Social Isolation by Design: Bias in Measuring Core Networks in Taiwan?

Abstract

The estimation and measurement of the size of egocentric networks have sparked vigorous discussion and debate. Drawing on datasets from the Taiwan Social Change Survey, this study explores methodological issues pertaining to the change of core networks in Taiwan from 1997 to 2017 via a modified Poisson mixture approach, assesses the efficiency of name generators as a survey instrument via Fisher Information Maximizer, and investigates the role of social desirability in reporting core networks. Net of other effects, the study finds that individuals expressing a strong sense of social desirability report significantly fewer close contacts and face a higher risk of social isolation. Name generators in this study are associated with trivial design errors and can yield estimates comparable to those produced by exact enumeration. These findings are situated in the drastic changes in face-to-face survey interviews as well as the cultural context of Taiwan and, more broadly, East Asia. They call for further research inquiries into methodological issues regarding measuring and estimating egocentric networks in a transnational and modern setting.

Keywords

name generator, core discussion network, social desirability bias, modified Poisson regression, design errors

Introduction

Egocentric network analysis has long been a prominent approach for scholars to navigate patterns and shifts in social interactions (Laumann 1966; Wellman 1979; Fischer 1982; Marsden 1987; Lin 1999). Researchers particularly rely on name generators to elicit information about an individual's immediate social circle (Fischer 1982; Burt 1984; Marsden 1987). As a survey tool, the name generator can be readily deployed in different research settings. Its popularity further renders estimates of egocentric networks comparable by using the same question item across different waves of a survey. Nevertheless, debates over the validity and efficacy of the name eliciting processes raise serious concerns such as recall bias, interviewer effects, and improper estimation (Bell, Belli-McQueen, and Haider 2007; Eveland Jr., Hutchens, and Morey 2013; Fischer and Bayham 2019; Golinelli et al. 2010; Marsden 2003; Marsden and Hollstein 2023). For example, when McPherson et al. (2006, 2008) identified a drastic increase in social isolation using the name generator with important-matter questions, their findings led to extensive debates about survey designs and interpretations of the name-generator data (Fischer 2009; Paik and Sanchagrin 2013). In these studies, social isolation typically refers to respondents who report zero alters in response to the name-generator question. McPherson et al.'s conclusions have been subject to critique, with subsequent scholarship seeking to decompose the structure of the core discussion network and to interrogate the substantive linkages between transformations in egocentric networks and broader processes of social change (Bearman and Parigi 2004; Brashears 2011, 2014).

This paper argues that research on the measurement and estimation of egocentric networks can benefit from further exploration of three potential methodological issues: a concern linked to the internal design of the instrument, and two external factors embedded in the situational and cultural contexts in social surveys. First, it is common that survey investigators censor the full

name list that the name generator elicits at a predetermined number of alters, and essentially leave a right-censored count for analyzers. While researchers (e.g., Marsden 2003) tried to use the lowest integer (e.g., six or seven) to denote all the right-censored counts, the practice of replacing all right-censored counts (e.g., six and more, seven and more) with its lowest count may lead to underestimation of the network size (Fu, Guo, and Land 2020; Guo et al. 2020). It is thus imperative to assess the performance and design errors associated with name generators by using proper statistical models for right-censored counts.

Second, the name generator is often embedded in contextual cues to elicit names (Burt 1984; Marsden et al. 1987). While existing research tends to focus on interviewer effects in measuring egocentric networks, interviewee effects such as social desirability bias may also exist. Social desirability bias refers to a distortion of responses toward more socially acceptable behaviors and attitudes when answering sensitive topics such as political stance, voting turnout, mental health status, and family conflicts (Creighton 2020; Fu and Lu 2012; Holbrook and Krosnick 2010; Phillips and Clancy 1970). Although social desirability bias has long been documented in measuring social values and political attitudes, it is often overlooked in social network analysis. In a society where respect for others' privacy is a social norm (Bedford and Hwang 2003; Benedict 1946), it may be less desirable for those denying any socially inappropriate attitudes and behaviors to reveal their close alters to an outsider (i.e., interviewer) during their dyadic social interactions (i.e., face-to-face surveys).

Finally, the rise of social isolation or the decline in personal networks, if substantiated, may not be unique to the United States. Over the last two decades, similar temporal patterns in another postindustrial society, Taiwan, have also puzzled sociologists. As Su notes (2020: 86), the proportion of Taiwanese who reported that they did not seek help from anyone or discuss important

matters with anybody surged from 6 percent in 1997 to 29 percent in 2017. Likewise, there was a substantial decrease in the size of personal networks across sociodemographic groups. In the past two decades, Taiwan has seen drastic social changes along with extended democratic transition (Chang and Chu 2007; Chu and Lin 2001). As a society with a complicated history of Japanese colonialism, the merging of Indigenous peoples and a population that migrated from mainland China, and a state-building conundrum, understanding changes in egocentric networks in Taiwan can help scholars decipher similar puzzles in the United States or other postindustrial societies.

This study aims to address these methodological or comparative issues by estimating changes in egocentric networks based on longitudinal data from the name generators in the Taiwan Social Change Survey (TSCS). TSCS includes the same name-generator questions in both the 1997 and 2017 waves, which ask respondents to identify alters with whom they "discuss personal matters." The paper first assesses the risk of social isolation and the size of personal networks with an innovative modified Poisson mixture approach, which helps utilize the recently proposed Fisher Information Maximizer to decompose design errors. It then evaluates the efficiency of the name-generator method, and explores the possible social desirability bias in measuring egocentric networks. Before analyzing these methodological issues, it will help to review the benefits and pitfalls of name generators in egocentric network studies, the contextual background of the seeming rise of social isolation in Taiwan, and the potential social desirability bias in social surveys in general.

Name Generators in Egocentric Network Analysis: Benefits and Pitfalls

The initial incorporation of a name generator into a questionnaire marked an innovative and promising step toward collecting network data in large-scale surveys (Laumann 1973; McCallister

and Fischer 1978; Burt 1984; Fischer 1982; Marsden 1987). By using important matters as a context in the name generator to elicit alters and recording the number of names with an upper limit, the 1985 General Social Survey (GSS) successfully collected network data at the national level and summarized the characteristics of personal networks in the United States (Burt 1984; Marsden 1987). While McPherson et al. (2006, 2008) underscore the radical increase in social isolation over 20 years using the 2004 GSS data, this conclusion has been challenged by concerns regarding erroneous coding, inconsistent results based on other surveys, and contradictory observations within the dataset (Fischer 2009; McPherson, Smith-Lovin, and Brashears 2009).

Beyond disputes about claims of drastic social changes, a parallel line raises methodological concerns. Name generators typically come with concrete cues, such as "Looking back over the last six months—who are the people with whom you discussed matters important to you?" from the 1985 GSS (Burt 1984; Marsden 1987) or "who are the people you most frequently talk to about your personal matters, worries, or private concerns" from the 1997 TSCS (Chiu 1998), which often lead respondents to interpret the context and situation differently as they attempt to enlist their personal network members (Fu 2005; Lee and Bearman 2017; Lin, Fu, and Hsung 2001; Marin and Hampton 2007). The use of "discussing important matters" that Burt proposes (1984) was intended to capture intimate interactions via key social ties, and other scholars have largely supported its validity (Marin 2004; Straits 1991). However, a subsequent study (Small 2013) finds that the core discussion network question did not just capture strong ties, but a mixture of intimate and less-close alters. Lee and Bearman (2017) further discern that the priming effect of the presidential debate in 2004 decreased the reported network size. Bearman and Parigi's (2004) study further shows that trivial discussion topics may not reveal important social ties. Using nationally representative data, Brashears (2014) demonstrates that people actually retained social

support from key alters, regardless of discussion topics at stake. These mixed findings generally suggest that respondents' subjective framing of specific survey questions and contexts shapes their responses to name generators. This paper thus argues that respondents' perception of social desirability embedded in name generators, if any, will likely affect their dyadic interactions with interviewers and survey responses.

