Heckathorn, 1997; Tourangeau et al., 2014). Unlike traditional snowball sampling, RDS incorporates a structured recruitment process supported by mathematical modelling, in which participants recruit their peers from their social networks. Information collected on respondents' network sizes and recruitment patterns is then incorporated into statistical estimators, designed to account for biases arising from non-random recruitment and produce population estimates under specified assumptions. Over the past three decades, RDS has been widely applied in studies of hard-to-reach population sub-groups such as intravenous drug users, sex workers, illegal migrants, ethnic minority communities, and LGBTQ+ groups, where conventional sampling approaches were either infeasible or prohibitively expensive (Todd et al., 2026; Tourangeau et al., 2014).

Although RDS has been extensively evaluated as a method for sampling hidden populations, its integration within probability-based survey designs has received little attention (for exceptions see Cornesse et al., 2026 and Middleton et al., 2022). The vast majority of the existing RDS studies operate independently of survey infrastructure and rely on convenience selection of varying number of initial participants, known as seeds (Todd et al., 2026). This feature has attracted sustained methodological criticism because the characteristics of the initial seeds may influence subsequent recruitment chains, particularly when recruitment does not proceed through sufficient waves to reach equilibrium and may introduce unquantifiable bias (Yan et al., 2020). As a result, concerns remain regarding the representativeness of RDS samples and the extent to which estimates depend on the initial selection of seeds.

This study examines a novel application of RDS by embedding it within a general population probability-based survey. Rather than using RDS as a stand-alone sampling strategy, we evaluate how RDS with probability-based seeds performs when recruiting young adults aged 18-24 years, a population sub-group that has historically shown lower participation rates in high-quality general population surveys. The initial seeds are drawn from the probability-based NatCen Opinion Panel, rather than being selected through convenience methods. This represents a significant departure from conventional RDS practice and addresses one of the principal methodological criticisms of respondent-driven sampling by grounding the recruitment process within an established probability-based sample. Combining probability-based seed selection with peer recruitment provides an opportunity to examine how network-based recruitment operates when initiated from an established probability-based sample, and whether this approach introduces new opportunities or challenges for survey implementation.

Peer recruitment offers several potential advantages in this context. Individuals may be better positioned than survey agencies to contact and engage members of their own peer network. This may be particularly true among sub-groups such as young adults, whose communication patterns increasingly rely on digital and interpersonal channels (e.g. sharing recommendations and other content of interest to one another via direct messaging services), or where trust in institutions is low. By leveraging existing social relationships, RDS recruitment may operate through different participation pathways from traditional survey invitations, particularly among individuals who are less likely to respond through conventional approaches. At the same time, successful recruitment depends on participant engagement throughout multiple stages of the recruitment process. Respondents must not only complete the survey themselves but also should actively recruit eligible peers, who must in turn agree to participate and continue the recruitment process. Consequently, recruitment success may vary substantially across seeds and recruitment chains, with many chains terminating after only a few waves while others may expand considerably.

The web-based implementation introduces additional methodological considerations. Online RDS substantially reduces fieldwork costs, speeds up data collection, and simplifies administration, making it an attractive approach for geographically dispersed large-scale surveys. However, digital recruitment also creates opportunities for non-compliant participation, including duplicate responses, ineligible participants from outside of target population sub-groups, survey bots answering instead of human respondents, fraudulent recruitment, and attempts to exploit monetary incentives, which are commonly provided in RDS recruitment. Robust protocols for verifying eligibility, detecting suspicious recruitment patterns and maintaining data quality are therefore essential components of online RDS studies. Understanding the recruitment patterns and the extent and nature of non-compliance are particularly important when considering the integration of RDS into probability-based surveys.

Another well-documented feature of RDS is the unequal productivity of recruitment chains. Numerous studies have observed that a relatively small number of initial seeds generate disproportionally large recruitment networks, while many seeds recruit few or no additional participants (Abdul-Quader et al., 2006; Jonsson et al., 2019). These highly productive ``super-seeds'' play a dominant role in determining the final sample composition and raise important methodological questions regarding sample dependence, recruitment dynamics, and statistical inference. Not much is known about super-seeds, and, therefore, examining the characteristics and contribution of these super-seeds to the final sample is critical for understanding the performance of RDS when incorporated into probability-based surveys.

This study evaluates the feasibility of implementing RDS within a probability-based survey infrastructure. Specifically, this paper addresses three main methodological themes: (1) recruitment cooperation and dynamics, (2) effects of different types of seeds, and (3) protocol non-compliance. The overarching aim is to examine the feasibility and methodological implications of implementing an RDS approach with probability-based seeds within a general population survey, using young adults as an empirical case study given their historically lower participation in general population surveys. The following research questions will be addressed:

RQ1.1: To what extent do participants engage in peer recruitment?

RQ1.2: To what extent are participants willing to engage in peer recruitment?

RQ1.3: What are the predictors of recruitment cooperation among both probability-based-selected seeds and the subsequent recruits?

RQ1.4: How do recruiter characteristics and recruiter-recruit similarity shape recruitment patterns?

RQ2.1: Do recruitment outcomes differ according to the characteristics of the initial probability-selected seeds, including whether seeds belong to the target population (aged 18-24) or the non-target population (aged 25 years and over)?

RQ2.2: Do highly productive ``super-seeds'' emerge, and how are they associated with the recruitment dynamics and the composition of the achieved sample?

RQ3.1: What forms of protocol non-compliance are observed in this feasibility study?

To address these research questions, this paper employs data collected as part of the RDS Feasibility Study (Jessop et al., 2026).

The remainder of the paper is organised as follows. Section 2 presents background and the literature review, Section 3 describes the feasibility study design, including the recruitment of seeds, the respondent-driven sampling protocol, recruitment procedures, and quality assurance measures. Section 4 presents the analytical framework and the measures used to evaluate recruitment performance. Section 5 reports the findings, focusing on recruitment dynamics, different types of seeds and the role of highly productive recruitment chains, and non-compliance patterns observed in the study. Section 6 discusses the methodological implications of embedding RDS within a probability-based general population survey, considers the limitations of the study, and identifies priorities for future research on recruitment processes, implementation challenges, and quality assurance.

Background and Literature

Respondent-driven sampling (RDS) is a network-based chain-referral sampling methodology developed to study population sub-groups for which no conventional sampling frame exists (Heckathorn, 1997). Unlike traditional snowball sampling, RDS combines peer recruitment with a network-based statistical framework that, under a set of assumptions, enables inference about the target population (Volz and Heckathorn, 2008; Goel and Salganik, 2009). These assumptions include target population membership, connected network, sampling with replacement, reciprocal social ties, random recruitment from participants' personal networks, and accurate reporting of network size (Gile and Handcock, 2010). While RDS has been widely applied internationally, particularly in public health research involving hidden populations, its use in the UK remains relatively limited, with only a small number of studies, including pilot work undertaken by the Office for National Statistics (for example, see Sosenko, 2025), evaluating its application in survey research.

The selection of initial seeds is a fundamental design feature of RDS. In conventional RDS studies, seeds are typically selected through convenience methods because no sampling frame is available for the target population. More details on seed selection can be found in Todd et al. (2026). Classical RDS theory argues that the influence of these non-probability-based seeds diminishes as recruitment proceeds through successive waves, with the recruitment process converging towards a stationary distribution that is largely independent of the initial sample (Heckathorn, 1997; Volz and Heckathorn, 2008). However, this assumption has been increasingly challenged. Using a theoretical analysis of inverse probability weighting (IPW) estimators, including the Volz-Heckathorn estimator, (Yan et al., 2020) showed that seed bias can persist in the limiting distribution under high-variance network conditions, implying that increasing sample size alone does not necessarily eliminate bias arising from non-randomly selected seeds. Empirical evaluations have similarly questioned the statistical efficiency of RDS. For example, Goel and Salganik (2010) found that the root mean squared error (RMSE) of RDS estimates was often comparable to that of unweighted sample means when the variables of interest were only weakly associated with respondents' network degree. They also reported design effects substantially larger than those commonly assumed in practice, frequently in the range of 5-10.

These findings motivate the use of probability-based seeds as a potential extension of the RDS design. By selecting seeds from an existing probability-based online panel, the initial sample is more likely to be geographically dispersed and demographically representative, providing access to a broader range of social networks than would typically be achieved through a small number of clustered convenience seeds. To date, this approach has not been evaluated in the RDS literature (for an ongoing evaluation in Germany see Cornesse et al., 2026). Reviews by Todd et al. (2026), Johnston et al. (2016) and Leonard (2025) found that all published RDS studies relied on convenience-based seed selection, highlighting the novelty of embedding RDS within an existing probability-based survey.

Participants' willingness and motivation to engage in peer recruitment represent important but often overlooked components of the RDS recruitment process. Unlike conventional surveys, RDS requires participants not only to complete the survey themselves but also to actively identify and recruit eligible peers. Recruitment success, therefore, depends on participants' willingness to use their social networks, their ability to identify eligible contacts, and the strength of their relationships with potential recruits. Existing research suggests that recruitment behaviour is influenced by individual characteristics, perceived burden, incentives, and social relationships, meaning that recruitment productivity is unlikely to be random across participants (Lee et al., 2020). Understanding the recruitment willingness is, therefore, important for interpreting recruitment patterns and assessing the extent to which observed RDS samples reflect network processes rather than differential participation behaviour.

One commonly used strategy to increase participation motivation across seeds and recruits is to use not only primary incentives, which reward individuals for completing the survey themselves, but also secondary incentives, which reward the recruiters for successfully encouraging others to participate (see (Heckathorn (1990) for the underlying theory of group-mediated compliance). This approach assumes that participants are motivated not just to maximise their own benefits, but also to help members of their social network earn rewards (for more on this, see Heckathorn's (1996) analysis of collective action dynamics). As a result, secondary incentives can appeal even to those who are not personally motivated by the direct reward, but who wish to support someone in their network. In such cases, secondary incentives transform the material rewards into “peer-based symbolic incentives” (Heckathorn, 1997, pp. 177-178), which may hold greater value for respondents more oriented towards supporting peers rather than getting money for themselves.

In addition to variability in willingness to recruit, RDS is also susceptible to selection bias arising from recruiters' decisions about whom to invite. The final sample reflects not only who agrees to participate but also who is selected for recruitment in the first place. Lee et al. (2020) demonstrate that recruitment cooperation is systematic rather than random, with coupon distribution and redemption influenced by participant characteristics and social relationships. Similarly, Liu et al. (2012) used egocentric network data and found that the assumption of random recruitment was violated for gender and education, with evidence of preferential recruitment of men and individuals with higher educational attainment, although the assumption held for age, marital status and mode of drug use. These findings are consistent with the broader survey methodology literature on survey non-response, which has long established that survey participation is rarely random but instead varies systematically across individuals and social groups (Groves and Couper, 1998; Groves et al., 2009; Bethlehem, 2010; Tourangeau et al., 2013).

Recruitment productivity also varies substantially across participants. For example, younger adults have been shown to be more willing to recruit than older adults (Axenfeld et al., 2026). A recurring finding in the RDS literature is that many participants recruit few or no additional respondents, while a small number of seeds generate disproportionately large recruitment chains. This variation begins with recruitment cooperation: across published RDS studies, coupon redemption rates are typically around 30%, indicating that only a proportion of participants successfully recruit peers (Lee et al., 2020). At the chain level, this can result in substantial concentration of recruitment among a small number of highly productive seeds or recruiters. For example, Abdul-Quader et al. (2006) reported that 1 of 8 seeds generated more than 90% of the achieved sample, while Jonsson et al. (2019) found that one recruitment chain accounted for 37% of all recruits. This “super-seed” phenomenon reflects substantial heterogeneity in recruitment success and raises important methodological questions regarding sample concentration, dependence on a small number of highly productive recruiters, and the validity of standard RDS assumptions. Understanding the recruitment productivity is, therefore, central to evaluating the feasibility of RDS, particularly when integrated within a probability-based survey.

A further challenge for RDS concerns participant non-compliance, which has implications beyond general data quality. Non-compliant behaviour can directly undermine the assumptions required for valid RDS inference. For example, misreporting age or eligibility status may violate the assumptions that participants are connected to the target population, while sharing recruitment invitations outside personal networks may violate assumptions regarding reciprocal social ties and random recruitment. Similarly, incentive-driven repeated participation as well as inaccurate reporting of personal network size (which may occur even without intentional non-compliance) can compromise the weighting procedures used by RDS estimators. These concerns are particularly relevant in web-based implementation of RDS, where remote participation, the absence of an interviewer and the use of monetary incentives may increase opportunities for fraudulent or low-quality responses. Jonsson et al. (2019) highlight the importance of monitoring and detecting such behaviours, demonstrating that non-compliance represents a key methodological challenge when implementing RDS online.

