Friends Don't Let Friends Free Ride

Online Supplemental Information

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A Network Specification

A.1 Motivation for Unweighted Network Specification

Two considerations motivated our decision not to use the frequency or duration of calls as weights, as other studies have done (Onnela et al., 2007; Miritello et al., 2013).

First, it is unclear whether frequency of communication is a good indicator of influence in a relationship. Within a given type of relationship (e.g. among co-workers), there is some evidence that frequency of communication in one electronic medium is a useful proxy for intensity of communication across all mediums (Haythornthwaite, 2005), but whether this holds across types of relationships is unknown.[26]

For example, people may make more calls to co-workers and business partners than to family members—even if the family relationships are more influential. For example, using data from California, Motahari et al. (2012) shows that calling patterns among family members are qualitatively different from calling patterns with others: calls to family members are more frequent but shorter. These findings illustrate how the mapping from call frequency or duration to significance-of-tie may vary across types of connections. Similarly, in a survey of 40 U.S. individuals who agreed to share phone records and fill out questionnaires about their connections, Wiese et al. (2015) finds that while call frequency and duration do predict self-reported tie strength, "many people in all tie strength levels had very little communication" (Wiese et al., 2015, 5). Wiese concludes that this is driven by substitution to in-person communication, substitution to email or other non-phone communication, and the fact that "[f]amily is close regardless of communication" (7).

Second, in the Venezuelan context we know that a non-trival share of communications take place via WhatsApp, and thus do not appear in our data. As these communications are especially likely among younger users, using text and phone frequency as a measure of importance of connections would necessarily privilege connections among older people, potentially biasing results.

[26] Indeed, (Haythornthwaite, 2005, p. 125) concludes only "that media use *within groups* conformed to a unidimensional scale." (Emphasis added.)

Indeed, fear of excluding ties among younger users is one reason that we use such a low threshold for connection inclusion.

A.2 Motivation for Undirected Network Specification

We treat connections as undirected because, first, information exchange in phone communications is inherently bi-directional. Second, and perhaps more importantly, the direction of a call can be surprisingly difficult to establish in the Venezuelan context. In Venezuela, the cost is borne by the person placing the call. As a result, many users engage in the practice of giving more affluent contacts a "missed call" (they call, let the phone ring once, then hang up) as a signal that they would like the more affluent contact to call them back, allowing the more affluent party to be billed. These missed calls do not appear in the data (call detail records are collected primarily for billing purposes, and missed calls aren't billed), so many bi-directional relationships may appear uni-directional in the data.

B Matching Strategy

For each protester p, we locate an observationally similar match m using the following recursive matching algorithm:

1. First, we create a set of potential matches including all individuals who subscribe to our Partner Telecom[27] and are registered to vote as the same polling place as p.
2. The algorithm looks for individuals who are perfect (exact) matches for p in terms of:
    - political party (registered member of the PSUV, or not, `PSUV`
    - whether they spent any weekdays in Caracas in the month preceding or following the protest (excluding the week of the protest) (binary, `any_weekday_in_caracas`)
    - whether they spent any weekends in Caracas in the month preceding or following the protest (excluding the week of the protest) (binary, `any_weekend_in_caracas`)
    - exact number of weekdays in Caracas in the month preceding or following the protest (excluding the week of the protest, `in_caracas_weekday`)

[27] Recall that all identified protestors are also Partner Telecom subscribers, because real-time geo-location is only available for Partner Telecom subscribers.

- exact number of weekend days in Caracas in the month preceding or following the protest (excluding the week of the protest, `in_caracas_weekend`)
- gender (binary, from voter registration data, `registration_female`)
- whether the user has a pre-paid or post-paid cellular plan (related to socio-economic status) (`post`)

3. If there is at least one person who is a perfect match for p along these dimensions (which happens in $\sim 70\%$ of cases), then a distance score is calculated with respect to normalized measures of age and spatial mobility,[28] and the individual with the lowest distance score becomes m.
4. If no individuals are identified who perfectly match p along the exact-match attributes, then the bottom-most attribute is moved from the list of attributes for which an exact-match is sought and is moved into the list of attributes for which a distance score is calculated. Steps 2 and 3 are then repeated until a single match is identified.

Success rates for various exact-match attributes can be found in Tables B.1- B.1.

Table B.1: Successful Matches on Exact-Match Attributes, Sept 1st

	Num exact matched by var
post	3515
registration_female	3539
in_caracas_weekend	3877
in_caracas_weekday	4057
any_weekend_in_caracas	4832
any_weekday_in_caracas	4946
psuv	5000
total matches	5000

C Additional tables and figures

C.1 Descriptives

Figures C.2b and C.2c reveal that communication centrality is only weakly correlated with neighborhood socioeconomic characteristics. In particular, it is only weakly correlated with the proportion of households in the neighborhood that have a cement floor. This captures whether a neighborhood has formal or informal housing, or whether the neighborhood is a *barrio* (in Venezuelan

[28] The day-to-day variance in the location of the user.