In addition, the name eliciting process inevitably burdens respondents, resulting in recall errors or training effects (Bell et al. 2007; Brashears 2011; Brewer and Webster 2000; Fischer 2009). For example, Fischer (2009) suggests that the extended question set in the 2004 GSS name generator could suppress willingness to name alters. To evaluate this concern, Brashears (2011) implemented a survey experiment to discern the training effect. The results show that training manipulation significantly produced more names but also had a negative effect on the likelihood of reporting zero names. In addition, respondents were more likely to forget names in surveys that ask for a longer reference period (Bell et al. 2007), while forgetting contacts seriously underestimated the size of egocentric core networks (Brewer and Webster 2000).

The name-eliciting process further poses challenges for network researchers when analyzing the resulting data. Since the burden of eliciting names grows substantially with the number of alters mentioned, it is common to cap the number of names at a certain limit. For example, both Marsden (1987) and McPherson et al. (2006, 2008) code the respondents who reported six or more names as 6.5 names. Such a right-censoring estimation is practical and helpful, but its methodological implications need to be addressed. When studying large organizations, eliciting five names might be sufficient to capture the members' network characteristics (Merluzzi and Burt 2013). However, in large-scale survey studies of personal network research, asking fewer alters could distort a respondent's network and cause bias in estimation (Stadel and Stulp 2022).

According to a simulation study, such measurement errors tended to decrease with increasing sample sizes of alters and even became negligible around upper bounds of ten to twelve names (Golinelli et al. 2010). While most extant studies rely on different surveys or simulated network data to assess the design of the name generator, it would be more compelling to compare the exact enumeration of names directly based on the same egocentric network.

Meanwhile, due to the lack of proper statistical tools to estimate right-censored counts from a Poisson (mixture) distribution, researchers arbitrarily assign an integer to represent the last right-censored category and rely on existing software packages for estimation (Eveland Jr. et al. 2013; Marsden 2003). Yet the probability of a specific count is conceptually and empirically different from the probability of *all* combined right-censored counts, and this approximation always leads to information loss and biased estimates (Guo and Fu 2024). As a rule, survey data collection always involves a trade-off between what researchers want and what respondents are willing to offer (Fu, Guo, and Land 2020). Although exact enumeration of social contacts via single-item questions demands less effort from interviewers and thus reduces between-interviewer differences in data collection (Marsden 2003), it may impose a greater cognitive burden on respondents and lead to excessive missing or biased data. In response to these issues, this study uses the modified Poisson mixture approach to modeling right-censored counts collected by name generators (Gu et al. 2023; Fu et al. 2020; Fu, Zhou, and Guo 2021; Fu, Guo, and Land 2018), and further employs a recently proposed method, the Fisher Information Maximizer, to evaluate the impacts of such approximation on the analysis of core networks (Guo and Fu 2024).

Social Isolation in Taiwan: An Artifact?

Before discussing the changes in social isolation and personal networks in Taiwan, it is useful to

revisit the debates on the drastic increase in social isolation in America (McPherson et al. 2006, 2008). On the one hand, it is possible that the organizational social life was shrinking and American people refrained from civic engagement (Putnam 2000). On the other hand, a fragmented society did not necessarily lead to the rise of social isolation. Shrinking discussion networks may only reflect changes in population structures and cultural values (Fischer 1975, 2008; Fischer and Mattson 2009). Furthermore, the emergence of cyberspace has greatly changed how people connect and communicate with each other (Wang and Wellman 2010; Wu 2023). In addition, researchers who hold different views tend to agree that people in postindustrial societies gradually transcend their immediate social circles and rely less on family and kin ties (Fischer 1982; Fischer and Mattson 2009; Wellman 1979).

Taiwan's change in the core network size between 1997 and 2017 is therefore an intriguing but not unique puzzle. Due to the mild transition from an authoritarian reign to a democratic institution, scholars prefer to categorize Taiwan's social culture as "Confucianism with a liberal face," which is a combination of traditional values such as valuing family and communal interest, social harmony, and support for democracy (Ling and Shih 1998). Although the increasing loneliness and isolation that older people experience have raised attention for their mental health and living situation (e.g., Tsai et al. 2022), Taiwan is recognized as a society that valorizes interpersonal connections with an emphasis on *guanxi* and *renqing* (Hwang 1987; Yang 1994; Marsh 2003). The paradox in the field of cultural and societal transition defies a linear assumption of modernization, which assumes that the society and cultural values change with the process of modernization and post-industrialization (Inglehart 1997). These intriguing shifts lead us to consider whether Taiwan is experiencing a similar trend of social isolation as that observed in other postindustrial societies.

Social Desirability Bias in Egocentric Network Analysis

When asked to provide information on sensitive or less desirable topics (e.g., drug use, sex behaviors, juvenile delinquency), respondents tend to underreport or misreport attitudes, behaviors, or events, especially during their interactions with unfamiliar interviewers (Edwards 1957; Nederhof 1985). For example, in electoral democracies people abide by social norms and are less likely to provide reliable information on political participation and ideologies (Creighton 2020; Holbrook and Krosnick 2010). In general, social desirability bias is an interviewee effect and largely not attributable to less-experienced, careless, or inadequately trained interviewers, although interviewers may subconsciously induce answers aligned with social expectations (Fu and Lu 2012). It is also worth noting that social desirability bias as an interviewee effect often involves prosocial deceptions in surveys (Nederhof 1985), and is different from respondents' satisficing strategies that aim at avoiding complex questions (Schaeffer and Dykema 2011).

Contextual cues used in the name-eliciting questions sometimes induce social desirability. Take the important-matter item as an example, the meaning of "discussing important matters" could vary with the context (Lee and Bearman 2017). Respondents either demonstrate a tendency to avoid conflicts in daily life when perceiving important matters as sensitive topics, or refrain from revealing sensitive information. Latkin et al. (2017) find that substance users who provide socially desirable answers tend to report smaller network sizes, which suggests that social desirability bias can be a factor relevant to network analysis. Like other surveys that use name generators, the name generator in the Taiwan Social Change Survey (TSCS) demands information on a network member's gender, marital status, place of origin, education and class status. Moreover, it asks the respondent (or "ego") to assess his/her intimacy with an alter, and the degree

of closeness between each pair of alters. If "the social world with the 'alter egos' in it is arranged around the self as a center in various degrees of intimacy and anonymity" (Schutz 1976: 70), Taiwanese may find it more socially desirable to keep their intimates anonymous from a stranger because close contacts are not necessarily distinct from family members and kin (Lin, Chen, and Fu 2010).

Social desirability can also be explained by cultural factors. Given Japan's takeover of Taiwan after the Treaty of Shimonoseki (Maguan) in 1895 and the later handover of Taiwan to the Republic of China in 1945, over the past two centuries Taiwanese society has been jointly shaped by Chinese and Japanese cultures. Both cultures, especially the latter, feature a sense of shame regarding alters' negatively evaluation of ego (Wong and Jeanne 2007). In her timeless work, Benedict (1946) describes Japanese culture as a "shame culture" and American culture as a "guilt culture," and points out, "A failure to follow their explicit signposts of good behavior, a failure to balance obligations or to foresee contingencies is a shame (*haji*). Shame, they say, is the root of virtue. A man who is sensitive to it will carry out all the rules of good behavior. 'A man who knows shame' is sometimes translated 'virtuous man,' sometimes 'man of honor'" (1946: 224). In a society where "*bu hao yi si*" (feeling embarrassed) is on the lips of many residents in everyday life, providing detailed private information on alters to a stranger might not live up to ego's standard of being a "virtuous man" and creates a cultural nuisance. In fact, underreporting in core discussion networks is not an exception to the general conclusion that shame-prone individuals tend to withdraw from or avoid socially undesirable scenarios (Tangney and Dearing 2002; Tracy, Robins, and Tangney 2007).