The extent and nature of non-compliance may also depend on the characteristics of the target population and recruitment context. Much of the early RDS literature focused on hidden populations, such as people who inject drugs or sex workers, where peer networking is central to accessing individuals who cannot be reached through conventional sampling approaches. However, as RDS has increasingly been applied to broader population sub-groups, including ethnic minority groups and general population samples, the assumptions underpinning recruitment and network connectivity may operate differently (Leonard, 2025). These differences highlight the need to evaluate how RDS recruitment processes operate when applied within probability-based general population surveys, where recruitment objectives, population coverage, and implementation constraints differ from traditional RDS applications.

Data

The NatCen Online Opinion Panel and Seed

The seeds for this study were recruited via the NatCen Opinion Panel. Members of the NatCen Opinion Panel are recruited through probability-based surveys that use the Postcode Address File (PAF) as the sampling frame. Participants are selected through probability-based sampling, and substantial efforts are made to maximise participation and data quality. Specifically, for this study, Panel participants were recruited from the British Social Attitudes study (BSA), from 2015 onwards. The BSA interviews people aged 18 and over across Britain (south of the Caledonian canal) from 2015 to 2023. Beginning in 2024, the BSA expanded to include Northern Ireland and lowered the minimum age for participation to 16. The BSA has used probability-based sampling from the PAF and transitioned to a push-to-web design from 2020 onwards, with respondents able to participate online or by telephone. Under this approach, households receive invitations for up to two adults to participate online, with an opt-in telephone option also available. Participants interviewed as part of the BSA were invited to join the Panel at the end of their interview.

For this study, eligible panel members were those aged 18 years or older, who had been recruited through BSA, remained active NatCen panel members, and had not withdrawn from the panel. A random sub-sample of 820 panel members was selected from this eligible pool as seeds. Although the target population for RDS recruitment was young adults aged 18-24, the study also examined whether seed characteristics influenced recruitment performance. The issued sample therefore included approximately equal numbers of seeds aged 18-24 and seeds aged 25 or older. This design allowed comparison of recruitment outcomes between seeds inside and outside the target population and enabled examination of whether older seeds could successfully recruit younger participants. The resulting probability-based seed selection represents a departure from conventional RDS practice, where seeds are typically recruited through convenience methods.

Following standard RDS procedures, seeds were invited to participate in an online survey and were then asked to recruit eligible peers using individually generated traceable coupons. Recruits were invited to continue the recruitment process using their own coupons, creating observable recruitment chains and waves of participants (up to a maximum of 10 waves). The questionnaire was approximately 15 minutes in length and included three modules: demographic characteristics, network- and community-related questions, and substantive survey measures designed to replicate a realistic general population survey experience. This design allows the study to evaluate recruitment feasibility and the methodological challenges of implementing RDS within a probability-based sampling framework. More details about this feasibility study design could be found in Jessop et al. (2026).

Of the 820 seeds invited to participate in the RDS study, 317 completed the survey, representing a seed response rate of 38.7%. Among participating seeds, 183 proceeded to the recruitment stage and invited at least one peer to participate. These participants generated ten subsequent recruitment waves through the distribution of traceable coupons, allowing the progression of recruitment waves to be observed during the RDS recruitment period (5 June to 21 July 2025). NatCen Panel fieldwork continued until 10 August 2025, although no further RDS recruitment took place after 21 July 2025.

The target population for this study is estimated at approximately 5.8 million young adults aged 18-24 in the UK, based on the Office for National Statistics (ONS) population projections (ONS, 2024). This represents an important departure from many previous applications of RDS, which have predominantly focused on relatively small, hidden, or hard-to-reach populations where no sampling frame exists and network-based recruitment is primarily used as an access strategy. By applying RDS within a large general population context, this study provides an opportunity to examine how peer recruitment operates among young adults at a scale and within a population context beyond those typically considered in the RDS literature.

Fieldwork

Seed recruitment included a soft launch period followed by mainstage fieldwork. Sampled panel members were contacted using a mixed-mode approach (letter, email and SMS), with multiple contact attempts scheduled across weekdays and weekends to encourage participation. Invitations included information on study purpose, survey content, data protection, and participation incentives. Seeds were offered a £5 voucher for survey completion. Data were collected online.

Participants who completed the survey were invited to recruit eligible peers using traceable electronic coupons, generating observable waves. A dual incentive structure was used as recommended in literature Todd et al., 2026), providing an incentive for survey completion and an additional incentive for each successful peer recruitment. Following lower than expected recruitment during the soft launch stage, the protocol was adapted for the mainstage fieldwork by increasing the maximum number of recruitment coupons available per participant from three to five and increasing incentives from £5 to £10. These adjustments were intended to increase recruitment productivity while maintaining the feasibility objectives of the study. The target sample size was subsequently revised from 3,000 to 1,500 respondents to offset the increase in incentive costs. The RDS fieldwork closed earlier than originally planned after exceeding the revised target sample size.

The achieved RDS sample comprised 2,229 productive respondents (excluding seeds), with an average of 1.1 successful recruits per participant. The achieved sample, together with the seed information, forms the basis of the analyses presented in this paper.

Figure 1 shows how the productive sample accumulated over the fieldwork period. Recruitment remained minimal through June and early July before rising steeply in mid-July: a single weekend (19–20 July) accounts for roughly two-fifths of the productive sample, and this surge was driven almost entirely by the super-seed chains, while recruitment through the non-super seed chains remained modest throughout.

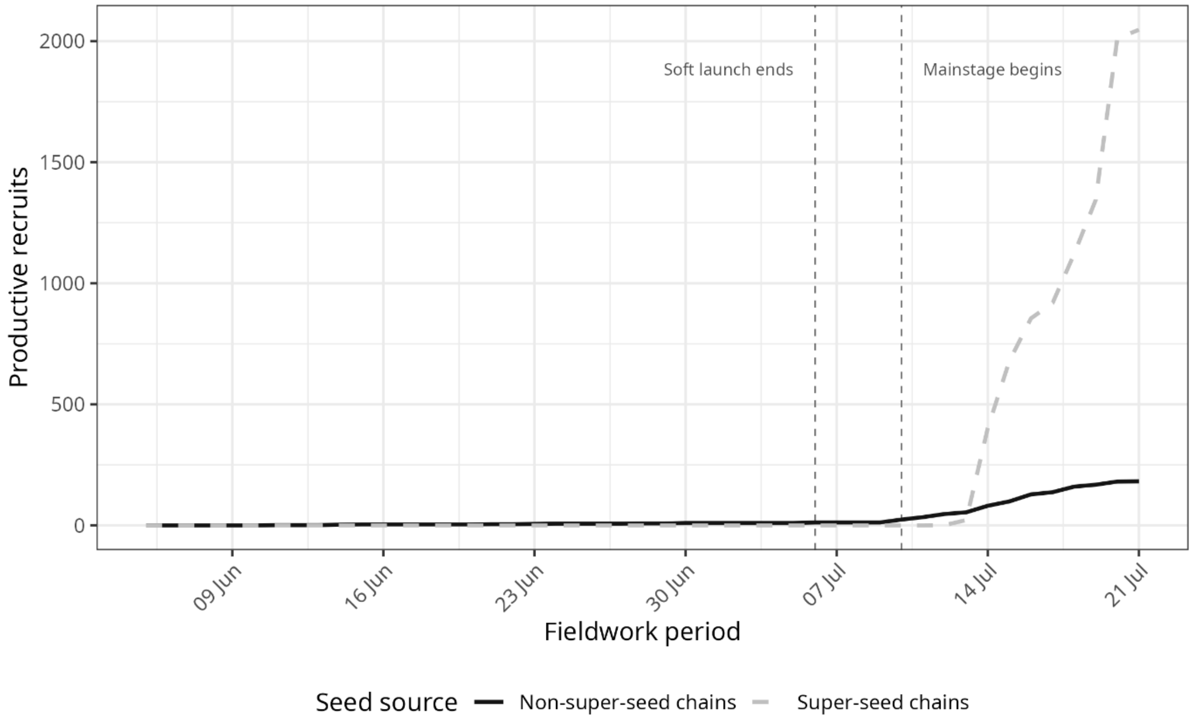

Fig. 1: Cumulative productive recruits over the fieldwork period (5 June–21 July 2025) by seed source. Dashed lines mark the end of the soft-launch phase (6 July) and the start of the mainstage phase (10 July) of seed recruitment.

Protocols and Non-Compliance Detection

To ensure data quality and to identify potential non-compliance, a series of adaptive protocols were implemented throughout the study, with adjustments made in response to emerging issues observed in real time during fieldwork.

At the start of the fieldwork, the RDS protocol included two-factor authentication to reduce duplicate participation, eligibility screening to confirm that participants were aged 18-24 and living in the UK, a requirement for a UK mobile number (should be starting with “07”), and automated checks relating to recruitment chains. These included a maximum chain length of 10 waves, completion speed monitoring, and duplicate email checks. Where these checks were triggered, cases were flagged (for example, duplicated voucher email addresses, duplicated phone numbers, rapid completion, or unauthorised identification details) and restricted from further peer recruitment. These flags primarily represent preventative quality-control measures and do not necessarily indicate deliberate non-compliance.

The protocol was adapted during fieldwork in response to emerging issues relating to potential non-compliance and highly productive recruitment chains. Additional age validation checks were introduced shortly after fieldwork began using three reference events: the Brexit referendum, the 9/11 attack, and the COVID-19 pandemic. These particular events were chosen to include one (COVID-19) within the direct experience of the target cohort and others (the Brexit referendum, the 9/11 attack) that require either early childhood or second-hand knowledge to answer accurately, so that inconsistent or implausible responses could help flag participants misrepresenting their age. Additional recruitment checks were also included: participants who reported that they did not personally know their recruiter were prevented from recruiting further participants, as this was considered inconsistent with the assumption of peer recruitment through existing social networks. Where unusually large or potentially problematic recruitment chains emerged, actions were taken to conduct additional checks. These included closing recruitment chains and pausing automated incentive payments to allow additional checks to be conducted. Further operational detail on the fieldwork implementation is available in the technical report Jessop et al. (2026).

Methodology

Unless otherwise stated, all analyses in this paper are based on the productive recruit sample, which excludes the initial probability-based seeds (N = 2,229). Where indicated, some tables use the full productive sample, including the seeds (N = 2,546). In addition, sensitivity analysis is conducted excluding cases identified as non-compliant in order to assess the robustness of findings and to inform the selection of the primary analytical sample for future analyses. Comparisons of RDS estimators as well as bias assessments within the Total Survey Error (TSE) framework are beyond the scope of this paper and will be included in companion articles.

To address the research questions, analyses were organised around three themes: (1) recruitment cooperation and recruitment patterns (RQ1.1, RQ1.2, RQ1.3 and RQ1.4), (2) recruitment outcomes according to seed characteristics and recruitment chain productivity (RQ2.1 and RQ2.2), and (3) protocol non-compliance (RQ3.1).

For RQ1.1, RQ1.2 and RQ1.3, descriptive statistics were used to summarise recruitment dynamics, participants' willingness to recruit, motivations for recruitment, recruitment outcomes across successive waves, predictors of recruitment, and recruiter-recruit relationships.

Factors associated with becoming a recruiter were examined using binary logistic and multilevel logistic regression models with random intercepts for recruitment chains to account for within-chain dependence. Cluster-robust standard errors were additionally estimated as a sensitivity analysis.

Formally, the binary outcome R_i equals 1 if participant *i* recruited at least one other participant and 0 otherwise, and is modelled as a function of a vector of socio-demographic and behavioural covariates $\boldsymbol{x_i}$ (sex, ethnicity, education, economic activity, disability, relationship status, political affiliation, network size, region and urban/rural location, housing tenure, financial situation, household size, relationship to and mode of invitation, recruitment motivation, share of same-age friends, and an indicator for super-seed chains). Models 1 and 2 are binary logistic regressions,

$$logit\{Pr(R_i = 1)\} = \beta_0 + x_i{}^T\beta, \quad (1)$$

estimated on the full sample including seeds (Model 1) and on recruits only (Model 2). Model 3 adds a chain-level random intercept to account for the dependence induced by the chain structured recruitment process,

$$logit\{Pr(R_{ic} = 1)\} = \beta_0 + x_{ic}{}^T\beta + u_c, \qquad u_c \sim N(0, \sigma_u^2), \quad (2)$$

and is estimated on recruits only. Coefficients are reported as odds ratios (expβ) with 95% confidence intervals; reference categories are listed in the table note. Generalised variance inflation factors confirmed that multicollinearity among the predictors was within conventional bounds.

To examine recruiter-recruit similarity (RQ1.4), intra-chain correlations (ICCs) were estimated to quantify the similarity of participants within recruitment chains. Higher ICCs indicate greater within-chain homogeneity and therefore stronger evidence of homophily, which is the tendency for individuals to be associated with and recruit others who are similar to themselves in observed characteristics. Conversely, lower within-chain similarity suggests that different recruitment chains capture more diverse parts of the underlying social network. Aggregate ICCs were calculated as weighted averages of category-specific ICCs, with weights based on the proportion of total variance attributable to each category (Breen and Ermisch, 2021). Confidence intervals were estimated using a nonparametric cluster bootstrap that resamples whole recruitment chains, which is appropriate for the clustered structure of the data.