Table B.1: Successful Matches on Exact-Match Attributes, PSUV

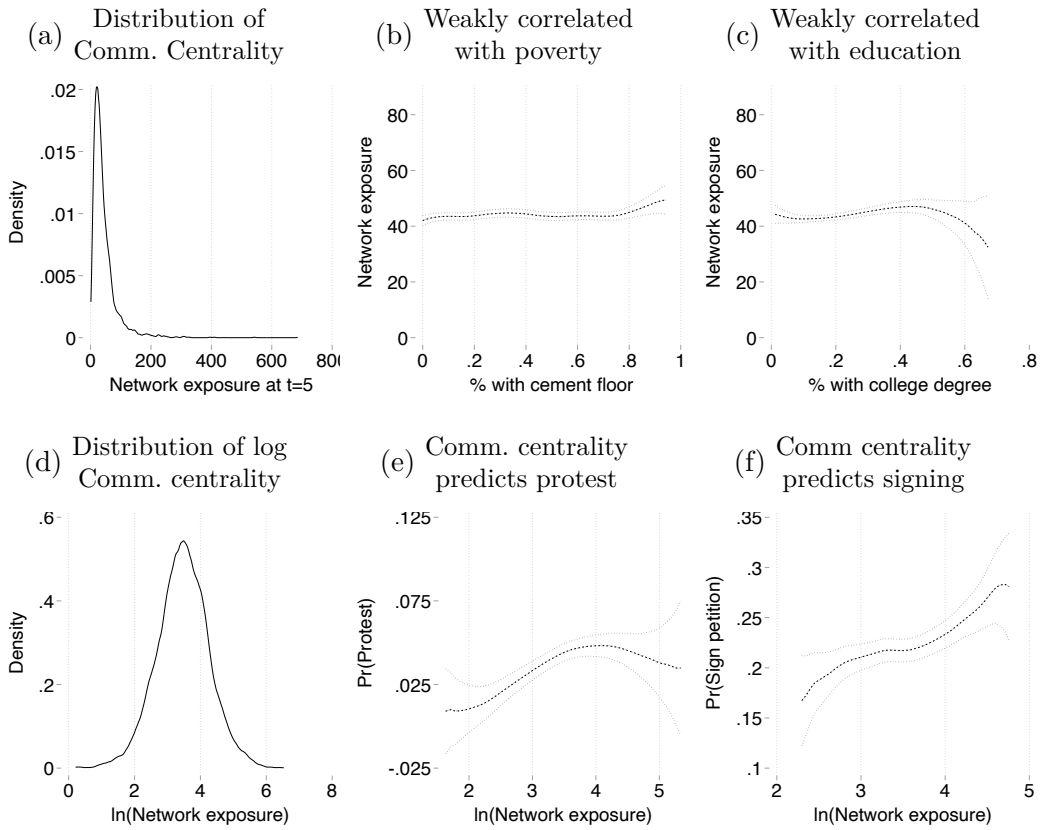
	Num exact matched by var
post	4792
registration_female	4805
in_caracas_weekend	4863
in_caracas_weekday	4895
any_weekend_in_caracas	4980
any_weekday_in_caracas	4989
psuv	5000
total matches	5000

Table B.1: Successful Matches on Exact-Match Attributes, MUD

	Num exact matched by var
post	4700
registration_female	4739
in_caracas_weekend	4803
in_caracas_weekday	4839
any_weekend_in_caracas	4961
any_weekday_in_caracas	4991
psuv	5000
total matches	5000

Figure C.2: Communication centrality predicts participation in the population

These figures describe the relationships between communication centrality and (a) neighborhood (census-tract) poverty, (b) neighborhood (census-tract) education, (c) protest participation, and (d) petition-signing, all using a representative sample of the population of six large Venezuelan states.



terms); the distribution of the proportion is bimodal, with modes close to zero and close to 0.8.[29] It is also only weakly correlated with the proportion of adults (over 25) in the neighborhood who have a college degree. (Note that the scales of the y-axes in these figures span the first 90 percent of the distribution of communication centrality).