Data and Methods

Data

All analyses draw upon data from the 1997 and 2017 waves of the Taiwan Social Change Survey (Chiu 1999; Fu 2021). The TSCS collected data on egocentric networks using the name-generator method and other network items in these two waves. As one of the largest general survey series (Smith et al. 2006), a member of the International Social Survey Program (ISSP) since 2001 and one of the founding members of the East Asian Social Surveys (EASS) since 2003, the TSCS has sampled and interviewed representative adults to track profound social, political, economic, and cultural changes in Taiwan since 1985 (Chang and Fu 2004). In both the 1997 and 2017 surveys the TSCS used the same sampling design by first categorizing all 358 towns and cities into seven strata based on major sociodemographic indices. The design then set numbers of target respondents in each of these seven strata following the principle of "probability proportionate to size" (PPS). To reach the numbers of target respondents in each stratum, a three-stage (town/city, village/precinct, individual person) sampling scheme guided each survey team to allocate the number of targets for both the village and town levels. A list of named individuals extracted from the Household and Population Register, with addresses, fulfilled the interviewers' need to visit each sampled individual to conduct a face-to-face interview. According to three definitions, the response rates for each survey varied between 48 percent and 65 percent with the 2017 survey reaching 50 percent based on the second standard set in the 2011 version of the calculation by the AAPOR (American Association for Public Opinion Research) (Fu et al. 2018; Fu and Chu 2008). The successful total cases of interviews were 2,836 for the 1997 survey, and 1,955 for the 2017 survey.

Variables

Both the 1997 and 2017 waves included multiple name-generator questions. To ensure the

consistency of measurement, the paper analyzes the following question, which has appeared in both waves, to estimate egocentric emotional networks:

In the past year, who are the people you most frequently talk to about your personal matters, worries, or private concerns (such as interpersonal relationships, etc.)? [If there are fewer than five people, please ask whether there are any others, and fill in the names or initials of these people in the table below].

This personal-matter question aligns with a common theoretical assumption that divides social networks by instrumental and emotional ends as a way to mobilize resources through connections (Burt 2019; Lin 2001). We consider it a type of egocentric core network despite its different contextual cues (Burt et al. 2012; Marin and Hampton 2007). The thresholds for right censoring in the name generators were five and six names in the 1997 and 2017 waves, respectively. The different thresholds prevent a direct comparison between the results from the two waves via traditional statistical models, and require the application of the modified Poisson (mixture) approach.

Four sociodemographic variables describe the respondents' background: age, sex (male coded as one and female coded as zero), marital status (married respondents coded as one and zero otherwise), and region of birth (southern Taiwan coded as one and other regions of birth coded as zero). Education, income, religious affiliation, and employment status—four key socioeconomic variables—serve as indicators of access to networks and network-based resources (Contreras et al. 2019; Lim and Putnam 2010; Lin 2000). Educational attainment was divided by whether the respondent obtained a college degree. The income variable was constructed based on the quartiles of respondents' monthly personal income in each survey wave. Those whose personal income was below the lower quartile (the bottom 25 percent) were coded as low income, whereas those whose

income was higher than the upper quartile (the top 25 percent) were coded as high income. Those between the lower- and upper-income quartiles served as the reference group. For employment status, those who had full-time employment were coded as one and zero otherwise. The analysis further categorizes the religion variable into three groups: religions demanding regular attendance at religious activities (including Muslim, Catholicism, Christianity, and Protestant) and other religions (including Buddhism, Taoism, and other folk religions) were coded into two separate groups, with nonreligious coded as the reference group.

The 2017 wave extracted three items from Crowne and Marlowe's (1960: 351) influential Social Desirability Scale, which reflect common social faux pas that are a key part of impression management in everyday interactions: taking advantage of others (item 15), being jealous (item 28), and gossiping (item 11). These three items capture highly common yet socially undesirable behaviors that respondents may be reluctant to admit, especially to a stranger. The survey team deliberately selected these three items because they effectively indicate the extent to which respondents purposely or inadvertently impress others by denying popular negative behaviors that are typically undesirable in the local cultural context, based on a series of empirical studies (Money 2023; Paulhus 1984, 1991; Yang 2004). When a respondent denies committing or intending to commit such "small evils" in human nature, we hypothesize that the network data collected during the survey is subject to social desirability bias. Respondents tend to answer in a way that conforms to socially approved norms, which in turn affects both the probability of giving zero names and the number of reported names.

The inclusion of these items provides an ideal opportunity to detect social desirability bias in name generators. The corresponding survey items are "wanting to take advantage of others," "being jealous of others' good fortune," and "gossiping about others." Respondents rated the

frequency of these feelings or intentions using a four-point scale, with "1" indicating "often" and "4" denoting "never." Principal component analysis (PCA, results in Appendix I) incorporates the three items and yields a key variable, *Virtuous*, which captures social desirability bias: higher values indicate that respondents avoided taking advantage of others, being jealous, or gossiping. Based on PCA results, two other variables characterize respondents with less-desirable behaviors and attitudes (see Appendix II for factor loadings). The variable *Sharky* describes those who tend to take advantage of others but are not gossipy, while the variable *Green-eyed* describes those who are often jealous of others. Following Land et al. (1990 note 22: 942–943), the procedure purged variables with small loadings in constructing the social desirability variables.

Modelling Strategies

The modified Poisson (mixture) approach estimates the size of egocentric networks (Fu, Guo, and Land 2020; Fu, Zhou, and Guo 2021), and the corresponding Fisher Information Maximizer evaluates design errors of the name generator (Guo and Fu 2024). First, the analysis considers the scenario of exact enumeration, which existing Poisson regression models readily analyze (Agresti 2012; Land, McCall, and Nagin 1996). Ego's exact report of names is denoted as the dependent variable Y that follows the Poisson distribution $\mathbf{Pois}(\mu)$. The dependent variable Y is modeled by covariates $\mathbf{X} = (1, X_1, \cdots, X_q)^T$ with their regression coefficients $\boldsymbol{\beta} = (\beta_0, \beta_1, \cdots, \beta_q)^T$ via the link function $\mu = \exp(\boldsymbol{\beta}^T \mathbf{X})$. With the use of a name generator, ego's right-censored count of names can be partitioned using a grouping scheme $\mathrm{G} = \langle l_1, l_2, \cdots, l_{N+1} \rangle$, where $N \geq 2$. One of these groups that log the name count is denoted as $\{\text{integer } k : l_i \leq k < l_{i+1}\}$, where $0 = l_1 < 1 = l_2 < \cdots < l_{N+1} = \infty$. The scheme indicates how counts are grouped and where right-censoring occurs. Taking the 2017

wave of TSCS as an example, the grouping scheme of answers from the name generator with six names as the threshold for right censoring is expressed as $\mathrm{G}^{*} = \langle 0,1,2,3,4,5,6,\infty \rangle$ where $N = 7$. To facilitate the subsequent assessment of design errors, an observation of the name generator in GRC counts has a multinomial distribution $Y_{\mathrm{G}} \sim \mathbf{M}(\theta_1^{\mathrm{G}},\cdots,\theta_N^{\mathrm{G}})$ over the groups so that the probability of a group is the combined probability masses of:

$$\mathbf{Prob}(Y_{\mathrm{G}} = j) \ = \theta^{\mathrm{G}}(j,\mu) = \sum_{k=l_j}^{l_{j+1}-1} e^{-\mu}\,\frac{\mu^k}{k!} \tag{1}$$

