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In a Society of Strangers, Kin Is Still Key: Identified Family Relations in Large-Scale Mobile Phone Data

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Abstract: Mobile call networks have been widely used to investigate communication patterns and the network of interactions of humans at the societal scale. Yet, more detailed analysis is often hindered by the lack of information about the nature of the relationships, even if some metadata about the individuals are available. Using a unique, large mobile phone database with information about individual surnames in a population in which people inherit two surnames: one from their father, and one from their mother, we can differentiate among close kin relationship types. Here, we focus on the difference between the most frequently called alters, depending on whether they are family relationships or not. We find support in the data for two hypotheses: (1) phone calls between family members are more frequent and last longer than phone calls between non-kin; and (2) the phone call pattern between family members show a higher variation depending on the stage of life-course compared to non-family members. We give an interpretation of these findings within the framework of evolutionary anthropology: kinship matters even when demographic processes, such as low fertility, urbanisation and migration, reduce access to family members. Furthermore, our results provide tools for distinguishing between different kinds of kin relationships from mobile call data when information about names is unavailable.

Keywords: social networks; mobile phone data; family; kin; generations; parenthood; siblings; friends

1. Introduction

In all human cultures, people live in intensely social environments. The basis of every human society is multi-generational, groups with strong pair bonds [1]. Throughout their lives, individuals build and maintain a particular set of social relations [2]: to close kin, more distant kin, non-kin peers, mating partners, and their respective kin and peers [3,4].

In high fertility, small-scale traditional societies which have characterised most of human evolutionary history, individuals tended to be surrounded by a network made up predominantly by relatives [5–8], while low fertility and urbanised modern societies consist mostly of social networks dominated by friends and acquaintances [9–13]. In both cases, frequent and meaningful social interactions play a key role in maintaining social bonds and enabling collaboration [14,15].



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The question of whether the intensity of relationships (e.g., frequency and duration of interactions) differs between biological relatives and non-kin has been widely studied. However, no clear consensus has emerged. Some sociologists and anthropologists argue that, in modern societies, the intensity of relationships with biological kin does not necessarily differ from that of non-kin ties [16,17]. In contrast, other scholars maintain that non-kin ties are generally more situational and fragile, reflecting their greater dependence on reciprocity and voluntary commitment [18].

A substantial body of sociological and anthropological research argues that, in contemporary societies, the distinction between kin and non-kin relationships has become increasingly blurred, with both types of ties exhibiting similar levels of emotional closeness and functional significance. Network-oriented approaches emphasize that personal communities are composed of overlapping constellations of relatives, friends, and partners, rather than clearly separated domains [19]. Likewise, Ref. [17] shows that friendship and kinship are governed by comparable processes of negotiation, reciprocity, and maintenance, particularly under conditions of individualization. Anthropological critiques further challenge the primacy of biological relatedness: Schneider [20] argued that kinship is culturally constructed rather than biologically given, while Holland [16] demonstrates that enduring social bonds often emerge through shared practices of care (“nurture kinship”), irrespective of genetic ties. Empirical studies of social support similarly indicate that close friends can provide levels of emotional and practical assistance comparable to, or even exceeding, those of relatives [21]. This literature suggests that tie intensity is shaped more by interactional dynamics and voluntary commitment than by biological relatedness per se.

In contrast, another strand of research maintains that kin and non-kin relationships remain fundamentally distinct due to their differing structural foundations, normative expectations, and evolutionary underpinnings. From an evolutionary perspective, William D. Hamilton’s theory [22,23] of inclusive fitness predicts systematically higher levels of altruism toward biological relatives, while Trivers argues [18] that cooperation among non-kin is more contingent on reciprocity and thus inherently less stable. Sociological analyses reinforce this distinction by highlighting the enduring role of institutionalized obligations within families, particularly in domains such as intergenerational support and caregiving [24].

The latter view is supported by studies both in biological sciences, in evolutionary life history theory [25–29], and in social sciences on life course behavioural differences [2,30], as well as further empirical work [31–34].

Behavioural studies of close social bonds indicate that humans prefer to cooperate with kin rather than non-kin [14,35–43], similar to other social mammals [44–46] and in line with inclusive fitness theory [23]. Between family generations, support is often altruistic and likely to flow from the older to the younger generations [39]. Family bonds are experienced as given before and beyond any conscious and deliberate individual act [47]. In contrast, compared to kin, relationships among just friends demand more reciprocal helping and higher frequency of contact in order to build and maintain relationship strength. Reciprocity and frequent contacts characteristic of friendships are likely to enhance trust and bonding, thus partly compensating for the lower shared genetic interest among non-kin [18,48] although friends are often low-level kin with genetic relatedness higher than the population average [49], but lower than kin assignment via linguistic kin terms [50].

Recent access to large communication data enabled entirely new ways of studying human interactions by mapping out the social network of interactions [51], to which the whole machinery of network science [52] can be applied. Especially mobile phone Call Detailed Records (CDR-s) provide unprecedented opportunities to study social relationships at a societal scale [53,54]. However, an important limitation of using such data is that usually no information about the type of the links (kinship, friendship, business link, etc.) is available, even if metadata about gender, age, location of the individuals are known.

Recent research has attempted to identify kin and peer relationship types from anonymous mobile communication data, based on a combination of phone call patterns and basic socio-demographic information (age and gender) of the callers, drawn from a contemporary European population [55,56]. This new methodology exploited the fact that the average mobile phone caller has up to six distinct peaks in the histogram of call frequency [55], as a function of the alters’ gender and age relative to the caller. The positions of these peaks are conspicuous [55]: two correspond with alters who are approximately one generation older. In these, the male most frequently called alter is a few years older on average than the female. This was independent of the ego’s sex. The assumption in that paper was that these two alters may correspond to the mother and the father of the ego.

