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GENSI: A new graphical tool to collect ego-centered network data

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ABSTRACT

This study (1) tested the effectiveness of a new survey tool to collect ego-centered network data and (2) assessed the impact of giving people feedback about their network on subsequent responses. The new tool, GENSI (Graphical Ego-centered Network Survey Interface), allows respondents to describe all network contacts at once via a graphical representation of their networks. In an online experiment, 434 American adults were randomly assigned to answer traditional network questions or GENSI and were randomly assigned to receive feedback about their network or not. The traditional questionnaire and GENSI took the same amount of time to complete, and measurements of racial composition of the network showed equivalent convergent validity in both survey tools. However, the new tool appears to solve what past researchers have considered to be a problem with online administration: exaggerated numbers of network connections. Moreover, respondents reported enjoying GENSI more than the traditional tool. Thus, using a graphical interface to collect ego-centered network data seems to be promising. However, telling respondents how their network compared to the average Americans reduced the convergent validity of measures administered after the feedback was provided, suggesting that such feedback should be avoided.

1. Introduction

Questions about people's social contacts have become increasingly popular in surveys, because hundreds of studies in many scientific fields have shown that social contacts influence people's behavior and attitudes (e.g., Berg, 2009; Borgatti and Foster, 2003; Burt et al., 2013). In typical ego-centered network surveys, respondents (egos) are first asked to list their social contacts (alters) in name generator questions (Hsieh, 2015). Subsequently, egos are asked to report attributes of their alters in name interpreter questions (Marsden, 2011). To determine the structure of the network (Burt, 1984), surveys typically continue to ask respondents to indicate, for every pair of alters, whether or how well the two people know each other (e.g., "Does Joe know Mary?").

Some researchers have raised questions about the quality of answers given in ego-centered network surveys because repeatedly answering the same questions for each alter or pair of alter may impose a cognitive burden on respondents (Hsieh, 2015; Tubaro et al., 2014). For each of a respondent's contacts, he or she must report that person's educational attainment, religious preference, number of children, and many more variables in typical studies. Moreover, the number of pairs of alters increases exponentially with the size of the network, so the number of questions about the network structure may be substantial (McCarty et al., 2007). This may reduce the quality of answers given particularly in online surveys where no interviewer is present who can perhaps motivate respondents to answer such repetitive questions effortfully (Matzat and Snijders, 2010; Vehovar et al., 2008).

With the increasing use of computers in survey data collection (e.g., computer-assisted self-interviewing (CASI), web surveys), the availability of graphical interfaces allows changing the way questions in ego-centered network surveys are asked (Coromina et al., 2014). Some observers have speculated that the use of graphic displays may enhance respondents' enjoyment of the reporting process (Hogan et al., 2007), reduce cognitive burden (Matzat and Snijders, 2010; Tubaro et al., 2014; Vehovar et al., 2008), and increase data quality (Coromina and Coenders, 2006). A number of researchers have developed graphical interfaces to collect network information (e.g., McCarty and Govindaramanujam, 2005; Tubaro et al., 2014), but none of these tools has been tested against a traditional ego-centered network survey.

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In this study, we explore whether a richly graphical presentation via a computer can be advantageous in the measurement of social network features. Building on insights from earlier research, we have developed a new, freely available, software tool for ego-centered network surveys. We test whether the graphical data collection tool increases respondents' enjoyment of the survey, reduces administration time, reduces problems with affirmative answering, and increases the validity of indicators. Also, building on the new trend of "personal informatics" in human–computer interaction research and in medical research, we explored the impact of a promise to respondents that they will learn new information about themselves by participating in the study.

1.1. Existing software

Some existing software programs make use of graphic interactive features to collect ego-centered network data in online surveys. The programs EgoNet, EgoWeb 2.0 and C-IKNOW first ask questions about alters and their relationships with each other and then present a picture of the network (McCarty and Govindaramanujam, 2005). In contrast, the program EgoWeb displays and updates a network picture in real time as a respondent inputs information about the network (McCarty and Govindaramanujam, 2005). Although these programs make use of graphical features for the network generation process, they still follow the traditional approach of asking each name interpreter question separately for each alter or pair of alters.

More recent programs make use of Web 2.0 graphical features to allow answering name interpreter questions for all alters at once. Lackaff's (2012) survey tool PASN first mines a respondents' Facebook profile and then uses Facebook profile pictures of the respondents' friends to represent network members. Respondents can then drag and drop those pictures into answer categories to answer questions. To indicate relationships between alters, the software requires respondents to answer for each alter separately, "Which of these people does [alter] know?" by dragging and dropping the names of the contacts into answer areas.

The software TellUsWho (Ricken et al., 2010) first mines a respondents' email account for names of potential contacts. These names are displayed on the computer screen, and respondents drag and drop the names to answer name generator and name interpreter questions. This program does not offer the possibility to ask for relationships between network contacts to assess the network structure but only allows generating groups of alters.

In the program ANAMIA EGOCENTER, respondents draw a sociogram of their networks, which constitutes reporting of connections between individuals visually by clicking on alters that have a relationship with each other (Tubaro et al., 2014). This software thus makes use of graphical features to generate the network structure but follows the traditional approach of asking each name interpreter questions separately for each alter. The software OpenEddi follows a similar approach by allowing respondents to indicate relationships by drawing lines between alters (Fagan and Eddens, 2015). Additionally, relationships can be indicated by sorting alters into piles or by the traditional approach of asking separately for each pair of alters whether a relationship exists. Name interpreter questions can be asked separately for each alter or by dragging and dropping names of alters into answer categories.

An innovative tool that combines the advantages of the existing software has recently been presented. netCanvas has been designed to handle large and complex networks by allowing respondents to interact with a visual representation of their network on a touchscreen device and it allows answering name interpreter questions at once for all alters by dragging and dropping names into answer categories (Hogan et al., 2016).