Correspondingly, the log-likelihood of the modified Poisson model is:

$$\ell_n^{\mathrm{G}}(\boldsymbol{\beta}) = \sum_{i=1}^{n} \log\theta^{\mathrm{G}}(Y_{\mathrm{G}}^i, \exp(\boldsymbol{\beta}^T \mathbf{X}^i)) \tag{2}$$

Results given by name generators may exhibit excessive zeros due to three possibilities: interviewers skip or stop probing the number of names, respondents refrain from giving any names because of privacy concerns or other reasons, and respondents have difficulty identifying their close contacts. These different origins of zeros require more fine-tuned modeling. For example, in the 1985 and 2004 waves of the GSS in the U.S., nearly 10 percent and 25 percent of respondents reported zero contacts in their core discussion networks, respectively (Marsden 1987; McPherson et al. 2009). Motalebi et al. (2023) suggest that the data generating process of egocentric networks follows a zero-inflated Poisson distribution. In this framework zero names are divided into structural zeros and stochastic zeros. Structural zeros suggest that respondents are not at risk of (the stochastic process of) having core discussion contacts and thus report zero names in a deterministic way, whereas stochastic zeros indicate that respondents are at risk of having core discussion contacts but report zero names due to the very nature of this stochastic process. While the issue of zero names has sometimes been analyzed separately (Marsden 1987; McPherson et al. 2006, 2008), we argue that the ZIP model better captures the name-elicitation process. Social

isolation refers to both structural zeros and stochastic zeros in this framework. The analysis thus considers a modified Poisson Mixture approach (Fu, Guo, and Land 2018). Now the exact count of names follows a zero-inflated Poisson (ZIP) distribution given by $Y \sim \mathbf{ZIP}(p, \lambda)$, where λ stands for the expected count of names and p is the proportion of individuals report at least one name:

$$\mathbf{Prob}(Y = k) = \begin{cases} (1-p) + pe^{-\lambda}, & k = 0, \\ pe^{-\lambda} \dfrac{\mu^{\lambda}}{k!}, & k \geq 1. \end{cases} \tag{3}$$

Correspondingly, the right-censored count of names follows a multinomial distribution $Y_{\mathrm{G}} \sim \mathbf{M}(\pi_1^{\mathrm{G}}, \cdots, \pi_N^{\mathrm{G}})$, where:

$$\pi^{\mathrm{G}}(j, \lambda, p) = \begin{cases} 1 - p + pe^{-\lambda}, & j = 1, \\ p \sum_{k=l_j}^{l_{j+1}-1} e^{-\lambda} \dfrac{\lambda^k}{k!}, & 2 \leq j \leq N. \end{cases} \tag{4}$$

The link function $\boldsymbol{p} = \dfrac{1}{1 + \exp\left(-\boldsymbol{\gamma}^{\mathrm{T}} \mathbf{V}\right)}$ has a set of covariates $\mathbf{V} = (1, V_1, \cdots, V_s)^T$ and their corresponding regression coefficient $\boldsymbol{\gamma} = (\gamma_0, \gamma_1, \cdots, \gamma_s)^T$. The configuration of the Poisson part in the modified Poisson mixture regression is the same as the modified Poisson regression. A hybrid-line search algorithm was implemented to obtain estimates of the Modified Poisson (mixture) models (Fu, Zhou, and Guo 2021).

Based on estimates from modified Poisson (mixture) models, the analysis uses the Fisher Information Maximizer (FIM) (Guo and Fu, 2024) to assess design errors attributable to right censoring. The FIM draws on estimates from generalized linear models to decompose the total design error into groups and grouping errors. More specifically, groups errors are attributable to fewer groups in a grouping scheme, or a lower threshold of right censoring in the current study.

Grouping errors refer to design errors caused by inappropriate grouping and/or right censoring decisions when the current grouping scheme is compared with an optimal one of the same N by the FIM. Because name generators only involve right-censoring rather than grouping of counts, groups errors are more relevant to our assessment of the efficiency of name generators. Moreover, the analysis also uses the FIM to obtain regressor-specific Fisher (information) ratios to assess the reduction in statistical efficiency from exact enumeration to right censoring. We calculated the Fisher ratio using a score function of the Fisher information matrix (see "Calculate Design Errors and Assess Grouping Schemes" in Guo and Fu [2024] for a detailed discussion). Considering the modified Poisson model in (2), its Fisher information matrix $\mathrm{F}^{\mathcal{G}}(\boldsymbol{\beta})$ was defined via Hessian matrix as follows:

$$\mathrm{F}^{\mathcal{G}}(\boldsymbol{\beta}) = -\mathrm{E}\left[\frac{1}{n} Hess(\ell_n^{\mathrm{G}}(\boldsymbol{\beta}))\middle|\left\{\mathbf{X}^i\right\}_{i=1}^{n}\right] = -\frac{1}{n}\sum_{i=1}^{n}\mathbf{E}\left[Hess(\ell_1^{\mathrm{G}}(\boldsymbol{\beta}))\middle|\mathbf{X}=\mathbf{X}^i\right],$$

The Fisher ratio has a maximum of 100 percent, whereas a higher value means less loss of efficiency caused by right censoring, as compared to exact enumeration.

Results

Table 1 presents descriptive statistics for cases with valid responses to the name generator in 1997 and 2017, highlighting key changes over time. Notably, the proportion of participants reporting no close contacts in their emotional networks in 2017 (32.07 percent) was significantly higher than in 1997 (6.06 percent), suggesting a potential rise of social isolation in Taiwan. The distribution of gender remained relatively stable across both waves, with roughly equal proportions at 50 percent of male and female participants. Participants who obtained a college degree increased from 24.02 percent in 1997 to 45.28 percent in 2017. The proportion of married respondents declined from

70.03 percent in 1997 to 55.65 percent in 2017. In 1997 23.73 percent of respondents lived in southern Taiwan, increasing to 36.24 percent in 2017. In both waves, more than 70 percent of respondents reported having religious beliefs, though most were religious without compulsory attendance. The full-time employment rate was 63.42 percent in 1997 and 60.99 percent in 2017. Personal income distribution also shifted slightly, with the proportion of low-income respondents decreasing from 28.51 percent to 21.48 percent, while the high-income group declined from 26.29 percent to 20.78 percent.

[Table 1 about here]

Table 2 compares the estimated results from two models in 1997 and 2017 while controlling for demographic and socioeconomic variables. For the modified Poisson model, male and older respondents reported fewer close contacts compared to female samples in both 1997 and 2017. In both models having a college degree had a significant positive influence on network size, which demonstrates that higher educational attainment enabled people to establish more connections. Participants with religious beliefs that require regular attendance, including Muslims, Catholics, Christians, and Protestants, named more closed contacts compared to the non-religious population in both 1997 and 2017. Full-time employment exerted no significant influence on one's network size in 1997 but reduced the reported number of names in 2017. Income level was a significant factor only in 2017, when a higher income level correlated with more reported names while the lower-income respondents reported fewer names.