Formally, following Lee et al. (2017), for each category of a categorical variable we defined a binary indicator $y_{ic} \in \{0,1\}$ for individual *i* in chain *c* (categories with very low frequency were collapsed) and fitted a logistic model with only a chain-level random intercept,

$$logit\{Pr(y_{ic} = 1)\} = \beta_0 + u_c, \qquad u_c \sim N(0, \sigma_u^2). \tag{3}$$

The (latent-scale) ICC is the share of the total variance attributable to between-chain variation,

$$\rho = \frac{\sigma_u^2}{\sigma_u^2 + \pi^2/3}, \tag{4}$$

where $\pi^2/3$ is the variance of the standard logistic distribution, i.e. the individual-level residual variance on the latent scale. For a variable with K categories, the aggregate ICC is the variance weighted average of the category-specific values (Breen and Ermisch, 2021), each weighted by its share of the total between-chain variance,

$$\rho_{agg} = \sum_{k=1}^{K} w_k \rho_k, \qquad w_k = \frac{\sigma_{u,k}^2}{\sum_{j=1}^{K} \sigma_{u,j}^2} \tag{5}$$

Ninety per cent confidence intervals for both the per-category and aggregate ICCs were obtained from a nonparametric cluster bootstrap (400 replicates). Because the chain is the natural re sampling unit in respondent-driven sampling, each replicate resamples whole recruitment chains with replacement, refits the random-intercept model, and re-estimates the ICC, with the inter val taken as the 5th and 95th percentiles across replicates. The same set of resampled chains is used for all categories of a variable within each iteration, so that the per-category and aggregate intervals remain mutually consistent.

For RQ2.1 and RQ2.2, recruitment outcomes were compared according to two characteristics of the recruitment chains: (i) the age of the probability-based-selected seed (18--24 years versus 25 years and over) and (ii) chain type (super-seed versus non-super-seed). Descriptive comparisons, supplemented by Pearson's chi-square tests for categorical variables, were used to examine differences in recruitment productivity, recruitment dynamics, willingness and motivation to recruit, chain characteristics, and patterns of recruiter-recruit similarity. For the super-seed analyses (RQ2.2), additional descriptive analyses examined the emergence, productivity, and contribution of highly productive recruitment chains, together with the implications of fieldwork closure for chain development. This framework provides the main analytical lens for comparing recruitment performance across different seed and chain types.

For RQ3.1, descriptive analyses were used to document different forms of protocol non-compliance, including duplicate participation, eligibility violations, departures from network-based recruitment, and recruitment concentration within highly productive chains. Sensitivity analyses were then conducted by repeating the principal recruitment analyses after excluding participants identified through the age-validation exercise as having confirmed age discrepancies, allowing the robustness of the main findings to be assessed.

All analyses were carried out in R (R Core Team, 2024}. Data management and tabulation used the **tidyverse** {Wickham et al., 2019), **janitor**, **scales** and **kableExtra** packages. Mixed-effects (multilevel) logistic models were fitted with **lme4** (Bates et al., 2015); model coefficients were extracted and exponentiated to odds ratios with **parameters** (Lüdecke et al., 2020), and intra-chain correlations were computed with **performance** (Lüdecke et al., 2021). Multicollinearity among the regression predictors was assessed using generalised variance inflation factors (**car**; Fox and Weisberg, 2019), and cluster-level uncertainty was evaluated with the **sandwich** (Zeileis, 2006) and **lmtest** (Zeileis, 2002) packages. Respondent-driven sampling quantities were estimated using the **RDS** package (Handcock et al., 2023), and confidence intervals for the intra-chain correlations were obtained from a nonparametric cluster bootstrap that resamples recruitment chains and refits the multilevel model with **lme4**.

Results

Overall Recruitment Dynamics and Recruitment Cooperation

Recruitment progression (RQ1.1)

RQ1.1: To what extent do participants engage in peer recruitment?

To examine recruitment dynamics, recruitment outcomes were calculated separately for each recruitment wave and disaggregated and presented in Table 1, providing a comprehensive overview of how recruitment evolved across successive waves. The analysis follows the progression of participants through the recruitment process by summarising at each recruitment wave the number of coupons distributed, productive completions and the completion rate, the participants eligible and willing to recruit others, and the resulting recruitment productivity.

Table 1: Recruitment dynamics by wave: coupons distributed, survey completion, willingness to recruit, and productivity (all participants).

	Recruitment wave											
Outcome	**Seed**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**	**W10**	**Total**
Potential invites	N/A	915	415	275	320	575	860	1105	1420	1600	1705	9190
Completed main survey	317	106	65	70	119	183	232	297	341	371	445	2546
Completion rate	N/A	12%	16%	25%	37%	32%	27%	27%	24%	23%	26%	24%
Potential recruiters	317	106	64	68	118	178	230	293	333	365	N/A	2072
Agreed to recruit	183	83	55	64	115	172	221	285	324	347	N/A	1849
Rate of agreement	58%	78%	86%	94%	97%	97%	96%	97%	97%	95%	N/A	89%
Successful recruits per participant	0.3	0.6	1.1	1.7	1.5	1.3	1.3	1.1	1.1	1.2	N/A	1.1
Successful recruits per participant (super seeds)	3.7	1.6	2.9	2.1	1.6	1.3	1.3	1.2	1.1	1.2	N/A	1.3
Successful recruits per participant (non-super seeds)	0.3	0.5	0.4	0.4	0.6	1.2	0.5	0.0	N/A	N/A	N/A	0.4

Note: "Potential recruiters" are productive participants eligible to invite others at a given wave, that is, those not blocked by the maximum-wave limit or the age-verification checks. Participants in the final (10th) wave are not counted, as no subsequent recruitment wave was possible.

Among the 820 probability-based-selected seeds invited to participate, 317 completed the survey, corresponding to a response rate of 38.7%. Table 1 shows that the recruitment process generated 2,229 productive recruits (excluding seeds), exceeding the target sample size of 1,500 within the fieldwork period. Recruitment progressed through 10 waves, with each participant generating an average of 1.1 productive recruits, indicating that peer recruitment process was able to sustain and extend recruitment beyond the initial seeds. As shown in Figure 2, cumulative recruitment exhibited an approximately exponential growth pattern during the fieldwork period.

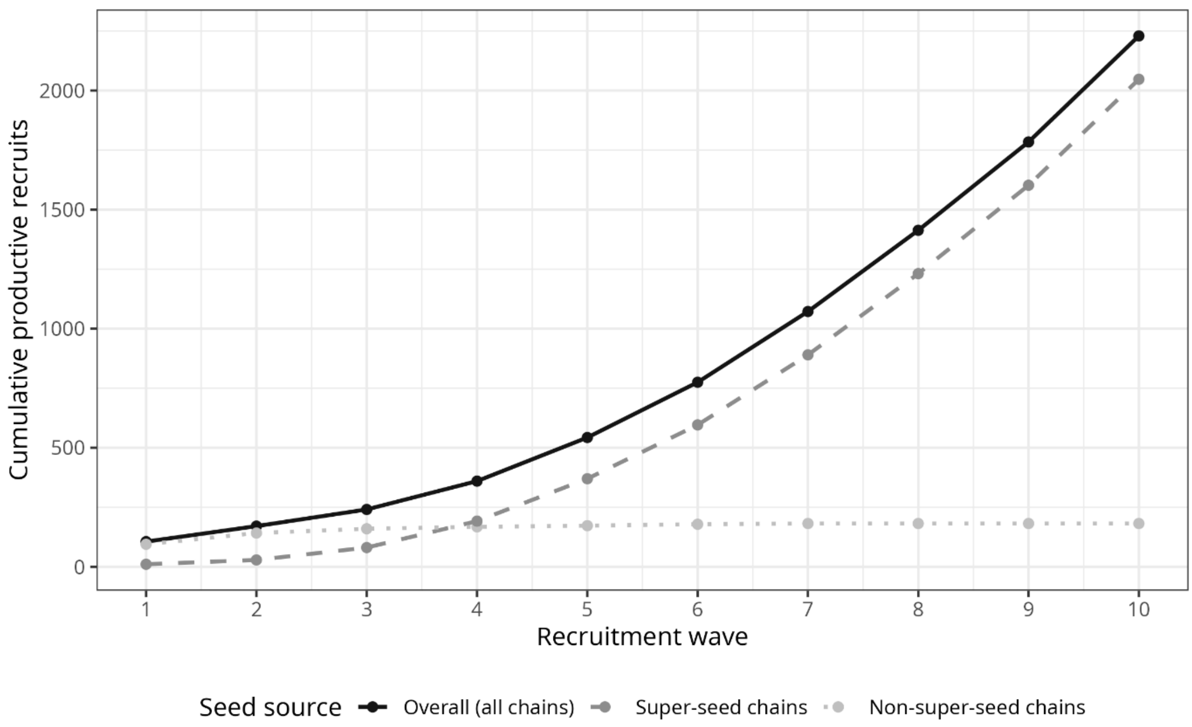

Fig. 2: Cumulative RDS recruitment by recruitment wave, overall and by seed source.

Figure 2 shows that recruitment was initially slow, with high non-response during the first two waves. However, recruitment increased substantially once initial chains became established. From the second wave onwards, the number of productive recruits and active recruiters increased across successive waves, reflecting the cumulative nature of peer recruitment, leading to non-response rates becoming similar to those observed in the RDS literature (Lee et al., 2020).

Table 2 summarises recruitment progression among probability-based-selected seeds, while Table 3 presents recruitment outcomes among participants recruited through the RDS process.

Table 2: Recruitment process: seed productivity, overall, by seed age group and by super-seed status.

	Overall		Seeds18-24		Seed 25+		Super-seeds		Non-super seeds	
Seed outcome	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Total seeds	317	100.00	128	100.00	189	100.00	3	100.00	314	100.00
Agreed to recruit others	183	57.73	104	81.25	79	41.80	3	100.00	180	100.00
At least one recruit started survey	55	17.35	39	30.47	16	8.47	3	100.00	52	100.00
At least one recruit completed survey	49	15.46	33	25.78	16	8.47	3	100.00	46	100.00

Note: Seeds aged 18–24 were significantly more likely to agree to recruit than seeds aged 25 and over ($\chi2(1) = 47.1$, $p<0.001$).

Table 2 shows that, of the 317 seeds, 183 (57.7%) agreed to recruit peers. This willingness was strongly patterned by age, with 81.3% of seeds aged 18-24 agreeing to recruit compared with 41.8% of those aged 25 and over. Ultimately, 55 (17.4%) of the seeds had at least one recruit start the survey and 49 (15.5%) had at least one recruit complete it productively; all three super-seeds did both.

Table3: Recruitment process: recruitment coupons and outcomes, overall, by seed age group and by super-seed status.

	Overall		Seeds18-24		Seed 25+		Super-seeds		Non-super seeds	
Recruit-ment outcome	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Total coupons	9190		4065		5125		7560		1630	
Started survey	2716	100.00	1269	100.00	1447	100.00	2507	100.00	209	100.00
Completed survey	2229	82.07	1030	81.17	1199	82.86	2047	81.65	182	87.08
Willing to invite others	1666	61.34	709	55.87	957	66.14	1520	60.63	146	69.86
Ø coupons per recruiting seed	50.22		39.09		64.87		2520.00		9.06	
Ø started recruits per recruiting seed	14.84		12.20		18.32		835.67		1.16	
Ø completed recruits per recruiting seed	12.18		9.90		15.18		682.33		1.01	
Ø willing recruits per recruiting seed	9.10		6.82		12.11		506.67		0.81	

Note: Percentages are relative to ‘Started survey’; per-seed averages use the number of recruiting seeds in each group as denominator.

Table 3 shows that among subsequent recruits, 9,190 recruitment coupons were distributed, resulting in 2,716 survey starts and 2,229 productive interviews, corresponding to a completion rate of 82.1% among those who initiated the survey. Among productive respondents, 1,666 (61.3%) indicated willingness to continue the recruitment process by inviting additional eligible peers and were given the opportunity to do so. Participants who were not eligible to recruit further (for example, those in wave 10 participants or those with duplicate email addresses) were not offered this opportunity. On average, each recruiting seed generated 50.2 distributed coupons, 14.8 survey starts, 12.2 productive interviews, and 9.1 participants who were willing to continue recruitment. It is important to note that the recruitment ended earlier than originally planned after the revised target sample size was exceeded. Consequently, the observed recruitment patterns reflect the fieldwork period available and may not capture the full potential growth of all recruitment chains.

These findings show that, although attrition occurs throughout the recruitment process, the majority of participants who initiated the survey completed it and many subsequently agreed to recruit others. Together, these patterns illustrate the potential for recruitment to expand rapidly once productive recruitment chains become established.

Willingness to recruit (RQ1.2)

RQ1.2 To what extent are participants willing to engage in peer recruitment?