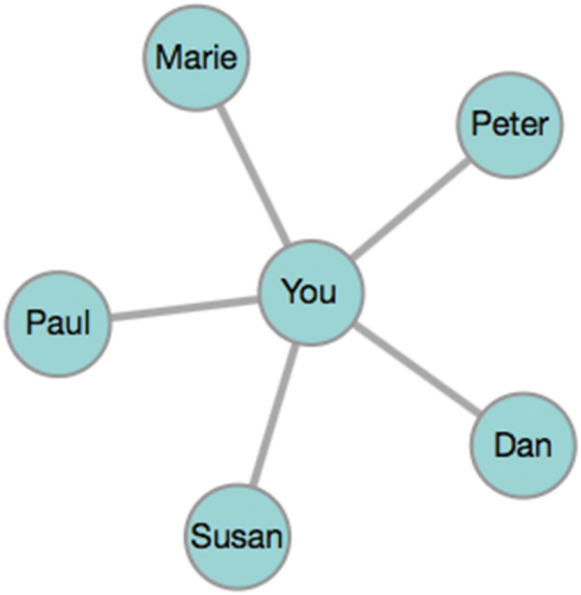

Fig. 1. Graphical representation of an ego-centered network with five alters.

1.2. The new graphical tool

GENSI (Graphical Ego-centered Network Survey Interface), the new tool evaluated in this paper, combines the ease of interacting with a graphical representation of a network when reporting on the network structure with the possibility to ask name interpreter questions about all alters at once. The approach is similar to netCanvas and OpenEddi but aims at survey researchers who want to implement a short ego-centered network module in a larger questionnaire. In GENSI, respondents type the names of their alters into a single box, one after the other (Vehovar et al., 2008).[1] After a name is typed, a little circle flies onto the screen displaying the name and is linked by a line to a circle with the label "You". Thus, a visual representation of a person's network is generated in real time (Fig. 1). Respondents answer subsequent questions about their network by interacting with this visual representation.

GENSI asks a single name interpreter question requesting an attribute of all network members (e.g., "Which of these people are women?"), rather than asking separate questions about individual network members, as is done in traditional ego-centered surveys (e.g., "Is Robert a man or a woman?"). Such name interpreter questions can be answered in either of two ways in GENSI. First, a dichotomous question about each network contact can be answered by clicking on names of alters. This changes the color of the circle around the name (Fig. 2a). Respondents can inspect and correct their answers by clicking (again) on the circles (Fig. 2b). Second, to report categorical attributes of the alters, respondents can drag and drop the circles containing the names of each alter in a response box for each answer option (Fig. 3).[2] The approach implemented in GENSI asking about one attribute of all alters before asking about another attribute of all alters has been shown to

[1] GENSI is designed to improve answers given to name interpreter questions in digital surveys. How to address the potential problem of an underreporting of the network size in name generator questions in online surveys (Matzat and Snijders, 2010) has been discussed by Hsieh (2015).

[2] Categorical attributes also include Likert-type scales with separate response options.

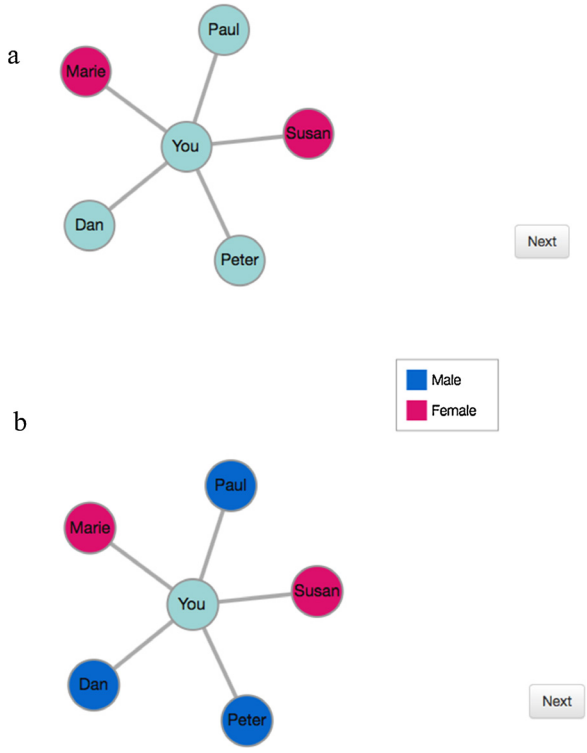

Fig. 2. Screenshot of a question for a dichotomous name interpreter question The questions read, a: "Which of these people are women? Please click on the names of the women in your network. Click 'Next' when you are done or if there are no women among your friends" and b: "We added a color for the men in your network. Please click 'Next' when everything is correct. If you want to change the sex of a person, simply click on the name."

reduce item nonresponse, break-offs (Vehovar et al., 2008), and to produce more reliable data (Coromina and Coenders, 2006) than does asking all questions about one alter before asking all questions about the next alter.

Relationships between the alters in a person's social network (the network structure) can be indicated by drawing lines between the names of two or more alters. Thus, instead of evaluating every pair of alters separately as it is done in traditional surveys (e.g., "Does Joe know Mary?"), respondents can click on the name of one person and then on the name of another person to create a line between the two circles (Fig. 4). Right-clicking on a line removes incorrectly positioned lines. This drawing of lines may reduce the burden for respondents, as only existing relationships have to be indicated, instead of having to explicitly report the presence or absence of a relation between every possible pair of alters (McCarty and Govindaramanujam, 2005). A video clip of GENSI is available in the online supplementary material.

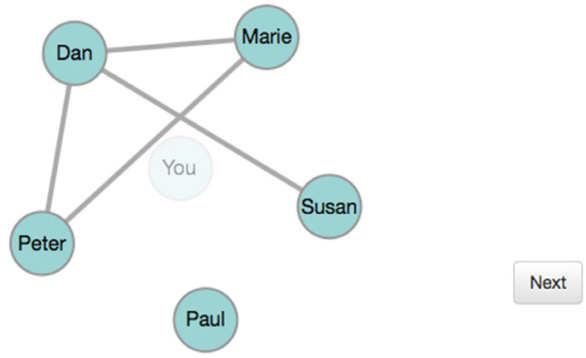

Fig. 4. Screenshot of a question asking for the network structure.