In the same-generation peaks, both the sex of the ego and the sex of the alter mattered. If the sex is different, then on average the male was a few years older than the female. If the sex was the same, there was no age difference. The paper suggested the assumption that in the former case the relationships are predominantly of romantic nature, while in the latter case these correspond mostly to best same-sex friend relationships.

The one-generation-younger peaks showed no sex difference in age. The assumption was that these were most likely the children of the ego.

The life course pattern of other phone call characteristics, for instance direction of call initiation and length of phone calls were consistent with this hypothesis, providing further support to it [55].

This methodology allowed a refined differentiation among close kin networks. However, these assignments of relationship types were hypothesised. For instance, while it is likely that the average person's most frequently called female alter who is one generation older is the person's mother, it is impossible to tell for sure.

Here, we move beyond this methodological limitation using a large phone database uniquely tagged with information about individual surnames. These are hashed, satisfying GDPR requirements, so that we can assure whether two names are identical, but we do not have access to the real names. Using surnames adds significantly more information, since for instance two full brothers are unlikely to have different surnames while two male friends are unlikely to have the same paternal and maternal surnames. This is especially so, since the data is from Chile, as in many Spanish-speaking countries, both the patrilineal paternal and matrilineal paternal names are part of the family name. Individuals, thus, have two family names: the first is the first family name of the father, and the second is the first family name of the mother. Phone companies record both family names of an overwhelming majority of their clients, enabling a refined detection of the nature of dyadic kin relationships in the communication database.

Making use of the information on surnames contained in the Chilean mobile phone data, we can distinguish between real relatives and “quasi” relatives. For instance, a one-generation-older female alter will be classified as the ego's mother only if the second name of the ego coincides with the first name of the alter. If this is not the case, we will refer to this alter as a “quasi-mother”. Our focus here is the set of cross-generational close family relationships: mother, father, daughter, son.

Based on the distinction between relatives and quasi relatives for the cross-generational relationships, we study the differences in the way subjects interact with kin and frequently called non-related individuals who, given their age and gender, could perform a similar role in the life of the individual. Thus, we compare, for instance, within the category of most frequently called one-generation-older female, depending on whether they are the mother of the ego or the most frequently called mother-aged female who is not the mother. We think of this as a comparison of the most important mother figure depending on whether she happens to be the real mother of the ego or a quasi-mother.

We study call patterns through four variables frequently used in previous studies: (i) frequency of calls for a specific dyad; (ii) fraction of total phone call time within a specific dyad compared to ego's total call time; (iii) out-call fraction: the proportion of outgoing calls, relative to the sum of incoming and outgoing calls within a specific dyad which represents the balance in the relationship; and (iv) the average call length [55].

Our first hypothesis concerns the intensity of the relationship—frequency and call length—with close biological kin versus with a non-kin, even if they occupy a similar role in the social network of the ego.

H1. If the most frequently called persons within a kin-category (e.g., mother, father, daughter, son) are genetic relationships, then we expect that the frequency, call length and fraction of time are higher compared to the quasi relationships. For instance, if we are comparing the egos' call patterns with the most frequently called one-generation-older females, we expect that if these women are the biological mothers of the egos, the frequency is higher compared to the unrelated quasi-mothers.

As noted above, a considerable amount of research suggests that, even in modern societies, kin and non-kin relationships remain fundamentally distinct due to their differing structural foundations, normative expectations, and evolutionary underpinnings, with biological kin ties typically exhibiting greater intensity [18,24,55]. In this respect, the main contribution of our paper is in providing further support for this view by presenting evidence for hypothesis H1 so that the main novelty lies in both the uniqueness of the dataset and the methodological approach employed. In contrast to traditional methods—constrained by limited sample sizes and the inherent subjectivity of self-reported survey data—Call Detail Records (CDRs), combined with information on both maternal and paternal names, offer large-scale, objective data that enable a more robust assessment of differences in the intensity of kin and non-kin relationships.

Our second hypothesis is based on the first. The higher intensity between biologically related versus non-related social contacts manifests itself especially in situations where one relies on the other for help or cooperation. These situations are not distributed evenly through life. Consider for instance the difference between the relationship of a daughter with her real mother and a quasi-mother when the daughter has her own offspring. Given the evolutionary explanation of females' survival past the end of reproduction is in general associated with grandmothing [56,57], one would expect a higher relative peak during this period for the real mother.

H2. We expect that the life-course-dependent variation of all the phone call patterns (frequency, fraction of time, call length and also out-call fraction) is higher for real relatives than apparent relatives. For instance, in the case of the mother figure, we expect that the life-course dependent variation of the direction of phone call initiation

(who calls whom), or the length of the phone call, is higher between the ego and the mother figure, if the latter is the actual rather than the quasi-mother of the ego.

The empirical investigation of the understudied life-course variation in relationship intensity is enabled by the unique dataset employed in this study, leading to new insight in this problem. This is the second main novelty of our paper. The high temporal resolution across the life course is crucial also for our theoretical framework grounded in evolutionary anthropology, particularly for interpreting both the elevated intensity of kinship ties and their systematic variation over the life course.

As the mobile call data do not contain information on users' offspring, we approximate the effects of parenthood by focusing on women of reproductive age. While this assumption does not hold at the individual level in all cases, it is reasonable to expect that the majority of women in this age range are affected by childcare responsibilities. Because our analysis is shaped by the demographic context of Chile, we provide in Supplementary Material S1 a summary of the population age distribution in 2015, the total fertility rate, and the mean age at first birth. This information allows readers to better assess the extent to which observed variations in call patterns can be interpreted as reflecting the transition to parenthood.

Note that we are not able to carry out a longitudinal study due to the limited time span of the data. When we refer to life-course-dependent variations, we mean that the characteristics in different age groups show systematic variations, and thus we assume that the cohort effects are significantly smaller than the effect of life-course.