Participants' willingness and motivations for peer recruitment are further examined in Tables 4-6. Table 4 demonstrates that the vast majority of productive respondents expressed a willingness to continue the recruitment process. Overall, 1,849 participants indicated that they were willing to invite additional eligible peers, while 153 declined to do so. Only 52 respondents (2.5%) reported that they did not know anyone aged 18-24 who they could invite. These findings suggest a high level of willingness to engage in peer recruitment among participants, with relatively few respondents reporting a lack of eligible social contacts.

Table 4: Willingness to invite others, overall and by seed age group and super-seed status.

	Overall		Seeds 18-24		Seeds 25+		Super-seeds		Non-super seeds	
Willingness to invite others	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Yes	1849	90.02	813	90.43	1036	89.70	1523	97.32	326	66.67
No	153	7.45	68	7.56	85	7.36	28	1.79	125	25.56
Don't know anyone aged 18-24	52	2.53	18	2.00	34	2.94	14	0.89	38	7.77
Total	2054	100.00	899	100.00	1155	100.00	1565	100.00	489	100.00

Note: The base is productive respondents who gave a substantive answer to the willingness question (N = 2,054); those for whom the question was not applicable (for example, final-wave and duplicate-email cases) and non-substantive responses such as don't know and refused are excluded. Chi-square tests of willingness by seed age group ($\chi2(2) = 1.83$, $p = 0.400$) and super-seed status ($\chi2(2) = 391.2$, $p < 0.001$).

Table 5 presents participants' main reasons for inviting others to participate in the study. Overall, the most frequently reported motivation was to support scientific research (42.5%), followed by the belief that others would enjoy completing the survey (24.4%). Monetary incentives were less commonly cited, with 14.2% reporting that they wanted others to receive a voucher and 11.8% indicating that receiving a voucher themselves was their primarily motivation.

Table 5: Reasons for being willing to invite others, overall and by seed age group and super-seed status.

	Overall		Seeds 18-24		Seeds 25+		Super-seeds		Non-super seeds	
Reason to invite others	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Receiving a voucher for myself	208	11.82	161	21.61	47	4.63	155	10.62	53	17.67
So that others can receive a voucher	249	14.15	166	22.28	83	8.18	167	11.44	82	27.33
To support scientific research	748	42.50	203	27.25	545	53.69	669	45.82	79	26.33
Others' curiosity to try new things	113	6.42	65	8.72	48	4.73	90	6.16	23	7.67
I think they will enjoy completing the survey	430	24.43	146	19.60	284	27.98	374	25.62	56	18.67
Other (Please specify)	12	0.68	4	0.54	8	0.79	5	0.34	7	2.33
Total	1760	100.00	745	100.00	1015	100.00	1460	100.00	300	100.00

Note: Base: productive respondents willing to invite others who gave a reason (N = 1,760); non-substantive responses (not applicable, refused) are excluded. Chi-square tests of the stated reason by group: seed age group $\chi2(5) = 259.38$, $p < 0.001$; super-seed status $\chi2(5) = 97.41$, $p < 0.001$.

Table 6 summarises the reasons given by participants who chose not to invite others to take part in the study. The most common reason, reported by 58.1% of the respondents who did not invite others was that they did not feel comfortable inviting others. A further 21.6% believed that completing the survey would require too much effort from those they would invite, while 9.5% felt that the recruitment process would require too much effort from themselves. Very few respondents indicated that they did not see the point of recruiting others (2.7%) and 8.1% cited other reasons. Overall, the findings suggest that reluctance to recruit was driven primarily by social discomfort rather than by a lack of perceived value or excessive burden.

Table 6: Reasons given for not being willing to invite others, overall and by seed age group and super-seed status.

	Overall		Seeds 18-24		Seeds 25+		Super-seeds		Non-super seeds	
Reason	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
I do not feel comfortable inviting others to take part	86	58.11	29	44.62	57	68.67	7	25.93	79	65.29
I do not see the point	4	2.70	3	4.62	1	1.20	2	7.41	2	1.65
Other (Please describe)	12	8.11	4	6.15	8	9.64	0	0.00	12	9.92
The effort is too much for me	14	9.46	9	13.85	5	6.02	5	18.52	9	7.44
The effort will be too much for those I would invite	32	21.62	20	30.77	12	14.46	13	48.15	19	15.70
Total	148	100.00	65	100.00	83	100.00	27	100.00	121	100.00

Predictors of recruitment cooperation (RQ1.3)

RQ1.3: What are the predictors of recruitment cooperation among both probability-based-selected seeds and the subsequent recruits?

To identify the characteristics associated with becoming a recruiter, we estimated binary logistic regression models. Table 7 presents the results for both the full sample, including seeds, and the sample of recruits only. Across the models, participants who are employed, those reporting a disability, and those who reported voting Reform UK were more likely to become recruiters. Recruitment was also positively associated with larger reported social networks, residence in the South West and East of England, being recruited by a colleague and via social media, having a greater proportion of friends of similar age, and belonging to a super-seed recruitment chain. These findings suggest that recruitment productivity is systematically associated with both individual characteristics and social network attributes, rather than occurring at random.

Table 7: Recruitment predictors: binomial regression odds ratios (95% CI). Model 1 includes seeds; Model 2 excludes seeds; Model 3 is a multilevel model (recruits only, chain random intercept).

	Model 1: Full sample			**Model 2: Recruits only**			**Model 3: Multilevel**		
Variable	OR	95% CI		OR	95% CI		OR	95% CI	
Sex: Female	0.87	[0.71, 1.06]		0.86	[0.70, 1.07]		0.84	[0.68, 1.04]	
Ethnicity: Black	0.95	[0.68, 1.32]		0.94	[0.67, 1.33]		0.89	[0.63, 1.26]	
Ethnicity: Asian	1.26	[0.87, 1.84]		1.15	[0.77, 1.73]		1.21	[0.80, 1.82]	
Ethnicity: Other	0.88	[0.55, 1.41]		0.77	[0.47, 1.25]		0.82	[0.50, 1.35]	
Education: Higher	0.98	[0.79, 1.21]		0.95	[0.76, 1.18]		0.91	[0.73, 1.14]	
Education: No Quals	0.25	[0.06, 0.76]	*	0.29	[0.04, 1.23]		0.30	[0.06, 1.53]	
Activity: Employed	1.29	[1.02, 1.64]	*	1.36	[1.06, 1.75]	*	1.37	[1.07, 1.76]	*
Activity: Unemployed	1.16	[0.77, 1.77]		1.21	[0.79, 1.87]		1.26	[0.81, 1.94]	
Activity: Other	1.00	[0.68, 1.46]		1.22	[0.80, 1.86]		1.23	[0.81, 1.87]	
Disability: Yes	1.45	[1.00, 2.10]	*	1.77	[1.15, 2.72]	**	1.85	[1.20, 2.85]	**
Relationship Status: MarriedPartner	1.05	[0.79, 1.39]		1.15	[0.85, 1.56]		1.15	[0.84, 1.56]	
Relationship Status: PartnerApart	0.87	[0.62, 1.22]		0.89	[0.62, 1.27]		0.89	[0.62, 1.28]	
Relationship Status: Other	0.39	[0.16, 0.85]	*	0.47	[0.18, 1.15]		0.50	[0.20, 1.25]	
Political affiliation: Conservative	1.08	[0.80, 1.46]		1.15	[0.84, 1.57]		1.13	[0.82, 1.55]	
Political affiliation: LibDem	1.04	[0.71, 1.51]		1.05	[0.71, 1.56]		1.06	[0.72, 1.57]	
Political affiliation: Reform	1.74	[1.10, 2.74]	*	1.80	[1.11, 2.94]	*	1.75	[1.08, 2.86]	*

Political affiliation: Other	1.02	[0.71, 1.48]		0.99	[0.67, 1.46]		1.01	[0.68, 1.51]	
Political affiliation: None	1.18	[0.91, 1.55]		1.16	[0.87, 1.54]		1.15	[0.86, 1.53]	
Network: 10	1.19	[0.92, 1.54]		1.15	[0.88, 1.50]		1.14	[0.87, 1.49]	
Network: 15	1.39	[1.05, 1.84]	*	1.36	[1.01, 1.83]	*	1.31	[0.96, 1.77]	.
Location: Rural	0.92	[0.62, 1.36]		1.13	[0.72, 1.75]		1.13	[0.72, 1.77]	
Tenure: Owns House	1.10	[0.88, 1.38]		1.10	[0.87, 1.39]		1.09	[0.86, 1.38]	
Tenure: Rents socially	1.28	[0.91, 1.81]		1.25	[0.88, 1.79]		1.29	[0.90, 1.85]	
Tenure: Other	0.59	[0.21, 1.50]		0.52	[0.17, 1.44]		0.55	[0.19, 1.57]	
Income: Comfortable	0.75	[0.55, 1.02]	.	0.75	[0.54, 1.04]	.	0.81	[0.58, 1.12]	
Income: Alright	0.86	[0.68, 1.08]		0.81	[0.63, 1.04]	.	0.86	[0.67, 1.10]	
Income: Difficult	0.81	[0.58, 1.12]		0.75	[0.53, 1.06]		0.70	[0.49, 0.99]	*
HH size: 2	0.98	[0.77, 1.23]		1.03	[0.80, 1.32]		1.04	[0.81, 1.33]	
HH size: 5	0.85	[0.64, 1.12]		0.87	[0.65, 1.17]		0.88	[0.66, 1.19]	
Region: South East	0.79	[0.55, 1.13]		0.70	[0.48, 1.02]	.	0.73	[0.50, 1.07]	
Region: North West	1.20	[0.87, 1.66]		1.11	[0.80, 1.56]		1.06	[0.76, 1.49]	
Region: Yorkshire and The Humber	0.81	[0.54, 1.20]		0.73	[0.48, 1.11]		0.72	[0.47, 1.10]	
Region: East Midlands	1.56	[1.02, 2.40]	*	1.57	[1.00, 2.47]	*	1.51	[0.95, 2.39]	.
Region: West Midlands	0.93	[0.64, 1.36]		0.92	[0.62, 1.36]		0.92	[0.62, 1.36]	
Region: South West	0.62	[0.39, 0.97]	*	0.60	[0.37, 0.97]	*	0.59	[0.36, 0.96]	*
Region: East of England	0.60	[0.37, 0.95]	*	0.59	[0.36, 0.98]	*	0.60	[0.36, 0.99]	*
Region: North East	2.28	[1.16, 4.55]	*	1.93	[0.95, 4.02]	.	2.00	[0.97, 4.14]	.
Region: Wales	0.61	[0.31, 1.16]		0.58	[0.29, 1.15]		0.56	[0.28, 1.13]	
Region: Scotland	1.12	[0.73, 1.70]		1.10	[0.70, 1.72]		1.12	[0.71, 1.76]	
Region: Northern Ireland	1.99	[0.88, 4.62]		2.13	[0.87, 5.62]		2.20	[0.87, 5.57]	.

Rel: Colleague	0.65	[0.47, 0.89]	**	0.66	[0.48, 0.91]	*	0.65	[0.47, 0.89]	**
Rel: Don't know person	0.86	[0.51, 1.45]		0.87	[0.52, 1.48]		0.92	[0.54, 1.56]	
Rel: Family	0.71	[0.49, 1.05]	.	0.70	[0.47, 1.02]	.	0.70	[0.47, 1.03]	.
Rel: Other	1.33	[0.55, 3.41]		1.35	[0.56, 3.48]		1.46	[0.59, 3.62]	
Rel: Partner	0.69	[0.38, 1.25]		0.66	[0.36, 1.20]		0.68	[0.37, 1.25]	
Rel: Seed/NA	0.57	[0.31, 1.08]	.	—	—	—	—	—	—
Invited: InPerson	0.81	[0.51, 1.27]		0.81	[0.51, 1.28]		0.79	[0.50, 1.24]	
Invited: Email	0.74	[0.47, 1.16]		0.76	[0.48, 1.20]		0.73	[0.46, 1.16]	
Invited: Phone	0.78	[0.47, 1.30]		0.79	[0.47, 1.31]		0.75	[0.45, 1.26]	
Invited: Text	0.72	[0.50, 1.05]	.	0.74	[0.51, 1.08]		0.71	[0.49, 1.04]	.
Invited: SocialMedia	0.62	[0.42, 0.90]	*	0.62	[0.42, 0.91]	*	0.59	[0.40, 0.87]	**
Motivation: Curiosity/Other	0.88	[0.56, 1.39]		0.87	[0.54, 1.39]		0.88	[0.55, 1.41]	
Motivation: Enjoy surveys	1.12	[0.80, 1.56]		1.13	[0.80, 1.60]		1.13	[0.79, 1.60]	
Motivation: Seed/NA	1.49	[1.12, 1.98]	**	1.52	[1.13, 2.06]	**	1.58	[0.87, 2.85]	
Motivation: Voucher others	0.48	[0.19, 1.12]	.	0.47	[0.18, 1.11]	.	0.49	[0.20, 1.20]	
Motivation: Voucher self	0.91	[0.58, 1.42]		0.80	[0.49, 1.29]		0.83	[0.51, 1.34]	
Friends same age: Few	0.74	[0.52, 1.05]	.	0.85	[0.58, 1.25]		0.92	[0.62, 1.34]	
Friends same age: Most	1.58	[1.25, 1.99]	***	1.77	[1.39, 2.26]	***	1.65	[1.29, 2.12]	***
Super-seed chain	4.14	[2.77, 6.27]	***	3.82	[2.54, 5.83]	***	4.41	[2.53, 7.69]	***

Note: Significance: *** p<0.001, ** p<0.01, * p<0.05, . p<0.1. No adjustment for multiple comparisons was applied, so individual p-values should be interpreted with this in mind. Reference categories: Male, White, below degree, student, no disability, single, Labour, network 0-5, urban, London, rents privately, getting by, HH size 3-4, friend, support research, some friends in age group. '—' indicates a category dropped in the recruits-only models.