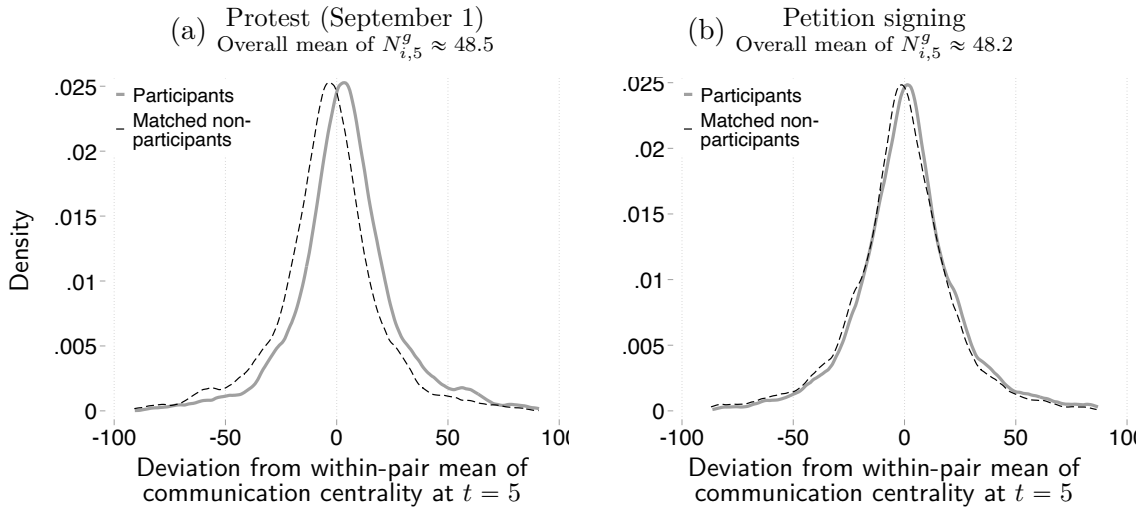
In contrast, Figures C.2e and C.2f reveal that communication centrality is strongly correlated with both protest participation and petition signing.

Figure C.3 plots the distribution of deviations from the within-pair means of communication centrality, i.e., the distribution of $N_i^g - \overline{N_{pair}^g}$. A person with a value of 1.5, for example, is exposed to three more people than her matched counterpart. These plots reveal that participants have higher communication

[29] By "neighborhood," we mean the census tract in which a person's polling place is located.

Figure C.3: Participants have higher communication centrality than their observationally similar counterparts

Each figure plots the distribution of deviations from the within-pair mean of communication centrality ($N^g_{i,5} - \overline{N^g_{pair,5}}$), separately for participants and matched non-participants.



For visual clarity, both figures exclude observations in the top and bottom 1% of the distribution of within-pair differences in communication centrality. We do not trim the sample when estimating Equation 2 below.

centrality than their observationally similar counterparts.

C.2 Correlation between communication centrality and eigenvector centrality

Table C.3: Network exposure at different time steps and eigenvector centrality: correlations

	$N^a_{i,1}$	$N^a_{i,2}$	$N^a_{i,3}$	$N^a_{i,4}$	$N^a_{i,5}$	$N^a_{i,6}$	$N^a_{i,7}$	$N^a_{i,8}$	$N^a_{i,9}$	E.C.
$N^a_{i,1}$	1.000									
$N^a_{i,2}$	0.981	1.000								
$N^a_{i,3}$	0.943	0.989	1.000							
$N^a_{i,4}$	0.898	0.964	0.993	1.000						
$N^a_{i,5}$	0.855	0.935	0.977	0.995	1.000					
$N^a_{i,6}$	0.816	0.906	0.957	0.985	0.997	1.000				
$N^a_{i,7}$	0.782	0.879	0.937	0.971	0.990	0.998	1.000			
$N^a_{i,8}$	0.754	0.855	0.919	0.958	0.981	0.993	0.999	1.000		
$N^a_{i,9}$	0.733	0.837	0.904	0.947	0.973	0.988	0.996	0.999	1.000	
E.C.	0.362	0.454	0.528	0.590	0.639	0.677	0.706	0.726	0.739	1.000

D Survey instrument

The order of the two blocks was randomly assigned across respondents.

D.1 Block 1, English

1. In 2016, opposition parties collected signatures on a petition requesting a recall referendum. Hundreds of thousands of people signed the petition, but millions chose not to sign, and many others wanted to sign but just didn't have time or energy. Did you happen to sign the 2016 recall referendum petition?

2. Did any of your friends or family members tell you what they thought of your decision [to sign the petition] [not to sign the petition], or did they keep their opinions to themselves? [Read responses]
    - They told me what they thought
    - They kept their opinions to themselves
    - No response

3. We're interested in whether people talked to their friends about whether to sign the recall referendum petition in 2016, or whether they kept their decisions to themselves. Think for a minute of your three closest friends. I will not ask you whether or not they signed the recall referendum petition, but I'm curious whether you know one way or the other. [Read responses]
    - Thinking of the first of the three friends you have in mind, do you know whether he or she signed? [Read responses]
        - Yes, I know whether or not he or she signed the petition
        - No, I don't know
        - No response
    - And now thinking of the second of the three friends you have in mind, do you know whether he or she signed?
        - Yes, I know whether or not he or she signed the petition
        - No, I don't know
        - No response
    - And now thinking of the third of the three friends you have in mind, do you know whether he or she signed?
        - Yes, I know whether or not he or she signed the petition
        - No, I don't know
        - No response

D.2 Block 2, English

1. In 2016, opposition parties organized protests to pressure the government to hold a recall referendum. Hundreds of thousands of people attended, but millions chose not to attend, and many others wanted to attend but just didn't have time or energy. Did you happen to attend the recall referendum protests in 2016, such as the Toma de Caracas?