2. Data and Methods

The data consists of aggregated, anonymized Call Detail Records (CDRs) from a Chilean Mobile Call Company accounting for 40% of the market share for the respective period. CDRs are generated automatically by the telephone company every time that a call is made or received by a person inside the network. This data is collected automatically for billing purposes.

Each record stores, among other things, the origin and destination number and antenna, a time stamp (day, hour, minute, second) and the duration of the call in seconds. The data used in this study was anonymized using several techniques (see the supplementary material for details).

The mobile network operator provides data only for calls in which the caller is within its network and for callees only if they are also subscribers of the same provider; consequently, details about callees outside the provider's network are missing. This limitation cannot be resolved by combining data from multiple providers, as differences in hashing and anonymization procedures prevent matching across datasets. Nevertheless, the provider's substantial market share (~40%) in Chile ensures that the dataset constitutes a large and statistically meaningful sample.

The data was collected for the 12 consecutive months of the year 2015, totalling 3,994,595,128 calls. Using all this data we created a graph where each node corresponds to a phone number, and there is an edge between two phone numbers if at least one phone call occurred between them. The final graph created consisted of 8,907,140 vertices and 112,744,511 edges.

Given an ego and an alter, we study call patterns through four variables: (i) Frequency: frequency of calls between them; (ii) FracOfTime: fraction of total phone call time within the specific dyad compared to ego's total call time; (iii) OutCallFrac: the proportion of outgoing calls, relative to the sum of incoming and outgoing calls within the specific dyad; and (iv) CallLength: the average time per call.

For identifying the close kin ego network, here we developed a variant of the methodology in [55]. The original methodology allowed the identification of ego's most important male and female contacts in one generation older groups, same-generation groups, and one generation younger groups, as outlined above in the Introduction. It hypothesised that these generations were likely to represent the mother, father, romantic partner, best friend, daughter, and son of the ego. Considering that we can only identify the age and gender of people within the same phone company, this identification naturally introduces considerable "false positive" type errors. In this paper we introduce filters based on further available information about the users, which substantially increases the accuracy of the estimation of the types of social and family relationships.

The metadata collected by the company includes, besides caller and alter age, gender, already used in [55] also anonymised last names, i.e., patrilineal paternity and the matrilineal paternity names, which enable us to construct such filters.

The categories were created based on the definitions of David-Barrett et al. [55] methodology, which detects candidate relationship categories by applying three filters: (1) a demographic filter (generation and gender) and (2) a call frequency filter. For each category, we add an additional (3) "surname" filter that uses patrilineal and matrilineal family names that separates the candidate mothers.

Thus, we used three filters to define the categories. First, we applied a demographic filter, which defined the position of each alter compared to the ego in terms of relative generations. This yielded sets of alters for each ego, who were an older generation, same generation, or younger generation. In each generation set, we separated the female and the male alters. Thus, this filter partitioned egos’ alters into six subsets based on relative age and sex.

Second, we used a call frequency filter for each subset of alters for each ego. This allowed us to identify the one alter in each subset (provided that the subset exists) with whom the ego conducted calls the most frequently.

Third, we used a surname filter where we compared the family names of the ego. A child takes as first last name the first last name of his/her father, and as second last name the first last name of his/her mother. If this last name rule applies, then we denote the selected alter as kin, for instance the father, and if they did not match then we denoted it as quasi-kin, for instance, the quasi-father.

Note that even with the use of the last name filter, it is still possible that some of the relationship types are misidentified (see Table 1). For instance, an ego may have the most frequent phone call with a one-generation-older woman with whom ego shares the last name both in the case of the mother, or the mother’s sister, i.e., the ego’s maternal aunt. Similarly, our assumptions leave room for false negatives, in cases where the kin relationship is not the most frequently called. The generation age grouping, frequent surnames and the fact that we can detect at most two kids (one daughter and one son), can also be a source of both false positives and false negatives.

Table 1. Relationship definitions.

	Demographic and Call Frequency Filter	Surname Filter	Possible Misidentification
Mother	Most frequent female contact 15–40 years older	Second last name of the ego is the same as the first last name of the alter.	Maternal aunt
Father	Most frequent male contact 17–42 years older	First last name of the ego is the same as the first last name of the alter.	Paternal uncle
Daughter	Most frequent female contact 15–40 (17–42) years younger for female (male) ego	First last name of the ego is the same as the first (male ego) or second last name (female ego) of the alter.	Niece (sister’s daughter)
Son	Most frequent male contact 15–40 (17–42) years younger for female (male) ego	First last name of the ego is the same as the first (male ego) or second last name (female ego) of the alter.	Nephew (brother’s son)

Thus, in the case of calls of mothers we first applied the demographic and call frequency filters in which we took the most frequently called female alter among all alters with ages of 15–40 years older than the ego. We partitioned this group in two:

- (a) Mother: The subgroup of alters that shared their first last names with the second last names of the ego. This filter will, with great certainty, identify actual mothers (and some maternal aunts, see Table 1).
- (b) Quasi-mother: The subgroup that did not share their first last names with the second last names of the ego. We assume that these are mother figures who are not the biological mother. (Note that a stepmother or a paternal aunt would be categorised here, as well as non-related mother figures.)

For each category, we created the same two subcategories with the corresponding filters.

The ‘candidate father’ is the most frequently called male alter among those who are 17–42 years older than the ego. If the first last name of the ego matches the first last name of the alter, then we consider it to be the ‘father’. (Note: this could include some paternal uncles). If this is not the case, then we label it as quasi-father.

The ‘candidate daughter’ is defined as the most frequently called female alter one generation younger than the ego. This is 17–42 years older for male egos and 15–40 for the female egos. If in addition the first last name of the ego matches first last name of the alter for the male egos (fathers) and first last name of the ego matches the second last name of the alter for female egos (mothers) we consider her to be the ‘daughter’. If this is not the case, we consider her to be the quasi-daughter. Female siblings of the candidate daughter and of the quasi-daughter are not considered in the analysis.