1.3. Hypotheses

Some researchers have argued that respondent motivation drops quickly while people answer similar questions about each alter in an ego-centered network study (Hogan et al., 2007; Matzat and Snijders, 2010). If this is true, this drop in motivation may compromise measurement accuracy, because less motivated people are generally less productive and effective (Csikszentmihalyi, 1990) and are less willing to invest mental effort when executing tasks (Capa et al., 2008). Furthermore, people who enjoy a task more make fewer mistakes when executing it (Puca and Schmalt, 1999). Because past research has found that interactive elements can increase respondents' task enjoyment (Venkatesh, 1999) and might thereby increase motivation, the graphical and interactive features of GENSI may create a more enjoyable survey experience that keeps respondents motivated. Moreover, motivation may not decline as quickly, because answering a single question about all alters at once may speed up the answering process.

H1. Respondents may enjoy answering GENSI more than answering a traditional ego-centered network questionnaire.

H2. GENSI may be completed more quickly than a traditional ego-centered network questionnaire.

The theory of survey satisficing (Krosnick, 1991, 1999) states that some respondents may not think deeply about their answers when they face a difficult reporting task. Instead, some respondents may satisfice and use a strategy to expedite the interview. They may say "don't know" if such an answer option is explicitly offered or use an answer strategy that makes it look as if a valid answer was chosen, when in fact, an answer was provided thoughtlessly (Krosnick et al., 2002). Such answer strategies increase measurement error, which in turn reduces convergent validity (i.e., the relations between correlated variables; e.g., Chang and Krosnick, 2009). Graphical elements in online surveys appear to reduce satisficing, as indicated by fewer "don't know" answers provided

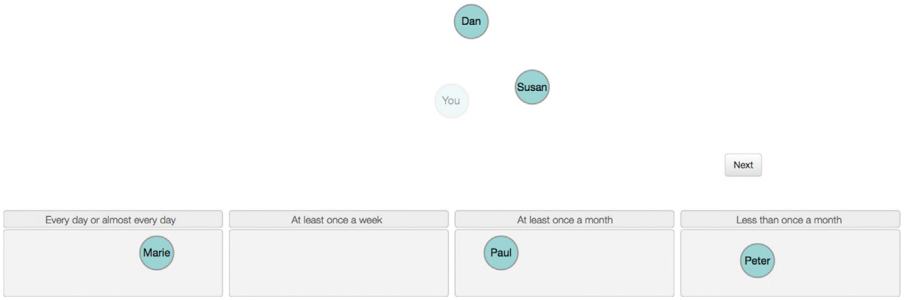

Fig. 3. Screenshot of a drag-and-drop question for a categorical name interpreter question. The question read, "How often do you talk to each person? Drag the circles with the names of each person into the box below that indicates how often you talk to each other."

(Deutskens et al., 2004). If the graphical features of GENSI increase respondent motivation, respondents may also satisfice less, reducing measurement error and increasing convergent validity.

The visual aids given in GENSI may reduce measurement error for another reason as well. Specifically, changing colors of the display and seeing name circles placed next to each other in answer boxes may make it easier for respondents to notice and correct mistakes. This, again, may increase convergent validity of answers given with GENSI.[3]

H3. The convergent validity of survey questions may be higher with GENSI than with a traditional ego-centered network questionnaire.

Especially potentially problematic with regard to survey satisficing are questions about the structure of a person's social network when every pair of alters has to be evaluated. Matzat and Snijders (2010) found that online data collection yielded higher network density (meaning more network contacts know each other) than did face-to-face data collection. This was due to significantly more people saying that everybody in their network knew everyone else in the online survey (density = 1) than in the face-to-face survey. These investigators attributed that difference to more non-differentiation in online answers in the form of repeated affirmative answering (what the investigators called "mechanical clicking"), in order to end the questionnaire more quickly. The ability to indicate relationships between alters in GENSI by drawing lines may reduce cognitive burden, as not every possible pair of alters must be explicitly described. As a consequence, there may be less affirmative answering and thus less exaggerated numbers of network connections.

H4. The density of ego-networks may be lower with GENSI than with a traditional ego-centered network questionnaire.

H5. Respondents may be less likely to indicate relationships between all network contacts with GENSI than with a traditional ego-centered network questionnaire.

1.4. Personal informatics

The study described in this paper also tested the impact of another manipulation: the provision of information about a respondent's social network. This idea builds on the notion of personal informatics, also called quantified self or personal analytics, which refers to giving people information about themselves (Choe et al., 2014). This approach has been used to motivate people to participate in burdensome research projects that ask them to track their amount of walking (Zulman et al., 2013) or take minute-by-minute photographs (for an overview, see Li et al., 2010). The idea behind personal informatics is similar to the very old approach of promising to give respondents results of a survey after they participate in it, as a way to increase willingness to participate (Levine and Gordon, 1958).

Whereas the promise of survey results has not proven to increase response rates (Yu and Cooper, 1983), personal informatics may be more successful, because they offer immediate feedback that is tailored to the individual participant. In the old approach, respondents would receive a report of the results weeks or months after the survey took place, and such a report would contain only aggregate statistics. The approach we tested instead gives respondents feedback immediately after they answer questions and facilitates comparison between each respondent's answers and aggregate results. Accordingly, respondents may report more enjoyment after answering the questions and receiving feedback than after answering the questions alone.

H6. Respondents who anticipate receiving feedback about their network may enjoy participation in the survey more than those who do not anticipate receiving such feedback.

Moreover, personal informatics may increase respondent motivation to provide accurate answers, because respondents will learn about their similarity to others accurately only if they give correct answers about themselves and their networks. As a consequence, respondents who are promised feedback may be less likely to satisfice. With less satisficing, we expect to see higher convergent validity and less dense networks, because respondents are less likely to exaggerate the number of relationships through affirmative answering.

H7. The convergent validity of questions may be higher among respondents who anticipate receiving feedback about their networks than among people who do not anticipate receiving such feedback.