[Table 2 about here]

The modified ZIP model decomposed zeros into the proportion of respondents not at risk of having core networks and those who were at risk. Corresponding to the results of the modified Poisson model, male and older respondents correlated with higher proportions of not at risk of

having core networks, and their networks were significantly smaller than female respondents in both 1997 and 2017. Having a college degree was associated with a lower proportion of not at risk of having core networks and larger network sizes in 2017, but showed no significant impact in 1997. Getting married reduced the network size but decreased the proportion of not at risk of having core networks in both 1997 and 2017. In both the 1997 and 2017 waves religious affiliation could increase the network size but showed no influence on the proportion of not at risk of having core networks. The income effects were not significant in 1997 after the ZIP model decomposed zeros. In 2017 lower-income respondents had fewer reported closed contacts and a higher proportion of not at risk of having core networks. Respondents from the higher income group correlated with a lower proportion of not at risk of having core networks, but showed no difference in the network size. Respondents born in southern Taiwan reported a larger network size in 2017 but showed a higher proportion of not at risk of having core networks in 1997.

Figure 1 illustrates the estimated relationship between the size of core discussion networks and the proportion of reporting zero names, holding all other variables constant at their average values. Estimates from the modified Poisson model showed a decline in the number of named alters, from an average of 3.80 to 2.12 alters, which reflected a shrinking core network size. The binomial component of the modified Poisson mixture model reveals a sharper increase in social isolation. The proportion of respondents not at risk of having core discussion contacts was 2.83 percent in 1997 and 20.09 percent in 2017. When combined with those at risk of having core discussion contacts but reported no names, the proportion of social isolation rises from 4.64 percent in 1997 to 21.99 percent in 2017, alongside a decrease in the average network size from 3.99 to 2.86 names.

[Figure 1 about here]

We then incorporated social desirability variables to reanalyze the 2017 data, as presented in Table 3. The modified Poisson regression model revealed that respondents who reported higher levels of socially desirable behaviors, namely portrayed themselves as seemingly more virtuous, reported significantly smaller core networks. Being green-eyed also reduced the reported size of personal emotional networks. In the ZIP model self-portraying as "virtuous" correlated with a higher proportion of not at risk of having core networks and fewer names at the same time. However, confessing to socially undesired behaviors demonstrated a different influence on unveiling closed contacts. Respondents who reported jealous behavior had fewer close contacts but showed no difference in the proportion of not at risk of having core networks. On the other hand, respondents who reported sharky behaviors were associated with a higher proportion of not at risk of having core networks but showed no difference in the number of names. Even though we cannot rely on testimonies in survey questions and justify them as social facts, the association between prompting social desirability and network size corroborated our hypothesis that virtuous respondents who denied committing socially undesirable behaviors also tended to retreat from disclosing their close social networks during the face-to-face interviews.

[Table 3 about here]

Table 4 presents the regression estimates and design errors for the generator in 2017, controlling for demographic and socioeconomic factors. The Fisher ratio in the last column demonstrates the relative efficiency between using the name generator as GRC counts and exact enumeration counts as in the conventional Poisson-regression. Since most of the Fisher ratio exceeded 90 percent, using the name generator to draw the size of egocentric networks is not significantly different from the exact enumeration of names. In terms of survey design, the current grouping scheme was not substantially different from the global optimal scheme, which modified

the exact name eliciting process from the first five names to the first four names, namely [0 name, 1 name, 2 names, 3 names, 4~5 names, 6~7 names, 8+names]. Overall, the name generator can be legitimately used in the survey without much loss of efficiency.

Given that the TSCS 1997 did not include measures for social desirability, the question remains as to why social desirability in 1997, presumably also present, did not cause the degree of underreporting as was observed two decades later. One possible answer may be that social desirability was not as prevalent during that survey. Figure 2 summarizes how many respondents denied doing three socially undesirable behaviors in seven waves of the TSCS that used the identical scale from 2006 to 2022. The overall responses to social desirability had been on the rise up to 2017. For example, in 2006 about 27.2 percent of the TSCS respondents denied doing all three common yet socially undesirable behaviors, but this proportion increased to 48.0 percent in 2017. This temporal change may have coincided with the decrease in the reported number of discussion network members. When Taiwanese became more unwilling to disclose personal information in the decade prior to 2017, especially in a face-to-face interview situation, they were not necessarily experiencing higher social isolation. Instead, they simply refrained from revealing information to the survey interviewers, given that it was an interaction with a total stranger.

[Figure 2 about here]

We further investigated which covariates explained the virtuous variable via an analysis of variance (Appendix II), and found that age explained a large proportion of its variation. Our auxiliary analysis showed that age and being less educated were positively associated with being virtuous (results available upon request). The rise in social isolation and the decline in core discussion groups may also reflect the difference in average ages between the two waves. The participants in this nationally representative survey in 2017, with ages ranging from 19 to 100,

were on average 5.9 years older than those in 1997 (ages ranging from 19 and 74, see Table 1), partly due to lifting the upper age cutoff of the target sample after the TSCS joined the ISSP in 2001, and partly due to Taiwan's rapidly aging population.

Conclusion and Discussion

Using data from the 1997 and 2017 waves of the Taiwan Social Change Survey, this study presents evidence that parallels the well-documented decline of core discussion network in the United States. Importantly, rather than treating this trend as straightforward proof of rising social isolation in Taiwan, this analysis contributes to the literature on the name generator and the measurement of isolation by addressing both internal and external methodological issues. First of all, we adopted a modified Poisson (mixture) method to estimate changes in egocentric core networks. The new estimates suggested that the decrease in the numbers of core network members may be a sign of the rise of social isolation in Taiwan over the last two decades. Additionally, the calculation of regressor-specific design errors via the Fisher Information Maximizer suggested that the TSCS's name generator was an efficient survey instrument with trivial information loss when compared with the scenario of exact enumeration.

The study further highlights the role of potential social desirability bias in asking about the name-generator question during face-to-face interviews with contextual cues: the *virtuous* respondents tended to report smaller core discussion networks, which have been linked to higher probabilities of social isolation. Such an interviewee effect was significant based on the analysis of the 2017 wave of the TSCS, the only accessible dataset that contained both a name generator and a social desirability scale. Since the extent of social desirability bias peaked during the second wave of the survey in 2017, it is plausible that a more profound interviewee effect might have also

contributed to the decline in network members reported over the two decades.

Finally, the findings suggest that any bias associated with name generators is more likely to arise in the implementation rather than the design or estimation. Goffman's (1959) dramaturgical analysis points out that survey participation itself is a performance: in the "front stage" of the face-to-face interview, respondents manage impressions and tailor their answers to social expectations, while the "back stage" remains largely private and often disguised. To some extent social desirability bias reflects the dynamics between the front stage and back stage that not only shape how people respond to name-generator questions, but also how researchers interpret latent network parameters based on observed survey answers. In this regard, is it possible that the rise in social isolation in Taiwan and elsewhere is an artifact because researchers intend to study ego's backstage life, or should we perceive the rise in social isolation as a literal reflection of ego's everyday presentation in the front stage? Likewise, should researchers distinguish between respondents who appear to be virtuous and those who are actually virtuous? Answers to those questions have important implications on the future use of name generators, and, more broadly, the analysis of egocentric networks.

This study is not without limitations, which suggests directions for future research. Drawing from datasets that facilitate temporal comparisons based on compatible modules from the same social survey series, the analysis covered only two waves of the TSCS. More compatible modules containing an identical name generator in future waves or from other surveys conducted in other parts of the world would yield informative findings, further extending inquiries into how network generators can help us understand the extent of social isolation under multiple social and cultural circumstances.

Moreover, social desirability measures were incorporated into the TSCS after 2006, which

prevents a direct comparison of the impacts of social desirability between the two waves in this study. If more social network surveys around the world incorporated similar items from established social desirability scales into the same module, the resulting datasets would help clarify the extent to which interviewee effects influence self-reported core network sizes across time and space. Since the social norms regarding self-disclosure and impression management could differ extensively from culture to culture, survey teams could select proper standardized social desirability questions that best fit the local context. With empirical data covering broader regional variations, future comparative studies on egocentric networks would further inform whether and how the survey results of name generators are subject to social desirability bias in different societies or ethnic groups.