Recruiter-recruit similarity (RQ1.4)

RQ1.4: How do recruiter characteristics and recruiter-recruit similarity shape recruitment patterns?}}

Table 8 shows the relationship between recruited participants and the person who invited them to the study. Most participants (90.8%) reported being recruited by a friend, colleague or a relative or family member. Very small proportions were recruited by a partner (3.6%) or through another type of relationship (1.2%). It is important to note that 4.3% of respondents reported that they did not know the person who invited them, indicating a potential departure from the protocol and the assumption that recruitment occurs through existing personal social networks. These participants were flagged for potential non-compliance, and were prevented from recruiting others.

Table 8: Relationship to the person who invited the respondent, overall and by seed age group and super-seed status.

	Overall		**Seeds 18-24**		**Seeds 25+**		**Super-seeds**		**Non-super seeds**	
Relationship	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Friend	1542	69.18	643	62.43	899	74.98	1429	69.81	113	62.09
Colleague	284	12.74	88	8.54	196	16.35	277	13.53	7	3.85
Relative/family member	198	8.88	122	11.84	76	6.34	158	7.72	40	21.98
I do not know the person who invited me	96	4.31	93	9.03	3	0.25	96	4.69	0	0.00
Partner	81	3.63	65	6.31	16	1.33	61	2.98	20	10.99
Other (please specify)	27	1.21	18	1.75	9	0.75	25	1.22	2	1.10
Refused/not answered	1	0.04	1	0.10	0	0.00	1	0.05	0	0.00
Total	2229	100.00	1030	100.00	1199	100.00	2047	100.00	182	100.00

Tables 9 and 10 examine recruitment similarity between recruiters and recruits across a range of socio-demographic characteristics. Overall, the findings provide evidence of homophily, whereby participants were more likely to recruit others with similar characteristics.

Table 9: Recruiter–recruit sex transition matrix (row-normalised): within each recruiter sex, the sex distribution of the recruits they brought in, overall and by super-seed status.

	Overall		Super-seed		Non-super seeds	
Recruiter	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**
Female	501 (54.2%)	424 (45.8%)	420 (51.9%)	390 (48.1%)	81 (70.4%)	34 (29.6%)
Male	429 (32.9%)	875 (67.1%)	398 (32.2%)	839 (67.8%)	31 (46.3%)	36 (53.7%)

Note: Cells show counts with row percentages. Each row gives the sex distribution of recruits brought in by recruiters of that sex. Productive recruited sample.

For gender, female recruiters were slightly more likely to recruit women than men (54.2% vs 45.8%), whereas male recruiters predominantly recruited men (67.1% vs 32.9%).

	Overall		Super-seed		Non-super seeds	
Recruiter	**No**	**Yes**	**No**	**Yes**	**No**	**Yes**
Ethnicity: recruit is White						
Non-White	291 (52.2%)	267 (47.8%)	259 (50.5%)	254 (49.5%)	32 (71.1%)	13 (28.9%)
White	242 (14.5%)	1429 (85.5%)	234 (15.3%)	1300 (84.7%)	8 (5.8%)	129 (94.2%)
Higher education: recruit has a degree						
No degree	945 (74.2%)	329 (25.8%)	887 (73.9%)	313 (26.1%)	58 (78.4%)	16 (21.6%)
Degree	333 (34.9%)	622 (65.1%)	295 (34.8%)	552 (65.2%)	38 (35.2%)	70 (64.8%)
Disability: recruit is disabled						
	1924 (94.3%)	117 (5.7%)	1814 (94.8%)	100 (5.2%)	110 (86.6%)	17 (13.4%)
	148 (78.7%)	40 (21.3%)	110 (82.7%)	23 (17.3%)	38 (69.1%)	17 (30.9%)

Note: Cells show counts with row percentages. Each row gives the No/Yes distribution of a recruiter category's recruits on the trait. Productive recruited sample.

Evidence of homophily was even stronger for ethnicity and educational attainment. White recruiters overwhelmingly recruited other White participants (85.5%), while non-White recruiters were considerably more likely to recruit other non-White participants (52.2%) than were White recruiters. Similarly, participants without a university degree predominantly recruited others without a degree (74.2%), whereas degree holders mainly recruited fellow graduates (65.1%). Some evidence of homophily was also observed for disability status. Although most recruits of non-disabled recruiters were themselves non-disabled (94.3%), disabled recruiters were substantially more likely than non-disabled recruiters to recruit another disabled participant (21.3% vs 5.7%). Taken together, these findings indicate that peer recruitment was not random but exhibited varying degrees of homophily across several socio-demographic characteristics, with the strongest evidence observed for ethnicity and educational attainment.

To conduct a more formal test of homophily, we estimated intra-chain correlations (ICCs) following the approach proposed by Lee et al. 2014. The ICC quantifies the extent to which individuals within the same recruitment chains are more similar to one another that to individuals in other chains.

Table 11 shows relatively high ICCs for ethnicity and region, suggesting that recruitment exhibited homophily with respect to these characteristics, whereby participants were more likely to recruit peers of the same ethnic background or from the same geographical region.

Table 11: Intra-chain correlation coefficients (ICC) for socio-demographic variables, with 90% bootstrap confidence intervals.

Variable	**ICC**	**CI lower**	**CI upper**
Ethnicity			
White	0.78	0.51	0.97
Black	0.32	0.00	0.89
Asian	0.96	0.78	0.99
Other	0.36	0.00	0.95
Aggregate	0.66	0.43	0.93
Sex			
Female	0.13	0.05	0.21
Male	0.13	0.05	0.21
Aggregate	0.13	0.05	0.21
Party			
Labour	0.10	0.00	0.35
Conservative	0.42	0.00	0.89
Liberal Democrat	0.00	0.00	0.11
Reform	0.00	0.00	0.58
Other Party	0.07	0.00	0.32
Aggregate	0.15	0.00	0.37
Employment			
Employed	0.04	0.00	0.09
Unemployed	0.06	0.00	0.36
Student	0.07	0.00	0.15
Other	0.00	0.00	0.08
Aggregate	0.05	0.00	0.12
Education			
Degree	0.39	0.15	0.58
A-Level	0.41	0.15	0.61
Other / No qualification	0.39	0.00	0.54
Aggregate	0.40	0.16	0.58
Disability			
With Disability	0.23	0.03	0.33
Without Disability	0.23	0.05	0.33
Aggregate	0.23	0.05	0.33
Relationship Status			
Single	0.13	0.00	0.20
Married / Partnered	0.17	0.00	0.37
Partner Not Living	0.22	0.03	0.37
Other	0.93	0.00	0.99
Aggregate	0.18	0.04	0.27
Region			
London	0.91	0.53	0.97
South East	0.94	0.50	0.98
North West	0.93	0.47	0.98
Yorkshire and The Humber	0.88	0.41	0.96
East Midlands	0.78	0.00	0.97
West Midlands	0.89	0.00	0.97
South West	0.98	0.00	0.99
East of England	0.57	0.00	0.96
North East	0.96	0.04	0.99

Wales	0.00	0.00	0.99
Scotland	0.93	0.02	0.98
Northern Ireland	0.91	0.00	0.99
Aggregate	0.86	0.50	0.95
Network Size			
Small Network	0.34	0.17	0.54
Medium Network	0.03	0.00	0.16
Large Network	0.13	0.00	0.33
Aggregate	0.16	0.08	0.30
Location			
Urban	0.00	0.00	0.40
Rural	0.22	0.00	0.83
Aggregate	0.09	0.00	0.52
Income			
Living comfortably	0.07	0.00	0.11
Doing alright	0.03	0.00	0.09
Just about getting by	0.02	0.00	0.05
Finding it difficult	0.10	0.00	0.19
Aggregate	0.05	0.00	0.08
Household Size			
2 People	0.15	0.00	0.27
4 People	0.04	0.00	0.15
5+ People	0.00	0.00	0.14
Aggregate	0.07	0.00	0.16

In contrast, the remaining characteristics displayed relatively low ICCs, indicating limited within-chain clustering and weaker evidence of homophilous recruitment. Overall, these findings suggest that, while recruitment was not entirely random, evidence of homophily was largely confined to characteristics that are closely linked to existing social networks, rather than being pervasive across all participant characteristics. Because the analysis rests on a small number of recruitment chains, the intervals for the high correlations, in particular for ethnicity and region, are wide, so these values should be read as indicating strong within-chain clustering rather than as precise estimates.

Recruitment outcomes by seed characteristics

Recruitment outcomes by age of seeds (RQ2.1)

RQ2.1: Do recruitment outcomes differ according to the characteristics of the initial probability-selected seeds, including whether seeds belong to the target population (aged 18-24) or the non-target population (aged 25 years and over)?

To examine whether recruitment outcomes differed according to characteristics of the initial probability-selected seeds, recruitment chains were compared according to whether they originated from seeds belonging to the target population (aged 18--24 years) or the non-target population (aged 25 years and over). Following the structure suggested for this comparison, we consider first the behaviour of the two sets of seeds and then the behaviour of the participants they recruited.

The two sets of seeds behaved differently at the point of agreeing to recruit. As shown in Table 2, seeds aged 18-24 were considerably more likely to agree to recruit peers than seeds aged 25 and over (81.3% compared with 41.8%), a difference that was significant ($\chi^2(1)$ = 47.1, p < 0.001$). Although seeds aged 25 and over were more numerous (189 compared with 128), a much smaller share of them agreed to begin recruitment, and only 8.5% went on to generate at least one productive recruit, compared with 25.8% of seeds aged 18-24.

We turn next to the behaviour of the participants recruited through each set of seeds. They were very similar in their willingness to recruit but differed in their reasons for doing so (Tables 4 and 5). Willingness to invite others was almost identical, with 90.4% of participants recruited through younger seeds and 89.7% of those recruited through older seeds willing to invite additional young adults, a difference that was not statistically significant ($\chi^2(2)$ = 1.83, p = 0.400).

Motivations for recruitment, by contrast, differed markedly between the two groups ($\chi^2(5) = 259.38$, $p < 0.001$). Participants in chains originating from younger seeds reported a relatively balanced mix of motivations, including receiving a voucher themselves (21.6%), enabling others to receive a voucher (22.3%), and supporting scientific research (27.2%). In contrast, participants recruited through older seeds were primarily motivated by supporting scientific research (53.7%) and by the belief that others would enjoy taking part (28.0%), with financial incentives playing a much smaller role. Notably, the motivational profile of participants in super-seed chains closely resembled that observed for chains originating from older seeds, whereas non-super-seed chains more closely reflected the pattern associated with younger seeds.

These comparisons must be interpreted with caution because recruitment was heavily concentrated within a small number of super-seed chains, and the super-seeds were not evenly distributed across the two age groups (Table 12). Two of the three super-seeds were young adults and one was aged 25 or over. As a result, 88.9% of the recruits attributed to younger seeds and 94.3\% of those attributed to older seeds originated from super-seed chains, so the raw comparison between age groups largely reflects the behaviour of these three chains rather than a general property of seed age. When the super-seed chains are set aside, the remaining seeds aged 18--24 recruited more productively than those aged 25 and over, generating 0.90 recruits per seed compared with 0.36. Comparisons of recruitment productivity by seed age should therefore be regarded as confounded with super-seed status.

Table 12: Recruitment productivity by seed age group and super-seed status. Recruits are grouped by their chain-root seed, and the non-super columns provide the comparison of seed age that is not distorted by the super-seed chains.

	Non-super seeds		Super-seeds	
Metric	**18-24**	**25+**	**18-24**	**25+**
Seeds (N)	126	188	2	1
Productive recruits	114	68	916	1131
Recruits per seed	0.90	0.36	458.00	1131.00

Taken together, these findings indicate that recruitment behaviour differed according to the age of the initial seed. Younger seeds were more willing to begin recruitment and, once the super-seed chains are excluded, more productive. Their recruits were equally willing to invite others but reported more voucher-oriented motivations, whereas participants recruited through older seeds more often cited support for scientific research.