H8. The density of the networks may be lower among respondents who anticipate receiving feedback about their network than among those who do not anticipate receiving such feedback.

H9. Respondents may be less likely to indicate relationships between all network contacts if they anticipate receiving feedback about their network.

1.5. The present study

These hypotheses were tested in an online survey experiment, in which respondents were randomly assigned to either answer a traditional ego-centered network questionnaire or the new graphical tool GENSI. Respondents were also randomly assigned to be told at the beginning of the questionnaire that they would receive the personal informatics or not, yielding a 2×2 design.

Convergent validity of the network questions (H3 and H7) was assessed by comparing the strength of the relation between white respondents' reports of having black network contacts and the respondents' attitudes toward blacks. Convergent validity refers to the extent to which measures of different constructs that theoretically should be related are indeed related. Numerous studies have shown that white people with more black contacts (for an overview see Pettigrew and Tropp, 2006) and with more white contacts who have black friends (extended contact, for an overview see Vezzali et al., 2014) have more positive attitudes toward blacks. Also an ego-centered network study found that white people who have more ethnic minority members in their network have more positive attitudes toward these minorities (Berg, 2009). The correlation between contact with blacks and positive attitudes toward blacks is thus well established. Finding such a correlation would indicate convergent validity for the ego-centered network measurement. If GENSI improves measurement quality, the correlation should be stronger than with a traditional network measurement.

2. Materials and methods

2.1. Data

Data were collected in a non-probability sample of U.S. residents recruited through Amazon Mechanical Turk (MTurk). An invitation to participate in a survey about social relationships was published on MTurk on July 20, 2014, and 468 respondents completed the questionnaire within 3 h. Completing the questionnaire took 6.07 min on average, and respondents were paid $1 for their

[3] Unfortunately, it was not recorded whether corrections were made during the answering process in the present study that might explain higher convergence validity.

Table 1
Means and standard deviations of continuous variables.

Variable	Mean	*SD*	Range	Valid *N*
Enjoyment	3.62	1.02	1–5	434
Participate again	4.34	0.85	1–5	434
Interesting	3.90	0.95	1–5	434
Completion time (minutes)[a]	6.07	6.56	1.62–126	434
Direct intergroup contact[b]	0.27	0.57	0–5	316
Extended intergroup contact[b]	1.83	1.39	0–5	316
Differential attitudes toward blacks[b]	3.79	0.57	1–7	313
Network size	4.39	1.08	1–5	434
Network density[c]	0.55	0.33	0–1	426
Age	33.66	11.57	19–74	434

[a] Mean completion time after removing 19 outliers was 5.32.
[b] These values are based on the subsample of white respondents ($n = 316$).
[c] The values are based on the subsample of respondents with at least two alters ($n = 426$).

participation. Thirty-four respondents failed an attention check at the end of the questionnaire and were removed from the sample.[4] The remaining 434 respondents in the final sample were predominantly highly educated (12% had a high school degree or less, 39% had some college experience, and 49% had a 4-year college degree), male (56%), and young (21% aged 19–24, 45% aged 25–34, 19% aged 35–44, 15% aged >44). Descriptive statistics for all variables are shown in Table 1.

The name generator question looked the same for the 217 respondents (50%) who completed a traditional ego-centered network questionnaire and the 217 respondents (50%) who used GENSI. This name generator asked "Who are the people outside of your home that you feel closest to? These may be friends, co-workers, neighbors, relatives, or anyone else who does not live with you" (Emerson et al., 2010).[5] Respondents could enter up to five contacts. The limit of five was chosen to keep the survey at a reasonable length and to mirror many large population surveys such as the General Social Survey (GSS), the American National Election Study (ANES), or the Netherlands Longitudinal Lifecourse Study (NELLS). The benefit of going past five nominations seemed minimal since 95.1% of respondents in the 2004 GSS[6] nominated five or fewer contacts and in a recent representative U.S. online survey 88.3% or respondents nominated five or fewer network contacts even though nominations were not limited (Brashears, 2011).

In the traditional ego-centered network questionnaire, respondents were asked every name interpreter question for each of their network contacts on a separate page. For instance, the question about the contacts' gender read, "Is [name 1] male or female?" and offered the answer options "male" and "female." After answering the question, respondents had to click "Next" to receive the same question for the second network contact.

2.2. Personal informatics

All respondents saw the following message before seeing the name generator question: "In the next section, you will be asked questions about people outside of your home to whom you feel closest. These may be friends, co-workers, neighbors, or relatives. Together, these people make up your social network." About half of the respondents ($N = 230$, 53%) were randomly assigned to also see this text: "At the end of the questionnaire, you will receive a report that tells you how similar your social network is compared to the average American." The feedback was provided after respondents described their social networks and before they reported their attitudes toward blacks and their enjoyment of the questionnaire. The feedback, compared size, density, and racial composition of respondent's network with data from a representative U.S. face-to-face ego-centered network study (Emerson and Sikkink, 2006). The exact wording of the report depended on respondents' answers and can be seen in the Online Appendix.

2.3. Measures of enjoyment

Enjoyment. At the end of the questionnaire, all respondents were asked, "How much did you enjoy answering this survey?" Response options on a 5-point scale ranged from "not at all" to "a great deal." Higher values indicate more enjoyment.

Participate again. Respondents were asked: "How likely is it that you will participate in another survey like this about your social network?" Answers could be given on a 5-point scale ranging from "not at all likely" to "extremely likely." Higher values indicate a higher likelihood to participate again.

Interesting. The question, "How interesting was this survey?" could be answered on a 5-point scale ranging from "not at all interesting" to "extremely interesting." Higher values indicate that respondents found the survey more interesting.

Completion time. Completion time was measured in milliseconds from the moment respondents clicked "next" after answering the first question until he or she clicked "next" after answering the last question in the survey, asking how interesting the survey was.