The ‘candidate son’ is the most frequently called male alter one generation younger than the ego is called ‘son’. This is 17–42 years older for male egos and 15–40 for the female egos. If in addition the first last name of the ego matches first last name of the alter for the male egos (fathers) and first last name of the ego matches the second last name of the alter for female egos (mothers) we consider him to be ‘son’. If this is not the case, we consider him to be quasi-son. Female siblings of the candidate son and of the quasi-son are neither considered in the analysis.

Consider the example in Figure 1. We have 4 females (in red) and 2 males (in blue) where each node is labelled with the two last names and age. The edges are labelled by the total number of phone calls.

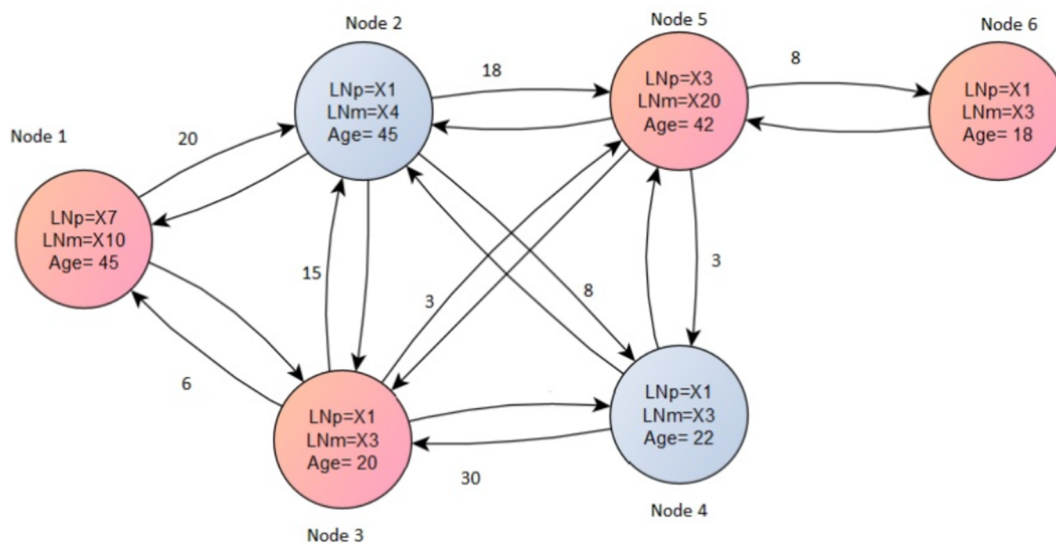


Figure 1. Example of a communication network among kin where LNp denotes paternal last name, and LNm maternal last name. Ages are indicated. Red circles: females; blue circles: males. The numbers near the arrows are the number of calls within the dyad.

In this example, Node 1 is a quasi-mother of Node 3 (and conversely, node 3 is the quasi-daughter of Node 1). Node 2 is the father of Node 4 and Node 4 is the son of Node 2. Finally, Node 5's daughter is Node 6 and Node 6's mother is Node 5.

3. Results

Our aim is to investigate differences in call patterns between a specific social alter and other alters of the same age group and gender.

First, we compared phone calls between egos and their mothers and egos and their quasi-mothers (see Figure 2). Our results show that there is a marked difference between phone calls with those that are identified as mothers and quasi-mothers. In particular, for both female and male egos: (i) the frequency of phone calls to mothers compared to quasi-mothers is higher at all ego ages; and (ii) apart from early 20s and 60+ egos, for all other ego ages the length of the phone call between the ego and the mother is longer than calls to quasi-mothers.

Furthermore, there is a particular age-dependent pattern when comparing out-call fraction and call length. The majority of phone calls to mothers during the ego's early 20s are initiated by their mother (up to 60%). In this period the phone calls between mother and adult child are also short. This pattern changes significantly by the age around 25 of the ego, when the ego becomes much more likely to initiate phone calls and when the average length of the calls doubles.

There is also a significant sex difference: female egos are more likely to have frequent phone conversations and longer phone calls with their mother than male egos, independent of age. In the case of the quasi-mother alters, a similar pattern can be seen for both female and male egos. However, we observe a difference in the out-call fraction. For 20-year-old egos, both mothers and quasi-mothers more frequently initiate their calls, this relation is reversed only for the mothers once the ego reaches late 20's-early 30's. For quasi-mothers this shift in call initiation does not occur.

These results are consistent with the earlier suggestion by David-Barrett et al. [55] that the shift in phone calls is most likely to be explained by increasing reliance on grandmaternal care. Mid-20s is indeed the mean mother's age at first birth in Chile. This would be consistent with the fact that there is a strong sex difference in call frequency to mothers at this age, not seen in alters of the same socio-demographic group who were quasi-mothers, that the initiation by the ego is most likely to take place at this period, also with a strong sex difference, and that the length of phone calls increase to a larger extent to mothers than to quasi-mother in this period.