Super-seeds vs Non-super-seeds (RQ2.2)

RQ2.2: Do highly productive ``super-seeds'' emerge, and how are they associated with the recruitment dynamics and the composition of the achieved sample?

A distinctive feature of the achieved sample was the emergence of three highly productive recruitment chains originating from individual seeds, accounting for 91.8% of all recruits (see Table 13).

Table 13: RDS recruited sample by seed source (recruits only).

Seed source	RDS recruits (N)	%
Super-seed 1	375	16.8
Super-seed 2	541	24.3
Super-seed 3	1131	50.7
All other seeds	182	8.2
Total	2229	100.0

Although the presence of so-called super-seeds has been documented in the RDS literature (Abdul-Quader et al., 2006; Jonsson et al. 2019; Todd et al., 2026), such chains warrant careful investigation because they may disproportionately influence the achieved sample. If recruits within these chains are relatively homogeneous, they may increase the potential for bias through differential recruitment. In online RDS studies employing monetary incentives, usually rapid chain growth may also indicate departures from the intended recruitment protocol, such as recruitment beyond existing social networks or other forms of non-compliance.

Given these considerations, we adapt a cautions analytical approach by distinguishing recruits originating from super-seed and non-super-seed chains in the analyses. While definitive evidence of protocol violations was identified for only one of the three super-seed chains (the first one), we analyse all three chains because it is probable that the remaining chains were also affected by unobserved non-compliance. This approach enables us to assess the robustness of the findings while avoiding potentially unwarranted assumptions about the integrity of individual recruitment chains.

The first two super-seed chains were identified on 15 July 2025, shortly after the launch of the mainstage data collection. Initial examination of the recruitment data did not reveal clear evidence of problematic recruitment behaviour. However, on 16 July it was discovered that survey links were being shared on public online forum Reddit, with at least one post describing how the study's age eligibility checks could be circumvented. As this suggested that recruitment was no longer occurring exclusively through existing social networks, recruitment from the affected chains was immediately terminated. On 21 July, a third super-seed chain was identified, by which point the achieved sample had exceeded the revised target of 1,500 interviews following the increase in participant incentive and the numbers of potential recruits per participant. Although there was no definitive evidence of protocol violations associated with this chain, the RDS fieldwork was closed immediately as the project's incentive budget had already been exceeded. Consequently, recruitment ended before all active chains had reached their natural conclusion, while the recruitment of new seeds was still ongoing, meaning that some non-super-seed chains were not able to develop fully. As such, analysis of these chains' productivity is likely to represent an under-estimate, compared to if they had been allowed to develop further.

The distinction between super-seeds and non-super-seeds becomes apparent when examining recruitment dynamics across successive waves. The three super-seeds reached the maximum permitted chain length of 10 waves and achieved a recruitment success rate of 27.1% with almost half of productive participants (49.2%) subsequently recruiting at least one additional participant. In contrast, non-super-seeds reached a maximum of seven waves, achieved recruitment success rate of 11.1% and only 18.1% of productive participants went on to recruit others. The full wave-by-wave recruitment process for each chain type is reported in A1 and A2. Cumulative recruitment also differed markedly between the two groups: super-seeds exhibited exponential growth, whereas non-super-seeds displayed slower but sustained growth throughout the fieldwork period (Figure 2). Importantly, this flatter growth pattern should not be interpreted as evidence of recruitment failure. Rather, it reflects a viable and self-sustaining recruitment process that, given a longer fieldwork period, would have continued to generate additional participants.

Observed recruitment chain lengths should be interpreted with caution for two reasons. First, as mentioned earlier, fieldwork was closed before many recruitment chains had reached their natural conclusion. Consequently, the observed average chain length of 2.14 waves (including super-seeds) and 1.63 waves (excluding them) should be regarded as lower-bound estimates rather than the maximum recruitment potential. Second, several protocol interventions, including the closure of super-seed chains and the termination of chains where potential non-compliance was identified, further truncated recruitment before some chains could develop fully. Overall, of the 183 seeds who agreed to recruit peers, 73.2% did not produce any recruits, so their chains ended at the seed, highlighting the considerable variability in recruitment success.

Among chains that did continue beyond the seed, however, recruitment was generally sustained. Table 14 shows that overall, 89.0% of successful recruitment branches (a branch is defined as a complete path from a seed to a leaf node, i.e., a terminal recruit who did not recruit anyone further) reached at least four waves, although this differed substantially by chain type: 98.0% of branches originating from super-seeds reached four or more waves, compared with only 11.0% of non-super-seed branches.

Table 14: Distribution of branch lengths (recruitment steps from seed to leaf), overall and by super-seed status.

	Total		**Super-seeds**		**Non-super seeds**	
Length	**N**	**%**	**N**	**%**	**N**	**%**
1	76	5.4	6	0.5	70	50.7
2	42	3.0	4	0.3	38	27.5
3	29	2.1	14	1.1	15	10.9
4	54	3.9	48	3.8	6	4.3
5	97	6.9	95	7.5	2	1.4
6	119	8.5	115	9.1	4	2.9
7	150	10.7	147	11.7	3	2.2
8	185	13.2	185	14.7		
9	202	14.4	202	16.0		
10	445	31.8	445	35.3		

Note: A branch is a single seed-to-leaf path (ending at a terminal recruit who recruited no one further); a recruitment chain is the whole tree of recruits from one seed and may contain several branches. N is the number of branches of each length; percentages are column percent-ages (each column sums to 100%).

Recruitment productivity also varied across participants. Just over half of recruiters (54.2%) successfully recruited one or two participants, while the remaining 45.8% recruited between three and five participants, illustrating again considerable heterogeneity in individual recruitment success (Figure 3).

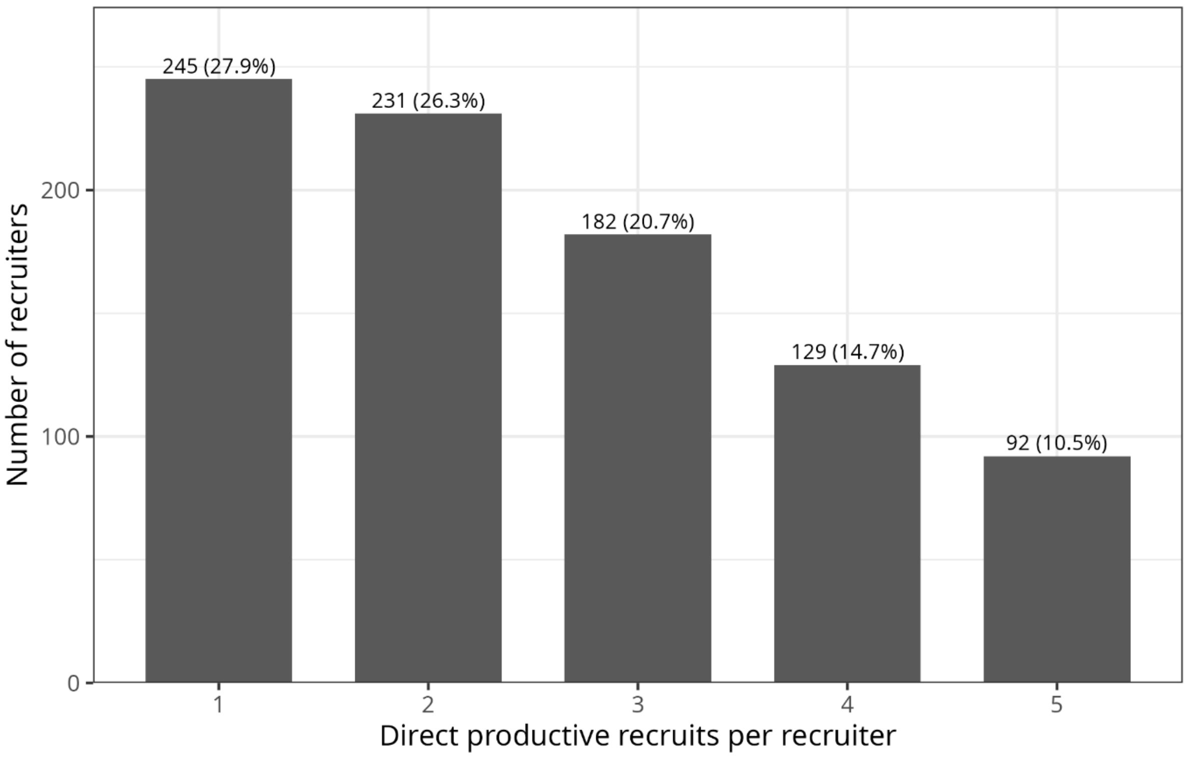

Fig. 3: Distribution of the number of direct productive recruits per recruiter (seeds excluded).

Marked differences in willingness to continue recruitment were observed between participants recruited through super-seed and non-super-seed chains, which was expected (see Tables 4 and 5). Almost all participants in super-seed chains (97.3%) indicated that they were willing to invite additional eligible peers, compared with 66.9% of those recruited through non-super-seed chains. Conversely, participants in non-super-seed chains were substantially more likely to report that they did not wish to recruit others (25.4% vs 1.8%) or that they did not know anyone aged 18-24 whom they could invite (7.7% vs 0.9%).

Participants recruited through super-seed and non-super-seed chains reported different motivations for inviting others to participate. Among participants in super-seed chains, the most common motivation was to support scientific research (45.8%), followed by the belief that others would enjoy completing the survey (25.6%). Voucher-related motivations were less prominent, with 11.4% wishing others to receive a voucher and 10.6% motivated by receiving a voucher themselves. In contrast, participants in non-super-seed chains were considerably more likely to cite monetary incentives as their primary motivation, particularly enabling others to receive a voucher (27.1%) and receiving a voucher themselves (18.2%). They were also less likely to report supporting scientific research as their main motivation (26.4%). These findings suggest that reported motivations for peer recruitment differed substantially between the two types of chains, with altruistic motivations being more prevalent among super-seed chains surprisingly and voucher-related motivations more common among non-super-seed chains.

Tables 9 and 10 examine recruitment similarity between recruiters and recruits across a range of socio-demographic characteristics compared between super-seed chains and non-super-seed chains. Comparisons between these two groups suggest that these patterns were broadly similar across the two groups, although some differences were evident. Gender homophily was more pronounced among female recruiters in non-super-seed chains, with 70.4% recruiting other women, compared with only 51.9% in super-seed chains. For ethnicity, White recruiters in non-super-seed chains were even more likely to recruit White participants (94.2%) than those in super-seed chains (84.7%), while non-White recruiters in non-super-seed chains were less likely to recruit another non-White participant (28.9% vs 49.5%). Patterns of educational homophily were remarkably consistent across the two chain types, with little difference in the propensity of degree and non-degree holders to recruit participants with similar educational backgrounds. Disability homophily appeared somewhat stronger in non-super-seed chains, where disabled recruiters recruited another disabled participant in 30.9% of cases compared with 17.3% in super-seed chains. Overall, while the strength of homophily varied somewhat between chain types, there was no evidence that the emergence of super-seed chains fundamentally altered the underlying tendency for participants to recruit socially similar peers.

Protocol Non-Compliance Detection Results

Types of non-compliance (RQ3.1)

R3.1: What forms of protocol non-compliance are observed in this feasibility study?

Non-compliance detection is essential in RDS because it provides a means of assessing and mitigating violations of key assumptions underlying network-based recruitment and population inference, thereby ensuring the validity of resulting estimates.

To assess the extent to which the core assumptions of RDS were satisfied, we examined a series of protocol flags designed to detect different forms of non-compliance. Rather than producing a single aggregate measure, each indicator was considered separately because it relates to a different RDS assumption (Table 15). Duplicate phone numbers (N = 19) and duplicated voucher email addresses (N = 8) may indicate duplicate participation or coordinated entries, thereby violating the assumptions of a connected network and sampling without replacement. No cases were flagged for implausibly rapid survey completion (speed flags; N = 0) or unauthorised access to the survey (unauthorised ID; N = 0), suggesting little evidence of these forms of non-compliance. Thirty-four participants failed the age knowledge checks introduced during fieldwork, raising concerns about whether they belonged to the target population of 18-24-year-olds and therefore to the underlying social network of interest. A further 96 participants reported that they did not personally know the individual who recruited them (Table 8), representing a direct violation of the assumption that recruitment occurs through existing reciprocal social ties.

Table 15: Individual non-compliance flag prevalence (total productive sample N = 2546; recruits N = 2229). Seeds cannot receive flags by design.

Non-compliance flag	N	% of total	% of recruits
Duplicated voucher email	8	0.3	0.4
Speed flag (CP)	0	0.0	0.0
Age check failure	34	1.3	1.5
Super-seed chain closure	916	36.0	41.1
Duplicated phone number	19	0.7	0.9
Unauthorized ID	0	0.0	0.0

Finally, recruitment within three exceptionally productive super-seed chains resulted in 916 participants having their recruitment chains closed (Table 15). Although this does not constitute a formal violation of RDS assumptions, such concentration limits the extent to which recruitment spans the wider social network and increases dependence on a small number of network clusters.