2.4. Measures used to assess convergent validity

Direct intergroup contact. The traditional version of the questionnaire asked for each network contact, "To which racial/ethnic group does [name alter] belong?" Answer options were "White (Caucasian)," "Black," "American Indian, Alaska Native, or Native Hawaiian," "Asian," "Hispanic," "Other," and respondents could check all that applied. In the graphical tool, the question read, "To which racial/ethnic group do these people belong? Drag the circles with the names of each person into the box below that indicates their racial/ethnic group." The answer categories were presented as boxes below the network picture, and respondents could drag and drop the names of their network contacts into the appropriate box. Answer options were the same as for the traditional questionnaire but the last box read "Mixed/Other." For each name dragged into this box, a separate pop-up window appeared after the respondents clicked "Next," asking "What is [name alter]'s race/ethnicity?" The same response categories as in the traditional version of the questionnaire were offered, and respondents could check each response option that applied. The number of black people (black only and black plus other race) in the respondent's network was treated as an assessment of direct intergroup contact, which could range from 0 to 5.

Extended intergroup contact. For each alter, all white respondents were asked, "Does [name alter] have one or more close friends who are black?" Extended contact is defined as the number of ingroup friends who have outgroup friends (Vezzali et al., 2014). Accordingly, it was measured by the number of white alters who had black friends. This indicator could range from 0 to 5.

Differential attitudes toward blacks. After all questions about the ego-centered network had been answered, all respondents were asked, "Do you feel warm, cold, or neither warm nor cold toward most white people?" and "Do you feel warm, cold, or neither warm

[4] To be sure that only respondents who read the survey instructions were included, the attention check question asked respondents to click on the fourth response option. Every respondent who failed to do so was removed from the sample at the time of analysis. Experimental conditions were not correlated with failing the attention check.
[5] This wording of the name generator question is taken from the 2006 "Portraits of American Life Study" (Emerson and Sikkink, 2006), a national representative study that served as basis of comparison in the personal informatics reports.
[6] The 2004 GSS allowed unlimited nominations of names even though name interpreter questions were only asked for the first five names.

nor cold toward most black people?" Answers were given on a 7-point scale ranging from "extremely warm" to "extremely cold." Attitudes toward blacks were measured as the difference between the black feeling thermometer rating and the white feeling thermometer rating. This measure was recoded to range from 1 to 7, with higher values indicating more positive attitudes toward blacks.

2.5. Constructed measures of network characteristics

Network size. Network size was the number of alters entered by the respondent, which empirically ranged from 1 to 5.

Network density. Network density was the number of network members who knew each other divided by the number of potential relationships between all network members (alter-density, see Wasserman and Faust, 1994). In the traditional ego-centered questionnaire, respondents could answer yes or no to the question, "Does [name alter 1] know [name alter 2]?" This question was asked about each dyad in the network. In the graphical version of the questionnaire, respondents were asked, "Which of these people know each other? To indicate that two persons know each other, click on the name of the first person and then on the name of the second person. This will create a line between the two." Fig. 4 shows how respondents could indicate which alters knew each other.

Density of 1 and of 0. A dummy variable was coded 1 for respondents whose network contacts all knew each other (22%) and 0 otherwise. A second dummy variable was code 1 for respondents who indicated that none of their network contacts knew each other (9%) and 0 otherwise.

2.6. Non-response probe

Because multiple studies have suggested that accidental or intentional item nonresponse may be a problem in online ego-centered network surveys (Matzat and Snijders, 2010; Vehovar et al., 2008), we implemented a nonresponse probe in all versions of the questionnaire. If a question in any part of the questionnaire was unanswered, a pop-up screen appeared on which respondents had to click "OK" to proceed.[7] If they really did not want to answer a question, they had to click "Next" a second time. Thus, not answering a question took one additional click than selecting an answer and proceeding to the next question.

3. Results

3.1. Break-offs and item non-response

There were no break-offs. This means that neither the graphical tool nor the personal informatics report caused respondents to end the survey prematurely. Having no break-offs allows comparing answers given between experimental conditions, which could otherwise be confounded with the break-off rate. Three respondents did not answer the questions about their attitudes toward blacks. There was no item non-response on any of the other questions suggesting that the non-response probe worked.

3.2. The graphical tool GENSI

GENSI led to more enjoyment of the questionnaire. People who used the new tool enjoyed the process significantly more than did the people who answered the traditional ego-centered network questionnaire ($M_{GENSI} = 3.78$ vs. $M_{traditional} = 3.45$; $F(1, 430) = 11.62$, $p < .001$, $d = .33$), thought the survey was significantly more interesting ($M_{GENSI} = 4.09$ vs. $M_{traditional} = 3.72$; $F(1, 430) = 16.98$, $p < .001$, $d = .40$), and said they were significantly more likely to participate in a similar survey in the future again ($M_{GENSI} = 4.42$ vs. $M_{traditional} = 4.26$; $F(1, 430) = 3.94$, $p = .048$, $d = .19$). This is in line with Hypothesis 1.

The more positive experience of answering GENSI was not due to shorter completion times. Answering the questions took equally long with the new graphical interface and the traditional version. The average completion time was 5.39 min for GENSI and 5.25 min for the traditional ego-centered network questionnaire ($F(1, 411) = .69$, $p = .406$).[8] This refutes Hypothesis 2.

The two questionnaire forms were equivalent in terms of the convergent validity of various measures of intergroup contact when predicting attitudes toward blacks. Controlling for white respondents' sex, age, and education, differential attitudes toward blacks was significantly predicted by direct intergroup contact ($b = .16$, SE = .06, $p = .004$), and extended intergroup contact ($b = .07$, SE = .02, $p = .004$). However, insignificant interactions of the type of questionnaire answered with direct contact ($b = .10$, SE = .11, $p = .358$, Model 1 in Table 2) or extended contact ($b = -.02$, SE = .05, $p = .649$, Model 2 in Table 2) indicated that the graphical survey tool did not affect the relations between these variables and attitudes toward blacks. This challenges Hypothesis 3.