2. Did any of your friends or family members tell you what they thought of your decision [to attend the protest] [not to attend the protest], or did they keep their opinions to themselves? [Read responses]
    - They told me what they thought
    - They kept their opinions to themselves
    - No response

3. We're interested in whether people talked to their friends about whether to attend the recall referendum protests in 2016, or whether they kept their decisions to themselves. Think for a minute of your three closest friends. I will not ask you whether or not they attended the protests in 2016, but I'm curious whether you know one way or the other. [Read responses]
    - Thinking of the first of the three friends you have in mind, do you know whether he or she protested? [Read responses]
        - Yes, I know whether or not he or she protested
        - No, I don't know
        - No response
    - And now thinking of the second of the three friends you have in mind, do you know whether he or she protested?
        - Yes, I know whether or not he or she sprotested
        - No, I don't know
        - No response
    - And now thinking of the third of the three friends you have in mind, do you know whether he or she protested?
        - Yes, I know whether or not he or she protested
        - No, I don't know
        - No response

D.3 Block 1, Spanish

1. En 2016 los partidos de oposición recogieron firmas para solicitar un referéndum revocatorio. >Firmó usted la petición del referéndum revocatorio de 2016?
    - Sí
    - No
    - No contesta

2. >Alguno de sus amigos o familiares le dijeron qué pensaban sobre su decisión [de firmar la peticón] [no firmar la petición], o fueron reservados con respecto a sus opiniones? (Enc. Leer opciones. Aceptar una sola respuesta)
    - Me dijeron lo que pensaban
    - Fueron reservados con respeto a sus opiniones
    - No contesta

3. Nos interesa saber si las personas hablaron con sus amigos sobre la firma de la petición para el referéndum revocatorio en 2016. Piense por un minuto en sus tres amigos más cercanos, recuerde que no queremos saber qué hicieron sus amigos, nos interesa saber si ellos compartieron con usted la decisón que tomaron.
    - Pensando en el primero de los tres amigos que tiene en mente, >sabe si firmó? (Enc. Leer opciones. Aceptar una sola respuesta)
        - Sí, sé si firmó o no la petición
        - No, no lo sé
        - No contesta
    - Y ahora, pensando en el segundo de los tres amigos que tiene en mente, >sabe si firmó? (Enc. Leer opciones. Aceptar una sola respuesta)
        - Sí, sé si firmó o no la petición
        - No, no lo sé
        - No contesta
    - Y ahora, pensando en el tercero de los tres amigos que tiene en mente, >sabe si firmó? (Enc. Leer opciones. Aceptar una sola respuesta)
        - Sí, sé si firmó o no la petición
        - No, no lo sé
        - No contesta

D.4 Block 2, Spanish

1. En 2016 los partidos de oposición organizaron protestas para presionar al gobierno a celebrar un referéndum revocatorio. >Asistió usted a las protestas a favor del referéndum revocatorio en 2016, como la denominada Toma de Caracas?
    - Sí
    - No
    - No contesta

2. >Alguno de sus amigos o familiares le dijeron qué pensaban sobre su decisión [de asisir a la protesta] [no asistir a la protesta], o fueron reservados con respecto a sus opiniones? (Enc. Leer opciones. Aceptar una sola respuesta)
    - Me dijeron lo que pensaban

- Fueron reservados con respeto a sus opiniones
- No contesta

3. Nos interesa saber si las personas hablaron con sus amigos sobre si asistirían o no a las protestas referéndum revocatorio en 2016. Piense por un minuto en sus tres amigos más cercanos, recuerde que no queremos saber qué hicieron sus amigos, nos interesa saber si ellos compartieron con usted la decisón que tomaron.
    - Pensando en el primero de los tres amigos que tiene en mente, >sabe si protestó? (Enc. Leer opciones. Aceptar una sola respuesta)
        - Sí, sé si protestó o no
        - No, no lo sé
        - No contesta
    - Y ahora, pensando en el segundo de los tres amigos que tiene en mente, >sabe si protestó? (Enc. Leer opciones. Aceptar una sola respuesta)
        - Sí, sé si protestó o no
        - No, no lo sé
        - No contesta
    - Y ahora, pensando en el tercero de los tres amigos que tiene en mente, >sabe si protestó? (Enc. Leer opciones. Aceptar una sola respuesta)
        - Sí, sé si protestó o no
        - No, no lo sé
        - No contesta