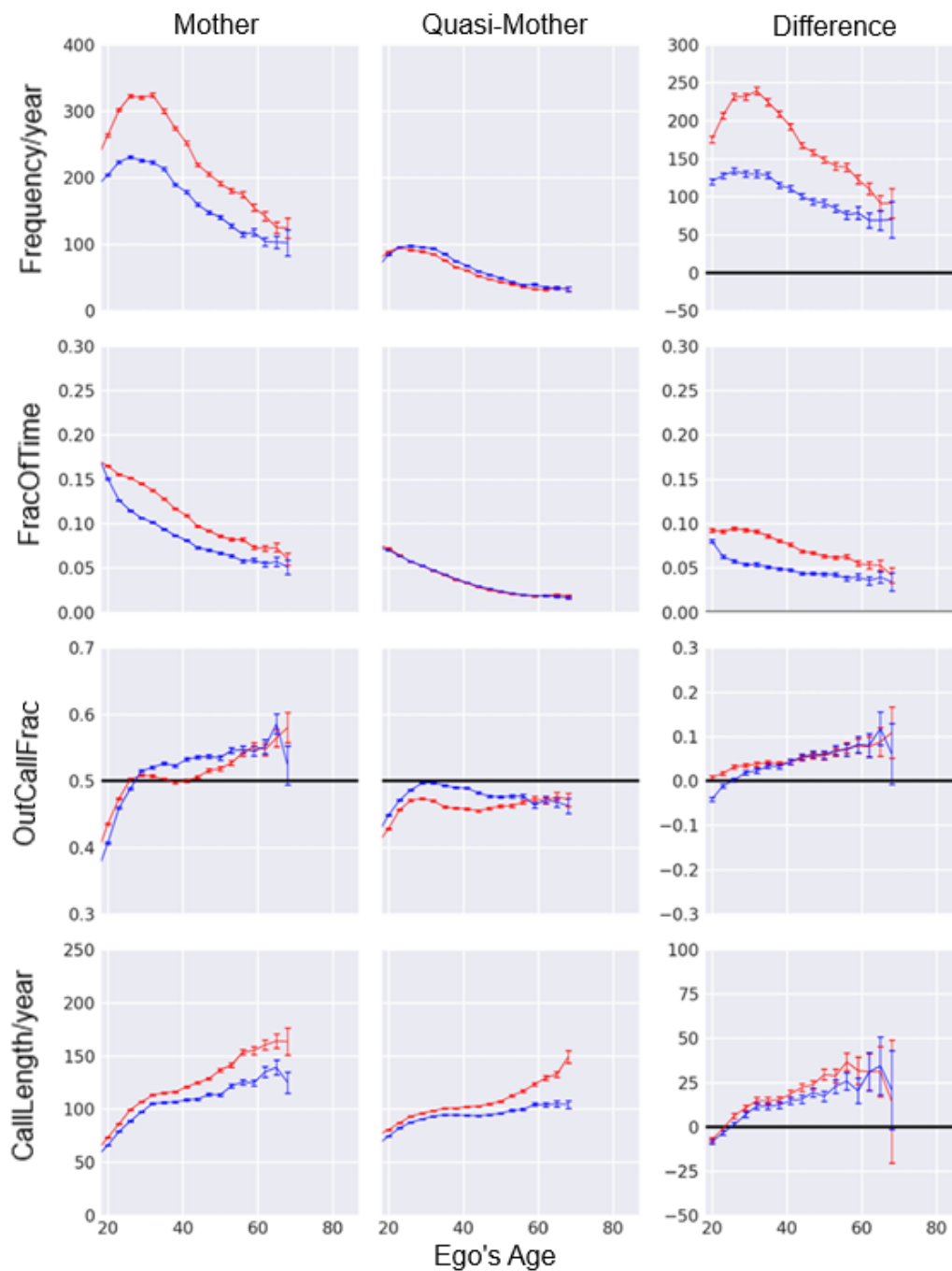


Figure 2. Call patterns (Frequency/year, FracOfTime, OutCallFrac and CallLength/year) between egos and their mothers (first column) and quasi-mothers (second column) as a function of the ego's age. The third column represents the difference between the mother and quasi-mother. The red and blue lines correspond to female and male egos respectively.

A further finding is that, in the case of non-kin the majority of outcalls are made by the older ego, independent of the age. This unbalanced reciprocity/direction might be explained by several factors, including additional spare time for women. Women retire earlier and have a labour force participation of 50% vs. 75% of men. The inequality is greater among males for kin, whereas the opposite holds for non-kin.

In the case of fathers compared to quasi-father (Figure 3) callers in the same generation, the overall pattern is similar to mothers vs. quasi-mothers. Both the call frequency is higher, and the call lengths are longer with fathers than with quasi-fathers.

However, there are some notable differences as well. First, the difference between frequently called fathers and frequently called quasi-fathers is smaller than in the case of mothers and quasi-mothers. Second, the strong gender difference observed in the case of mothers vs. quasi-mothers is muted in the case of fathers vs. quasi-fathers.