The new graphical tool produced less dense ego-centered networks than the traditional questionnaire. An ANOVA indicated that network size did not differ between the conditions ($M_{GENSI} = 4.47$ vs. $M_{traditional} = 4.31$; $F(1, 430) = 2.29$, $p = .131$). However, of the respondents who mentioned at least two alters ($N = 426$), those who saw the graphical version reported a mean density of 0.52, whereas those who saw a traditional survey design reported a mean density of 0.61 ($F(1, 422) = 8.49$, $p = .004$, $d = .28$). This is in line with Hypothesis 4. The difference was driven by more respondents indicating relationships between all network contacts in the traditional questionnaire. A significantly larger proportion of respondents in this condition reported a network density of 1 than in the condition with the new survey tool (traditional = 0.27 vs. GENSI = 0.17; χ^2 (1) = 5.42, $p = .020$, $d = .23$). This is in line with the idea that the graphical interface reduces mechanical clicking that has been identified as problem in online network surveys (Matzat and Snijders, 2010) and thus supports Hypothesis 5. The lower density in the GENSI condition was not due to a larger proportion of people reporting a density of zero with the graphical interface (GENSI = 0.11 vs. traditional = 0.07; χ^2 (1) = 1.25, $p = .263$).

3.3. Personal informatics

Receiving personal informatics reports did not increase respondents' enjoyment. People who got feedback about their networks did not enjoy the survey more ($M_{informatics} = 3.63$ vs. $M_{none} = 3.60$; $F(1, 430) = .001$, $p = .96$), did not think it was more interesting ($M_{informatics} = 3.93$ vs. $M_{none} = 3.88$; $F(1, 430) = .06$, $p = .811$), and did not say they would be more likely to participate in a similar survey ($M_{informatics} = 4.33$ vs. $M_{none} = 4.35$; $F(1, 430) = .23$, $p = .633$) than respondents who did not get the report.[9]

In fact, the personal informatics report seemed to have undermined the positive effect of the new graphical survey tool on

[7] The pop-up screen read, "We noticed that you didn't answer this question. It would very helpful for our research if you did. Please feel free to either give an answer or to go to the next question by clicking 'Next' again."

[8] 19 respondents in both conditions who took extremely long times to complete the questionnaire (3rd quartile + 2.2 IQR, Hoaglin and Iglewicz, 1987) were removed from this calculation.

[9] Not surprisingly, receiving the personal informatics report increased the completion time significantly ($M = 5.48$ vs. $M = 5.13$ after removing outliers; $F(1, 411) = 4.56$, $p = .033$, $d = .21$).

Table 2
Coefficients of OLS regressions predicting differential attitudes toward blacks among white respondents.

Parameters	Model 1		Model 2		Model 3		Model 4	
	b	SE	*b*	SE	*b*	SE	*b*	SE
Sex (male)	−.17**	.06	−.17**	.06	−.16*	.06	−.16*	.06
Age	−.002	.002	−.002	.003	−.002	.003	−.002	.003
Education[a]								
Some college	.20*	.10	.20*	.10	.19*	.10	.19	.10
4-year college degree	.19*	.09	.20*	.09	.17	.09	.19*	.09
Direct contact	.12	.07	.16**	.06	.32***	.09	.15**	.06
Extended contact	.06**	.02	.07*	.03	.07**	.02	.11***	.03
GENSI[b]	.09	.07	.15	.10	–		–	
GENSI × direct contact	.10	.11	–		–		–	
GENSI × extended contact	–		−.02	.05	–		–	
Personal informatics[c]	–		–		.14	.07	.21*	.10
Personal informatics × direct contact	–		–		−.27*	.11	–	
Personal informatics × extended contact	–		–		–		−.08	.05
Intercept	3.56***	.15	3.54***	.15	3.54***	.15	3.53***	.15
Adj. R^2	.07		.07		.08		.07	

Note: $N = 313$ due to three cases with missing values on the dependent variable.
[a] Reference category is high school degree or less.
[b] Reference category is the traditional questionnaire.
[c] Reference category is not being promised and receiving the personal informatics report.
***$p < .001$; **$p < .01$; *$p < .05$ (two-tailed tests).

enjoyment of the experience. ANOVAs indicated significant interactions between the type of network reporting tool used and receipt of personal informatics when predicting respondents' likelihood to participate again ($F(1, 430) = 5.73$, $p = .017$, $d = .23$) and their judgments of how interesting the survey was ($F(1, 430) = 4.21$, $p = .041$, $d = .20$). There was no such significant interaction predicting enjoyment of the survey ($F(1, 430) = .45$, $p = .504$). Fig. 5 depicts the two significant interactions.

Using the new survey tool increased the likelihood to participate in the future again only among respondents who did not get the personal informatics report (Fig. 5a). The graphical survey tool increased respondents' reports of how interesting the survey was less among people who got the personal informatics report than among those who did not (Fig. 5b). This suggests that the personal informatics report reduced respondents' enjoyment of the new tool, thus undermining its positive impact on ultimate enjoyment of the entire survey experience.

This unexpected pattern of results may be due to the content of the information that some respondents received in their personal informatics reports. Among those who got a personal informatics report ($N = 230$), people who were told that their network was larger than that of most Americans were marginally significantly more likely to participate again in the future ($M = 4.41$ vs. $M = 4.13$; $t(98) = 1.95$, $p = .054$, $d = .28$) and said the survey was more interesting ($M = 4.03$ vs. $M = 3.68$; $t(108) = 2.46$, $p = .015$, $d = .36$) than respondents who were told that their network is equally large or smaller than that of most Americans. ANOVAs indicated that the feedback that people's networks were loosely connected, closely connected, or very closely connected was related to differences in the enjoyment indicators (enjoyment: $M = 3.69$ vs. $M = 3.87$ vs. $M = 3.17$; $F(2, 224) = 7.45$, $p < .001$, $d = .60$; participate again: $M = 4.29$ vs. $M = 4.56$ vs. $M = 4.08$; $F(2, 224) = 5.16$, $p = .006$, $d = .38$; interesting: $M = 4.00$ vs. $M = 4.10$ vs. $M = 3.58$; $F(2, 224) = 5.16$, $p = .006$, $d = .51$). And respondents who were told that their network was racially more diverse than that of most Americans said they enjoyed the questionnaire more ($M = 3.86$ vs. $M = 3.54$; $t(112) = 2.10$, $p = .038$, $d = .31$) and said the survey was more interesting ($M = 4.12$ vs. $M = 3.85$; $t(110) = 1.93$, $p = .056$, $d = .28$) than respondents who were not told this information. These results suggest that certain feedback messages in a personal informatics report might be counterproductive for respondents' enjoyment of the survey.