To further assess the quality of participants recruited through the super-seed chains, an age validation follow-up survey was administered to all 2,047 recruits originating from these chains, which was a novel quality control mechanism. Of these, 1,544 responded (75.4%), while 503 (24.6%) did not complete the follow-up and therefore could not be independently verified. Among respondents, 711 (46.0%) reported a date of birth consistent with the age provided during the original survey, 717 (46.4%) reported a different age but one that remained within the target age range of 18-24 years, and 116 (7.5%) reported an age outside the target population. This validation exercise represents the most direct assessment available of whether participants recruited through the most productive chains belonged to the intended target population.

To maximise data quality and provide conservative estimates, both the "incorrect but within target" and the "outside target" groups were excluded from the cleaned analytical sample used in companion papers. Although some discrepancies may reflect privacy concerns or reporting errors rather than deliberate non-compliance, this conservative approach minimises the risk of including participants whose eligibility cannot be confidently verified. Equivalent age validation was not conducted for recruits outside the super-seed chains (N = 182), and therefore their eligibility could not be assessed with the same degree of certainty.

Sensitivity Analysis: Effect of Excluding Non-Compliant Cases on Recruitment Outcomes

This sub-section presents a sensitivity analysis examining the effect of excluding non-compliant cases on key recruitment outcomes. This involves a trade-off between excluding flagged participants and preserving sample size. It is important to emphasise that this is a supplementary robustness check rather than a redefinition of the primary analytic sample for this paper. In this paper, the full productive sample remains the main basis for analysis, whereas the cleaned sample is used as the primary analytic sample in the follow-up papers using this feasibility study data, where inference and estimation are the central focus.

The exclusion criteria are based on the age validation follow-up survey. Specifically, we remove respondents classified as either ``incorrect but within target age range'' or ``outside the target age range''. The resulting cleaned sample retains all seeds (who were not subject to validation), recruits who reported a correct age, and recruits who were not independently verified, including non-respondents to the follow-up survey and non-super-seed recruits who were not issued the validation instrument.

Using this restricted sample, we recompute key descriptive recruitment indicators, including recruitment rates, chain length distributions, recruiter participation, and motivational profiles. The objective is to assess whether core patterns of recruitment dynamics and the contrast between super-seed and non-super-seed chains remain substantively unchanged after excluding clearly non-compliant cases.

This approach imposes a conservative boundary on data cleaning. While more extensive diagnostic checks (e.g. IP address analysis or response pattern detection) are possible, they fall outside the scope of this paper. The central question addressed here is, therefore, whether the substantive conclusions about recruitment behaviour are robust to the exclusion of participants with confirmed age discrepancies.

Table 16 shows the results of the sensitivity analysis. The sensitivity analysis shows that excluding 833 cases classified as non-compliant reduces the total sample from 2,546 to 1,713, with all removals coming from super-seed chains, while the non-super-seed sample remains unchanged. Despite this reduction, key structural features of recruitment remain stable: average chain length (2.14) and the proportion of chains that died after the seed (73.2\%) are unchanged, and the dominant motivation for recruitment is broadly similar across samples. However, some behavioural measures shift, including a decline in the overall recruiter rate (from 37.2% to 32.4%) and a marked increase in the share of recruiters with only 1--2 recruits (from 54.2% to 76.2%), indicating a contraction in high-intensity recruitment activity once super-seed-driven cases are removed. Overall, the results suggest that core recruitment dynamics are robust, but super-seed chains substantially shape observed recruitment intensity. These findings support using the cleaned sample, excluding cases with confirmed age discrepancies, in the companion papers, where the emphasis shifts from recruitment dynamics to representativeness and statistical inference.

Table 16: Sensitivity analysis: recruitment statistics before and after excluding non-compliant cases (age-validation 'incorrect, within target' and 'outside target').

	Full sample	Cleaned sample	Change
Sample size (total)	2546	1713	-833
of which recruits	2229	1396	-833
from super-seed chains	2047	1214	-833
from non-super-seed chains	182	182	0 (unchanged)
Cases excluded	—	833	—
Recruiter rate	37.2%	32.4%	-4.8 pp
Avg chain length (max wave)	2.14	2.14	0
Chains died after seed	73.2%	73.2%	0 pp
Recruiters with 1-2 recruits	54.2%	76.2%	22 pp
Top motivation (recruits)	To support scientific research (52.9%)	To support scientific research (49.8%)	-3.1 pp

Note: Recruiter rate is the proportion of recruits who recruited at least one further productive participant (830 of 2,229 in the full sample). Seeds are excluded from both the numerator and the denominator.

Discussion

This study evaluated the feasibility of using RDS with probability-based seeds to recruit young adults. If effective, this approach could in the future provide a practical method for boosting the representativeness of young adults within a general population probability-based survey, therefore improving the efficiency of recruiting this typically under-represented group. Using seeds drawn from the NatCen Opinion Panel, we examined recruitment cooperation, willingness and motivation to engage in peer recruitment, recruiter-recruit similarity, the emergence and influence of super-seed chains, and the nature and implications of protocol non-compliance. By distinguishing between super-seed and non-super-seed recruitment chains and implementing a series of adaptive quality assurance procedures, the study provides one of the first comprehensive assessments of the operational and methodological performance of probability-seeded RDS in a general population survey.

Overall, the findings demonstrate that respondent-driven sampling can successfully generate sustained peer recruitment within a general population probability-based survey, although substantial attrition occurred at each stage of the recruitment process. Recruitment began slowly, with relatively high levels of non-response, but became increasingly self-sustaining as productive recruitment chains were established. Around one-third of participating seeds, who agreed to recruit others, successfully generated at least one productive recruit, and over one-third of productive respondents subsequently recruited at least one additional participant. These results are consistent with the findings reported by (Lee et al., 2020). Willingness to recruit was high, with nine in ten participants indicating that they were prepared to invite eligible peers, and the most frequently reported motivation was to support scientific research, followed by the expectation that others would enjoy taking part. Participants who chose not to recruit were primarily deterred by discomfort about inviting others rather than by a lack of interest in the study or the effort involved. This distinction has practical implications for recruitment messaging: because the main barrier was social discomfort rather than motivation or burden, messaging that reduces the perceived awkwardness of inviting a peer (for example, by normalising the request or providing participants with ready-made wording to share) may be more effective than messaging that simply emphasises incentives or the value of the research. Similarly, given the differences in motivation observed between chains, future RDS studies should experiment with tailoring recruitment messaging to the values likely to resonate with different sub-groups — for example, framing appeals around civic or scientific contribution for some participants and around the direct benefit to the recruit for others — and test whether this affects recruitment cooperation and productivity.

Recruitment predominantly occurred through existing social relationships, particularly friendships, providing support for the assumption that recruitment largely followed established social networks. Finally, both the intra-chain correlation analyses and recruiter-recruit comparisons indicated evidence of homophily, particularly for ethnicity and geographic region, suggesting that recruitment was not entirely random but tended to occur between individuals with similar socio-demographic characteristics. This finding is consistent with the general results reported by Lee et al. (2020) and Liu et al., 2012).

Several findings help explain the substantial variation in recruitment productivity observed across recruitment chains. One particularly important finding concerns the characteristics of the initial probability-based seeds. Recruitment productivity was shaped far more by the emergence of super-seeds than by the age of the seed. The single most productive chain originated from a seed aged 25 or over, yet two of the three super-seeds were young adults, and 94.3% of the recruits attributed to older seeds came from that one older super-seed. Once the super-seed chains are set aside, the remaining seeds aged 18-24 recruited more productively than those aged 25 and over, generating 0.90 recruits per seed compared with 0.36, and seeds aged 18-24 were also far more likely to agree to recruit in the first place (81.3% compared with 41.8%). These patterns are consistent with Axenfeld et al. (2026), who reported that young adults were more willing to recruit others, and indicate that the apparent effectiveness of older seeds reflected the disproportionate contribution of a single older super-seed rather than a general advantage of recruiting through older seeds. At the level of the recruits themselves, willingness to invite further participants was very similar across the two groups, but the participants recruited through older seeds more often reported altruistic motivations such as supporting scientific research, whereas those recruited through younger seeds were more strongly influenced by monetary incentives.

An important finding is that while probability-based seeds provide an advantageous and geographically dispersed starting point, they do not guarantee successful recruitment, with a high seed mortality rate (73.2%) consistent with previous RDS studies Lee et al. (2020). Recruitment productivity was highly uneven across chains in our feasibility study, with 91.8% of all recruits originating from just three super-seed chains. This finding is consistent with the results reported by Abdul-Quader et al. (2006) and Jonsson et al. (2019). The emergence of highly productive super-seed chains created a structural tension: these chains were essential for achieving sufficient sample size, yet they concentrated recruitment within a small number of network clusters. The comparisons between super-seed and non-super-seed chains reveal substantial differences in recruitment dynamics, while showing broadly similar patterns of social selection. As expected, super-seed chains were considerably more productive, reaching the maximum permitted chain length of 10 waves, achieving a recruitment success rate of 27.1% (compared with 11.1% for non-super-seed chains), and generating exponential growth throughout fieldwork. Participants within these chains were also much more likely to continue recruitment, with 49.2% successfully recruiting at least one additional participant compared with 18.1% in non-super-seed chains, and 97.3% expressing willingness to invite others (versus 66.9%). In addition, participants in super-seed chains were more likely to report altruistic motivations for recruitment, particularly supporting scientific research, whereas those in non-super-seed chains more frequently cited voucher-related incentives. Despite these marked differences in recruitment productivity and motivation, the two groups exhibited similar patterns of homophily. In both chain types, participants tended to recruit others with similar socio-demographic characteristics, particularly with respect to ethnicity and educational attainment, although homophily was somewhat stronger for gender and disability within non-super-seed chains. Overall, these findings suggest that the exceptional productivity of the super-seed chains was driven primarily by differences in recruitment success and willingness to recruit, together with some fraudulent activity reported for one chain, rather than by fundamentally different patterns of social selection. This phenomenon, documented in prior studies (e.g., Abdul-Quader et al., 2006 Jonsson et al., 2019), appears to be a structural feature of RDS rather than an anomaly, raising important design questions about how to anticipate and manage uneven recruitment in practice. These findings suggest that close fieldwork monitoring is essential. Monitoring dashboards capable of identifying rapidly growing chains, stalled chains and unusual recruitment patterns are beneficial. Adaptive data collection and monitoring, with pre-planned interventions can detect and mitigate emerging problems in real time.

The majority of RDS studies do not include separation of sub-samples, such as super-seed and non-super-seed chains, meaning that important features of the recruitment process may remain hidden. As a result, the apparent performance of RDS may be overstated. It is, therefore, important to report and examine the underlying data generating process, including the contribution of individual recruitment chains. Greater attention should be given to understanding the super-seed phenomenon and to developing methods for distinguishing between naturally occurring variation in recruitment productivity and recruitment patterns arising from non-compliance or fraudulent behaviour. Further methodological work is needed to establish best practice for handling recruitment chains in which fraudulent activity is identified. It remains unclear whether entire chains should be terminated and excluded from the analysis, or whether only recruitment occurring after the detection of fraudulent behaviour should be removed, or whether exclusion should be limited to the individuals directly involved while retaining the remainder of the chains. These decisions have important implications for data quality, statistical efficiency, and data collection costs, and there is currently no evidence to guide researchers. Addressing these methodological questions should, therefore, be a priority for future research.

In our study, chains were truncated and it is important for future studies to identify super-seeds quickly and allow longer recruitment windows for the chains, which grow slower. Real-time monitoring of recruitment activity should be implemented to prevent super-seed chains from dominating the sample, as controlling the number of recruitment waves alone is insufficient.

A second major set of findings relates to non-compliance in web-based incentivised RDS. Although most recruitment proceeded in line with expected RDS protocols and the majority of participants appeared to engage with the study in good faith, the study identified multiple forms of potential non-compliance, including age misreporting and inconsistencies in recruitment eligibility. These issues were concentrated within a small number of highly productive super-seed chains rather than being widespread across the sample. The age validation follow-up survey introduced as a novel quality control mechanism, identified a mix of fully consistent responses, inconsistent but still age-eligible responses, and a smaller proportion of ineligible participants. Other potential indicators of non-compliance, such as duplicate participation, implausible response times, and unauthorised access, were rare or absent. Overall, the findings demonstrate that non-compliance in online, incentivised RDS is not widespread but can be structurally concentrated, highlighting the importance of balancing data quality with sample size through appropriate validation and cleaning procedures. They also demonstrate that successful implementation of online RDS requires careful fieldwork design, including substantial piloting and testing, continuous real-time monitoring of recruitment patterns, early detection of emerging super-seeds, and adaptive adjustments to incentives and coupon allocations during fieldwork. Post-fieldwork validation and data cleaning remain essential to address residual non-compliance that cannot be prevented during data collection. More broadly, these findings suggest that implementing RDS in a general population, online setting is not straightforward and that further methodological development is needed before it can be considered a fully robust technique for boosting probability-based surveys.