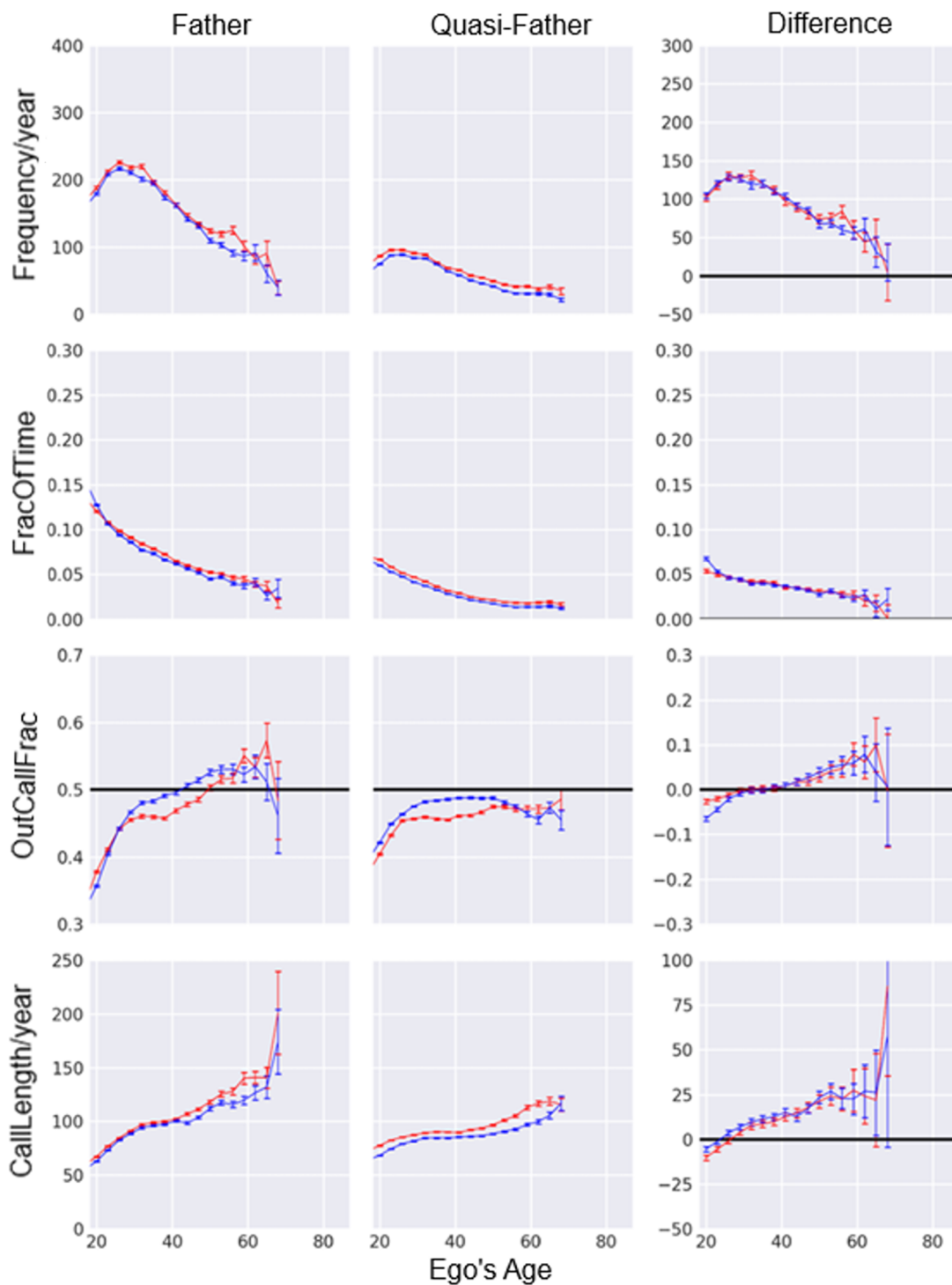


Figure 3. Call patterns (Frequency/year, FracOfTime, OutCallFrac and CallLength/year) between egos and their fathers (first column) and quasi-fathers (second column) as a function of the ego’s age. The third column represents the difference between the father and quasi-father. The red and blue lines correspond to female and male egos respectively.

The pattern that we saw with mothers and fathers as compared to quasi-parents is further repeated in calls with those that were identified as daughters vs. quasi-daughters (Figure 4). In particular, the frequency of calls with daughters is higher than to quasi-daughter most frequent callers, and last longer. The sex difference in call pattern is also confirmed: mothers are more likely to have frequent and long phone calls with their daughter than are fathers.

There is a similar pattern with sons as with daughters above, however, the difference between sons vs. quasi-sons is smaller (Figure 5).