The personal informatics report *reduced* the convergent validity of subsequent measures. The association of direct intergroup contact with blacks in the network with attitudes toward blacks was significantly weaker among white respondents in the personal informatics condition than among those who did not get the feedback about their network ($b = -.27$, SE = .11, $p = .015$, Model 3 in Table 2). The association of extended intergroup contact with attitudes toward blacks was marginally significantly weaker among respondents who anticipated receiving the personal informatics report ($b = -.08$, SE = .05, $p = .078$, Model 4 in Table 2). This disconfirms Hypothesis 7.

Network size ($M_{\text{informatics}} = 4.37$ vs. $M_{\text{none}} = 4.42$; $F(1, 430) = .32$, $p = .571$) and network density did not differ significant between respondents who were promised personal informatics and those who were not ($M_{\text{informatics}} = 0.53$ vs. $M_{\text{none}} = 0.57$; $F(1, 422) = 1.58$, $p = .210$). Likewise, the proportion of respondents who said that all network contacts knew each other did not vary between

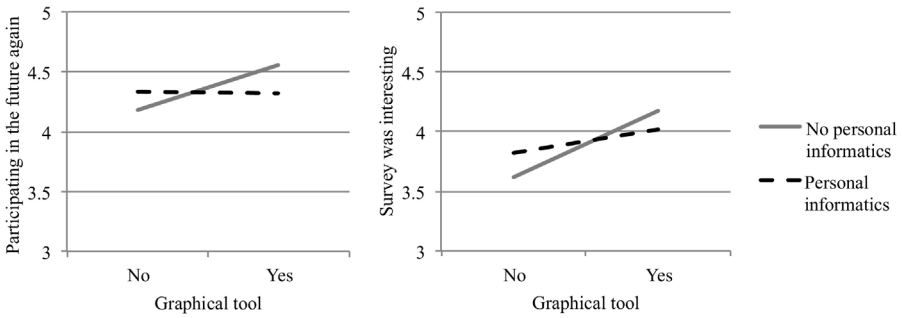

Fig. 5. Mean values of enjoyment measures in each experimental condition.

these groups of respondents (informatics = 0.21 vs. none = 0.23; χ^2 (1) = 0.25, p = .621). This disconfirms Hypotheses 8 and 9. Also the proportion of respondents with a density of zero did not vary significantly (informatics = 0.10 vs. none = 0.07; χ^2 (1) = 2.22, p = .14). Among white respondents, the amount of direct contact with blacks in the network ($M_{informatics}$ = 0.27 vs. M_{none} = 0.26; F(1, 312) = .05, p = .833) and the frequency of extended contact with blacks ($M_{informatics}$ = 1.73 vs. M_{none} = 1.94; F(1, 312) = 1.87, p = .172) did not differ between people promised the feedback and those not promised the feedback. Use of the graphical interface vs. the traditional questions did not interact with the personal informatics condition in predicting any of the network characteristics.

4. Discussion

4.1. Graphical survey tool

This study suggests that graphical features available in computer-based surveys allow a more effective way to measure ego-centered networks than traditional online questionnaires. Advocates of graphical elements have suggested that these features may increase respondents' enjoyment of a survey (Hogan et al., 2007), may reduce cognitive burden (Matzat and Snijders, 2010; Vehovar et al., 2008), and may also increase data quality (Coromina and Coenders, 2006). The study reported here constitutes the first test that we know of such claims with a digital questionnaire and offers some support for them.

GENSI increased respondents' enjoyment of the questionnaire. Those who saw the graphical interface enjoyed answering the questionnaire significantly more, thought the questionnaire was more interesting, and were more likely to participate in a similar survey in the future again. This was not due to faster administration of the questionnaire with the graphical tool. Average completion time did not differ between GENSI and the traditional design. However, the finding of more enjoyment is in line with expectations that graphical features in ego-centered network questionnaires might increase respondents' enjoyment of the survey (Hogan et al., 2007) and might increase respondent motivation to complete the questionnaire properly (Matzat and Snijders, 2010).

These results contrast with those of some pioneering research on graphical elements in online surveys, which did not indicate beneficial results (Couper et al., 2004). Other researchers drew more positive conclusions about the impact of graphical elements on answer quality (Coromina and Coenders, 2006; Deutskens et al., 2004). However, a lot of this research was conducted over a decade ago when graphical features in web surveys were much more rudimentary and when people were less used to interacting with graphical features on the Internet. Our study found that the graphical tool positively affected respondents' evaluation of the questionnaire. It therefore seems worthwhile to explore the impact of newly available Web 2.0 graphic technologies in other online surveys (see also Dillman et al., 2009).

Matzat and Snijders (2010) found that ego-centered networks were denser in an online survey than in a face-to-face survey. Significantly more people in their online survey said that everyone in their network knew each other, which the authors took to be a measurement artifact. The lower network density produced by GENSI than by traditional measures administered online may therefore suggest superiority of the new tool over a traditional ego-centered network questionnaire without graphical features in online administration. In line with this idea, fewer respondents who used GENSI indicated relationships between all alters (density = 1) than did respondents who answered traditional questions, perhaps reducing the problem of "mechanical clicking" identified by Matzat and Snijders (2010).

Use of GENSI did not affect another indicator of data quality, the convergent validity of the network characteristics and subsequently asked measures. Network measures of interracial contact were significant predictors of interracial attitudes, just as in earlier research (Berg, 2009). However, these relations did not differ between the traditional questionnaire and GENSI. This suggests that the new graphical tool does not produce data of a lower quality than the existing approach.