Several practical lessons emerge for future probability-based RDS designs. Selecting seeds from a probability-based panel is a viable mechanism for improving coverage and reducing reliance on convenience samples, but should be paired with protocols designed to be adaptive and responsive from the outset rather than introduced reactively during fieldwork: non-compliance checks and age validation, in particular, should be built in from the start. Incentives and coupon allocations should then be adjusted incrementally as fieldwork progresses, allowing the effect of each change to be assessed, rather than altered in a single step. Managing super-seeds is a key challenge and requires real-time monitoring, including at weekends, together with adaptive coupon allocation and controls that go beyond simple limits on the number of recruitment waves. Because different sub-groups may respond differently to the same protocols, substantial piloting and testing remain essential. Sample size planning should also account for high seed mortality and potentially large design effects (Goel and Salganik, 2010). Post-fieldwork, we recommend structured quality checks (e.g. age validation follow-up surveys), systematic data cleaning, and analytical adjustments (e.g. weighting and estimator choice) to address non-compliance that cannot be fully prevented during data collection. Finally, an open question remains regarding the replicability of these findings under the same protocol, highlighting the need for further research on the validity and robustness of RDS implementation strategies.

Although this paper has focused on recruitment dynamics, RDS is often discussed primarily in terms of sampling theory and statistical estimation. From a Total Survey Error (TSE) perspective, however, the recruitment process itself constitutes an important source of survey error. Applying the TSE framework to RDS, Lee et al. (2017) conceptualise recruitment as a sequence of stages at which participation may be lost. These include whether eligible participants agree to recruit, whether respondents subsequently distribute coupons to their peers, whether nominated peers accept the invitation, and whether those peers ultimately participate in the survey. Consequently, the achieved sample is shaped by cumulative non-response occurring at multiple points in the recruitment process rather than a single response decision. Understanding where recruitment losses occur is therefore essential for evaluating the performance of RDS and identifying opportunities to improve recruitment efficiency. This topic is beyond the scope of this paper and will be investigated in a companion article.

Overall, the evidence suggests that RDS with probability-based seeds is operationally feasible, but only when embedded within a carefully designed framework of continuous monitoring, adaptive fieldwork procedures, and rigorous post-fieldwork validation. The companion paper builds on these findings by examining representativeness, estimator performance, and violations of core RDS assumptions within a Total Survey Error framework.

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References

Abdul-Quader, A. S., Heckathorn, D. D., McKnight, C., Bramson, H., Nemoir, C., Sabin, K., Gallagher, K. and Des Jarlais, D. C. (2006) Effectiveness of respondent-driven sampling for recruiting drug users in New York City: Findings from a pilot study. *Journal of Urban Health*, **83**, 459–476.

Axenfeld, J. B., Cornesse, C., McKone Leonard, M., Gerlitz, J.-Y., Witton, J. and Zinn, S. (2026) Willingness to participate in respondent-driven sampling: findings from the German Social Cohesion Panel. *Journal of Survey Statistics and Methodology*, **00**, 1–16.

Bates, D., Mächler, M., Bolker, B. and Walker, S. (2015) Fitting linear mixed-effects models using lme4. *Journal of Statistical Software*, **67**, 1–48.

Bethlehem, J. (2010) Selection bias in web surveys. *International Statistical Review*, **78**, 161–188.

Breen, R. and Ermisch, J. (2021) Sibling models, categorical outcomes, and the intra-class correlation. *European Sociological Review*, **37**, 497–504.

Cornesse, C., Kraft, K. and Zinn, S. (2026) Bias assessment in respondent-driven sampling within a general population panel. In *Panel Survey Methods Workshop.* Nuremberg, Germany.

Domarchi, C., Ndebele, N., Maslovskaya, O., Fitzgerald, R., Lynn, P. and Comanaru, R. (2026) Accessibility and inclusivity in self-completion surveys: Evidence review. *Tech. Rep. 14*, University of Essex, Colchester, UK. URL: https://surveyfutures.net/reports/.

Fox, J. and Weisberg, S. (2019) An R Companion to Applied Regression. Thousand Oaks, CA: Sage, 3rd edn. Gaia, A., Brown, M., Calderwood, L., Nicolaas, G., Jessop, C. and Scholes, A. (2026) Differential monetary incentives in social surveys: Evidence review. *Tech. rep.*, University of Essex, Colchester, UK.

Gile, K. J. and Handcock, M. S. (2010) Respondent-driven sampling: An assessment of current methodology. *Sociological Methodology*, **40**, 285–327.

Goel, S. and Salganik, M. J. (2009) Respondent-driven sampling as Markov chain Monte Carlo. *Statistics in Medicine*, **28**, 2202–2229.

Goel, S. and Salganik, M. J. (2010) Assessing respondent-driven sampling. *Proceedings of the National Academy of Sciences*, **107**, 6743–6747.

Groves, R. M. and Couper, M. P. (1998) *Nonresponse in Household Interview Surveys.* New York: John Wiley & Sons.

Groves, R. M., Fowler, F. J., Couper, M. P., Lepkowski, J. M., Singer, E. and Tourangeau, R. (2009) *Survey Methodology*. Hoboken, NJ: John Wiley & Sons, 2nd edn.

Groves, R. M. and Heeringa, S. G. (2006) Responsive design for household surveys: Tools for actively controlling survey errors and costs. *Journal of the Royal Statistical Society Series A: Statistics in Society*, **169**, 439–457.

Handcock, M. S., Fellows, I. E. and Gile, K. J. (2023) *RDS: Respondent-Driven Sampling*. R package.

Heckathorn, D. D. (1990) Collective sanctions and compliance norms: A formal theory of group-mediated social control. *American Sociological Review*, **55**, 366–384.

Heckathorn, D. D. (1996) The dynamics and dilemmas of collective action. *American Sociological Review*, **61**, 250–277.

Heckathorn, D. D. (1997) Respondent-driven sampling: A new approach to the study of hidden populations. *Social Problems*, **44**, 174–199.

Jessop, C., Maslovskaya, O. and Cornesse, C. (2026) Respondent driven sampling feasibility study: Technical summary. *Survey Futures Report 11*, University of Essex, Colchester, UK. URL: https://surveyfutures.net/reports/.

Johnston, L. G., Hakim, A. J., Dittrich, S., Burnett, J., Kim, E. and White, R. G. (2016) A systematic review of published respondent-driven sampling surveys collecting behavioral and biologic data. *AIDS and Behavior*, **20**, 1754–1776.

Jonsson, J., Stein, B., Johansson, K., Bodin, T. and Strömdahl, S. (2019) A performance assessment of web-based respondent driven sampling among workers with precarious employment in Sweden. *PLOS ONE*, **14**, e0210183.

Lee, S., Ong, A. R. and Elliott, M. (2020) Exploring mechanisms of recruitment and recruitment cooperation in respondent driven sampling. *Journal of Official Statistics*, **36**, 339–360.

Lee, S., Suzer-Gurtekin, Z. T., Wagner, J. and Valliant, R. (2017) Total survey error and respondent driven sampling: Focus on nonresponse and measurement errors in the recruitment process and the network size reports and implications for inferences. *Journal of Official Statistics*, **33**, 335–366.

Leonard, M. M. (2025) Conducting respondent-driven sampling with ethnic minority populations: The state of the field. *Survey Practice*, **19**. Special Issue.

Liu, H., Li, J., Ha, T. and Li, J. (2012) Assessment of random recruitment assumption in respondent-driven sampling in egocentric network data. *Social Networking*, **1**, 13–21.

Lohr, S. (2021) *Sampling: Design and Analysis*. Chapman and Hall/CRC, 3rd edn.

Lüdecke, D., Ben-Shachar, M. S., Patil, I. and Makowski, D. (2020) *parameters: Extracting, Computing and Exploring the Parameters of Statistical Models*. R package.

Lüdecke, D., Ben-Shachar, M. S., Patil, I., Waggoner, P. and Makowski, D. (2021) performance: An R package for assessment, comparison and testing of statistical models. *Journal of Open Source Software*, **6**, 3139.

Lynn, P. (2024) A framework for identifying and addressing the risk of exclusion from social surveys. *Tech. Rep. 3*, University of Essex, Colchester, UK. URL: https://surveyfutures.net/working-papers/.

Middleton, D., Drabble, L. A., Krug, D., Karriker-Jaffe, K. J., Mericle, A. A., Hughes, T. L. and Trocki, K. F. (2022) Challenges of virtual rds for recruitment of sexual minority women for a behavioral health study. *Journal of Survey Statistics and Methodology*, **10**, 466–488.

Office for National Statistics (2026) *National population projections: 2024-based.* ONS website, statistical bulletin, released 28 April 2026. URL: https://www.ons.gov.uk/peoplepopulationandcommunity/populationandmigration/populationprojections/bulletins/nationalpopulationprojections/2024based.

R Core Team (2024) *R: A Language and Environment for Statistical Computing.* R Foundation for Statistical Computing, Vienna, Austria. URL: https://www.R-project.org/.

Schouten, B., Calinescu, M. and Luiten, A. (2013) Optimizing quality of response through adaptive survey designs. *Journal of Official Statistics*, **29**, 339–366.

Sladka, V. and Lynn, P. (2025) Targeted procedures for tackling survey non-response: Evidence review. *Tech. Rep. 5*, University of Essex, Colchester, UK. URL: https://surveyfutures.net/reports/.

Sosenko, F. (2025) *Accuracy of respondent driven sampling estimates: A test using the 2021 English census data as a benchmark.* SocArXiv preprint. URL: https://osf.io/preprints/socarxiv/yvw57_v2.

Todd, M., Li, T., Maslovskaya, O., Cornesse, C. and Jessop, C. (2026) Respondent driven sampling: Evidence review. Tech. Rep. 10, University of Essex, Colchester, UK. URL: https://surveyfutures.net/reports/.

Tourangeau, R., Conrad, F. G. and Couper, M. P. (2013) *The Science of Web Surveys*. New York: Oxford University Press.

Tourangeau, R., Edwards, B., Johnson, T. P., Wolter, K. M. and Bates, N. (2014) *Hard-to-Survey Populations*. Cambridge University Press.

Volz, E. and Heckathorn, D. D. (2008) Probability based estimation theory for respondent driven sampling. *Journal of Official Statistics*, **24**, 79–97.

Wickham, H. et al. (2019) Welcome to the tidyverse. *Journal of Open Source Software*, **4**, 1686.

Yan, Y., Hanlon, B., Roch, S. and Rohe, K. (2020) Asymptotic seed bias in respondent-driven sampling. *Electronic Journal of Statistics*, **14**, 1577–1610.

Zeileis, A. (2006) Object-oriented computation of sandwich estimators. *Journal of Statistical Software*, **16**, 1–16.

Zeileis, A. and Hothorn, T. (2002) Diagnostic checking in regression relationships. *R News*, **2**, 7–10.

Appendix A. Recruitment dynamics by seed type

The recruitment funnel of Table 1 is reproduced separately for super-seed and non-super-seed chains in Table A1 and Table A2.

Table A1: Recruitment dynamics by wave for super-seed chains.

	Recruitment wave											
Outcome	**Seed**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**	**W10**	**Total**
Potential invites	N/A	15	45	85	245	540	835	1080	1410	1600	1705	7560
Completed main survey	3	11	18	52	111	178	226	294	341	371	445	2050
Completion rate	N/A	73%	40%	61%	45%	33%	27%	27%	24%	23%	26%	27%
Potential recruiters	3	11	18	51	110	173	224	290	333	365	N/A	1578
Agreed to recruit	3	9	17	49	108	167	216	283	324	347	N/A	1523
Rate of agreement	100%	82%	94%	96%	98%	97%	96%	98%	97%	95%	N/A	97%
Successful recruits per participant	3.7	1.6	2.9	2.1	1.6	1.3	1.3	1.2	1.1	1.2	N/A	1.3

Table A2: Recruitment dynamics by wave for non-super-seed chains.

	Recruitment wave											
Outcome	**Seed**	**W1**	**W2**	**W3**	**W4**	**W5**	**W6**	**W7**	**W8**	**W9**	**W10**	**Total**
Potential invites	N/A	900	370	190	75	35	25	25	10	0	0	1630
Completed main survey	314	95	47	18	8	5	6	3	0	0	0	496
Completion rate	N/A	11%	13%	9%	11%	14%	24%	12%	0%	N/A	N/A	11%
Potential recruiters	314	95	46	17	8	5	6	3	0	0	N/A	494
Agreed to recruit	180	74	38	15	7	5	5	2	0	0	N/A	326
Rate of agreement	57%	78%	83%	88%	88%	100%	83%	67%	N/A	N/A	N/A	66%
Successful recruits per participant	0.3	0.5	0.4	0.4	0.6	1.2	0.5	0.0	N/A	N/A	N/A	0.4

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