Like many other large-scale social surveys other than the General Social Survey (Marsden, Fekete, and Baum 2021), the TSCS typically focuses on questionnaire surveys without supplemental data from other collection methods. As a result, it is difficult to cross-validate whether and how the estimation of personal networks varies by social desirability bias with comparable results from in-depth interviews, focus groups, or survey experiments (e.g., list experiment) (Cyr 2016; Gonzalez-Ocantos et al. 2012). The only exception was that some respondents in the 2017 TSCS Network module also agreed to provide their contact records on Facebook, which yielded rich information about how indirect contacts became direct contacts online (Lee et al. 2022). However, this extra data source only revealed the extent to which these respondents networked on one particular online platform. Future studies could supplement a large-scale survey with background information to understand more comprehensively how people maintain their personal networks and perceive or recall the networking.

Like other self-reported measures, the findings of the name generator in the same cross-

sectional survey series yield noticeable temporal differences because the representative respondents in a later wave have different patterns of networking from their counterparts in the previous wave. As implied in this study, survey results also diverge because people have changed in the extent to which they are willing to share information about their personal networks. Such a shift in survey response behaviors reflects widespread impacts from pertinent policy changes, as with the case of Taiwan's Personal Data Protection Act (PDPA). After the PDPA came into effect in 2012, it became more common for residents to exercise their legal right to refuse to disclose detailed information about any personal matters. Even when respondents agreed to be interviewed, such reservation during interviews often made it harder to obtain unbiased and comprehensive information in large-scale face-to-face surveys. Such surveys have generally become increasingly difficult to implement, particularly in a respondent's residence or workplace. Under such circumstances, interpreting the findings from such a labile survey item as the name generator (Marsden, Fekete, and Baum 2021: 542) would indeed require extra caution.

When an increasing number of people become more reserved and reluctant to respond to sensitive questions in social surveys, does it signify a trend that also indicates or breeds social isolation, or that the society has further fragmented, and people have diverged in how they interact with others in disclosing personal matters, a trend propelled by the rapid transformation of communication technologies? Since the practice of social surveys also experienced tremendous changes over the decades, to what extent can network researchers rely on conventional social surveys to analyze the fragmenting trends of social networking? How can the preexisting mixed method approaches incorporate big data to better understand social isolation or alternative forms of social integration?

This study probably raises more questions than it answers. If one denies ever doing or even

trying to do highly common yet socially undesirable behaviors under the specific situation of interaction during a face-to-face interview, to what extent can researchers expect the same respondent to fully cooperate and give unbiased answers to other sensitive questions? The 1997 survey did not include the social desirability scale, so the exact change from 1997 to 2017 is unknown. However, it makes us ponder whether the increasing zero names from the name generator is equivalent with rising social isolation in society. To decipher the rise of social isolation in Taiwan, we need to elucidate the link between population aging and the consciousness or behaviors of being virtuous in Taiwanese society. As C. Wright Mills observes (Mills and Gitlin 2000), only when we have clarified and systematically evaluated a sociological hypothesis that explains the specific sociopsychological mechanisms by which cultural factors operate can we elucidate social changes in a given culture. It is only in this way that we can gain a clearer and more holistic understanding of the relationship between a social phenomenon and its cultural context.

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Tables and Figures

Table 1 Descriptive Statistics of Variables, Taiwan Social Change Survey 1997 and 2017

Number of Core Discussion Contacts	Mean	
	TSCS1997 (N=2823)	TSCS2017 (N=1946)
None	6.06%	32.07%
1 person	8.43%	17.01%
2 persons	9.46%	13.82%
3 persons	26.67%	12.59%
4 persons	13.64%	5.70%
5 persons	35.74%	9.25%
6 persons and more		9.56%
Demographic Variables		
Male	50.96%	51.90%
Age	43.11	49.01
College Educated	24.02%	45.28%
Married	70.03%	55.65%
Southern Taiwan	23.73%	36.24%
Socioeconomic Variables		
Average Monthly Income (New Taiwan Dollar)*	29710.55	36169.18
Religions Requiring Regular Attendance	3.97%	5.54%
Other Religions	73.78%	71.20%
Full-time Employment	63.42%	60.99%
Social Desirability		
Taking advantage of others		
Often	—	0.26%
Sometimes	—	2.52%
Seldom	—	19.51%
Never	—	77.52%
Jealous		
Often	—	0.77%
Sometimes	—	10.42%
Seldom	—	21.92%
Never	—	66.58%
Gossipy		
Often	—	0.72%
Sometimes	—	10.73%
Seldom	—	33.06%
Never	—	55.29%

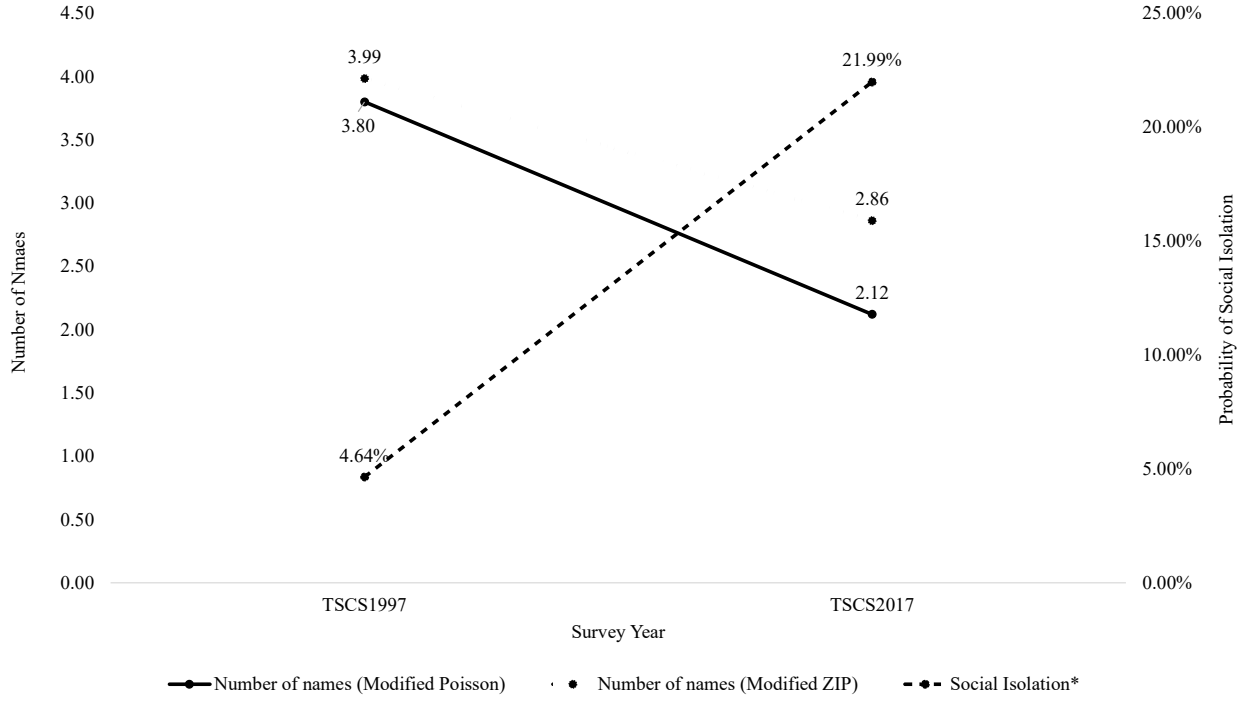
*Note: The average income was calculated based on original income categories.