4.2. Personal informatics

Telling respondents up front that they would receive feedback on how their network compared to the average American did not affect respondents' answers to the network questions. Researchers in the field of human-computer interaction have used the promise that people would learn something about themselves to recruit participants (Li et al., 2010; Zulman et al., 2013). However, the mere promise of feedback about their network in the present study did not affect or improve people's reports of the network size, density, or characteristics of the network contacts. This is in line with decades old research, which found that people were no more likely to participate in a survey if they had been promised to later receive a report of the results of the survey (Yu and Cooper, 1983).

Providing the feedback that compared the respondents' network to the average American network had negative consequences for people's enjoyment of the questionnaire and for data quality. Specifically, receiving feedback about one's network countered the positive effect of the graphical survey tool on respondents' enjoyment of the survey. There were also weaker correlations between network characteristics and subsequent questions about known correlates when respondents saw the personal informatics report, indicating worse convergent validity. Thus, the provision of comparative feedback about respondents' networks at the end of the questionnaire was not an effective strategy to increase respondents' motivation. This is in line with research on feedback interventions more generally, which have been found to very often reduce instead of enhance performance (Kluger and DeNisi, 1996). It is also consistent with research on health communication that found that framing information in terms of comparisons can be ineffective. For instance, black people reacted with more positive emotions to information about cancer when the message emphasized progress than when the message emphasized a poorer cancer outcome for blacks compared to whites (Nicholson et al., 2008). This suggests that comparing answers of respondents to other people in a personal informatics report is not a promising tool to improve answer quality.

Exploratory analyses shed some light on this finding. Respondents' enjoyment of the survey differed depending upon the messages they received in the personal informatics report. People who were told that their network was larger than that of most Americans, who were told that their network was loosely connected or closely connected, and people who were told that their network was more diverse than that of most American enjoyed the survey more than respondents who received different messages. This suggests that some messages in a personal informatics can be perceived as unpleasant and should be avoided. However, knowing in advance what will be unpleasant seems challenging. Even within the U.S., there are regional differences in the extent to which people derive well-being from being autonomous (high in the Mountain region, low in West North Central) or having positive relations with others (high in New England, low in the East South Central, see Plaut et al., 2002). Thus, telling some people that they are very different from the average American may be uplifting, whereas this may be bad news to other people.

4.3. Limitations

The study reported in this paper was only implemented with MTurk participants, who are not representative of any population. It remains thus unclear how well the present results generalize to other potential respondents. Future studies could compare GENSI to traditional ego-centered questionnaires with representative samples.

The setup of the current study does not allow ruling out an alternative explanation for the lower density of networks when respondents used GENSI compared to a traditional questionnaire. Without being asked to evaluate each pair of alters separately in the graphical tool, some respondents may have forgotten to indicate some relationships. Other respondents were perhaps discouraged by the extra work involved in drawing each additional line. We could rule out that the lower network density was caused by more people indicating no ties at all in GENSI. However, the fact that there are no ties present in the default setting of GENSI reduces network density if relationships are forgotten. One direct solution to the problem of forgetting relationships would be to prompt respondents to indicate for every pair of alters whether a tie exists or not. However, this would mirror the traditional questionnaire approach in which a separate question is asked for every alter-alter combination. This would counter our effort to reduce respondent burden through the graphical interface. Thus, more research is needed to test whether the default setting of GENSI is problematic. Future research could test this with a debriefing interview in which respondents are asked to reconsider each tie decision they made in the graphical tool to find out if they accidentally or purposefully overlooked relationships.

4.4. Practicality

GENSI can be easily implemented in existing large-scale online surveys. For instance, it has been successfully applied in a study of the nationally representative LISS panel in the Netherlands. It works on all commonly-used Internet browsers (with the exception of very old versions of Internet Explorer) and can be completed on desktop computers and tablets. GENSI also works on smaller mobile devices, such as mobile phones, though the displays are mostly too small to show all details. Importantly, even though GENSI was designed for online surveys, it can also be applied during computer-assisted self-interviewing (CASI) during face-to-face surveys.

A practical limitation for future research with GENSI is that the tool is only suitable for small ego-centered networks. When the number of alters exceeds seven or eight, it gets visually challenging to see all circles in a network. A more complex tool such as netCanvas (Hogan et al., 2016), TellUsWho (Ricken et al., 2010) or ANAMIA EGOCENTER (Tubaro et al., 2014) may be better suited for research with big ego-centered networks. However, many researchers and many large population surveys (e.g., GSS, ANES, NELLS) limit respondents to five or fewer alters to keep the network questions to a feasible length within a larger survey. The new tool is well-suited for this purpose. It is available in Javascript source code and as such easy to implement in existing survey software. Responses are recorded in a CSV file that can be read into any statistical software package. Interested researchers can download GENSI from http://www.tobiasstark.nl/GENSI and use it free of charge.

5. Conclusion

Social network measurement has become hugely important in many lines of social science investigation. Previous research has suggested that collecting ego-centered network data in online surveys can be problematic (Matzat and Snijders, 2010). Even thought data quality can also be jeopardized by interviewers who falsely report no or very few network contacts (Eagle and Proeschold-Bell, 2015; Paik and Sanchagrin, 2013), face-to-face interviews or telephone interviews in which interviewers can motivate respondents to answer repetitive name interpreter questions effortfully may still be the best way to gauge ego-centered network data (Marsden, 2011).

No matter which mode of data collection is chosen, the measurement of attributes of social networks can be time-consuming and cognitively demanding for survey respondents. Therefore, researchers have tremendous incentives to make the process as efficient and as enjoyable as possible. The study reported here yielded promising findings encouraging further pursuit of GENSI, which takes advantage of computer administration to reduce cognitive burden and increase respondent engagement. However, there are still open questions such as the way in which the structure of a respondent's network should best be measured with a graphical tool. We look forward to future research exploring the potential value that GENSI or tools like it may bring to making social network measurement more efficient and effective.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.socnet.2016.07.007.

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