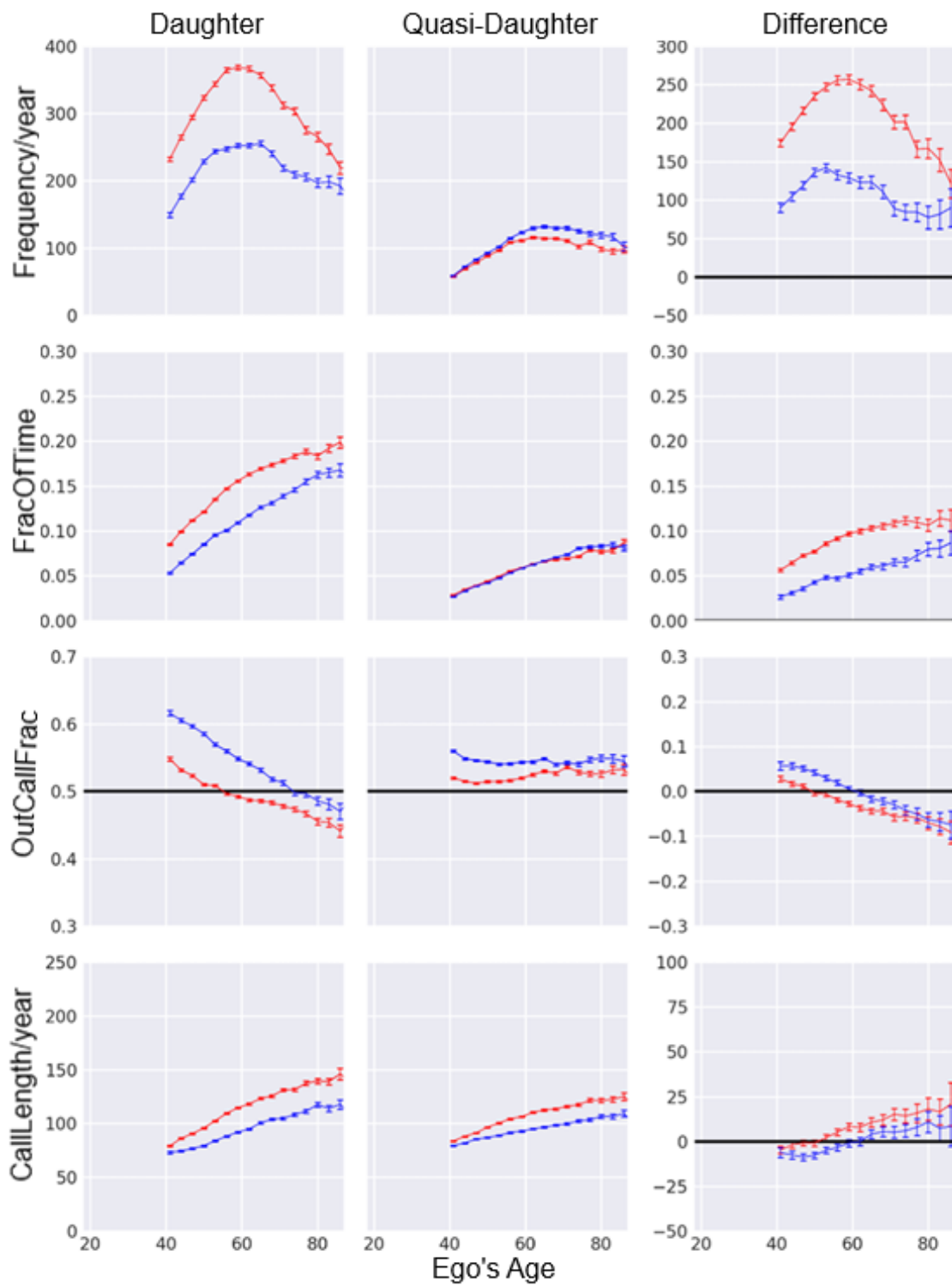


Figure 4. Call patterns (Frequency/year, FracOfTime, OutCallFrac and CallLength/year) between egos and their daughter (first column) and quasi-daughter (second column) as a function of the ego's age. The third column represents the difference between the daughter and quasi-daughter. The red and blue lines correspond to female and male egos respectively.

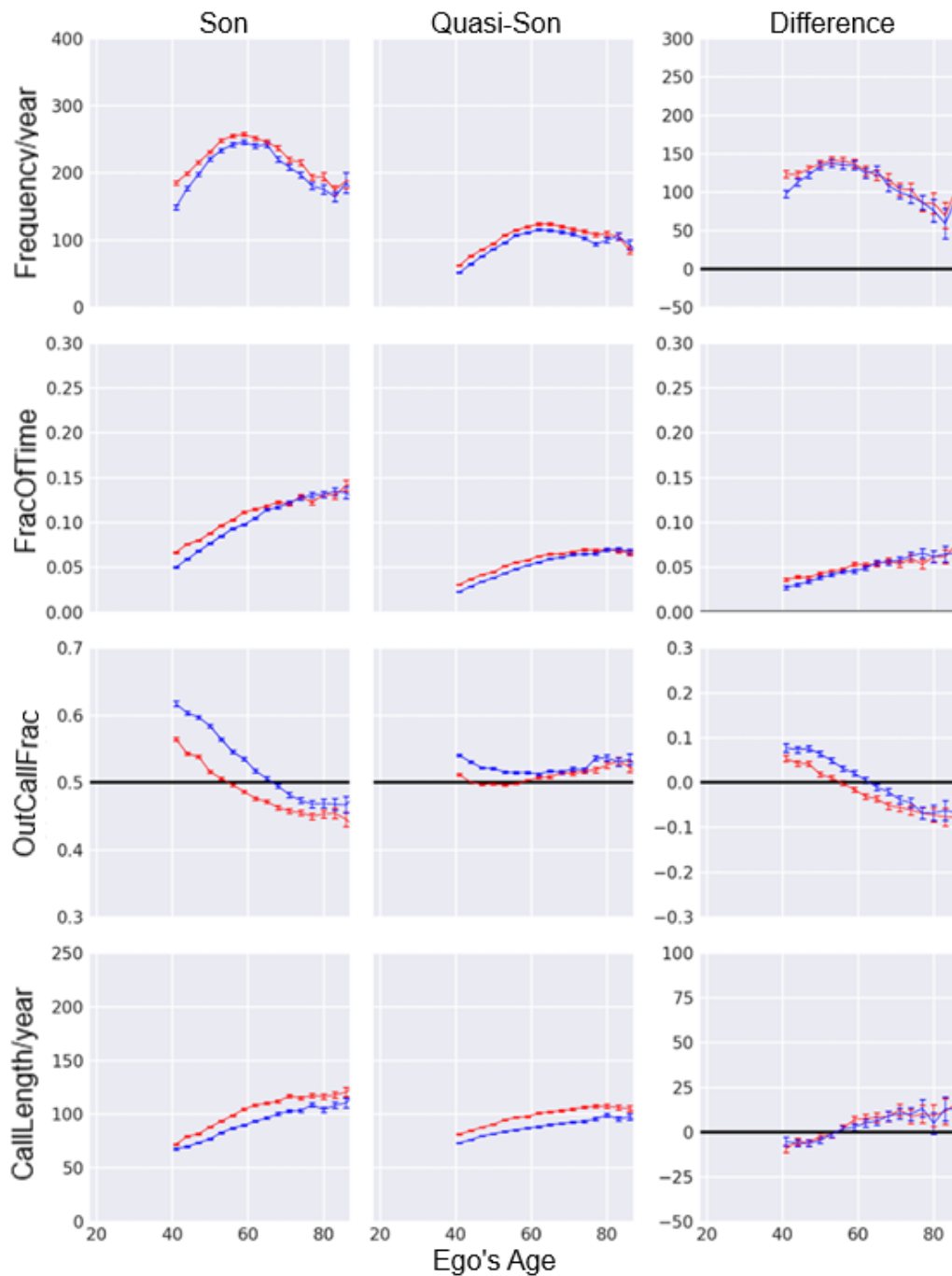


Figure 5. Call patterns (Frequency, FracOfTime, OutCallFrac and CallLength) between egos and their son (first column) and quasi-son (second column). The third column represents the difference between the son and quasi-son. The red and blue lines correspond to female and male egos respectively.

We also measured the life-course-dependent variation of the phone call pattern in the case of frequency, fraction of time, out call fraction, length of phone call (Table S4, in Supplementary Material). For every variable we observe higher variation for every category of kin compared to quasi-kin. (e.g., male father, vs. male quasi father variation). This gives support to our second hypothesis. The higher intensity between biologically related versus non-related social contacts manifests itself especially in situations where one relies on the other for help or cooperation, e.g., daughters having their own offspring (see first row, in Figure 2) where the peak in frequency and difference with non-kin to mothers occur during that period 24–40 years. Our results are consistent with the fact that these situations take place in a specific period of the life cycle.