Table 2 Regression Estimates of Core Discussion Networks from Modified Poisson (Mixture) Model, Taiwan Social Change Survey, 1997 and 2017

	Modified Poisson Regression				Modified Poisson Mixture Model	
	Number of Contacts		Risk of Social Isolation		Number of Contacts	
Survey Year	1997	2017	1997	2017	1997	2017
Male	-0.147***	-0.021***	1.146***	0.058***	-0.100***	-0.008***
	(0.023)	(0.001)	(0.309)	(0.006)	(0.024)	(0.002)
Age	-0.006***	-0.394***	0.033***	1.247***	-0.004***	-0.185***
	(0.001)	(0.034)	(0.009)	(0.179)	(0.001)	(0.037)
College Educated	0.152***	0.189***	-0.332	-0.571**	0.143***	0.098*
	(0.027)	(0.039)	(0.379)	(0.195)	(0.029)	(0.042)
Married	-0.073**	-0.053	-0.537†	-0.554**	-0.101***	-0.189***
	(0.025)	(0.038)	(0.275)	(0.176)	(0.026)	(0.041)
Religions Requiring Regular Attendance	0.245***	0.208**	-1.410	-0.642	0.205***	0.151*
	(0.056)	(0.070)	(1.149)	(0.440)	(0.058)	(0.072)
Other Religions	0.136***	-0.039	-0.404	-0.264	0.122***	-0.072.
	(0.027)	(0.039)	(0.280)	(0.207)	(0.028)	(0.042)
Full-time Employment	-0.004	-0.157***	0.277	0.248	0.011	-0.122*
	(0.037)	(0.045)	(0.409)	(0.215)	(0.039)	(0.048)
Low Income	-0.064	-0.340***	0.034	0.872***	-0.064	-0.138*
	(0.039)	(0.057)	(0.423)	(0.228)	(0.041)	(0.062)
High Income	0.014	0.199***	-0.635†	-0.609*	-0.017	0.072
	(0.028)	(0.044)	(0.377)	(0.243)	(0.030)	(0.047)
Southern Taiwan	-0.033	0.144***	0.528*	-0.176	-0.011	0.120**
	(0.022)	(0.034)	(0.251)	(0.168)	(0.023)	(0.037)
Intercept	1.594***	1.942***	-4.955***	-4.229***	1.577***	1.648***
	(0.056)	(0.085)	(0.682)	(0.449)	(0.059)	(0.093)

Note: *** p< 0.001, ** p< 0.01, * p< 0.05, † p< 0.1. Standard errors in parentheses.

Figure 1 Change in the Size of Core Discussion Networks and the Probability of Social Isolation in Taiwan, 1997 and 2017



Note: The probability of social isolation is the sum of those not at risk of the stochastic process of having core discussion contacts (the binomial component), and those at risk of the process but still have no contacts by chance (the Poisson component).

Table 3 Regression Estimates of Core Discussion Networks from Modified Poisson (Mixture) Model, Taiwan Social Change Survey 2017

	Modified Poisson Regression	Modified Poisson Mixture Model	
	Number of Contacts	Probability of Social Isolation	Number of Contacts
Male	-0.367***	1.209***	-0.172***
	(0.035)	(0.184)	(0.038)
Age	-0.018***	0.051***	-0.006***
	(0.001)	(0.007)	(0.002)
College Educated	0.171***	-0.455*	0.094*
	(0.039)	(0.200)	(0.042)
Married	-0.057	-0.592**	-0.194***
	(0.038)	(0.181)	(0.041)
Religions Requiring Regular Attendance	0.199**	-0.574	0.152*
	(0.070)	(0.443)	(0.073)
Other Religions	-0.042	-0.265	-0.071†
	(0.039)	(0.212)	(0.042)
Full-time Employment	-0.160***	0.257	-0.131**
	(0.045)	(0.220)	(0.048)
Low Income	-0.316***	0.821***	-0.125*
	(0.057)	(0.233)	(0.062)
High Income	0.189***	-0.621*	0.069
	(0.044)	(0.247)	(0.047)
Southern Taiwan	0.147***	-0.210	0.123***
	(0.034)	(0.172)	(0.037)
Virtuous	-0.145***	0.417**	-0.102***
	(0.021)	(0.134)	(0.022)
Green-eyed	-0.130***	0.251	-0.108**
	(0.036)	(0.216)	(0.038)
Sharky	-0.057**	0.264*	-0.032
	(0.020)	(0.132)	(0.021)
Intercept	1.786***	-3.964***	1.555***
	(0.089)	(0.465)	(0.096)

Note: $***$ $p< 0.001$, $**$ $p< 0.01$, $*$ $p< 0.05$, † $p< 0.1$. Standard errors in parentheses.

Table 4 Regression Estimates of Core Discussion Network and Design Errors of Name Generator

	Poisson Regression Estimates		Design errors			
	Estimate	95% Confidence Interval	Total	Groups	Grouping	Fisher Ratio
Intercept	1.786***	(1.612, 1.96)	0.054	0.034	0.020	0.946
Male	-0.018***	(-0.021, -0.015)	0.031	0.024	0.007	0.969
Age	-0.367***	(-0.435, -0.299)	0.035	0.027	0.008	0.965
College Educated	0.171***	(0.095, 0.248)	0.027	0.025	0.002	0.973
Married	-0.057	(-0.131, 0.018)	0.031	0.025	0.005	0.969
Religions Requiring Regular Attendance	0.199**	(0.062, 0.337)	0.118	0.060	0.058	0.882
Other Religions	-0.042	(-0.118, 0.034)	0.050	0.034	0.016	0.950
Full-time Employment	-0.160***	(-0.249, -0.071)	0.073	0.041	0.031	0.927
Low Income	-0.316***	(-0.427, -0.205)	0.048	0.030	0.017	0.952
High Income	0.189***	(0.103, 0.275)	0.044	0.031	0.013	0.956
Southern Taiwan	0.147***	(0.08, 0.214)	0.054	0.035	0.020	0.946
Virtuous	-0.145***	(-0.187, -0.104)	0.059	0.037	0.022	0.941
Green-eyed	-0.057**	(-0.096, -0.018)	0.072	0.043	0.029	0.928
Sharky	-0.130***	(-0.2, -0.061)	0.060	0.037	0.023	0.940
McFadden's Adj R^2	0.121	AIC	5954		BIC	6029
Score (universal scheme)	36.820	Score (global scheme)	34.445	Score (current scheme)		34.538
	ZIP Regression Estimates		Design errors			
Poisson Part	Estimate	95% Confidence Interval	Total	Groups	Grouping	Fisher Ratio
Intercept	1.125***	(0.751, 1.499)	0.062	0.042	0.020	0.938
Male	-0.139***	(-0.212, -0.066)	0.046	0.037	0.009	0.954
Age	-0.014.	(-0.03, 0.002)	0.049	0.038	0.011	0.951
College Educated	0.431***	(0.28, 0.582)	0.041	0.036	0.005	0.959
Married	-0.091*	(-0.177, -0.006)	0.040	0.036	0.005	0.960
Religions Requiring Regular Attendance	0.127.	(-0.015, 0.27)	0.110	0.057	0.054	0.890
Other Religions	-0.032	(-0.112, 0.048)	0.059	0.041	0.018	0.941
Full-time Employment	-0.071	(-0.172, 0.03)	0.072	0.045	0.027	0.928