4. Discussion

Our paper contributes to the study of the intensity of relationships of kin and non-kin. This work extends the existing literature in two ways: First, we have presented results from a mobile phone communication network

covering ~40% of the market in Chile. Although our data are more detailed and comprehensive than ever before, we have no direct information about biological relationships; however, given the availability of both paternal and maternal names, our conclusions are valid with high probability. This reliable and high-quality dataset allows us to identify specific biological kin ties and compare them to non-kin relationships occupying similar structural positions within ego networks. Second, we analyse life-course variation in relationship intensity and offer an interpretation grounded in evolutionary anthropology.

In contrast to studies suggesting a diminishing difference between the intensity of kin and non-kin relationships in modern societies [16,17], our results provide support for hypothesis H1. This hypothesis posits that, among frequently contacted individuals within a given category (e.g., mother, father, daughter, son), biologically related ties exhibit higher interaction intensity—measured in terms of call frequency, call duration, and share of communication time—than comparable quasi-kin relationships. We have shown that the previous attempts to identify family ties and the related behaviour went in a proper direction [55], however, using the opportunity given by the unique Chilean data, it is possible to test the hypotheses even closer. We have confirmed that the previously found effects are present and even more pronounced in genetically related ties compared to non-related ties. Thus, we have shown that whether a real family relationship underlies the mobile phone interaction between ego and alters matters in the key characteristics of the interaction.

When comparing cases in which the most frequent calling partner is a relative versus a non-relative, we find that the call frequency is higher, the share among all the phone calls is higher, and the length of the calls is higher. This confirmed our first hypothesis. We have also shown that the life course dependent variation of the relationship in the call initiation direction is higher when the most frequent caller is relative compared to a non-relative. This confirmed our second hypothesis.

Furthermore, we have found that the difference between mothers and quasi-mothers is muted between fathers and quasi-fathers. This finding is in line with the fact that women are more likely to maintain the cross-generational bond within a family [55]. They may also reflect the effects of divorce and remarriage.

At this point, it is important to note that the available data include information on names, gender, and age, but do not contain details on family status, such as the presence of children. This limitation prevents us from making individual-level distinctions between women with and without children. More broadly, this reflects a well-known challenge in the use of mobile communication data for social research [53,54]. The advantages of such data are evident: they provide large sample sizes and a level of objectivity that cannot be achieved with traditional survey-based methods. However, because these data are not collected for specific research purposes, they are often incomplete with respect to key variables—in this case, whether women of reproductive age have children.

In such situations, the standard approach is to rely on scientifically sound assumptions, as we do here. Although we cannot directly distinguish between women with and without children, it is reasonable to assume that the average behaviour of women in their reproductive years is influenced by childcare responsibilities for a substantial proportion of this group. The demographic evidence discussed in the Introduction and in Supplementary Material S1 supports this assumption. Consequently, we expect the overall effect of children on communication behaviour to be observable at the aggregate level, even if it is attenuated by the presence of women without children.

That genetic relatedness matters is far from being a new finding [31–34], violated only in very few relationships of any individual [58]. The importance of life-course phases in social behaviour has also been established in the context of social networks [59–61]. However, to our knowledge, this is the first study that has differentiated between social dyads of maximum-level importance depending on the presence or absence of kin relatedness. This result contributes to our understanding of how social network edges vary along the underlying type of relationship as well as the phase of the life-course that the interacting parties are in.

Supplementary Materials

The additional data and information can be downloaded at: <https://media.sciltp.com/articles/others/2606081506177863/J.-Soc.-Phys.-25120038-SM.pdf>. Figure S1. Ratios of relationship types filtered using the last-names technique from the frequency-age-sex method. Table S1. Population structure in Chile, in 2015. Table S2. Age of women at first birth in Chile, 2008–2015. Table S3. Fertility rate in Chile 2008–2015. Table S4. Life-course-dependent differences in distribution, mean, and median of kin and non-kin, for every category. (Values smaller than 10^{-6} are set to 0). For this comparison to be valid, every non-kin group was downsampled considering the size of every Age-Sex-Relationship cohort. For example, If 23 year old mothers are 5230 and non-mothers 21,000, Non mothers were randomly sampled to 5230. This procedure was done, because when age increases, kin detection decreases and non-kin group increases by default and this produces a non-balanced sample. Table S5. Standard

deviation of means across time, and total standard deviation of groups. (Values smaller than 10^{-6} are set to 0). Table S6. Aggregated CDRs. Table S7. Client' Registry Database. References [62,63] are cited in supplementary materials.

Author Contributions

T.D.-B.: Conceptualization, supervision, analysis of statistical results, writing; S.D.: Data cleaning, programing, statistical analysis; C.R.-S.: Data acquisition, data curation, conceptualization, analysis; L.B.: Data acquisition, data curation, conceptualization; I.B.: Conceptualization, analysis; A.R.: Conceptualization, analysis J.K.: Conceptualization, analysis, writing, editing. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

Ethical permission for this project was granted by the Ethics Committee of Universidad del Desarrollo under the code CEII09-2019.

Informed Consent Statement

Not applicable.

Data Availability Statement

Due to the Non-Disclosure Agreement with the company, we are not able to make the data publicly available.

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Conflicts of Interest

Given his role as Editor-in-Chief of *J. Soc. Phys.*, J.K. had no involvement in the peer review of this paper and had no access to information regarding its peer-review process. Full responsibility for the editorial process of this paper was delegated to another editor of the journal.

Use of AI and AI-Assisted Technologies

No AI tools were utilized for this paper except reformatting the referencing scheme.

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