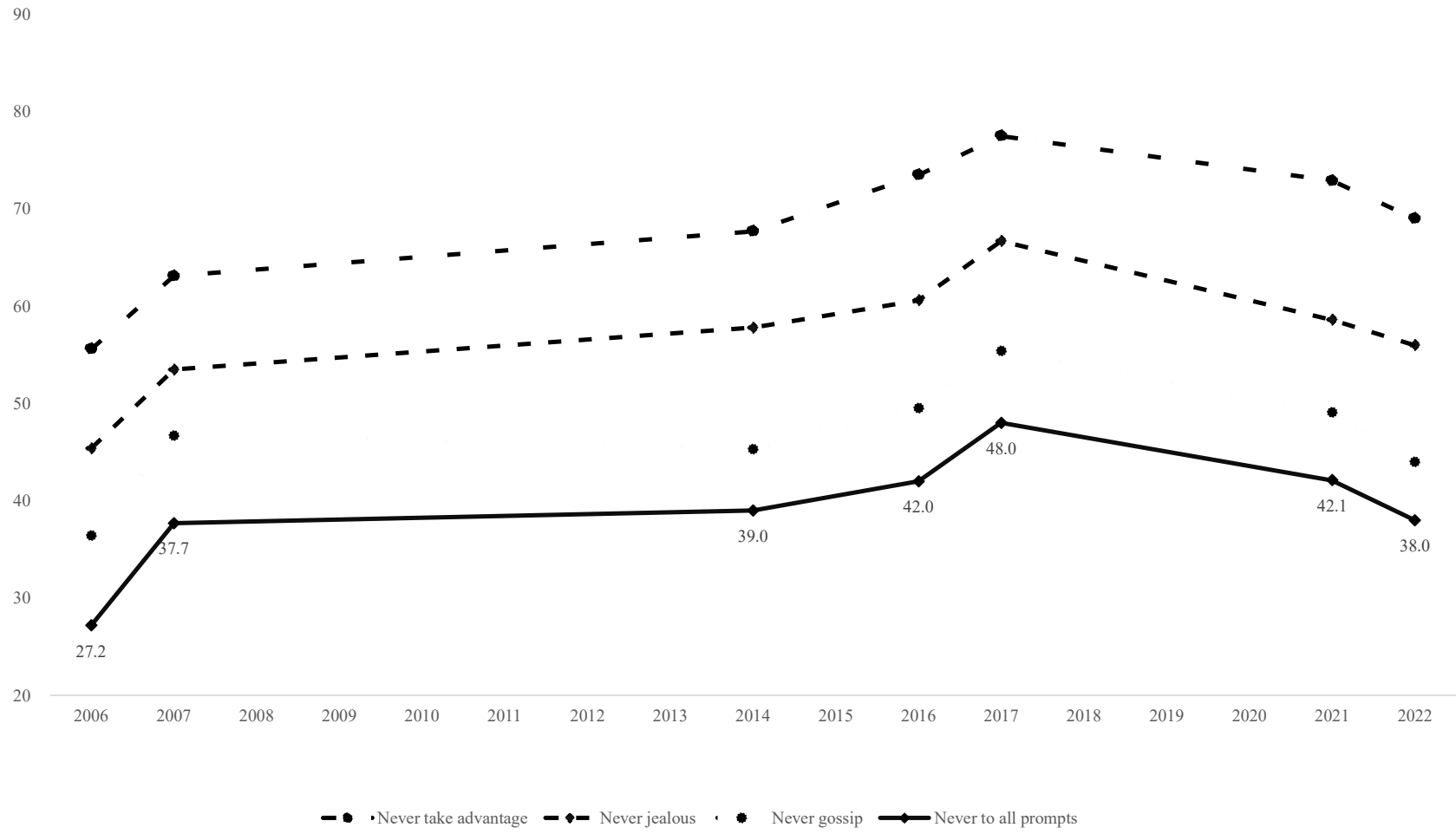
(continued)

Table 4 Continued

	ZIP Regression Estimates		Design errors			
Poisson Part	Estimate	95% Confidence Interval	Total	Groups	Grouping	Fisher Ratio
Low Income	-0.087	(-0.212, 0.038)	0.062	0.042	0.021	0.938
High Income	0.142**	(0.053, 0.231)	0.049	0.038	0.011	0.951
Southern Taiwan	0.098**	(0.026, 0.169)	0.061	0.042	0.020	0.939
Virtuous	-0.091***	(-0.134, -0.048)	0.065	0.043	0.023	0.935
Green-eyed	-0.106**	(-0.179, -0.033)	0.071	0.045	0.026	0.929
Sharky	-0.037.	(-0.078, 0.004)	0.066	0.043	0.023	0.934
Bernouli Part						
Intercept	-2.165**	(-3.733, -0.597)	0.002	0.001	0.001	0.998
Male	0.386*	(0.063, 0.708)	0.002	0.001	0.000	0.998
Age	0.041	(-0.02, 0.101)	0.002	0.001	0.000	0.998
College Educated	-0.647**	(-1.125, -0.169)	0.002	0.002	0.000	0.998
Married	-0.574**	(-0.923, -0.225)	0.001	0.001	0.000	0.999
Religions Requiring Regular Attendance	-0.640	(-1.466, 0.185)	0.002	0.001	0.001	0.998
Other Religions	-0.167	(-0.565, 0.231)	0.002	0.001	0.001	0.998
Full-time Employment	0.347	(-0.08, 0.774)	0.002	0.001	0.001	0.998
Low Income	0.407.	(-0.048, 0.862)	0.002	0.001	0.001	0.998
High Income	-0.618**	(-1.079, -0.157)	0.002	0.002	0.001	0.998
Southern Taiwan	-0.003	(-0.332, 0.327)	0.002	0.001	0.001	0.998
Virtuous	0.396**	(0.127, 0.666)	0.002	0.001	0.001	0.998
Green-eyed	0.045	(-0.382, 0.472)	0.002	0.001	0.001	0.998
Sharky	-0.101	(-0.354, 0.151)	0.002	0.001	0.001	0.998
McFadden's Adj R	0.094	AIC	5568		BIC	5718
Score (universal scheme)	1.151	Score (global scheme)	1.148		Score (current scheme)	1.146

Note: *** p< 0.001, ** p< 0.01, * p< 0.05, . p< 0.1. The current grouping scheme for both the Poisson and the ZIP regression is [0 name, 1 name, 2 names, 3 names, 4 names, 5 names, 6+ names]. The global optimal scheme for both the Poisson and the ZIP regression is [0 name, 1 name, 2 names, 3 names, 4~5 names, 6~7 names, 8+ names].

Figure 2 Percentage of Those Who Answered “Never” to Social Desirability Questions (%), Taiwan Social Change Survey 2006 – 2022 (N=15,320)



Appendix I Principal Component Analysis of Social Desirability Questions

	Virtuous	Sharky	Green-eyed
Loadings			
Taking advantage of others	**0.571**	**-0.644**	0.509
Jealous	**0.601**	-0.095	**-0.794**
Gossipy	**0.559**	**0.760**	0.332
Eigenvalues	1.939	0.592	0.469

Note: Factor loadings used to construct new variables of social desirability (virtuous, sharky, and green-eyed) based on existing variables (taking advantage of others, jealous, and gossipy) are **in bold**.

Appendix II Analysis of Variance of the Virtuous Variable

	Virtuous		
	Sum of Squares	Degree of freedom	Mean Sum of Squares
Model	695.199***	82	8.478
Male	0.113	1	0.113
Age	350.231***	73	4.798
College Educated	14.007**	1	14.007
Married	1.103	1	1.103
Religions Requiring Regular Attendance	1.318	1	1.318
Other Religions	0.000	1	0.000
Full-time Employment	0.116	1	0.116
Low Income	2.803	1	2.803
High Income	0.002	1	0.002
Southern Taiwan	2.270	1	2.270
Residual	2362.7164	1,495	1.580

Note: $***$ $p< 0.001$, $**$ $p< 0.01$, $*$ $p< 0.05$.